INOVANCE

Advancing industrial technology,
for a better world



SV680N-INT Series Servo Drive

Function Guide

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

Data code PS00021316B00

Legal Information

Copyright

Copyright © Shenzhen Inovance Technology Co., Ltd. 2024. All rights reserved.

This documentation is the exclusive property of Shenzhen Inovance Technology Co., Ltd. No individual or entity may excerpt, reproduce, modify, translate, or distribute any content herein without written consent from Inovance.

Legal action will be taken against infringement.

Trademarks

INOVANCE is a registered trademark of Shenzhen Inovance Technology Co., Ltd. and its affiliated companies. All other trademarks or registered trademarks mentioned in this documentation are the property of their respective owners. Unauthorized use of these trademarks by third parties for any purpose without written authorization could violate the rights of their owners.

Disclaimer of Liability

Due to continuous updates and improvements of products and technologies, the content of this documentation may not fully match the actual products. In the event of any discrepancies, the actual products shall prevail.

The contents are subject to change without notice due to product upgrade.

Waste Disposal

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

Qualified Personnel

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

Proper Use of the Product

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

Preface

Introduction

The SV680N-INT series servo drive is a premium servo drive featuring high speed, high precision, high performance, and commissioning-free functions. It is compliant with CE, UL, KC, EAC, UKCA, and TUV certifications. It is specially suitable for applications that require premium functions.

The drive covers a power range from 0.05 kW to 7.5 kW and supports the EtherCAT communication protocol. Used together with the host controller, multiple servo drives can be networked for operation through EtherCAT. The servo drive comes with adaptive stiffness level setting, inertia auto-tuning, and vibration suppression functions for easy use. The drive, together with an MS1 series high-response servo motor (with ultra-low, low, or medium inertia) equipped with a 23- or 26-bit single-turn/multi-turn absolute encoder, any third party servo motor, linear motor or DDR motor, serves to deliver a quiet and stable operation and accurate process control through features like fully closed-loop, internal process segment and gantry synchronization.

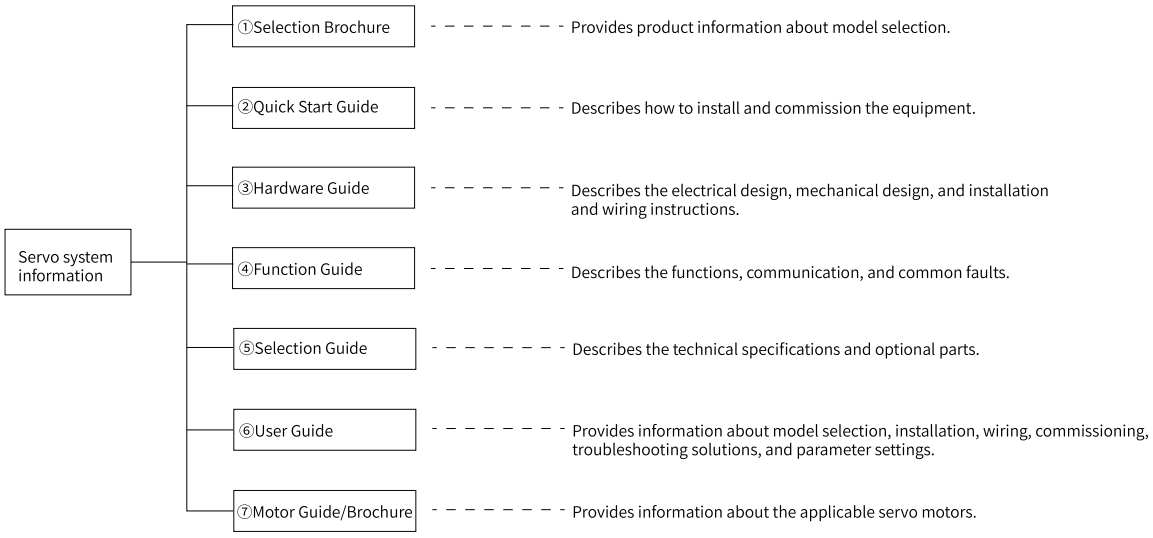
The drive also comes with features like safe torque off (STO), dynamic braking, and brake output (external relay not needed) as standard and supports extension of seven kinds of safety functions and bus safety function FSoE. The optional PINT model offers 24 V backup power for continuous safe production. This servo drive serves to achieve quick and accurate position control, speed control, and torque control through high-performance solutions for automation equipment in industries such as electronic manufacturing, lithium batteries, manipulators, packaging, and machine tools.

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

Note

- The drawings in the user guide are shown for demonstration only, which may not match the product purchased.
- The user guide is subject to change without notice due to product upgrade, specification modifications as well as efforts to improve the accuracy and convenience of the user guide.

More documents



No.	Name	Code	Description
①	SV680-INT Series Flagship Servo Drive	19120362	Provides information about product selection, including the list of supporting components, technical data on the drive and motor, and cable selection guide.
②	SV680N-INT Series Servo Quick Start Guide	PS00021317	Introduces product models, installation, and quick commissioning.
③	SV680N-INT Series Servo Drive Hardware Guide	PS00021315	Describes the installation and wiring of the drive, including pre-installation preparation, unpacking and handling, mechanical installation, and electrical installation.
④	SV680N-INT Series Servo Drive Function Guide	PS00021316	Describes the functions and parameters of the product, including function overview, basic servo functions, tuning instructions, and parameter descriptions.
⑤	SV680N-INT Series Servo Drive Selection Guide	PS00021313	Provides information about product selection, including the list of supporting components, technical data on the drive and motor, and cable selection guide.
⑥	SV680N-INT Series Servo Drive User Guide	PS00021314	Provides information about model selection, installation, commissioning, function, troubleshooting and parameters of the equipment.
⑦	MS1-R-INT Series Servo Motor Selection Guide	PS00017523	Describes product information, general specifications, motor selection, cable selection, certification categories and standards of the motor.
	MS1-R Series Servo Motor Installation Guide	PS00005407	Describes the installation of the motor, including motor installation flowcharts, wiring, unpacking and handling, mechanical installation, and electrical installation.
	Direct Drive Motor Stages and Drives	19120011	Describes product information, general specifications, motor selection, cable selection, certification categories, and standards of the motor.

Revision history

Date	Version	Revision
July 2026	B00	**Added:** • Content about Size B models (SV680NT1R4I-GINT, SV680NT2R3I-GINT, SV680NT1R4SGINT, and SV680NT2R3S-GINT). • Section "Voltage Injection Auto-tuning". **Updated:** • Content about P-type models. • Made structural optimization. • Updated section "Magnetic Pole Auto-tuning". • Updated section "Auto-tuning Process". • Updated section "STune". • Updated section "Fully-closed Loop": Added safety precautions for the fully closed-loop function. • Updated section "Dual-axis Gantry Commissioning": Added safety precautions for gantry synchronization. • Updated section "Certifications, Directives, and Standards": Updated the functional safety certifications. • Updated the description of parameter H32.73. **Deleted:** Content related to FunIN.25, FunIN.26, and FunIN.27.
December 2024	A06	**Added:** Section "Conformance Certification".
December 2024	A05	**Added:** Parameters related to functional safety models.
October 2024	A04	Made minor corrections.
2024-08	A03	Made minor corrections. Updated the parameters and faults.
April 2024	A02	Made minor corrections.
March 2024	A01	Made minor corrections.
February 2024	A00	First release.

Access to the guide

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

- Visit *https://www.inovance.com/global*, and choose **Service&Support > Support > Documentation Download**.
- Scan the **QR code** on the product with your smartphone.
- Scan the QR code below to install **My Inovance** app, where you can search for and download the guide.



Warranty disclaimer

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

Even within the warranty period, maintenance can be charged for the following product damage:

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

When applicable, relevant maintenance fee will be charged according to the latest Price List of Inovance. If otherwise agreed upon, the agreed terms and conditions shall prevail.

For details, see the Warranty Card.

Table of Contents

Legal Information 1

Preface 1

1 Fundamental Safety Instructions 14

1.1 General Safety Instructions 14

1.2 Industrial Information Security 19

1.3 Certifications, Directives, and Standards 20

1.4 Terms and Abbreviations 21

1.5 Safety Parameters 21

2 Function Overview 23

3 Basic Functions of the Servo Drive 27

3.1 Setting and Display of Operation Modes 27

3.2 Conversion Factor 28

3.3 Servo Drive States 30

3.3.1 Control Word 6040h 33

3.3.2 Status Word 6041h 33

3.4 Process Segment Mode 35

3.4.1 Triggering Process Segment Mode 35

3.4.2 Related Parameters 38

3.4.3 Operation Mode 40

3.4.4 DO and Sequence 51

3.5 Position Control Mode 51

3.5.1 Function Block Diagram 53

3.5.2 Position reference input 53

3.5.3 Reference Frequency Division/Multiplication (Electronic Gear Ratio) 64

3.5.4 Position Reference Filter 69

3.5.5 Frequency division output 70

3.5.6 Motion Control Completed, Internal Command Completed, Positioning Completed, Proximity 73

3.6 Speed Control Mode 80

3.6.1 Function block diagram 81

3.6.2 Speed Reference Input 81

3.6.3 Ramp Function 93

3.6.4 Zero Clamp 95

3.6.5 Speed Reference Limit 96
3.6.6 Speed-Related DO 97
3.7 Torque Control Mode 98
3.7.1 Function block diagram 99
3.7.2 Torque reference input 100
3.7.3 Torque Reference Filter 106
3.7.4 Torque Reference Limit 107
3.7.5 Speed Limit in Torque Control Mode 113
3.8 Profile Position (PP) Mode 115
3.8.1 Function Block Diagram 116
3.8.2 Configuration Block Diagram 116
3.8.3 Recommended Configuration 118
3.8.4 Related Parameters 119
3.8.5 Related Function Settings 122
3.9 Profile Velocity (PV) Mode 124
3.9.1 Function Block Diagram 124
3.9.2 Configuration Block Diagram 124
3.9.3 Recommended Configuration 124
3.9.4 Related Parameters 125
3.9.5 Related Function Settings 126
3.10 Profile Torque (PT) Mode 128
3.10.1 Function Block Diagram 128
3.10.2 Configuration Block Diagram 129
3.10.3 Recommended Configuration 129
3.10.4 Related Parameters 129
3.10.5 Related Function Settings 132
3.11 Homing Mode (HM) 134
3.11.1 Function Block Diagram 134
3.11.2 Configuration Block Diagram 135
3.11.3 Recommended Configuration 135
3.11.4 Related Parameters 135
3.11.5 Related Function Settings 138
3.11.6 Homing Operation 139
3.12 Cyclic Synchronous Position (CSP) Mode 156
3.12.1 Function Block Diagram 157
3.12.2 Configuration Block Diagram 157
3.12.3 Recommended Configuration 157
3.12.4 Related Parameters 157

3.12.5 Related Function Settings 160
3.13 Cyclic Synchronous Velocity Mode (CSV) 160
3.13.1 Function Block Diagram 161
3.13.2 Configuration Block Diagram 161
3.13.3 Recommended Configuration 161
3.13.4 Related Parameters 161
3.13.5 Related Function Settings 164
3.14 Cyclic Synchronous Torque Mode (CST) 164
3.14.1 Function Block Diagram 164
3.14.2 Configuration Block Diagram 164
3.14.3 Recommended Configuration 165
3.14.4 Related Parameters 165
3.14.5 Related Function Settings 167
4 Common Functions 170
4.1 Absolute System 170
4.1.1 Overview 170
4.1.2 Related Parameters 171
4.1.3 Precautions for Using the Battery Box 177
4.2 Full Closed-loop 178
4.2.1 Fully Closed-loop Parameter Settings 178
4.2.2 Encoder Parameter Settings 182
4.2.2.1 BiSS-C encoder 182
4.2.2.2 SSI encoder 184
4.2.2.3 EnDat Encoder 185
4.2.3 Enabling Fully Closed-loop Settings 186
4.3 Software Position Limit 188
4.4 Software Reset 190
4.5 Motor Protection 190
4.6 DI Filter Time 192
4.7 EtherCAT-forced DO Function 193
4.8 Position Comparison 194
4.9 Black Box 203
4.10 Touch Probe Function 206
4.11 SEMI F47 Voltage Drop 211
4.12 Accuracy Compensation 213

4.12.1 Accuracy Compensation Function....213
4.12.2 Application Cases....219
4.13 Quadrant Friction Compensation....232
4.14 Backlash Compensation....234
5 Gantry Synchronization....236
5.1 Function Wiring....236
5.2 Gantry Commissioning Solutions....239
5.3 Gantry Commissioning Procedure....242
5.4 Single-axis Installation and Commissioning Instructions....243
5.5 Dual-axis Gantry Commissioning Instructions....243
5.5.1 Commissioning Procedure for Gantry Synchronization Control Scheme 1....244
5.5.2 Commissioning procedure for gantry synchronization control solution 2....250
5.6 Gantry Applications in Fully-closed Mode....251
5.7 Flexible Gantry Homing Trajectory....252
6 Safety Functions [Functional Safety Models]....267
6.1 Safety Overview....267
6.1.1 List of Safety Functions....267
6.1.2 Terms and Abbreviations....268
6.1.3 Safety Standards and Specifications....269
6.1.4 Precautions....271
6.2 General....275
6.3 Software Parameter Configuration....276
6.4 Safety DI/DO Function....279
6.4.1 Safety DI Function....279
6.4.2 Safety DO Function....281
6.5 FSoE....282
6.5.1 Overview....282
6.5.2 Fixed Safety PDO Setting....283
6.6 STO....284
6.6.1 Overview....284
6.6.2 STO Triggered by Local Mode....284
6.6.3 Triggering STO in Bus Mode....288
6.6.4 Sequence Diagram....289
6.7 Safe Brake Control (SBC)....291

6.7.1 Overview 291
6.7.2 SBC Triggered by Local Mode....291
6.7.3 SBC Triggered by Bus Mode 296
6.7.4 Sequence Diagram 297
6.8 Safe Stop 1 (SS1)....299
6.8.1 Overview 299
6.8.2 SS1 Triggered by Local Mode....299
6.8.3 SS1 Triggered in Bus Mode 303
6.8.4 Sequence Diagram 306
6.9 Safe Stop 2 (SS2)....308
6.9.1 Overview 308
6.9.2 SS2 Triggered by Local Mode....308
6.9.3 SS2 Triggered in Bus Mode 312
6.9.4 Sequence Diagram 315
6.10 Safe Operating Stop (SOS) 317
6.10.1 Overview 317
6.10.2 SOS Triggered by Local Mode 317
6.10.3 SOS Triggered by Bus Mode....319
6.10.4 Sequence Diagram....320
6.11 Safety-limited Speed (SLS)....321
6.11.1 Overview 321
6.11.2 SLS Triggered by Local Mode....321
6.11.3 SLS Triggered by Bus Mode 326
6.11.4 Sequence Diagram....328
6.12 Safe Direction (SDI) 329
6.12.1 Overview 329
6.12.2 Triggering SDI in Local Mode....330
6.12.3 SDI Function Triggered Through Safety Bus....335
6.12.4 Sequence Diagram....336
6.13 Safe Speed Monitor (SSM)....338
6.13.1 Overview 338
6.13.2 SSM Triggered Locally....338
6.13.3 SSM Output in Bus Mode 340
6.13.4 Sequence Diagram....341
6.14 STO Response Time 342
6.14.1 Response Time for Triggering Safety Functions in Local Mode 342
6.14.2 Response Time in Bus Mode....342

6.15 Safety Module Working with Beckhoff Safety CPU 343
6.16 Safety Module Working with Pilz Safety PLC Unit 367
6.17 Fault Reset 423
6.18 Commissioning and Operation 424
6.18.1 Pre-operation Inspection 424
6.18.2 Trial Run 424
6.18.3 Verification and validation 425
7 STO Integration 430
7.1 Overview 430
7.2 Functions and Monitoring 431
7.3 Fault Reset 433
7.4 Safety Function Response Time 434
7.5 Acceptance and Verification 434
8 Communication 437
8.1 Communication via EtherCAT 437
8.1.1 Communication Overview 437
8.1.1.1 Communication Technical Data 437
8.1.1.2 Communication Specifications 438
8.1.1.3 Protocol Description 438
8.1.2 Hardware Configuration 439
8.1.2.1 Terminal Arrangement 439
8.1.2.2 EtherCAT Communication Wiring Example 440
8.1.3 Communication Transmission Mode 442
8.1.3.1 Structure of EtherCAT Communication 442
8.1.3.2 Communication State Machine 443
8.1.3.3 Distributed Clock 444
8.1.3.4 Status indicator 445
8.1.4 Communication Data Frame Structure 447
8.1.4.1 Process Data 447
8.1.4.2 Service Data Object (SDO) 452
8.1.5 Communication Parameters 453
8.2 EtherCAT Communication Configuration Examples 454
8.2.1 AM600 Series Controller as the Host Controller 454
8.2.2 Omron Controller as the Host Controller 460
8.2.3 Beckhoff Controller as the Host Controller 473
8.2.4 KEYENCE KV7500 as the Host Controller 486

8.2.4.1 Configuring the Servo Drive....486
8.2.4.2 Configuring KEYENCE KV7500 Software Tool....486
8.2.4.3 Trial Run....500
8.2.5 EASY Series Controller as the Master....502
9 Tuning....513
9.1 Overview....513
9.2 Speed current loop adjustment....514
9.3 Inertia Auto-tuning....517
9.3.1 Offline Inertia Auto-tuning....518
9.3.2 Online Inertia Auto-tuning....520
9.4 Automatic Gain Tuning....521
9.4.1 STune....521
9.4.2 ETune....527
9.5 Manual Gain Tuning....534
9.5.1 Technical Data....534
9.5.2 Gain Switchover....537
9.5.3 Position Reference Filter....541
9.5.4 Feedforward Gain....541
9.5.5 PDFF Control....543
9.5.6 Torque Disturbance Observer....544
9.5.7 Speed Observer....545
9.5.8 Model Tracking....547
9.5.9 Friction Compensation....549
9.5.10 Encoder Scale Fluctuation Suppression....550
9.5.11 Motor Cogging Torque Fluctuation Compensation....552
9.6 Parameter Tuning in Different Control Modes....554
9.6.1 Parameter Adjustment in Speed Control Mode....554
9.6.2 Parameter Adjustment in Position Control Mode....554
9.6.3 Parameter Adjustment in Torque Control Mode....555
9.7 Vibration Suppression....556
9.7.1 Mechanical Resonance Suppression....557
9.7.2 Low-Frequency Resonance Suppression at the Mechanical End....561
9.8 Mechanical Characteristic Analysis....564
9.9 High-performance Tuning....565
10 Parameter Description....569
10.1 H00 Servo Motor Parameters....569

10.2 H01 Drive Parameters 577
10.3 H02 Basic Control Parameters 581
10.4 H03 Terminal Input Parameters 592
10.5 H04 Terminal Output Parameters 605
10.6 H05 Position Control Parameters 608
10.7 H06 Speed Control Parameters 622
10.8 H07 Torque Control Parameters 637
10.9 H08 Gain Parameters 645
10.10 H09 Auto-tuning Parameters 660
10.11 H0A Fault and Protection Parameters 679
10.12 H0b Monitoring Parameters 698
10.13 H0C Fault and Protection Parameters 2 715
10.14 H0d Auxiliary Function Parameters 718
10.15 H0E Communication Function Parameters 723
10.16 H0F Fully Closed-loop Parameters 731
10.17 H11 Multi-position Parameters 743
10.18 H12 Multi-speed Parameters 764
10.19 H14 Gantry Synchronization Parameters 785
10.20 H15 Machine Tool Parameters 796
10.21 H16 Variable Monitoring 799
10.22 H17 VDI/DO Parameters 802
10.23 H18 Position Comparison Output Parameters 844
10.24 H19 Target Position Parameters 849
10.25 H1E Oscilloscope Variables 889
10.26 H1F Software Tool Parameters 893
10.27 H21 Current Loop Gain Switchover Parameters 895
10.28 H22 Process Segment Parameters 895
10.29 H23 Process Segment Parameters 908
10.30 H30 Variables Read Through Communication 915
10.31 H31 References Set Through Communication 927
10.32 H32 Direct Drive Parameters 929

10.33 H33 Compensation Parameters 946
10.34 H34 Servo Motor Parameters 2 961
10.35 1000h Object Dictionary 962
10.36 6000h Object Dictionary 977
11 Safety Parameters 1001
11.1 H02 Basic Control Parameters 1001
11.2 H0A Fault and Protection Parameters 1001
11.3 H20 Functional Safety Parameters 1002
11.4 6000h Object Dictionary 1021
12 Troubleshooting 1040
12.1 Fault Severity Level and Display 1040
12.2 Fault Reset 1041
12.3 Troubleshooting 1041
12.3.1 List of Fault Codes 1041
12.3.2 List of Alarm Codes 1051
12.3.3 Description of Fault Codes 1053
12.3.3.1 Troubleshooting Faults 1053
12.3.3.2 Internal Faults 1149
12.3.4 Description of Alarm Codes 1149
13 Appendix 1170
13.1 Expansion Safety Function Terminals CN9 and CN10 1170
13.2 FSoE Connection and Setting 1178
13.3 FAQ About Encoder Configuration 1178
13.4 DI/DO Function Assignment 1182
13.5 DIDO Function Assignment [Functional Safety N] 1187
13.6 Service and Support 1189

1 Fundamental Safety Instructions

1.1 General Safety Instructions

Safety disclaimer

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

Safety levels and definitions

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

Safety Instructions

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

Unpacking
WARNING • Do not install the product in the case of any damage, rust, or signs of use on the product or accessories upon unpacking. • Do not install the product in the case of water seepage into the product or missing or damaged components upon unpacking. • Do not install the product in the case of any discrepancy between the product you received and the product name on the packing list.
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 for damage, rust, or dents on the surfaces of the product and accessories upon unpacking. • After unpacking, check the contents against the packing list to ensure that the equipment and accessories are in the correct quantities, and that all documentation is complete.

Storage and transportation
WARNING • Large or heavy equipment must be handled by qualified professionals using specialized hoisting equipment. Failure to comply could result in personal injury or equipment damage. • Before hoisting the equipment, ensure that components such as the front cover and terminal blocks are secured firmly with screws. Loosely connected components may fall off and result in personal injury or equipment damage. • Do not stand or stay below the product which is being hoisted. • When hoisting the equipment with a steel rope, ensure the equipment is hoisted at a constant speed without suffering from vibration or shock. Do not turn the equipment over or let the equipment stay hanging in the air. Failure to comply could result in personal injury or equipment damage.
Caution • Handle the equipment with care and mind your step during transportation to prevent personal injury or equipment damage. • When carrying the equipment with bare hands, hold the equipment casing firmly with care to prevent parts from falling. Failure to comply could result in personal injury. • Store and transport the equipment based on the storage and transportation requirements. Failure to comply could result in equipment damage. • Do not store or transport the equipment in locations where the equipment may be exposed to splashing water or rain, direct sunlight, strong electric field, strong magnetic field, or strong vibration. • Store the equipment for up to three months. Take stricter protective measures and carry out the necessary inspections for a longer storage time. • Pack the equipment securely and properly before transportation. Use a fully enclosed container for long-distance transportation. • Do not transport the equipment with other devices or items that may impact or cause harm to the equipment.

Installation

DANGER

- Ensure peripheral power distribution requirements are met, and select air switches, fuses, cables, and cable terminals correctly.
- Use standard torque for screw fastening, and use appropriate terminal crimping tools for crimping terminals.
- Ensure heat dissipation requirements are met and design inlet and outlet airflow duct properly.
- Avoid environments with dripping water, conductive foreign objects (such as carbon fiber filaments, conductive metal dust, metal chips), and salt spray.

Failure to follow the above instructions will pose a fire risk.

- This equipment must be operated only by trained and qualified electrical personnel. Non-professionals must not operate this equipment.

WARNING

- Read through the guide and safety instructions before installation.
- Do not install this equipment in places with strong electric or magnetic field.
- Before installation, check that the mechanical strength of the installation site can bear the weight of the equipment. Failure to comply may result in mechanical hazards.
- Do not wear loose clothes or accessories during installation. Failure to comply may result in an electric shock.
- When installing the equipment in an enclosed environment (such as a cabinet or case), use cooling devices (such as fans or air conditioners) to cool the space and meet the installation environment requirements. Failure to do so can result in equipment overtemperature or fire accidents.
- Do not retrofit the equipment.
- Do not fiddle with the bolts used to fix equipment components or the bolts marked in red.
- When the equipment is installed in a cabinet or terminal device, appropriate guard devices (guards for fire, electrical, and mechanical protection) meeting applicable IEC standards and local laws and regulations must be provided.
- Before installing devices with strong electromagnetic interference, such as a transformer, install a shielding device for the equipment to prevent malfunction.
- Install the equipment onto an incombustible object such as a metal. Keep the equipment away from combustible objects. Failure to comply may result in a fire.

The edges of the equipment metal enclosure are sharp. Note the following precautions during installation to avoid personal injury or cable damage:

- When performing installation, handling, or maintenance operations, always wear cut-resistant gloves.
- Avoid direct skin contact with enclosure edges and cut surfaces during operation.

Caution

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

Wiring

DANGER

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

WARNING

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

Caution

- During wiring, follow the proper electrostatic discharge (ESD) procedure and wear an anti-static wrist strap. Failure to comply may result in damage to the equipment or its internal circuits.
- Use the shielded twisted pair cable to wire the control circuit, and connect the shield to the grounding terminal of the equipment. Failure to comply may result in equipment malfunction.

Power-on

DANGER

- Before power-on, check that the equipment is installed properly with reliable wiring and the motor can be restarted.
- Before power-on, make sure that the power supply meets equipment requirements to prevent equipment damage or even a fire.
- After power-on, do not open the cabinet door or protective cover of the equipment. Do not touch any terminals, or remove any part of the equipment at power-on. Failure to comply will result in an electric shock.

WARNING

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

Operation



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



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

Maintenance



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



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

Repair



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



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

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

Additional precautions

Cautions for the dynamic brake

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

Precautions for grounding

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

Effects of electromagnetic fields on medical implants

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

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

Safety labels

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

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

1.2 Industrial Information Security

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

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

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

Caution

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

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

1.3 Certifications, Directives, and Standards

Table 1–1 Compliance list

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

Note

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

1.4 Terms and Abbreviations

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

1.5 Safety Parameters

SV680 is STO-only.

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

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

The SV680 series servo drive supports multiple safety functions: safe torque off (STO), safe braking control (SBC), safe stop 1 (SS1), safe operation stop (SOS), safe stop 2 (SS2), safe speed limit (SLS), safety speed monitor (SSM), and safety direction (SDI).

Item	Safety parameter
SIL	SIL3, IEC 61508 Maximum SIL3, EN IEC 2021
PFH	SS1-t/SBC/STO safety function: PFH ≤ 8.82 x 10^{-9}[1/h (8.82% of SIL3) SS1-r/SS2/SLS/SSM/SDI safety function: PFH ≤ 2.39 x 10^{-8}[1/h (23.9% of SIL3) When all safety functions start at the same time: PFH ≤ 2.39 x 10^{-8}[1/h (23.9% of SIL3)
Cat.	3, EN ISO 13849- 1
PL	e, EN ISO 13849-1
DTI	STO/SS1/SS2/SOS/SLS/SDI/SSM safety function: ≤ 20 ms SBC safety function: ≤ 150 ms per channel
MTTFd	SS1-t/SBC/STO: 639.59 years SS1-r/SS2/SLS/SSM/SDI: 324.24 years
DCavg	≥ 90% (medium)
T1	20 years
Mission time	20 years
HFT	1
SC	SC3
MTTR	0 hour
MRT	0 hour
Application mode	High demand or continuous mode
Device type	Type B
Safe speed accuracy	2197.98 rpm

Note

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

2 Function Overview

Functions of the servo drive are listed below. See details in corresponding chapters.

Function		Description	References
Model specifications		Servo motor, DDL motor, DDR motor, and third-party motor types supported by the SV680-INT drive.	-
Second encoder		ABZ incremental encoders, Inovance communication-type encoders, BiSS-C encoders, SSI encoders, and EnDat 2.2 encoders.	-
High-resolution encoder		The servo drive is equipped with a high-performance encoder with resolution up to 2^{26}(67108864) PPR.	-
AI, AO		Supports AI and AO.	-
Built-in brake		Used to monitor the brake status in real time.	*SV680N-INT Series Servo Drive Hardware Guide*
External braking resistor		Used in case of insufficient braking capacity of the built-in braking resistor.	*SV680N-INT Series Servo Drive Hardware Guide*
Electronic gear ratio		Input pulse can be reduced or amplified: 0.001 to 4000 × Encoder resolution/10000.	*SV680N-INT Series Servo Drive Hardware Guide*
Status display		The servo drive status is displayed on the 5-digit 8-segment LED.	*SV680N-INT Series Servo Quick Start Guide*
External I/O display		The ON/OFF state of external I/O signals is displayed.	-
Inertia auto-tuning	Offline	The servo drive automatically calculates the load inertia ratio through inertia auto-tuning.	-
	Online	The host controller sends a command to make the motor rotate, and the servo drive calculates the load inertia ratio in real time.	-
Gain auto-tuning	Supports two auto-tuning modes: STune and ETune.	The servo drive generates a group of gain parameters based on the correct inertia ratio.	-

Function		Description	References
Manual gain tuning	Basic gains	If the auto-tuned gain values fail to deliver desired performance, fine-tune the gains manually to improve the performance.	-
	Gain switchover	Used to apply different gains for different status (operating or stop) of the motor. Gains can also be switched by external terminals during operation.	-
	Reference filter	Filters the position, speed, and torque references.	-
	Feedforward gain	Improves the following behavior.	-
	PDFF control	Adjusts the speed loop control mode to improve the anti-interference capability at low frequency range.	-
	Torque disturbance observer	Improves the resistance against torque disturbance.	-
	Speed observer	The speed observer, which facilitates quick positioning, applies in applications with slight load characteristic change and constant inertia.	-
	Model tracking	The model tracking control can improve response and shorten the positioning time. It is available only in position control mode.	-
	Friction compensation	Used to perform positive/negative compensation based on the operating direction. It is active only in position control.	-
	Encoder scale fluctuation suppression	Prevents operation noise caused by position fluctuation or speed fluctuation in the control loop. It also suppresses the fluctuation component of the output caused by speed fluctuation.	-
	Motor cogging torque fluctuation compensation	Reduce speed fluctuation while ensuring stable system margin.	-
Parameter tuning in different control modes	Used for parameter tuning in speed/position/ torque modes.	-	-
Vibration suppression	Mechanical resonance suppression	Suppresses mechanical resonance that may be generated when the response speed is excessively high.	-
	Low-frequency resonance suppression at the mechanical end	Activate the filter used to suppress low-frequency resonance.	-
Mechanical characteristic analysis		Used to analyze the resonance frequency and characteristics of the mechanical system through a PC installed with Inovance software tool.	-
High-performance auto-tuning		Used to analyze the mechanical resonance point and system bandwidth, and to simulate the effect on loop control when filters are used and parameters are tuned.	-
Profile position (PP) mode		The host controller sets parameters through the bus, and the servo drive generates position references and performs positioning control.	-
Profile velocity (PV) mode		The host controller sets parameters through the bus, and the servo drive generates speed references and performs speed control.	-

Function	Description	References
Profile torque mode (PT)	The host controller sets parameters through the bus, and the servo drive generates torque references and performs torque control.	-
Homing mode (HM)	The host controller selects the homing mode through parameters, and the servo drive performs homing automatically with the position feedback set to the preset value.	-
Process segment mode	Through process segment setting, the servo drive performs positioning control, fixed speed control, and parameter writing based on the process segment setting command.	-
Position control mode	Used to make the servo drive operate in the position control mode. **Note: N-type machines support only the multi-segment position function.**	-
Speed control mode	Used to make the servo drive operate in the speed control mode.	-
Torque control mode	Used to make the servo drive operate in the torque control mode.	-
Cyclic synchronous position (CSP) mode	The host controller generates position references and sends the references cyclically through the bus. The servo drive performs positioning control.	-
Cyclic synchronous velocity (CSV) mode	The host controller generates speed references and sends the references cyclically through the bus. The servo drive performs speed control.	-
Cyclic synchronous torque (CST) mode	The host controller generates torque references and sends the references cyclically through the bus. The servo drive performs torque control.	-
Position reference filter	Used to achieve smooth acceleration and deceleration.	-
Interrupt positioning	Used to interrupt present position reference and execute the set displacement.	-
Frequency-division output	Used to output the position reference pulses or the position pulses fed back by the encoder in the form of phase A/phase B quadrature pulses.	-
Homing	Used to search for the mechanical home automatically to locate the relative position between the mechanical home and mechanical zero	-
Zero clamp	Used to keep the motor speed below a certain value in the speed control mode to lock the position.	-
DI signal assignment	Used to assign functions such as S-ON to corresponding pins.	-
Forced DO	Used to output signals not related to the drive status forcibly or used to check the wiring of output signals.	-
Touch probe	This function is the same as the position latch function.	-
Black box	Used to capture the data at the moment of fault or save the data automatically under specified conditions.	-
SEMI F47 Voltage Drop	This function is used together with H0A.84 (Hold time of instantaneous stop), the drive can continue to run when the power supply voltage drops.	-

Function	Description	References
Accuracy compensation	Used to calibrate the motor physical accuracy through compensation, which is supported by DDL and DDR motors.	-
Gantry synchronization	Used to achieve synchronization of two axes.	-
Position comparison output	Used to output a DO signal with designated pulse width after the drive reaches the preset target position.	-
STO function	The safe torque off (STO) function brings the machine safely into a no-torque state and prevents it from unexpected start.	-

3 Basic Functions of the Servo Drive

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

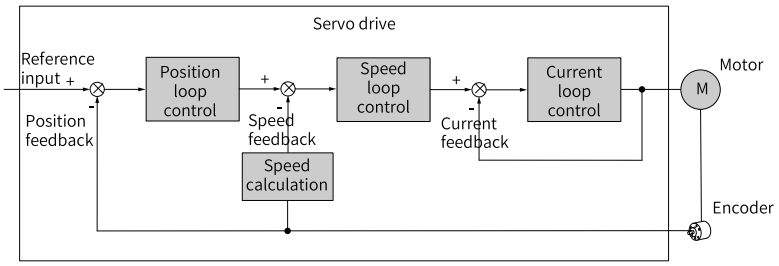


Figure 3-1 Structure of a basic servo system

As the control core of the servo system, the servo drive performs accurate position, speed, torque, or hybrid control on the servo motor by processing the input signals and feedback signals. Position control is the most important mode of a servo system.

Descriptions of the control modes are as follows:

- Position control mode:
  Position control 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 mode:
  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 mode:
  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. This control mode is mainly applicable to the winding and unwinding devices with strict tension requirements. In these scenarios, the torque always changes with the winding radius so that the tension will not change along with the change of the winding radius.

3.1 Setting and Display of Operation Modes

Introduction to servo operation modes

The operation mode of the servo drive is set in 6060h. The operation mode of the servo drive is viewed in 6061h.

☆ Related parameters:

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
6060h	6060h	Servo drive mode selection	1: Profile position (PP) mode 3: Profile speed (PV) mode 4: Profile torque (PT) mode 6: Homing mode (HM) 8: Cyclic synchronous position (CSP) mode 9: Cyclic synchronous velocity (CSV) mode 10: Cyclic synchronous torque (CST) mode	0	-	Real time	"6060h" on page 980
6061h	6061h	Operation mode display	1: Profile position (PP) mode 3: Profile speed (PV) mode 4: Profile torque (PT) mode 6: Homing mode (HM) 8: Cyclic synchronous position (CSP) mode 9: Cyclic synchronous velocity (CSV) mode 10: Cyclic synchronous torque (CST) mode	0	-	Read-only	"6061h" on page 981

Communication cycle supported by each mode

The SV680N-INT series servo drive supports a minimum synchronization cycle of 250 μs and a maximum synchronization cycle of 20 ms.

3.2 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.

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

☆Related parameters

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
6091.01h	6091-01h	Motor resolution	1 to 4294967295	1	-	At stop	"6091_en.01h" on page 990
6091.02h	6091-02h	Shaft resolution	1 to 4294967295	1	-	At stop	"6091_en.02h" on page 990

Calculating servo motor position factor

Take the ball screw as an example:

Minimum reference unit f_c = 1 mm

Lead P_B = 10 mm/r

Reduction ratio n = 5:1

Resolution of Inovance motor with 26-bit serial encoder (P) = 67108864 (PPR)

Therefore, the position factor is calculated as follows:

Position factor:

$$\text{Position factor} = \frac{\text{Motor resolution P x n}}{P_B} = \frac{67108864 \times 5}{10} = \frac{335544320}{10} = 33554432$$

Therefore, 6091.01h = 33554432; 6091.02h = 1. That means when the load shaft displacement is 1 mm, the motor displacement is 33554432.

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

Calculating direct drive motor position factor

For example, Inovance DDR communication encoder (H00.00 = 14201) is connected directly without the reducer.

Minimum reference unit f_c = 1 degree

Travel per revolution P_B = 360 degrees

Motor resolution (P) = 8388608 (PPR)

Therefore, the position factor is calculated as follows:

Position factor:

$$\text{Position factor} = \frac{\text{Motor resolution P}}{P_B} = \frac{8388608}{360}$$

Therefore, 6091.01h = 8388608; 6091.02h = 360. That means when the load moves 360 degrees, the motor displacement is 8388608.

For example, Inovance DDL communication encoder (H00.00 = 14202) is connected directly without the reducer.

Minimum reference unit f_c = 1 mm

Motor pole pitch (N-N) x P_B = 32 mm x (2 x H00.48)

Motor resolution (P) = 8388608 (PPR)

Therefore, the position factor is calculated as follows:

Position factor:

$$\text{Position factor} = \frac{\text{Motor resolution P}}{P_B} = \frac{8388608}{32}$$

Therefore, 6091.01h = 8388608; 6091.02h = 32. That means when the load moves 32 mm, the motor displacement is 8388608.

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

Reference case for setting electronic gear ratio of linear motors

Minimum reference unit = 1 mm

Encoder resolution: 0.5 μm/pulse

The reduction ratio is 1:1 because the linear motor moves linearly

The position factor is calculated as follows:

Position factor = 1 mm/(0.5 μm/pulse) = 2000

The load displacement is 1 mm, the motor rotor moves 1 mm, and the encoder feeds back 2000 pulses.

3.3 Servo Drive States

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

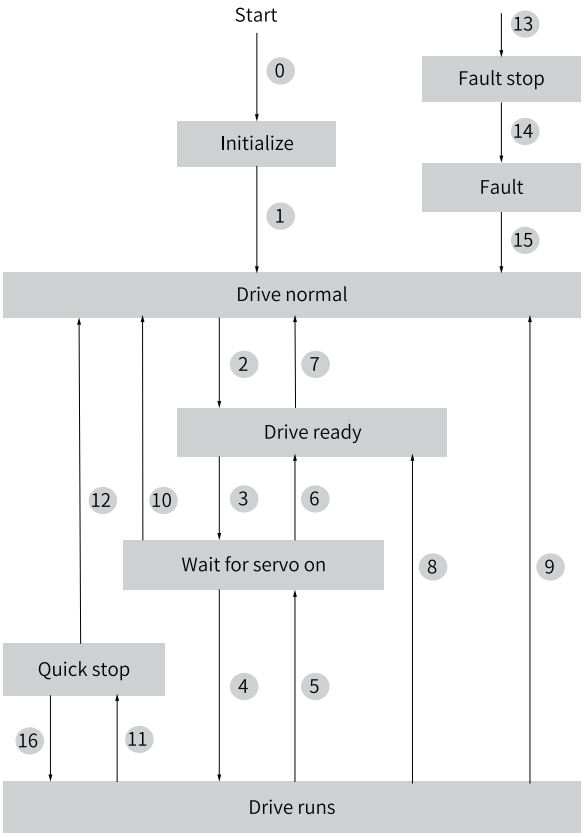


Figure 3-2 State switchover of CiA402 state machine

See the following table for descriptions of different states.

Initialization	Initialization of the servo drive and internal self-inspection are done. Parameters cannot be set and the driving function cannot be executed.
No fault	No fault exists in the servo drive or the fault has been cleared. Parameters can be set.
Ready to switch on	The servo drive is ready to run. Parameters can be set.
Wait for the S-ON signal	The servo drive is waiting for the S-ON signal. Parameters can be set.
Servo running	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 that can be edited during operation can be set.
Quick stop	Quick stop is activated and the servo drive is in the process of quick stop. Only parameters that can be edited during operation can be set.
Stop at fault	A fault occurs and the servo drive is in the process of stop. Only parameters that can be edited during operation can be set.
Fault	The stop process is done and all the drive functions are disabled. Parameters can be modified for troubleshooting purpose.

The following table describes the control commands and status switchover.

CiA402 state switchover		Control word 6040h	bit0 to bit9[1] of status word 6041h
0	Power-on → Initialization	Natural transition, control command not required	0x0000
1	Initialization → No fault	Natural transition, control command not required If an error occurs during initialization, the servo drive directly enters status 13.	0x0250/0x270
2	No fault → Servo ready	0x0006	0x0231
3	Servo ready→Waiting for the S-ON signal	0x0007	0x0233
4	Waiting for the S-ON signal→Servo running	0x000F	0x0237
5	Servo running→Waiting for the S-ON signal	0x0007	0x0233
6	Waiting for the S-ON signal→Servo ready	0x0006	0x0231
7	Servo ready → No fault	0x0000	0x0250
8	Servo running → Servo ready	0x0006	0x0231
9	Servo running → No fault	0x0000	0x0250
10	Waiting for the S-ON signal → No fault	0x0000	0x0250
11	Servo running → Quick stop	0x0002	0x0217
12	Quick stop → No fault	Quick stop mode 605Ah can be set to 0 to 3. The process is performed automatically and no control command is required.	0x0250
13	Non-fault state→Stop at fault	If a fault occurs in any status other than "fault", the servo drive automatically switches to the stop-at-fault state, without the need for a control command.	0x021F
14	Stop at fault→Fault	Natural transition applies after stop and no control command is required.	0x0218
15	Fault→No fault	0x80 Bit7 is rising edge-triggered. bit7 is maintained at 1, and other control commands are ineffective.	0x0250
16	Quick stop → Servo running	Set 605A to a value between 5 to 7. 0x0F will be sent after stop.	0x0237

Note

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

3.3.1 Control Word 6040h

6040h **Control word**

Comms. address:	6040h	Unit:	-
Min. value:	0x0	Data type:	UInt16
Max. value:	0xFFFF	Change mode:	Real time
Default value:	0x0	Effective mode:	Real time

Value range:
0x0 to 0xFFFF

Description:
Sets the control command.

bit	Name		Description
0	Switch on	Switch on	1: Active; 0: Inactive
1	Enable voltage	Enable voltage	1: Active; 0: Inactive
2	Quick stop	Quick stop	0: Active; 1: Inactive
3	Servo running	Enable operation	1: Active; 0: Inactive
4 to 6	Operation mode specific	Operation mode specific	Related to the operation mode of the servo drive.
7	Fault reset	Fault reset	0: Inactive 0→1: Fault reset is available only for faults and alarms that can be reset. 1: Other control commands are invalid. 1→0: Inactive
8	Halt	Halt	1: Active; 0: Inactive
9	Operation mode specific	Operation mode specific	Related to the servo drive operation mode.
10	Reserve	Reserve	Not assigned
11 to 15	Manufacturer-specific	Manufacturer-specific	Manufacturer-specific

Note

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

3.3.2 Status Word 6041h

6041h **Status word**

Comm. address:	6041h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFF

Description

Indicates the servo drive status.

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

MSB LSB

Note：ms=manufacturer-specific；oms=operation mode-specific；ila =internal limit active；tr=target 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 3–1 Description of each bit of 6041h

Bit	Name		Description
0	Ready to switch on	Ready to switch on	1: Active; 0: Inactive
1	Switch on	Switch on	1: Active; 0: Inactive
2	Enable operation	Enable operation	1: Active; 0: Inactive
3	Fault	Fault	1: Active; 0: Inactive
4	Enable voltage	Enable voltage	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 activated 0: Inactive
10	Target reach	Target reach	1: Active; 0: Inactive
11	Internal limit active	Internal limit active	1: Active; 0: Inactive
12 to 13	Operation mode specific	Operation mode specific	Related to the servo drive operation mode.
14	Manufacturer-specific	Manufacturer-specific	Undefined
15	Home find	Home find	0: Home not found 1: Home found

Table 3–2 Descriptions of setpoints of 6041h

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

Note

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

3.4 Process Segment Mode

Set H02.00 (Control mode) to 7 (Position control mode) through the keypad or Inovance software tool to make the drive operate in the process segment mode. The process segment mode is a multi-function position mode integrated with homing, constant speed control, and positioning control.

16 process segments are available, in which process segment 0 is the homing mode and process segments 1 to 15 are defined by users. The interval time and linkage mode among process segments can also be selected as needed. The setting flowchart is as follows.

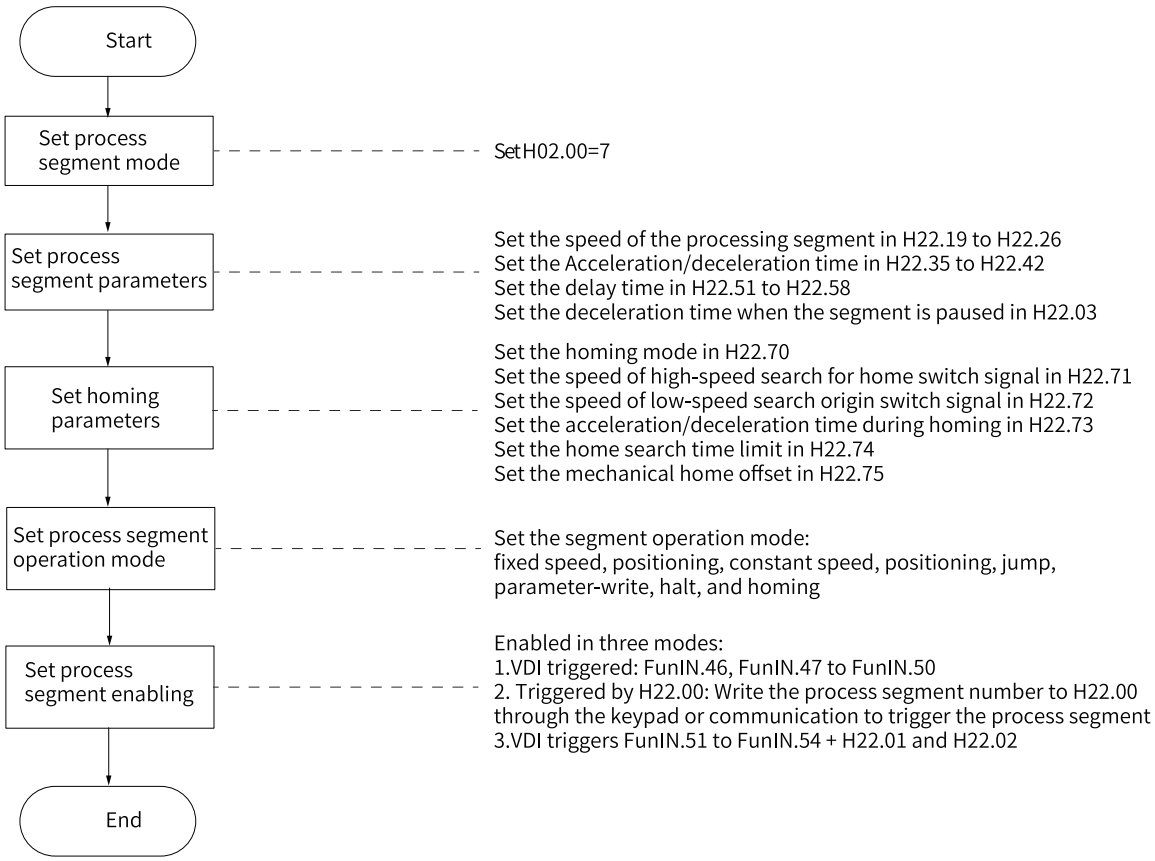


Figure 3-3 Flowchart for setting process segment mode

3.4.1 Triggering Process Segment Mode

The following table shows how to trigger the process segment mode.

Trigger mode	Trigger source	Description
Triggered by DI	DI: FunIN.46 (PrEnable) + FunIN.47 to 50 (PrCMD1 to 4)	Combine FunIN.47 to FunIN.50 to form the process segment number to be triggered. Trigger the process segment through the rising edge of FunIN.46.
Triggered by parameter	H22.00	Write the process segment number to H22.00 through the keypad or communication to trigger the process segment.
Triggered by DI and parameter	DI: FunIN.51...54 (ProceEvTri1...4) + H22.01/H22.02	Set the process segment number to be triggered through H22.01 and H22.02. H22.01: DI: Triggered by the rising edge of FunIN.51 to FunIN.54 H22.02: DI: Triggered by the falling edge of FunIN.51 to FunIN.54
Homing	DI: FunIN.32 (HomingStart)	Trigger the process segment through the rising edge of FunIN.32.
	H22.00 = 0	H22.00 is set to 0.
	FunIN.46 + FunIN.47...FunIN.50 (combined segment number being 0)	When the process segment is triggered by the rising edge of FunIN.46, the motor executes homing based on the set homing mode and home speed.
Halt	DI: FunIN.55 (PrSuspend)	Trigger the process segment through the rising edge of FunIN.55.
	H22.00 = 1000	When H22.00 is set to 1000, the process segment in progress is stopped immediately and the motor ramps to stop based on the deceleration time defined by H22.03. The motor remains enabled after stop.

When a DI is used to trigger the process segment, assign the DI of the servo drive with corresponding function and set the active logic of this DI.

Note

- PrEnable, PrSuspend, and ProceEvTri1 to ProceEvTri4 signals are edge-triggered. When DI is used, the effective signal width of the DI must be at least 0.125 ms.
- In the process segment mode, FunIN.32 (HomingStart) is used to trigger the process segment homing mode.
- In the position mode, FunIN.32 (HomingStart) is used to trigger the local homing mode.

☆Related parameters:

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
H22.00	2022-01h	Process segment command trigger	0 to 1000	0	-	Real time	"H22_en.00" on page 895
H22.01	2022-02h	Process segment triggered by the event rising edge	0 to 65535	0	-	Real time	"H22_en.01" on page 895

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
H22.02	2022-03h	Process segment triggered by the event falling edge	0 to 65535	0	-	Real time	"H22_en.02" on page 896
H22.03	2022-04h	Acceleration/ Deceleration time upon process segment pause	0: Acceleration/Deceleration time 1: Acceleration/Deceleration time 1 2: Acceleration/Deceleration time 2 3: Acceleration/Deceleration time 3 4: Acceleration/Deceleration time 4 5: Acceleration/Deceleration time 5 6: Acceleration/Deceleration time 6 7: Acceleration/Deceleration time 7	0	-	Real time	"H22_en.03" on page 896

Table 3–3 Description of function No.

Code	Name	Description	Name
FunIN.32	HomingStart	Homing enable	Active: Homing enabled (The HomingStart signal cannot be triggered repeatedly during homing.) Inactive: Homing inhibited
FunIN.46	PrEnable	Process segment enable	The process segment can be enabled only when the rising edge of PrEnable signal is active. Otherwise, the process segment function is inactive.
FunIN.47	PrCMD1	Process segment command switchover 1	The process segment number is a 4-bit binary. The relationship between the segment number and PrCMD1...PrCMD4 is shown in "Table 3-4" on page 37. The DI logic is level-triggered. The PrCMD1 value is 1 upon active level input or 0 upon inactive level input.
FunIN.48	PrCMD2	Process segment command switchover 2	
FunIN.49	PrCMD3	Process segment command switchover 3	
FunIN.50	PrCMD4	Process segment command switchover 4	
FunIN.51	PrEvent1	Event trigger process segment 1	The DI for event trigger process segment is used together with H22.01 and H22.02.
FunIN.52	PrEvent2	Event trigger process segment 2	
FunIN.53	PrEvent3	Event trigger process segment 3	
FunIN.54	PrEvent4	Event trigger process segment 4	
FunIN.55	PrSuspend	Process segment pause	When the rising edge of PrSuspend signal is active, the process segment in progress stops immediately and the motor ramps to stop based on the deceleration time defined by H22.03. The motor remains enabled after stop.

Table 3–4 Relationship between the segment number and CMD1 to CMD4

PrCMD4	PrCMD3	PrCMD2	PrCMD1	Segment No.
0	0	0	0	0
0	0	0	1	1

PrCMD4	PrCMD3	PrCMD2	PrCMD1	Segment No.
…				
1	1	1	1	15

3.4.2 Related Parameters

The speed setpoint (SpdSet) and acceleration/deceleration time (AccTime/DecTime) for each segment in the process segment, and the interval time (DelayTime) upon completion of each process segment are set by three groups of parameters respectively, with each parameter group containing eight parameters.

During operation, you can select one parameters from these three parameter groups respectively to generate the process segment.

1. Speed setpoint (SpdSet) (0.1 rpm to 6000.0 rpm)
   Corresponding to H22.19 to H22.26 (unit: 0.1 rpm).

2. Acceleration/Deceleration time (AccTime/DecTime) (0 ms to 65535 ms)
   Corresponding to H22.35 to H22.42

   The acceleration/deceleration time indicates the time for a motor to change from 0 rpm to 1000 rpm. The actual acceleration/deceleration time is therefore as follows:

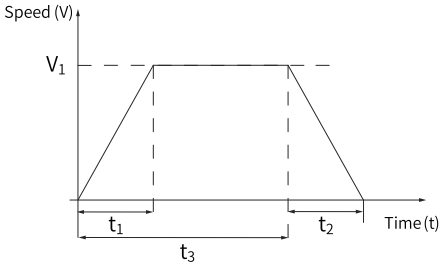


Figure 3-4 Example of the curve in fixed speed mode

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

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

The actual deceleration time t_2 is:

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

3. Interval time after completion of process segment (DelayTime) (0 ms to 65535 ms)
   The corresponding parameters are H22.51 to H22.58.

☆Related parameters:

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
H22.19	2022-14h	Target speed	0.1 to 6000.0	50.0	[mm/s]/ [rpm]	Real time	" *H22_en.19* *on page 898*
H22.20	2022-15h	Target speed 1	0.1 to 6000.0	200.0	[mm/s]/ [rpm]	Real time	" *H22_en.20* *on page 898*

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
H22.21	2022-16h	Target speed 2	0.1 to 6000.0	500.0	[mm/s]/ [rpm]	Real time	"H22_en.21" on page 899
H22.22	2022-17h	Target speed 3	0.1 to 6000.0	1000.0	[mm/s]/ [rpm]	Real time	"H22_en.22" on page 899
H22.23	2022-18h	Target speed 4	0.1 to 6000.0	1500.0	[mm/s]/ [rpm]	Real time	"H22_en.23" on page 899
H22.24	2022-19h	Target speed 5	0.1 to 6000.0	2000.0	[mm/s]/ [rpm]	Real time	"H22_en.24" on page 899
H22.25	2022-1Ah	Target speed 6	0.1 to 6000.0	2500.0	[mm/s]/ [rpm]	Real time	"H22_en.25" on page 900
H22.26	2022-1Bh	Target speed 7	0.1 to 6000.0	3000.0	[mm/s]/ [rpm]	Real time	"H22_en.26" on page 900
H22.35	2022-24h	Acceleration/ deceleration time	0 to 65535	50	ms	Real time	"H22_en.35" on page 900
H22.36	2022-25h	Acceleration/ Deceleration time 1	0 to 65535	200	ms	Real time	"H22_en.36" on page 900
H22.37	2022-26h	Acceleration/ Deceleration time 2	0 to 65535	500	ms	Real time	"H22_en.37" on page 901
H22.38	2022-27h	Acceleration/ Deceleration time 3	0 to 65535	1000	ms	Real time	"H22_en.38" on page 901
H22.39	2022-28h	Acceleration/ Deceleration time 4	0 to 65535	1500	ms	Real time	"H22_en.39" on page 901
H22.40	2022-29h	Acceleration/ Deceleration time 5	0 to 65535	2000	ms	Real time	"H22_en.40" on page 901
H22.41	2022-2Ah	Acceleration/ Deceleration time 6	0 to 65535	2500	ms	Real time	"H22_en.41" on page 902
H22.42	2022-2Bh	Acceleration/ Deceleration time 7	0 to 65535	3000	ms	Real time	"H22_en.42" on page 902
H22.51	2022-34h	Delay after completion of the process segment	0 to 65535	0	ms	Real time	"H22_en.51" on page 902
H22.52	2022-35h	Delay time 1 after completion of the process segment	0 to 65535	50	ms	Real time	"H22_en.52" on page 902
H22.53	2022-36h	Delay time 2 after completion of the process segment	0 to 65535	200	ms	Real time	"H22_en.53" on page 902

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
H22.54	2022-37h	Delay time 3 after completion of the process segment	0 to 65535	500	ms	Real time	"H22_en.54" on page 903
H22.55	2022-38h	Delay time 4 after completion of the process segment	0 to 65535	1000	ms	Real time	"H22_en.55" on page 903
H22.56	2022-39h	Delay time 5 after completion of the process segment	0 to 65535	1500	ms	Real time	"H22_en.56" on page 903
H22.57	2022-3Ah	Delay time 6 after completion of the process segment	0 to 65535	2000	ms	Real time	"H22_en.57" on page 903
H22.58	2022-3Bh	Delay time 7 after completion of the process segment	0 to 65535	3000	ms	Real time	"H22_en.58" on page 904

3.4.3 Operation Mode

The process segment mode supports the homing mode, constant speed mode, and positioning mode. Six operation modes are available, which are homing mode, constant speed mode, positioning mode, jump mode, parameter-write mode, and halt mode.

The homing mode is set in process segment 0 and the halt mode is set in process segment 1000. Other modes are set in process segments 1 to 15.

Each group of process segments consists of two parts, process segment definition and process segment data. The process segment parameters are H23.00 to H23.62 (16 groups in total), with each parameter group containing two 32-bit parameters.

<table>
<tr><th colspan="5">Definition of process segment</th></tr>
<tr><th>bit</th><th>Function</th><th colspan="3">Value</th></tr>
<tr><td rowspan="6">3 to 0</td><td rowspan="6">Mode</td><td colspan="3"></td></tr>
<tr><td>bit3 to bit0</td><td>Process segment mode</td><td>Description of process segment</td></tr>
<tr><td>0001</td><td>Constant speed mode</td><td>-</td></tr>
<tr><td>0010</td><td>Positioning mode</td><td>Stop upon positioning completed</td></tr>
<tr><td>0011</td><td>Positioning mode</td><td>Executing the next segment upon positioning completed</td></tr>
<tr><td>0111</td><td>Jump mode</td><td>Jumping to the designated process segment</td></tr>
<tr><td>1000</td><td>Parameter-write mode</td><td>Writing specific parameters</td></tr>
<tr><td>7 to 4</td><td>-</td><td colspan="3">-</td></tr>
<tr><td>11 to 8</td><td>-</td><td colspan="3">-</td></tr>
<tr><td>15 to 12</td><td>-</td><td colspan="3">-</td></tr>
<tr><td>19 to 16</td><td>-</td><td colspan="3">-</td></tr>
<tr><td>23 to 20</td><td>-</td><td colspan="3">-</td></tr>
<tr><td>27 to 24</td><td>-</td><td colspan="3">-</td></tr>
<tr><td>31 to 28</td><td>-</td><td colspan="3">-</td></tr>
</table>

Process segment data	
bit	Value
31 to 0	-

Note

If block 15 is the NC block that is automatically loaded to the last, the first block applies after block 15 is executed.

Homing mode

When process segment 0 is triggered, the homing function is triggered.

In process segment mode, the software homing function cannot be enabled.

See the following table for definitions of the homing mode.

Definition of process segment		
bit	Function	Value
3 to 0	-	-
7 to 4	PathNum	0: The motor stops upon homing completed 1 to 15: After homing is completed, the PathNum segment is executed automatically after the DelayTime elapses.
11 to 8	-	-
15 to 12	-	-
19 to 16	-	-
23 to 20	DelayTime	0 to 8: Waiting time index after process segment is completed H22.51 to H22.58% For details, see " *Parameter Description*" on page 569
27 to 24	-	-
31 to 28	-	-

Process segment data	
bit	Value
31 to 0	Process segment data (32-bit) (unused)

Related parameters:

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H22.70	2022-47h	Homing mode of process segment	-32767 to 32768	-2	-	Real time	" *H22_en.70*" on page 904
H22.71	2022-48h	Speed of high-speed homing ON/OFF signal	0 to 3000	100	[mm/s]/[rpm]	Real time	" *H22_en.71*" on page 904
H22.72	2022-49h	Speed of low-speed homing ON/OFF signal	0 to 1000	10	[mm/s]/[rpm]	Real time	" *H22_en.72*" on page 904
H22.73	2022-4Ah	Acceleration/Deceleration time during homing	0 to 1000	1000	ms	Real time	" *H22_en.73*" on page 905

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H22.74	2022-4Bh	Homing time limit	0 to 65535	10000	ms	Real time	"H22_en.74" on page 905
H22.75	2022-4Ch	Mechanical home offset	-2147483648 to 2147483647 (encoder unit)	0	Reference unit	Real time	"H22_en.75" on page 905
H22.79	2022-50h	Relative/Absolute homing	0 to 65535	0	-	Real time	"H22_en.79" on page 905

☆ Related parameters:

Param.	Name	Function	Description
FunOut.16	HomeAttain	Homing completed	Active: Homing completed in process segment mode Inactive: Homing not completed

Constant speed mode

Mode 1 is the constant speed mode. When the constant speed mode is in progress, the motor operates to the set speed based on the set acceleration/deceleration time, and then keeps operating at the set speed.

Definition of process segment				
bit	Function	Value		
3 to 0	Mode	1		
7 to 4	Func	bit	Function	Description
		4	Updated immediately (ImmedUpd)	The present segment overrides the previous segment, which means the previous segment will be interrupted so as to execute present segment. For details, see "Special mode" on page 49Special mode.
		5	Loading next segment (Auto)	The next process segment applies after the constant speed is reached and the Delaytime elapses.
		6	Unit	0: 0.1 rpm 1: PPS (pulses/s) (reference unit)
		7	-	-
11 to 8	AccTime	Index of the acceleration/deceleration time Index H22.35 to H22.42		
15 to 12	DecTime			
19 to 16	...	-		
23 to 20	DelayTime	Index of the interval time after the process segment is completed Index H22.51 to H22.58		
27 to 24	-	-		
31 to 28	-	-		

Process segment data	
bit	Value
31 to 0	Target speed (accurate to 0.1 RPM)

Where:

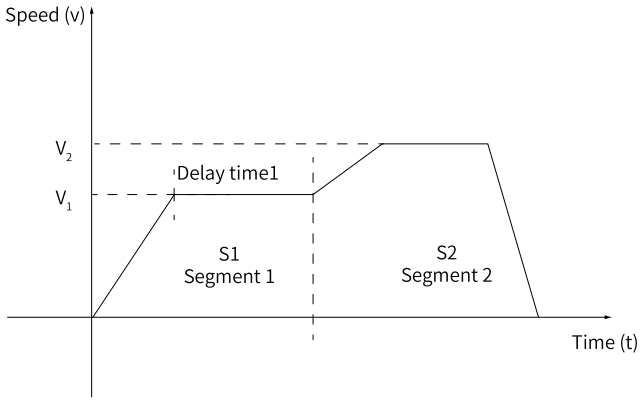


Figure 3-5 Time-speed curve

Segment 1: Constant speed mode; DelayTime1: Time interval set for the constant speed mode; V_1: Speed set for the constant speed mode.

Segment 2: Positioning mode; V_2: Speed set for the positioning mode.

S1 represents displacement 1 and S2 represents displacement 2.

Positioning mode

Modes 2 and 3 indicate the positioning mode. In mode 2, the servo drive stops when positioning is completed. In mode 3, the next segment will be executed when positioning is completed.

When the positioning mode is in progress, the motor accelerates or decelerates at present speed to the set speed based on the set acceleration/deceleration time. After operating at constant speed for a period of time, the motor decelerates to 0 rpm based on the set deceleration time. Finally, the motor stops at the position set by the positioning mode.

<table>
<tr><th colspan="3">Definition of process segment</th></tr>
<tr><th>bit</th><th>Function</th><th>Value</th></tr>
<tr><td>3 to 0</td><td>Mode</td><td>Positioning mode 2: Stop upon positioning completed
Positioning mode 3: Execute the next segment upon positioning completed</td></tr>
<tr><td>7 to 4</td><td>Func</td><td>
<table>
<tr><th>bit</th><th>Function</th><th>Description</th></tr>
<tr><td>4</td><td>Updated immediately (ImmedUpd)</td><td>The present segment overrides the previous segment, which means the previous segment will be interrupted so as to execute present segment. For details, see “Special mode” on page 49 Special mode.</td></tr>
<tr><td>5</td><td>Overlap (OverLap)</td><td>The present segment can overlap with the next segment. During overlapping, the interval time of present segment is set to 0 forcibly. For details, see “Special mode” on page 49 Special mode.</td></tr>
<tr><td>6</td><td rowspan="2">Position reference type (CmdType)</td><td rowspan="2">bit6 and bit7 set to 00: Absolute positioning command (Final position = Target position)
bit6 and bit7 set to 10: Incremental positioning command (Final position = Previous final position + Target position)</td></tr>
<tr><td>7</td></tr>
</table>
</td></tr>
<tr><td>11 to 8</td><td>AccTime</td><td rowspan="2">Index of the acceleration/deceleration time
Indexes H22.35 to H22.42</td></tr>
<tr><td>15 to 12</td><td>DecTime</td></tr>
<tr><td>19 to 16</td><td>SpdSet</td><td>Index of the speed setpoint
Indexes H22.19 to H22.26</td></tr>
<tr><td>23 to 20</td><td>DelayTime</td><td>Index of the interval time after the process segment is completed
Indexes H22.51 to H22.58</td></tr>
<tr><td>27 to 24</td><td>-</td><td>-</td></tr>
<tr><td>31 to 28</td><td>-</td><td>-</td></tr>
</table>

Process segment data	
bit	Value
31 to 0	Target position (32-bit) (reference unit)

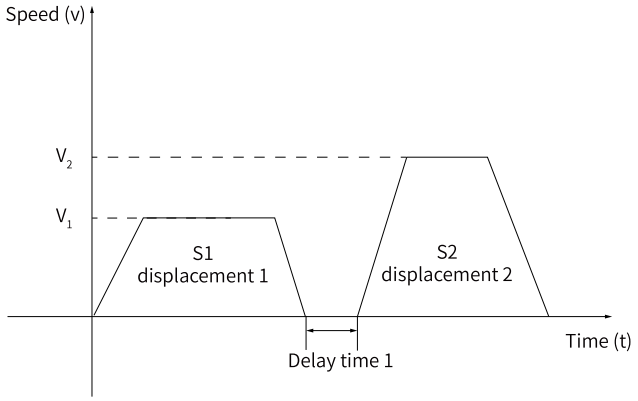


Figure 3-6 Time-speed curve

Segment 1: positioning mode; Mode = 3; OverLap = 0; Delaytime1: interval time set for the positioning mode; V_1: Speed set for the positioning mode.

Second segment: Positioning mode, Mode=2, ImmedUpd=0, V_2: Speed set for the positioning mode.

S1 represents displacement 1 and S2 represents displacement 2.

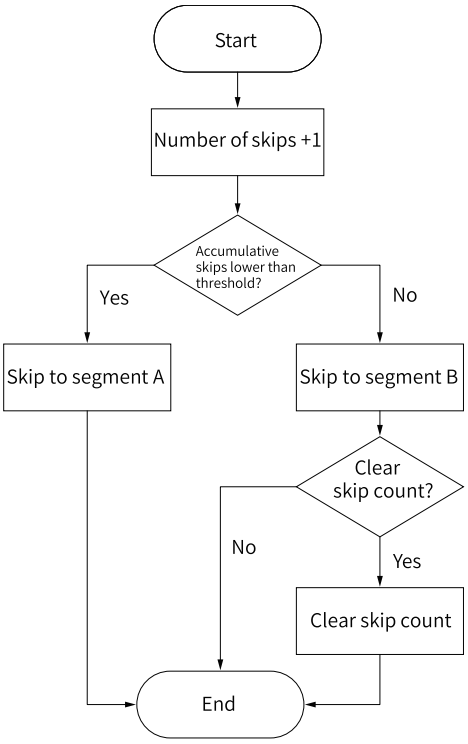
Jump mode

Mode 7 represents the jump mode. When the jump mode is in progress, the drive can jump to any process segment. When the target process segment exceeds the process segment range, E126.0 is reported.

Definition of process segment		
bit	Function	Value
3 to 0	Mode	7
4	Updated immediately (ImmedUpd)	The present segment overrides the previous segment, which means the previous segment will be interrupted so as to execute present segment. For details, see “*Special mode” on page 49 Special mode*.
8 to 5	Threshold for jump	Index of the jump threshold Indexes H22.83 to H22.90
9	Flag for clearing the cumulative count when jumping to process segment B	1: Clear the cumulative number of jumps when jump to process segment B
19 to 10	-	-
23 to 20	DelayTime	Index of the interval time after the process segment is completed Indexes H22.51 to H22.58
31 to 24	-	-

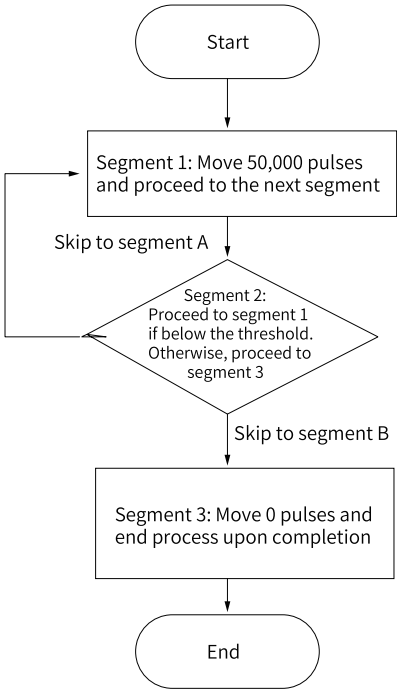
Process segment data	
bit	Value
7 to 0	Number of process segment B
15 to 8	Number of process segment A
31 to 16	Cumulative number of jumps

The jump operation is conditional. Every time the jump operation is executed, the jump count will be incremented by 1. When the cumulative count is lower than this cumulative number of jumps, process segment A applies. Otherwise, process segment B applies. When jumping to process segment B. If bit9 that is defined by the process segment is 1, the cumulative count will be cleared and cumulated from zero again at next jump. The following shows the execution flowchart.

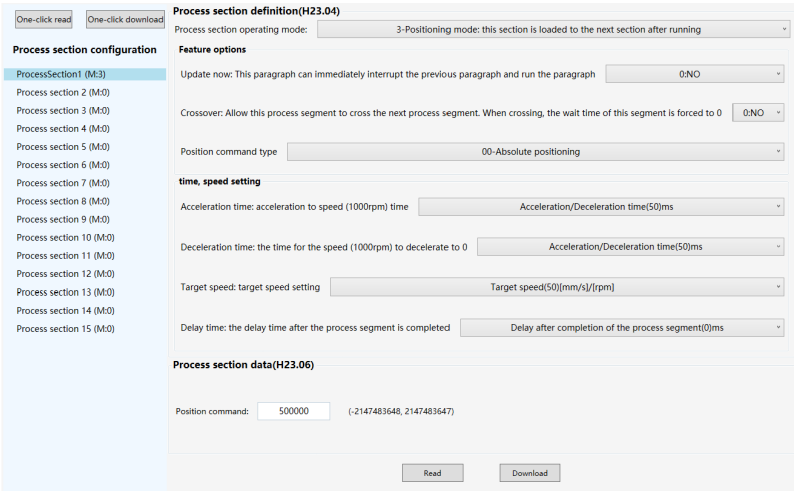


Application case

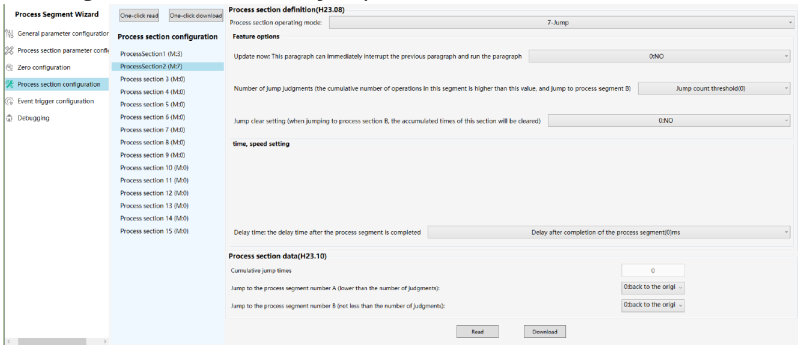
In the following example, the process segment jump function is used to achieve limited repetitive multi-position operations.



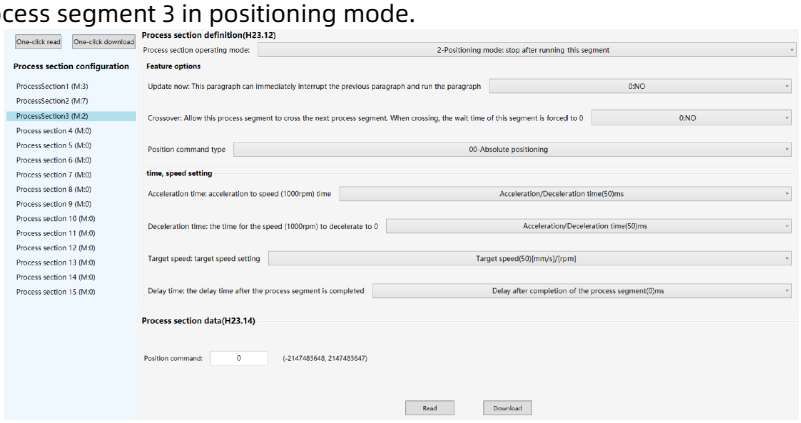
1. Configure process segment 1 as the position mode, and set 50000 pulses for forward operation.



2. Configure process segment 2 and use the jump function.



3. Configure process segment 3 in positioning mode.



Parameter-write mode

Mode 8 represents the parameter-write mode. When parameter-write mode is in progress, you can re-write new parameters to the designated parameters and the new parameter can be saved to EEPROM as needed.

<table>
<tr><th colspan="3">Definition of process segment</th></tr>
<tr><th>bit</th><th>Function</th><th>Value</th></tr>
<tr><td>3 to 0</td><td>Mode</td><td>8</td></tr>
<tr><td>7 to 4</td><td>Func</td><td>
<table>
<tr><th>bit</th><th>Function</th><th>Description</th></tr>
<tr><td>4</td><td>Updated immediately (ImmedUpd)</td><td>The present segment overrides the previous segment, which means the previous segment will be interrupted so as to execute present segment. For details, see “Special mode” on page 49 Special mode.</td></tr>
<tr><td>5</td><td>Loading next segment (Auto)</td><td>The next process segment applies automatically after the Delaytime elapses.</td></tr>
<tr><td>6</td><td>Save (Save)</td><td>0: Parameters not saved to EEPROM
1: Parameters saved to EEPROM</td></tr>
<tr><td>7</td><td>-</td><td>-</td></tr>
</table>
</td></tr>
<tr><td>11 to 8
15 to 12</td><td>No.
(H_Idx)</td><td>Parameter number</td></tr>
<tr><td>19 to 16
23 to 20</td><td>Group No.
(H_Grp)</td><td>Parameter Group No.</td></tr>
<tr><td>27 to 24</td><td>DelayTime</td><td>Index of the interval time after the process segment is completed
Indexes H22.51 to H22.58</td></tr>
<tr><td>31 to 28</td><td>-</td><td>-</td></tr>
</table>

Process segment data	
bit	Value
31 to 0	Designated parameter data (32-bit)

Halt mode

During operation of the process segment (positioning mode, constant speed mode, or homing mode), if 1000 is written to H22.00 or FunIN.55 (PrSuspend) is triggered, the motor interrupts present operation mode immediately and ramps to stop based on the deceleration time defined by H22.03. After stop, the motor keeps enabled and stays at a standstill. When the process segment is triggered again, the motor resumes normal operation.

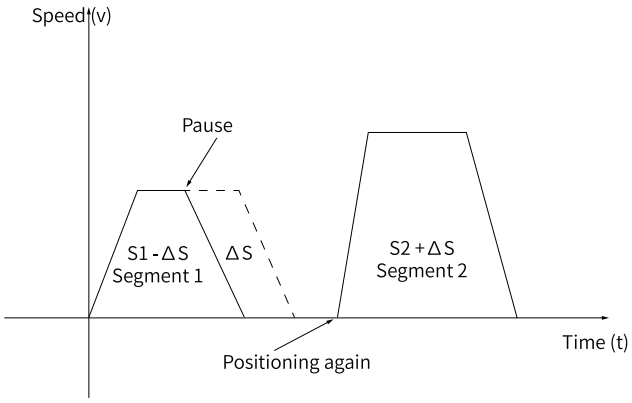


Figure 3-7 Time-speed curve

1st segment: Positioning mode (The motor ramps to stop when halt is triggered during operation.)

Segment 2: Positioning mode

S1 represents the set displacement 1. S2 represents the set displacement 2. ΔS represents the remaining displacement after stop at specified position.

Special mode

ImmedUpd and OverLap functions are special functions which serve to generate complex process segment paths once triggered.

- **Overlap (OverLap)**
  When the overlap function is in progress, the present process segment can overlap with the next process segment. During overlapping, the interval time of present segment is set to 0 forcibly. The overlap function can be used in positioning control only.

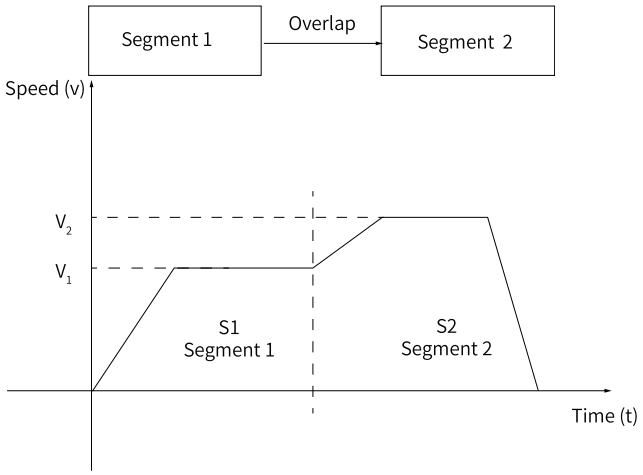


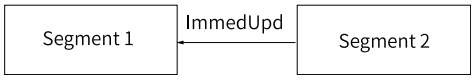
Figure 3-8 Time-speed curve

Segment 1: Positioning mode; Mode=3; OverLap=1, V_1: Speed set for the positioning mode.

Segment 2: Positioning mode; ImmedUpd=0, V_2: Speed set for the positioning mode.

S1 represents the displacement for segment 1 and S2 represents the displacement for segment 2.

- **Updated immediately (ImmedUpd)**
  When the ImmedUpd mode is in progress, the present segment overrides the previous segment, which means the previous segment will be interrupted so as to execute present segment. The ImmedUpd mode can be used in positioning control and constant speed control.



The ImmedUpd mode can be further divided into internal ImmedUpd mode and external ImmedUpd mode.

  - Internal ImmedUpd mode

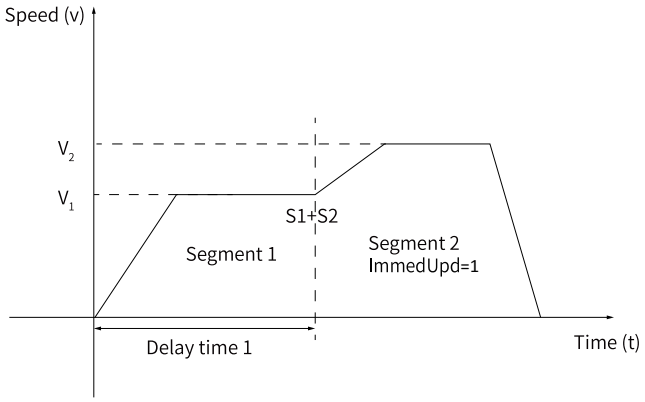


Figure 3-9 Time-speed curve

Segment 1: positioning mode; Mode = 3; DelayTime1: interval time set for the positioning mode; V_1: Speed set for the positioning mode.

Segment 2: ImmedUpd=1, V_2: Speed set for segment 2.

If segment 2 is the positioning mode, S1 is the displacement for segment 1, and S2 is the displacement for segment 2, then the final positioning position is the sum of S1 and S2.

- External ImmedUpd mode

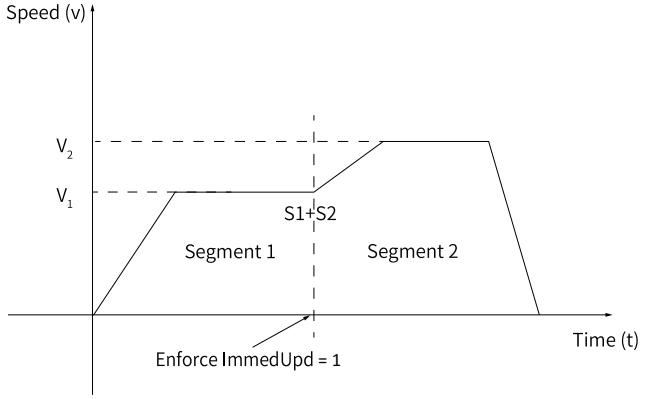


Figure 3-10 Time-speed curve

Segment 2: Positioning mode $_1$: Speed set for the positioning mode.

Segment 2: ImmedUpd=1, V_2: Speed set for the second segment.

If segment 2 is the positioning mode, S1 is the displacement for segment 1, and S2 is the displacement for segment 2, then the final positioning position is the sum of S1 and S2.

Note

- The ImmedUpd function has higher priority over the overlap function, which means when the overlap function is set for process segment 1 and the ImmedUpd function is set for process segment 2, the ImmedUpd function will be executed immediately when process segments 1 and 2 are in progress.
- The external ImmedUpd function has higher priority over the internal ImmedUpd function.

3.4.4 DO and Sequence

FunOUT.22 (CmdOK, internal command completed) can be used to check whether the process segment command is done transmitting. FunOUT.5 (COIN, positioning completed) can be used to check whether positioning is done. FunOUT.24 (McOk, motion control completed) can be used to check whether motion control is done.

The sequence for process segment is shown as follows (taking positioning mode and H05.20 = 0 as example):

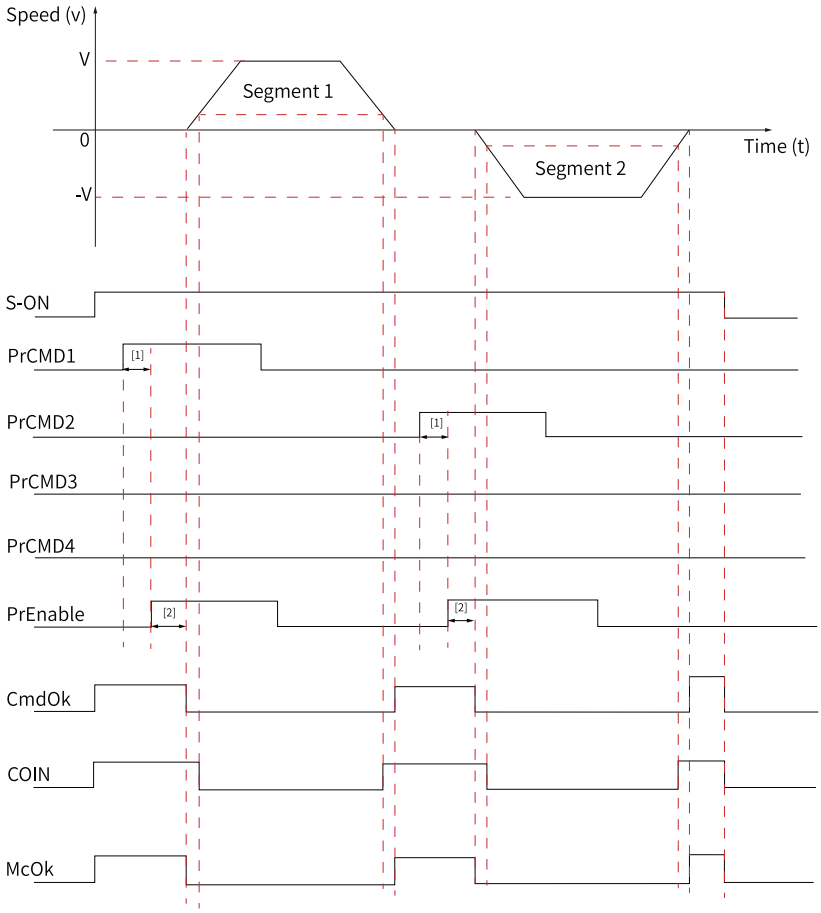


Figure 3-11 Sequence of process segment

Note

- [1] When the DI is used, the effective signal width of the DI must be at least 0.125 ms.
- [2] The PrEnable signal is edge-triggered. The effective signal width of the DI must be at least 0.125 ms.

3.5 Position Control Mode

Note

In position control mode, model N only supports multi-position.

★Terms:

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

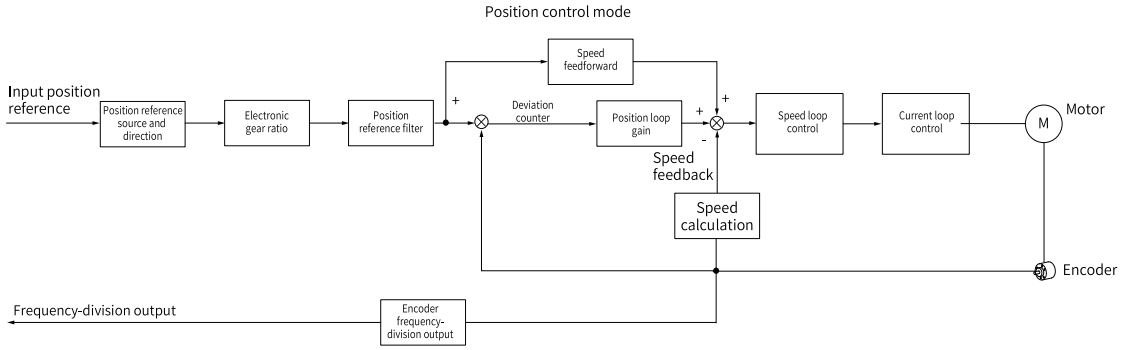


Figure 3-12 Position control diagram

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

In the following diagram, the basic parameter settings are used to describe the position control mode.

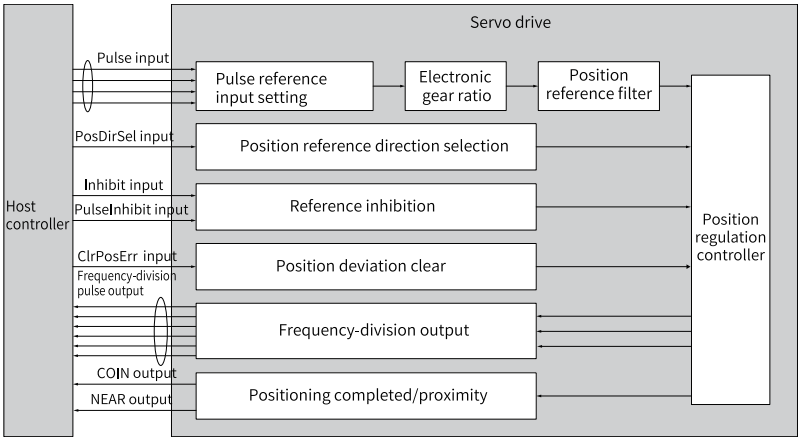


Figure 3-13 Signal exchange between the drive and the host controller

3.5.1 Function Block Diagram

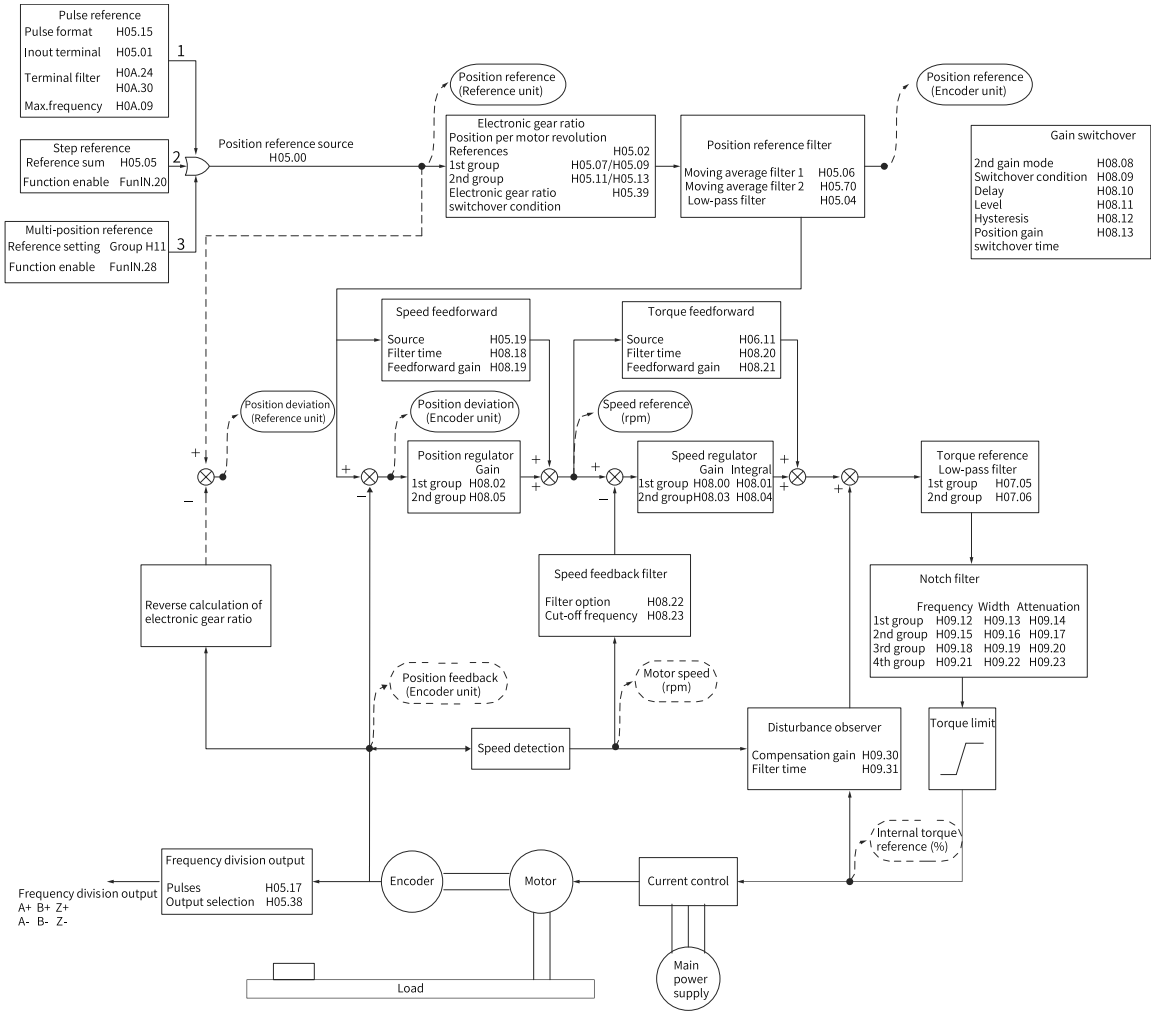


Figure 3-14 Block diagram of position control

3.5.2 Position reference input

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

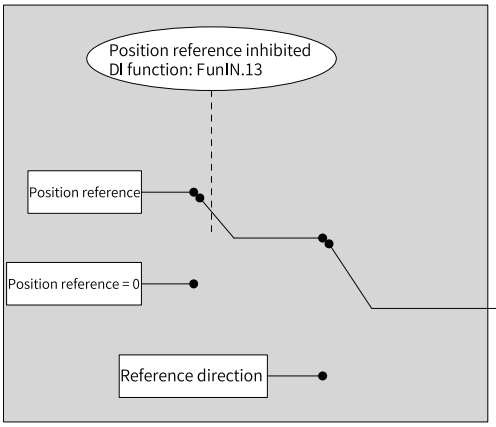


Figure 3-15 Block diagram of position reference input setting

Position reference source

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

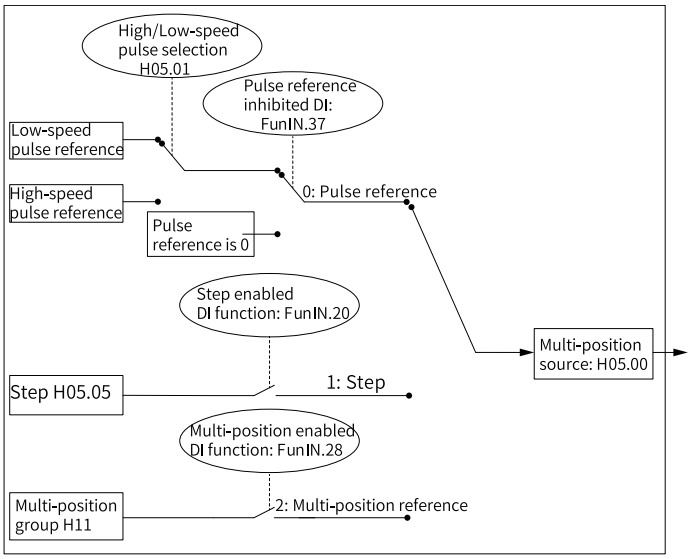


Figure 3-16 Setting of the position reference source

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.00	2005-01h	Main position reference source	2: Multi-position reference	2	-	Real time	"H05_en.00" on page 608

- **Multi-position reference as the position reference source (H05.00 = 2)**
  The servo drive supports multi-position operation. It stores 16 position references. You can set the displacement, maximum running speed, and acceleration/deceleration time of each position. You can also set the time interval and switch mode between positions according to actual requirements. The setting flowchart is shown in the following figure.

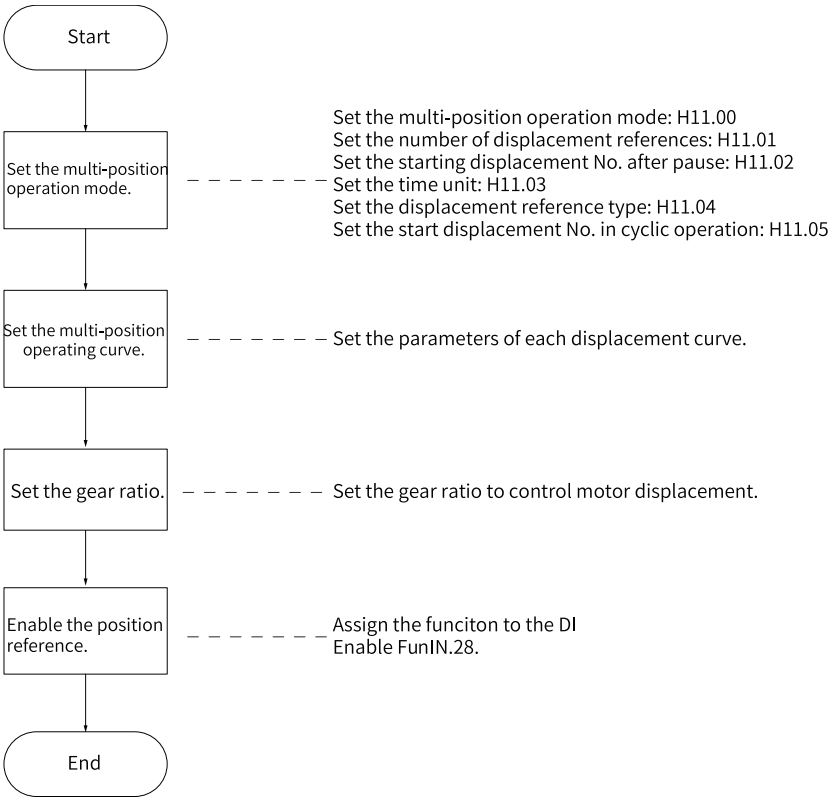


Figure 3-17 Flowchart of setting multi-position reference as the source

- Multi-position running mode

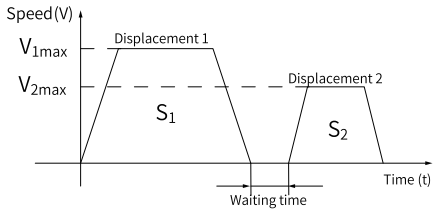
  ☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H11.00	2011-01h	Multi-position running mode	0: Individual operation (number of displacements defined by H11.01) 1: Cyclic operation (number of displacement defined by H11.01) 2: DI-based operation (defined by DI) 3: Sequential operation 5: Axis-controlled continuous operation	1	-	At stop	"H11_en.00" on page 743
H11.01	2011-02h	Number of position references in multi-position mode	1 to 16	1	-	At stop	"H11_en.01" on page 747
H11.02	2011-03h	Starting position No. after pause	0: Continue to execute the remaining positions 1: Start from position 1	0	-	At stop	"H11_en.02" on page 747
H11.03	2011-04h	Waiting time unit	0: ms 1: s	0	-	At stop	"H11_en.03" on page 748

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H11.04	2011-05h	Displacement reference type	0: Relative displacement reference 1: Absolute displacement reference	0	-	Real time	"H11_en.04" on page 748
H11.05	2011-06h	Starting position No. in sequential operation	0 to 16	0	-	At stop	"H11_en.05" on page 748

1. **Stop after running a single cycle (H11.00 = 0)**

Table 3–5 Description of individual operation

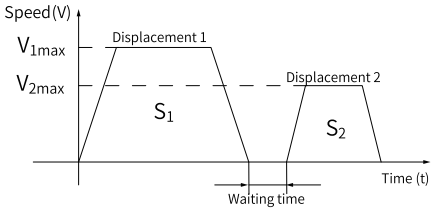
Mode description	Operating curve
• The drive stops after one cycle of operation. • The drive switches to the next position automatically. • The time interval between positions can be set as needed. • The PoslnSen (multi-position reference enable) signal is level-triggered.	 V_{1max}, V_{2max}: maximum values of the 1st and 2nd speeds S_1, S_2: displacements of 1st and 2nd positions • The positioning completed signal is active after each displacement is reached. • If the multi-position reference enable signal is turned off during running, the servo drive discards the uncompleted displacement and stops. After the stop process is completed, the positioning completion signal is active. • After the PoslnSen signal is enabled again, the drive executes the displacement defined by H11.02. • If the S-ON signal is switched off during operation, the motor stops as defined by H02.05 (Stop mode at S-ON OFF). The COIN (positioning completed) signal is deactivated after the motor stops.

★Terms:

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

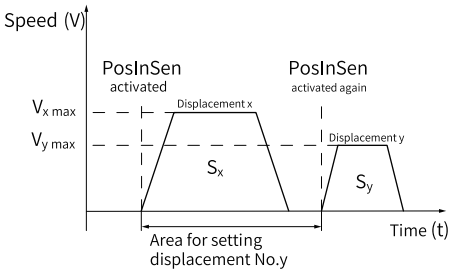
2. **Cyclic operation (H11.00 = 1)**

Table 3–6 Description of cyclic operation

Mode description	Operating curve
• The drive starts from position 1 again after each cycle of operation. • The drive switches to the next position automatically. • The time interval between positions can be set as needed. • The cyclic operation mode remains active when the FunIN.28 (Multi-position reference enable) is active. • The PoslnSen (multi-position reference enable) signal is level-triggered.	 V_{1max} , V_{2max} : maximum values of the 1st and 2nd speeds S_1 , S_2 : displacements of 1st and 2nd positions • The positioning completed signal is active after each displacement is reached. • If the PosInsen signal is switched off during operation, the drive abandons the unfinished displacement and stops. The COIN (positioning completed) signal is activated after the drive stops. • After the PoslnSen signal is enabled again, the drive executes the displacement defined by H11.02. • If the S-ON signal is switched off during operation, the motor stops as defined by H02.05 (Stop mode at S-ON OFF). The COIN (positioning completed) signal is deactivated after the motor stops.

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

Table 3–7 Descriptions of DI-based operation

Mode description	Operating curve
• When the servo drive runs the current position, you can set the next position No. After the position reference of the current number is completed, the servo motor stops. After the PoslnSen (position reference enable) signal is enabled again, the present displacement will be executed. • The speed No. is determined by the DI logic. • The time internal between positions is determined by the command delay of the host controller. • The PoslnSen (multi-position reference enable) signal is edge-triggered.	 V_{xmax} , V_{ymax} : maximum operating speeds at position x and position y S_x , S_y : displacements of xth and yth positions • The positioning completed signal is active after each displacement is reached. • If the PosInsen (multi-position reference enable) signal is switched off during operation, the drive continues to execute the unfinished displacement and outputs the COIN (positioning completed) signal. • The position No. is switched over according to the following sequence: a. Wait until displacement x is done executing before switching the displacement number. b. When displacement x is in progress or done, switch off the PoslnSen (multi-position reference enable) signal first, and then change the displacement No. from x to y (if x = y, the drive executes displacement x again). c. After displacement x is done executing, switch on the PoslnSen (multi-position reference enable) signal again to make the drive execute displacement y. • If the S-ON signal is switched off during operation, the motor stops as defined by H02.05 (Stop mode at S-ON OFF). The COIN (positioning completed) signal is deactivated after the motor stops.

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

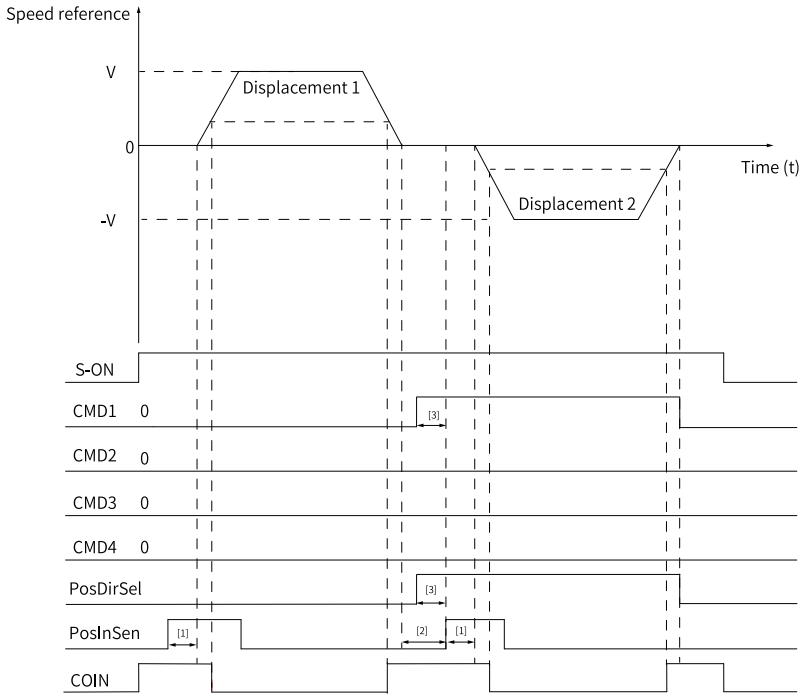


Figure 3-18 Multi-position time sequence

Note

- [1]: The PosInSen signal is edge-triggered. The minimum signal widths required by the normal DI and high-speed DI are 3 ms and 0.25 ms respectively.
- [2]: The area for switching the displacement number, which refers to the interval that starts from the time when the last position reference is transmitted to the time when the next PosInSen (multi-position reference enable) signal is activated again.
- [3]: When a normal DI is used, an effective signal width of 0.125 ms must be maintained.

☆ Related parameters:

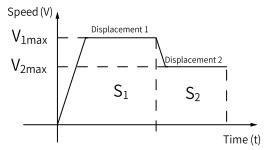
No.	Name	Function name	Function
FunIN.6	CMD1	Multi-reference switchover 1	The position No. is a 4-bit binary. The relationship between the position No. and CMD1 to CMD4 is shown in *"Table 3-8" on page 59*. The DI terminal logic is level-triggered. The signal is 1 when the input level is valid, and 0 when the input level is invalid.
FunIN.7	CMD2	Multi-reference switchover 2	
FunIN.8	CMD3	Multi-reference switchover 3	
FunIN.9	CMD4	Multi-reference switchover 4	

Table 3–8 Relationship between the position No. and CMD1 to CMD4

CMD4	CMD3	CMD2	CMD1	Segment No.
0	0	0	0	1
0	0	0	1	2
...				
1	1	1	1	16

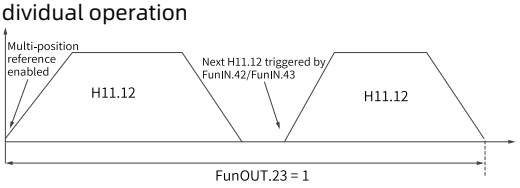
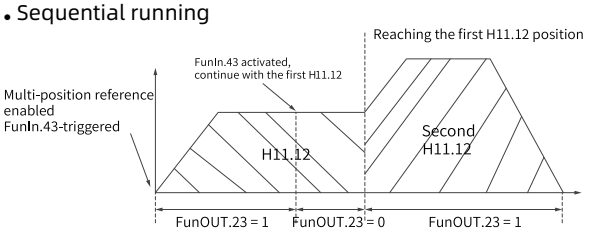
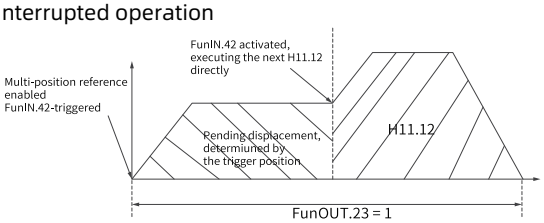
4. **Sequential operation (H11.00 = 3)**

Table 3–9 Description of sequential operation

Mode description	Operating curve
• The drive stops after one cycle of operation. • (H11.05 = 0 or H11.05 > H11.01). • The starting position after the first cycle of operation is defined by H11.05. • The drive switches to the next position automatically. • There is no waiting time between positions. • The PoslnSen (multi-position reference enable) signal is level-triggered.	 V_{1max} , V_{2max} : maximum values of the 1st and 2nd speeds S_1 , S_2 : displacements of 1st and 2nd positions • The positioning completed signal is active after each displacement is reached. • If the PosInsen signal is switched off during operation, the drive abandons the unfinished displacement and stops. The COIN (positioning completed) signal is activated after the drive stops. • After the PoslnSen signal is enabled again, the drive executes the displacement defined by H11.02. • If the S-ON signal is switched off during operation, the motor stops as defined by H02.05 (Stop mode at S-ON OFF). The COIN (positioning completed) signal is deactivated after the motor stops.

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

Table 3–10 Description of axis-controlled continuous operation

Mode description	Operating curve
• The drive executes only one displacement. • The individual operation mode, sequential operation mode, and interrupted operation mode are included. • The PoslnSen (multi-position reference enable) signal is level-triggered.	• Individual operation  • The PoslnSen (multi-position reference enable) signal is triggered only once (FunIN.43/42 triggered later). The drive stops after executing the distance defined by H11.12. • Sequential running  • The PoslnSen (multi-position reference enable) signal is triggered only once. Write H11.12 again and activate FunIN.43 when the distance defined by the first H11.12 is still in progress.• After receiving the new distance (or speed), which is the second H11.12, the servo drive continues executing the first H11.12 until the distance defined by the first H11.12 is reached. Then it starts to execute the second H11.12 directly. The travel distance therefore is the sum of the first H11.12 and the second H11.12. • Interrupted operation  • The PoslnSen (multi-position reference enable) signal is triggered only once. Write H11.12 (such as 1000000) again and activate FunIN.42 when the first H11.12 (such as 9000000) is still in progress. After receiving the new distance (or speed), which is the second H11.12, the drive stops executing the first H11.12 and turns to executing the second H11.12.

☆ Related parameters:

No.	Definition	Function name	Function
FunIN.42	MultiBlockTrig	Axis control command executed immediately	Active: Newly written command activated immediately Inactive: Newly written command not activated
FunIN.43	MultiBlockWr	Axis control command not executed immediately	Active: Newly written command activated after current displacement is done executing Inactive: Newly written command not activated
FunOUT.23	WrNextBlockEn	Command input	Active: Next command input allowed Inactive: Next command input inhibited

- Setting multi-position operating curve

  The servo drive supports 16 position references. You can set the displacement, maximum running speed, and acceleration/deceleration time of each position. The following descriptions take the 1st position as an example.

  ☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H11.12	2011-0Dh	Displacement of position 1	-1073741824 to +1073741824	10000	Reference unit	Real time	"H11_en.12" on page 749
H11.14	2011-0Fh	Maximum running speed of position 1	1 to 10000	200	[mm/s]/[rpm]	Real time	"H11_en.14" on page 749
H11.15	2011-10h	Acceleration/ Deceleration time of position 1	0 to 65535	10	ms	Real time	"H11_en.15" on page 750
H11.16	2011-11h	Waiting time after completion of position 1	0 to 10000	10	ms(s)	Real time	"H11_en.16" on page 750

The actual motor running curve according to the preceding setting is shown in the following figure.

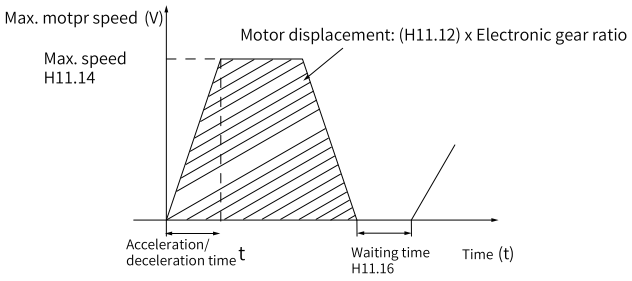


Figure 3-19 Motor running curve of 1st displacement

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

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

For the parameter settings of the other 15 displacements, see *" Parameter Description" on page 569*.

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

  ☆ Related function No.:

No.	Definition	Function name	Function
FunIN.28	PosInSen	Multi-position reference signal enable	Active: The motor executes the multi-position reference. Invalid: Servo motor in locked state Note: • When H11.00 is set to 0, 1, or 3, the logic of the DI assigned with the PosInSen signal is level-triggered. • When H11.00 is set to 2, the logic of the DI assigned with the PosInSen signal is edge-triggered.

Position reference inhibited

FunIN.13 (Inhibit) is used to inhibit position references.

- Position reference inhibited function
  The drive sets all the position references to 0, which means it does not respond to any internal or external position references, and the motor is in the locked state in the position control mode. In this case, the servo drive can be switched over to other control modes.

  To use FunIN.13(Inhibit, position reference), assign FunIN.13 to a certain DI and set the active logic of this DI. It is recommended to use the high-speed DI (DI7 or DI8) terminal.

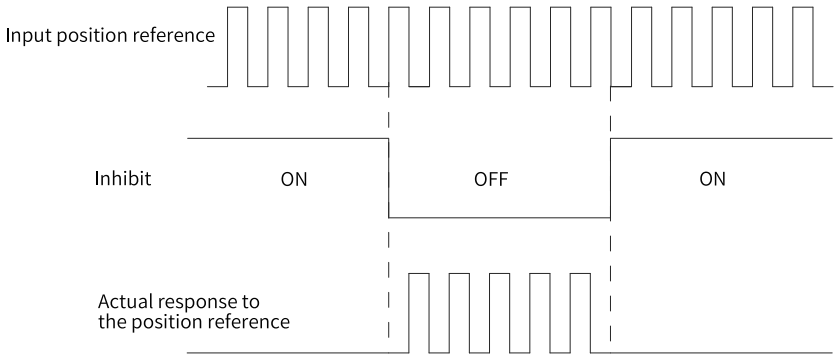


Figure 3-20 Waveform example of position reference inhibited

☆ Related function No.:

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

3.5.3 Reference Frequency Division/Multiplication (Electronic Gear Ratio)

Definition of the electronic gear ratio

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

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

★Terms:

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

Procedure for setting the electronic gear ratio

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

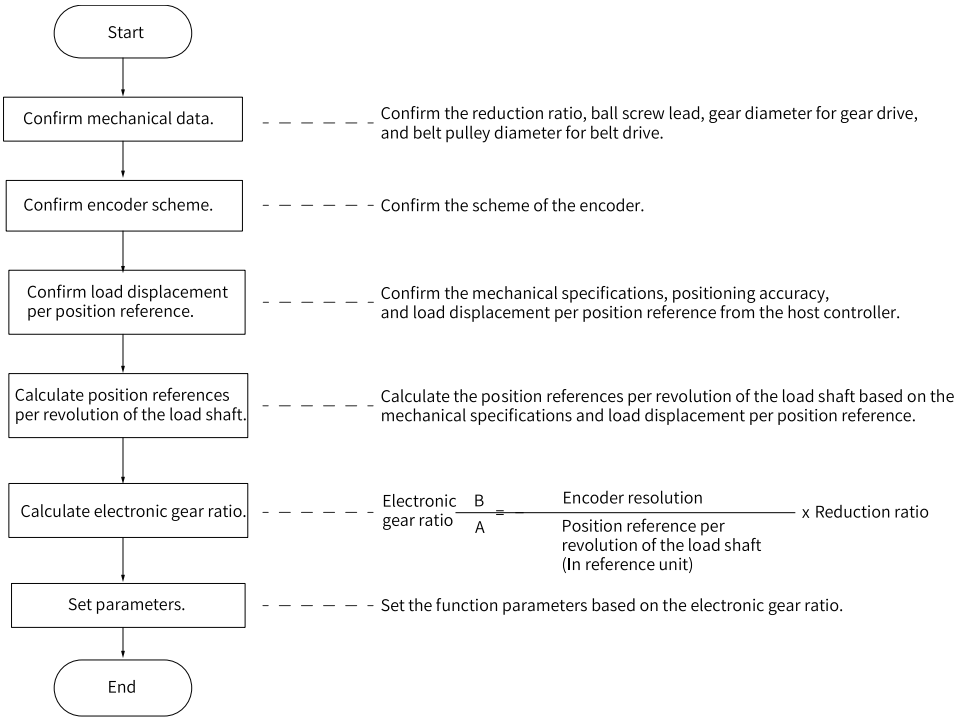


Figure 3-21 Procedure for setting the electronic gear ratio

See the following figure for how to set parameters.

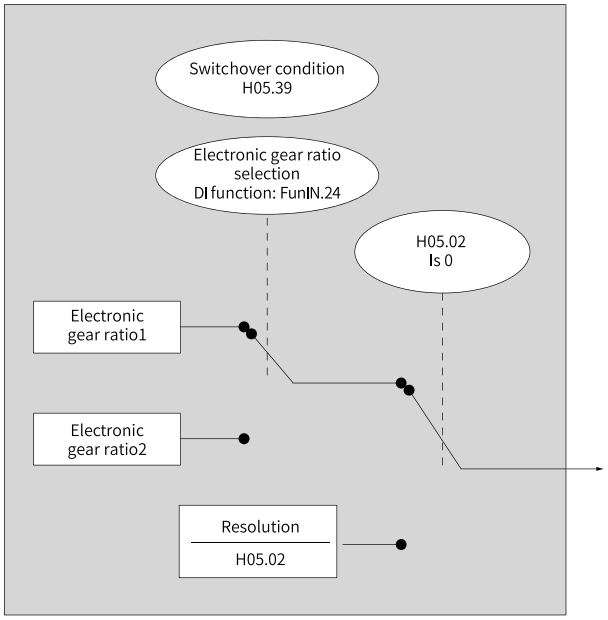


Figure 3-22 Procedure for setting the electronic gear ratio

Note

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

Electronic gear ratio $\frac{B}{A} = \frac{\text{Resolution}}{\text{H05.02}}$

. When H05-02 is set to 0, electronic gear ratios 1 and 2 are invalid.

Related parameters

- Setting the electronic gear ratio parameters

  ☆ Related parameters:

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H05.02	2005-03h	Pulses per revolution	0 to 4294967295	0	[P/N-N]/ [P/Rev]	At stop	"H05_en.02" on page 609
H05.07	2005-08h	Electronic gear ratio 1 (numerator)	1 to 1073741824	1	-	Real time	"H05_en.07" on page 609
H05.09	2005-0Ah	Electronic gear ratio 1 (denominator)	1 to 1073741824	1	-	Real time	"H05_en.09" on page 610
H05.11	2005-0Ch	Electronic gear ratio 2 (numerator)	1 to 1073741824	1	-	Real time	"H05_en.11" on page 610
H05.13	2005-0Eh	Electronic gear ratio 2 (denominator)	1 to 1073741824	1	-	Real time	"H05_en.13" on page 610

- Switching the electronic gear ratio

Caution

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

  - When H05.02 = 0, electronic gear ratio switchover is supported. Determine whether to switch between electronic gear ratios 1 and 2 based on mechanical conditions and set the condition for switching the electronic gear ratio.
  - Only one electronic gear ratio is effective at any moment.
  - The effective time of real-time change in the electronic gear ratio is also restricted by the switchover condition.

  ☆ Related parameters:

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H05.39	2005-28h	Electronic gear ratio switchover condition	0: Switching after the position pulse reference kept 0 for 2.5 ms 1: Switched in real time	0	-	At stop	"H05_en.39" on page 615

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

  ☆ Related parameters:

Param.	Name	Function	Description
FunIN.24	GEAR_SEL	Electronic gear ratio selection	Inactive: Electronic gear ratio 1 used in position control mode Active: Electronic gear ratio 2 used in position control mode

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

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

The resolution of the serial encoder is 2^n(P/r), where "n" is the number of bits of the serial encoder.

For example, the resolution of a 26-bit serial encoder is 2^{26}PPR, which is 67108864 PPR.

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

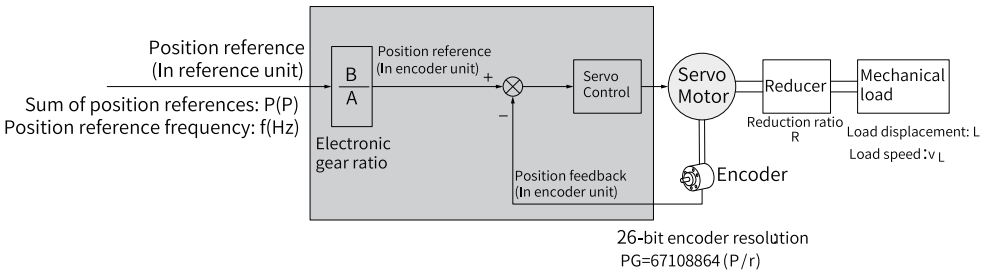


Figure 3-23 Relationship among the position reference (reference unit), load displacement, and electronic gear ratio

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

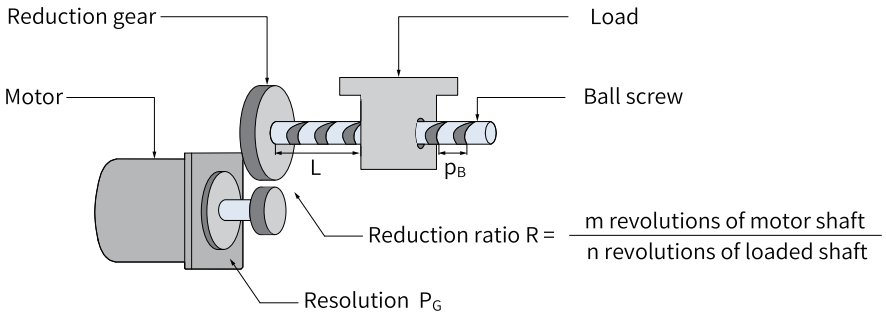


Figure 3-24 Ball screw

- If a pulse of the servo drive corresponds to load displacement ΔL (mm):

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

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

Therefore, the electronic gear ratio is:

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

- The load displacement L(mm) and position reference sum P(P) are known.

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

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

  Therefore, the electronic gear ratio is:

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

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

  Load shaft rotating speed: $\frac{V_L}{P_B}$ (r/s)

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

  Relationship between position reference frequency, electronic gear ratio and motor speed:

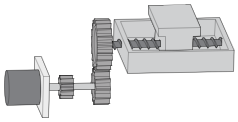
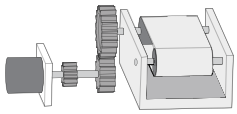
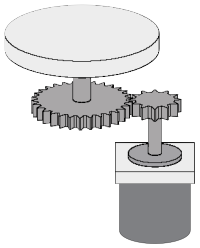
  $$f \times \frac{B}{A} = v_M \times P_G$$

  Therefore, the electronic gear ratio is:

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

- Example for setting the electronic gear ratio

Table 3–11 Example for setting electronic gear ratio

Item	Name	Mechanical structure		
		Transmission with ball screw	Transmission with belt pulley	Rotary load
	-			
1	Mechanical parameters	Reduction ratio R: 1:1 Screw lead: 0.01 m	Reduction ratio (R): 5/1 Diameter of belt pulley: 0.2 m (Circumference of belt pulley): 0.628 m	Reduction ratio (R): 10/1 Load angle of rotation per revolution of the load shaft: 360°
2	Encoder resolution	26-bit = 67108864 PPR	26-bit = 67108864 PPR	26-bit = 67108864 PPR
3	Load displacement per position reference (reference unit)	0.0001 m	0.000005 m	0.01 degree

Item	Name	Mechanical structure		
4	Position references per revolution of the load shaft (reference)	$\frac{0.01}{0.0001} = 100$	$\frac{0.628}{0.000005} = 125600$	$\frac{360}{0.01} = 36000$
5	Calculation	$\frac{B}{A} = \frac{67108864}{100} \times \frac{1}{1}$	$\frac{B}{A} = \frac{67108864}{125600} \times \frac{5}{1}$	$\frac{B}{A} = \frac{67108864}{36000} \times \frac{10}{1}$
6	Setting	H05.07=67108864 H05.09=100	H05.07=335544320 H05.09=125600	H05.07=671088640 H05.09=36000

3.5.4 Position Reference Filter

Position reference filter serves to filter the position references (in encoder unit) multiplied or divided by the electronic gear ratio, which includes first-order low-pass filtering and moving average filtering. It involves the first-order filter and moving average filter.

It is applicable to the following conditions:

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

☆Related parameters:

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
H05.04	2005-05h	First-order low-pass filter time constant	0.0 to 6553.5	0.0	ms	At stop	"H05_en.04" on page 609
H05.06	2005-07h	Moving average filter time constant 1	0.0 to 128.0	0.0	ms	At stop	"H05_en.06" on page 609

Note

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

An excessively high setpoint delays the responsiveness, so set a proper filter time constant based on actual conditions.

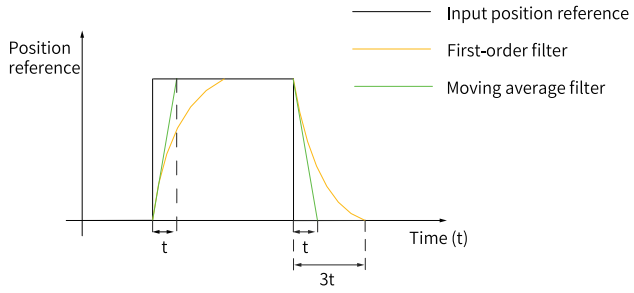


Figure 3-25 First-order filter and moving average filter for rectangular position references

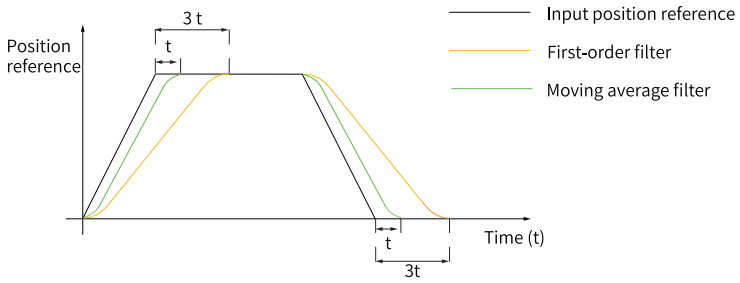


Figure 3-26 First-order filter and moving average filter for trapezoid position references

3.5.5 Frequency division output

Caution

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

Parameter	bit	Description
H05.41	Bit 0: Frequency-division Z signal output polarity	0: Positive (falling edge-triggered) 1: Negative (rising edge-triggered)
	Bit 1: OCZ signal output polarity	0: Positive (falling edge-triggered) 1: Negative (rising edge-triggered)

The frequency-division output function outputs the position reference pulses or encoder feedback position references as A/B phase quadrature pulses.

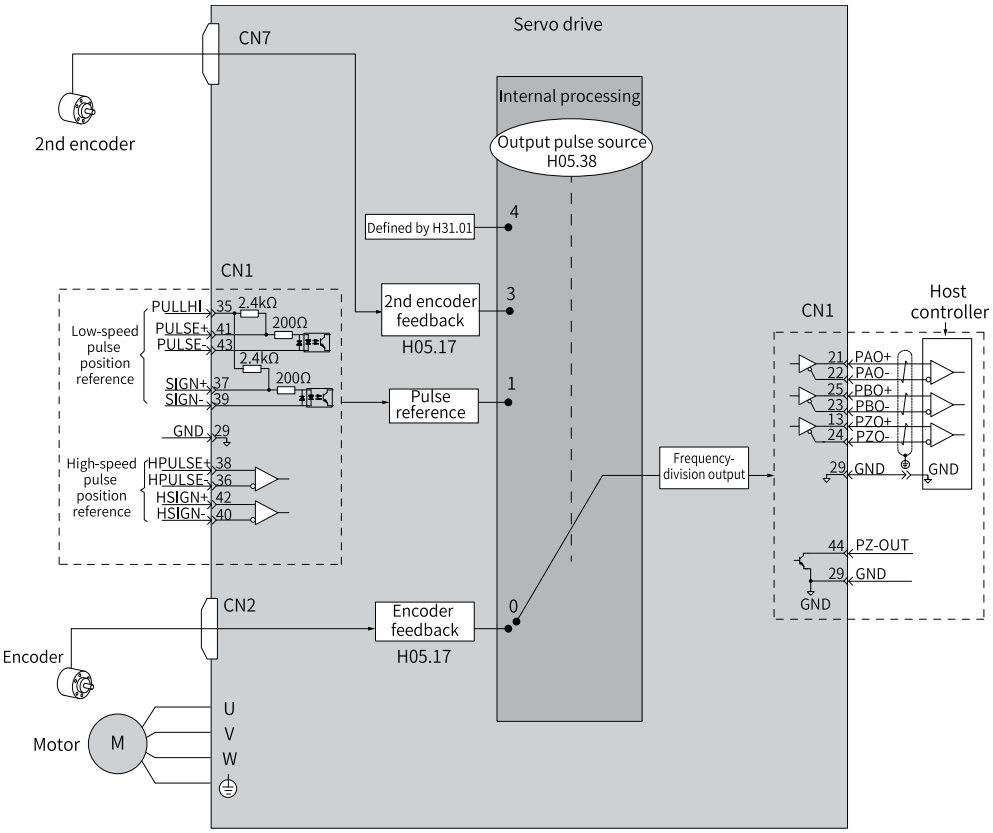


Figure 3-27 Schematic diagram of frequency-division output

- It is recommended to use synchronous output (H05.38 = 1) of pulse references in case of synchronous tracing of multi-axis servo pulses. When the host controller is used for closed-loop feedback, it is recommended to use encoder frequency-division output (H05.38 = 0).
- When the host controller provides closed-loop feedback, it is recommended to use encoder frequency-division output (H05.38 = 3). When the host controller provides a set output frequency, it is recommended to use frequency-division output (H05.38 = 4).

The servo drive provides one frequency-division terminal:

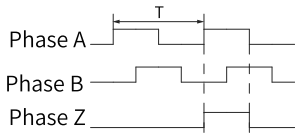
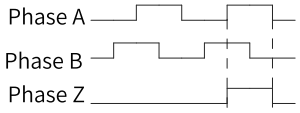
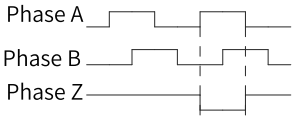
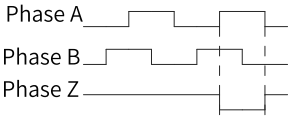
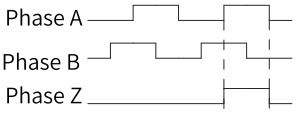
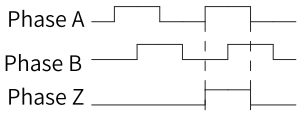
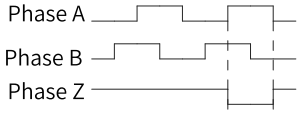
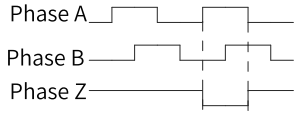
- Phase A pulses: PAO+ and PAO-, differential output, maximum output pulse frequency: 4 Mpps
- Phase B pulses: PBO+ and PBO-, differential output, maximum output pulse frequency: 4 Mpps
- Phase Z pulses: PZO+ and PZO-, differential output, maximum output pulse frequency: 4 Mpps
- PZ-OUT, GND, open-collector output, maximum output pulse frequency 100 kpps

When using the frequency-division output function, set the output pulse source (H05.38), phase (H02.03), resolution (H05.17), and phase Z pulse polarity (H05.41) according to requirements.

When the output source is encoder frequency-division pulse (H05.38 = 0), the motor rotates one revolution and the phase A/B output pulses per motor revolution are determined by H05.17 (Encoder frequency-division pulses). The pulse width (T) of phase A/B is determined by the motor speed. The phase Z, whose width is also T, is synchronized with phase A. The Z signal is output once per motor revolution.

When the output source is set in H31.01 (H05.38 = 4), the output pulse frequency of phase A/B (quadrupled frequency) is determined by H31.01. In this case, no phase Z pulse is output.

Table 3–12 Pulse diagrams of encoder frequency-division output (H05.38 is 0)

H02.03 (Output pulse phase)	H05.41 (Z pulse output polarity)	Pulse output diagram of forward run	Pulse output diagram of reverse run
0	0	 Phase A leads phase B by 90°.	 Phase B leads phase A by 90°.
	1	 Phase A leads phase B by 90°.	 Phase B leads phase A by 90°.
1	0	 Phase B leads phase A by 90°.	 Phase A leads phase B by 90°.
	1	 Phase B leads phase A by 90°.	 Phase A leads phase B by 90°.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H02.03	2002-04h	Output pulse phase	0: Phase A leads phase B 1: Phase A lags behind phase B	0	-	At stop	"H02_en.03" on page 582
H05.17	2005-12h	Number of encoder frequency-division pulses	0 to 4194303	2500	[P/N-N]/[P/Rev]	At stop	"H05_en.17" on page 610

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.38	2005-27h	Frequency-division output source	0: Encoder frequency-division output 2: Frequency-division output inhibited 3: Second encoder frequency-division output 4: H31.01	0	-	Real time	"H05_en.38" on page 615
H05.41	2005-2Ah	Z pulse output polarity	Bit 0: Frequency-division Z output polarity 0: Positive (high level upon active Z pulse) 1: Negative (low level upon active Z pulse) Bit 1: output polarity 0: Positive (high level upon active Z pulse) 1: Negative (low level upon active Z pulse) bit2: Inner loop probe Z signal source 0: Motor Z signal 1: Frequency-division output Z signal bit3 to bit15: N/A	0x1	-	At stop	"H05_en.41" on page 616

3.5.6 Motion Control Completed, Internal Command Completed, Positioning Completed, Proximity

- "Motion control completed" refers to the completion of command transmission and positioning in position control mode. In this case, the drive outputs a McOK (motion control completed) signal, and the host controller, upon receiving the signal, acknowledges that motion control is completed.
- "Internal command completed" refers to the completion of command transmission. In this case, the internal multi-position reference is zero. The drive therefore outputs a CmdOk (Internal command completed) signal, and the host controller, upon receiving the signal, acknowledges that the internal command has been transmitted. Homing completion is not dependent on the completion state of internal commands.
- Positioning completion: When the position deviation meets the condition set by users (H05.20), positioning in position control mode is completed. Meanwhile, the servo drive outputs a positioning completed (COIN) signal, and the host controller, after receiving this signal, acknowledges that positioning is completed.

The following figure shows the schematic diagram.

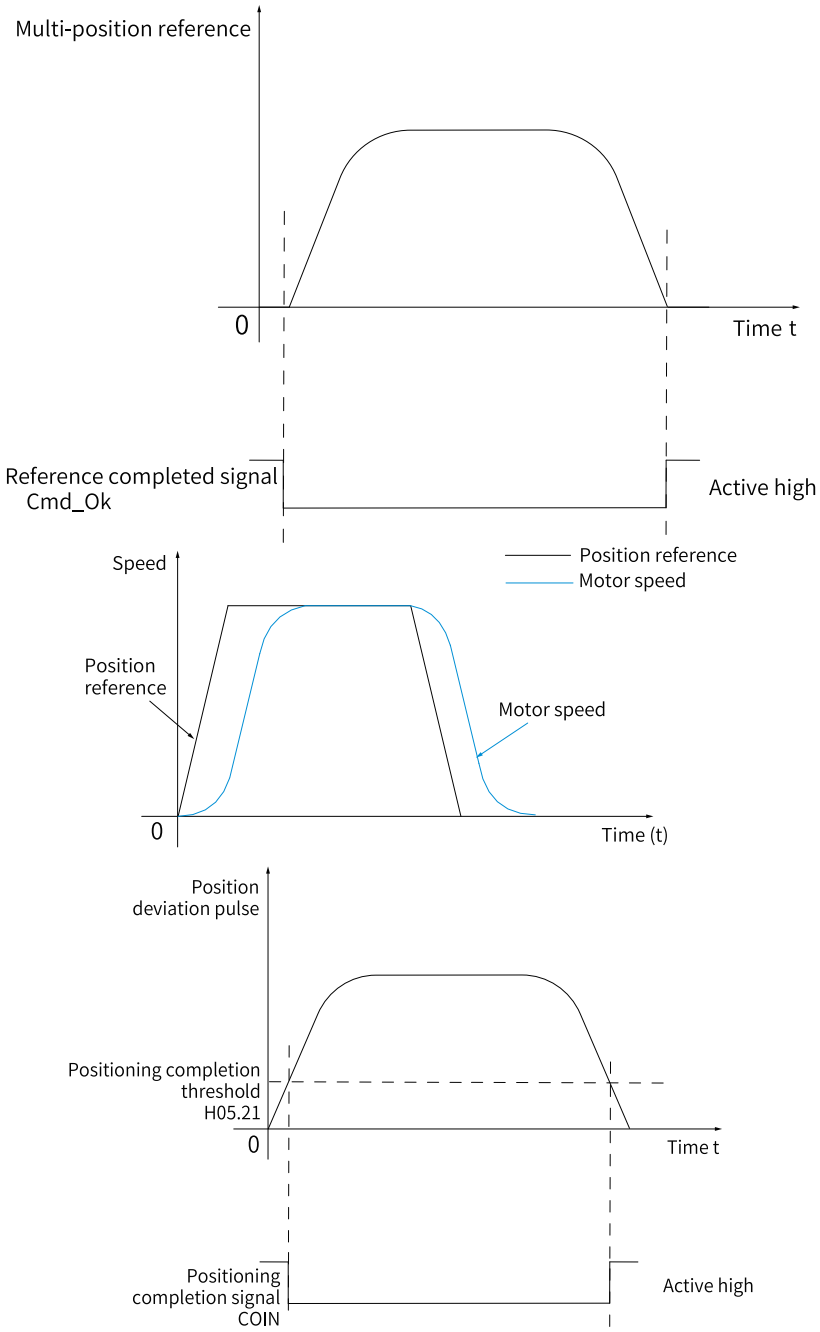


Figure 3-28 Description of positioning completed/proximity functions

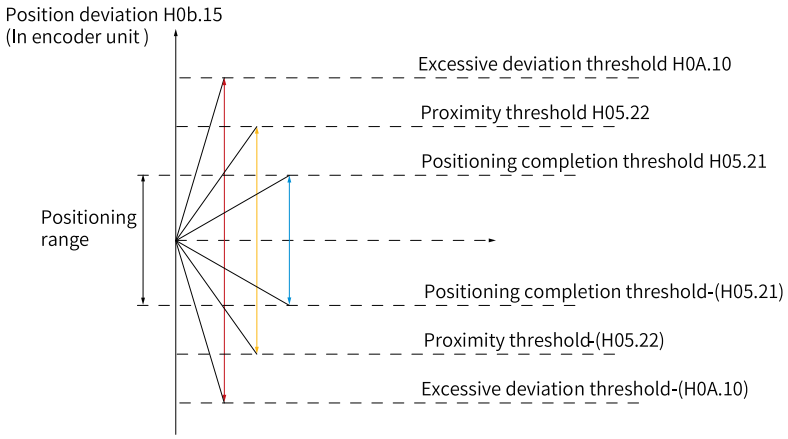
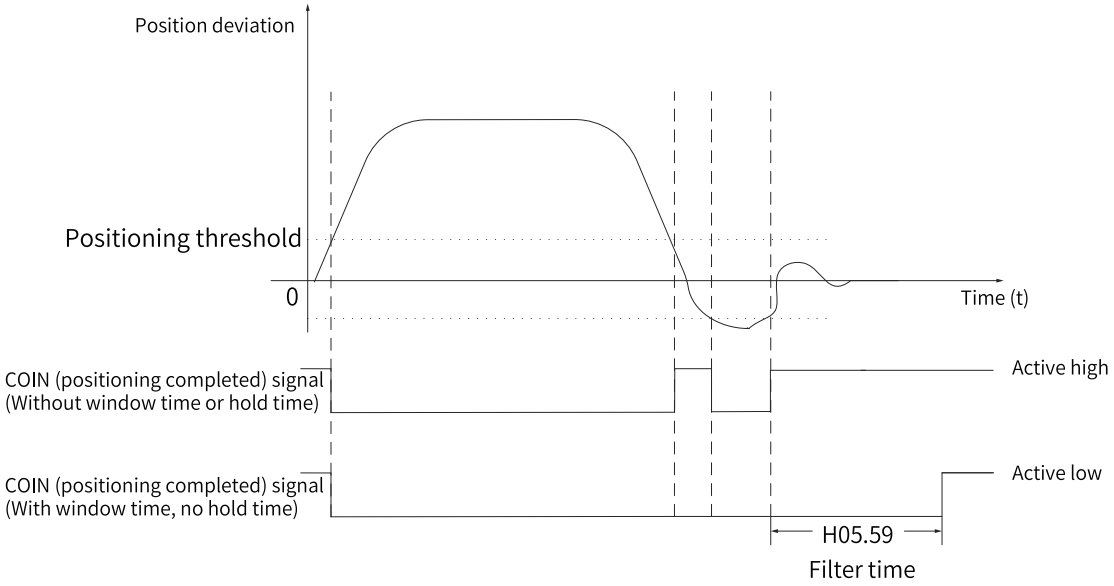


Figure 3-29 Signals related to position deviation

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

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



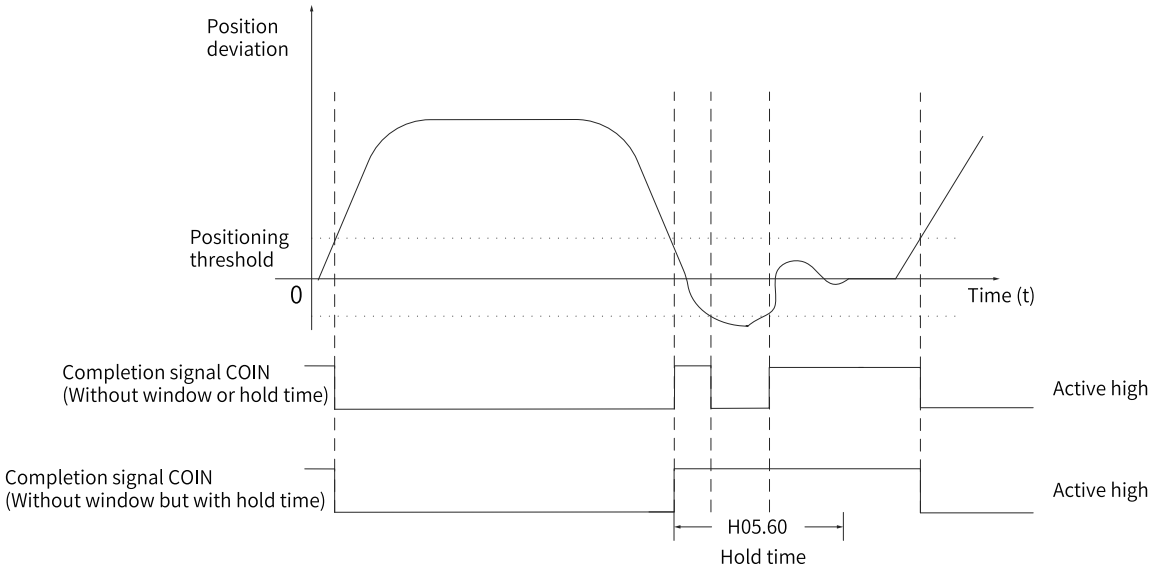


Figure 3-30 Schematic diagram for the window time (H05.59) and hold time (H05.60) of positioning completed signal

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

☆ Related parameters:

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H05.20	2005-15h	Condition for positioning completed signal output	0: The absolute value of position deviation is lower than the value of H05.21. 1: The absolute value of position deviation is lower than the value of H05.21 and the filtered position reference is 0. 2: The absolute value of position deviation remains lower than the value of H05.21 and the unfiltered position reference is 0. 3: The absolute position deviation remains lower than the value of H05.21 and the unfiltered position reference is 0. If the positioning hold time stays within the time defined by H05.60 and the position reference is 0, the positioning completed signal will be output. After the positioning hold time defined by H05.60 elapses, whether the positioning completed signal is outputted depends on the non-filtered position reference and absolute value of position deviation. 4: The absolute value of position deviation is lower than the value of H05.21 and the filtered position reference is 0. If the positioning hold time stays within the time defined by H05.60 and the position reference is 0, the positioning completed signal will be output. After the positioning hold time defined by H05.60 elapses, whether the positioning completed signal is output depends on the filtered position reference and absolute value of position deviation. 5: The absolute value of position deviation is lower than the value of H05.21, with zero speed signal ON and the position reference being 0. 6: The absolute value of position deviation is lower than the value of H05.21, with zero speed signal ON and the filtered position reference being 0. 7: Positioning completion is checked after the delay defined by H05.60 elapses, with the unfiltered position reference being 0. The positioning completed signal ON is output when the non-filtered position reference is 0 and the absolute value of position deviation is lower than the value of H05.21.	0	-	Real time	"H05_en.20" on page 611

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H05.20	2005-15h	Condition for positioning completed signal output	8: Positioning completion is checked after the delay defined by H05.60 elapses and the filtered position reference is 0. The positioning completion signal ON is output when the filtered position reference is 0 and the absolute value of position deviation is lower than the value of H05.21. 9: Positioning completion is checked after the delay defined by H05.60 elapses when the non-filtered position reference is 0 and the absolute value of position deviation is lower than the value of H05.21. The positioning completed signal ON is output when the non-filtered position reference is 0 and the absolute value of position deviation is lower than the value of H05.21. 10: Positioning completion is checked after the delay defined by H05.60 elapses when the filtered position reference is 0 and the absolute value of position deviation is lower than the value of H05.21. The positioning completion signal ON is output when the filtered position reference is 0 and the absolute value of position deviation is lower than the value of H05.21.	0	-	Real time	"H05_en.20" on page 611
H05.21	2005-16h	Threshold of positioning completion	1 to 65535 Note: This parameter is active only when H02.00 is not set to 9.	46976	Encoder unit	Real time	"H05_en.21" on page 613
H05.22	2005-17h	Proximity threshold	1 to 65535 Note: This parameter is active only when H02.00 is not set to 9.	65535	Encoder unit	Real time	"H05_en.22" on page 614
H05.59	2005-3Ch	Positioning window time	0 to 30000	0	ms	Real time	"H05_en.59" on page 620
H05.60	2005-3Dh	Hold time of positioning completed	0 to 30000	0	ms	Real time	"H05_en.60" on page 620
H0A.17	200 A-12h	Reference pulse selection	0: Pulse unit 1: Reference unit	1	-	At stop	"H0A_en.17" on page 682

Caution

- Set H05.22 to a value higher than H05.21 in general cases.
- H05.21 only reflects the absolute threshold when the positioning completed signal is active. It is not related to the positioning precision.
- An excessively high speed feedforward gain (H08.19) or low-speed operation reduces the absolute position deviation. In this case, the COIN (positioning completed) signal may keep active if H05.21 is set to an excessively high value. To improve the positioning accuracy, decrease the value of H05.21.
- When H05.21 is set to a low value along with small position deviation, you can change the condition for outputting the COIN (positioning completed) signal in H05.20.
- An inactive S-ON signal deactivates the COIN (positioning completed) signal and NEAR (proximity) signal output.
- The output of position proximity DO is not affected by H05.60 (positioning completion holding time) or H05.59 (positioning window time) and you need not to evaluate the change of the positioning command.

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

☆ Related parameters:

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H05.60	2005-3Dh	Hold time of positioning completed	0 to 30000	0	ms	Real time	"H05_en.60" on page 620

☆ Related parameters:

Param.	Name	Function	Description
FunOUT.5	COIN	Positioning completed	Active: The absolute value of position deviation meets the threshold defined by H05.21 in position control mode, indicating positioning is completed. Inactive: The servo drive is in the process of completion in position control mode.
FunOUT.6	NEAR	Target position approach	Active: The absolute value of position deviation meets the condition defined by H05.22, indicating the servo drive is close to the target position. Inactive: The servo drive is in the process of proximity in position control mode.
FunOUT.22	CmdOk	Internal command completed	Active: The transmission of the multi-position reference or interrupt positioning reference is completed in position control mode. Inactive: The transmission of the multi-position reference or interrupt positioning reference is in progress in position control mode.
FunOUT.24	McOk	Motion control completed	Active: The transmission of the multi-position reference or interrupt positioning reference and the positioning process are completed in position control mode. Inactive: The transmission of the multi-position reference or interrupt positioning reference or positioning is in progress in position control mode.

3.6 Speed Control Mode

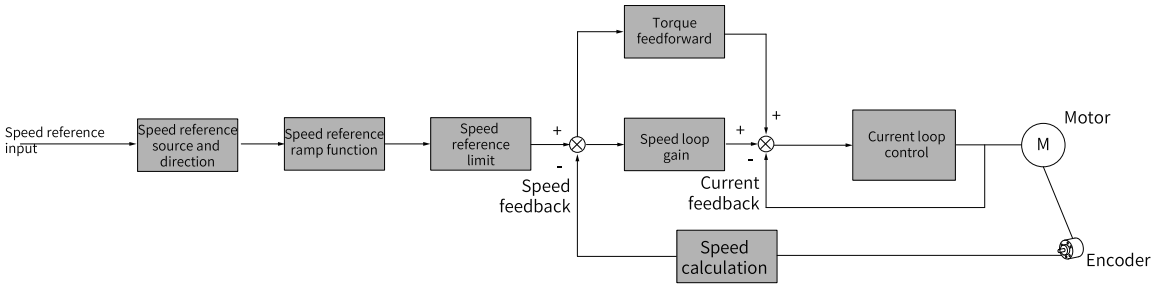


Figure 3-31 Block diagram of speed control

Set H02.00 (control mode selection) to 0 (speed control mode) through the keypad or the Inovance software tool to make the servo drive operate in speed control mode. Set the drive parameters based on the mechanical structure and technical specifications. In the following figure, the basic parameter settings are used to describe the speed control mode.

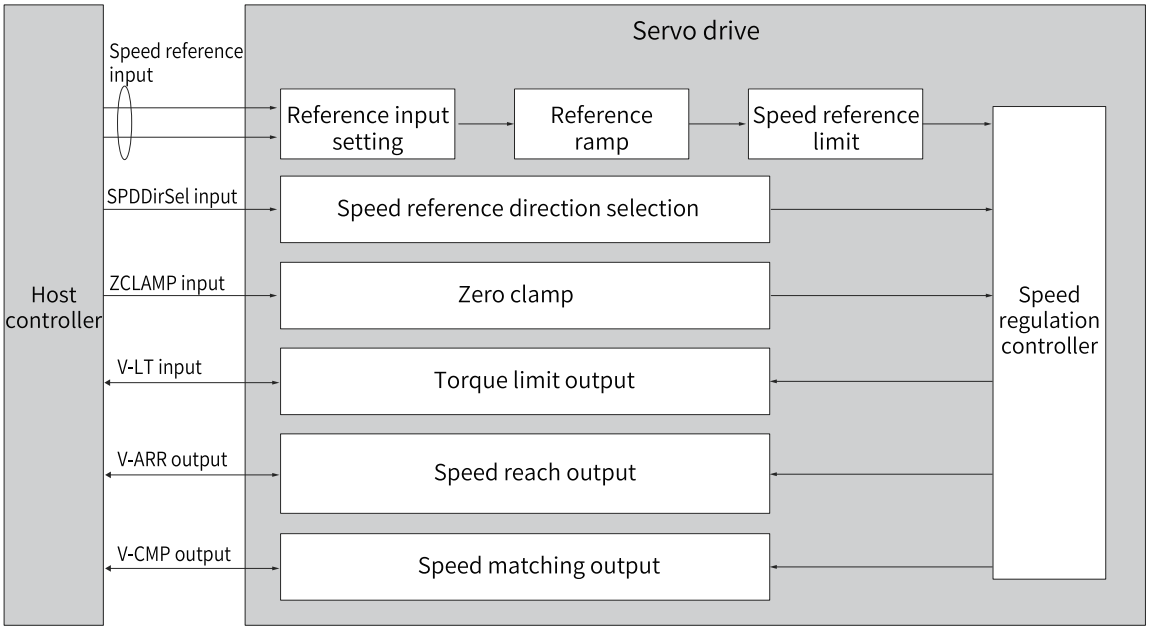
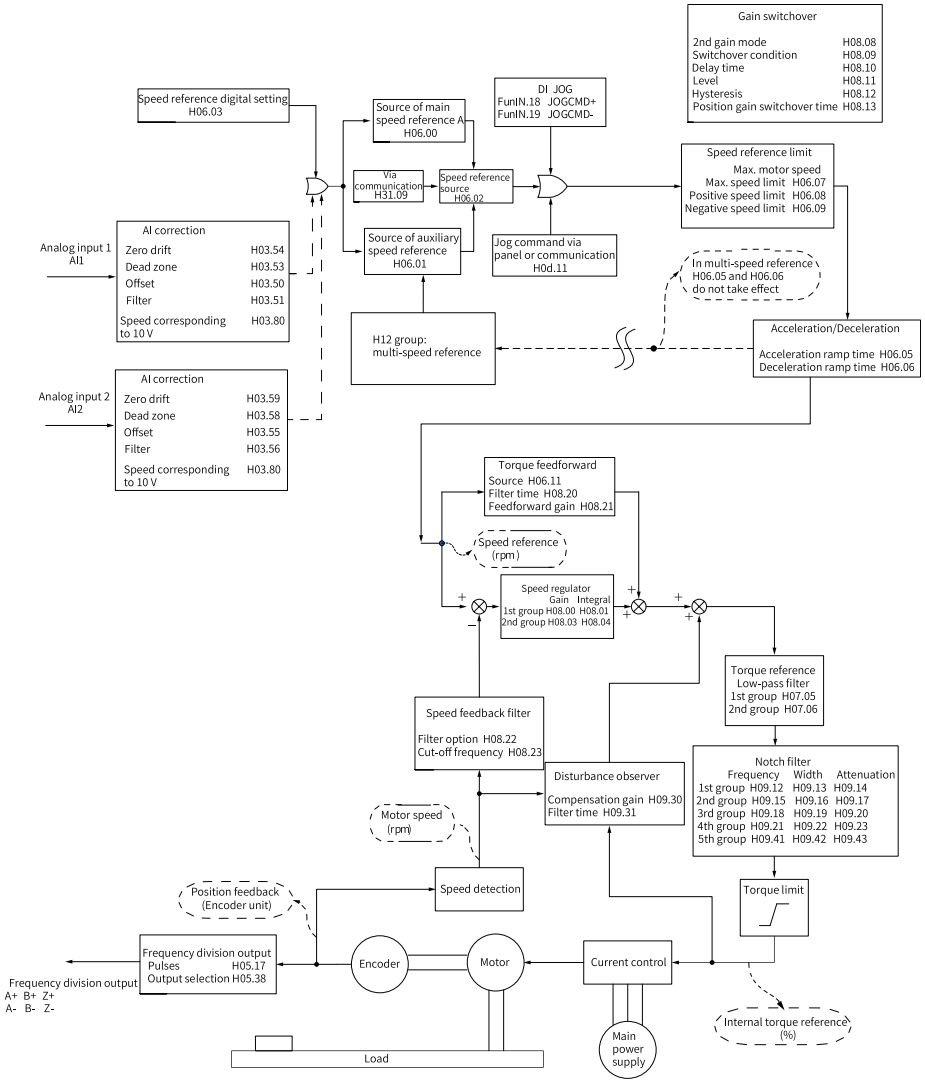


Figure 3-32 Signal exchange between the drive and the host controller

3.6.1 Function block diagram



3.6.2 Speed Reference Input

Speed reference source

Five speed reference sources are available in speed control mode, which can be set in H06.02.

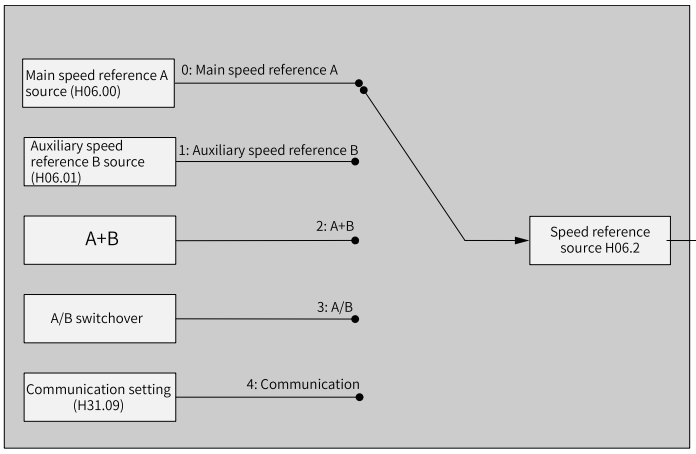


Figure 3-33 Speed reference source

☆ Related parameters:

Parameter	Comm. address	Parameter name	Setpoint	Default value	Unit	Change mode	Page
H06.02	2006-03h	Speed reference source	0: Source of main speed reference A 1: Source of auxiliary speed reference B 2: A+B 3: Switchover between A and B 4: Communication	0	-	At stop	"H06_en.02" on page 623

- **Source of main speed reference A**

  The sources of main speed reference A include digital setting and analog voltage setting. Digital setting refers to the internal speed reference. Analog voltage setting refers to the external speed reference.

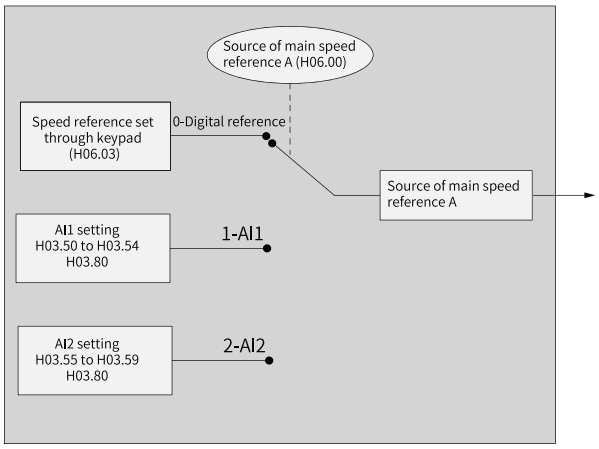


Figure 3-34 Source of main speed reference A

☆ Related parameters:

  - **Digital setting**

    The speed reference is set in H06.03.

    ☆ Related parameters:

Parameter	Comm. address	Parameter name	Setpoint	Default value	Unit	Change mode	Page
H06.03	2006-04h	Speed reference set through operating panel	-10000 to +10000	200	[mm/s]/ [rpm]	Real time	"H06_en.03" on page 624

- **Analog voltage setting**

  The analog voltage signal output by the host controller or other devices is processed and then used as the speed reference.

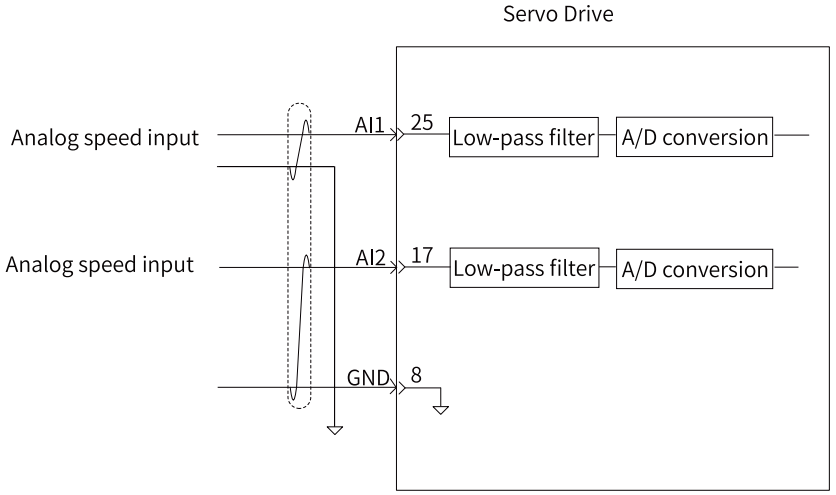
  Analog voltage input terminal:

  The servo drive provides two AIs: AI1 and AI2.

  AI1 voltage-type input: 16-bit, -10 V to +10 V; maximum allowable voltage: ± 12 VDC; input impedance: 74 kΩ.

  AI2 voltage-type input: 12-bit, -10 V to +10 V; maximum allowable voltage: ±12 VDC; input impedance: 74 kΩ.

  Analog input circuit:



Note

AI/AO terminals: AI1 corresponds to No. 25 pin, AI2 corresponds to No. 17 pin, and GND corresponds to No. 8 pin.

Procedure:

The following figure takes AI1 as an example to describe the analog setting of the speed reference.

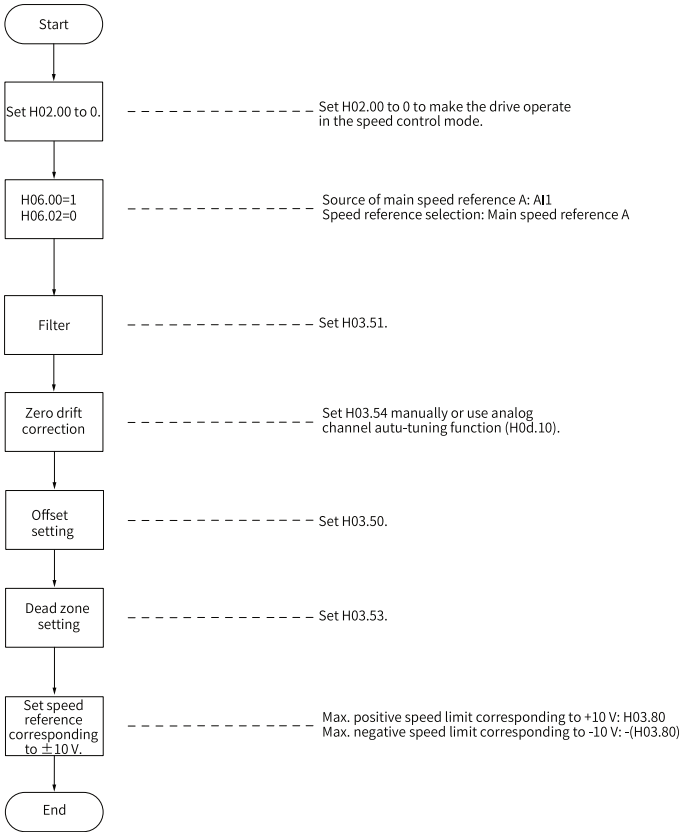


Figure 3-35 Flowchart of setting speed reference by analog voltage

Terms:

- Zero drift: the value of the servo drive sampling voltage relative to GND when the input voltage of the analog channel is zero.
- Offset: the input voltage value of the analog channel when the sampling voltage is zero after zero drift calibration.
- Dead zone: the input voltage range of the analog channel when the sampling voltage is zero.

In the following figure, y_1 represents the unprocessed AO voltage, y_6 represents the final speed reference after being processed by the servo drive.

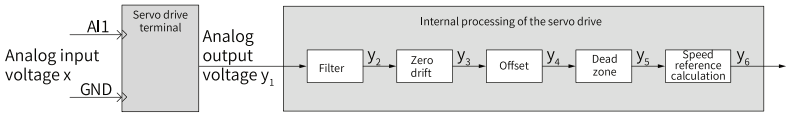


Figure 3-36 AI processing of servo drive

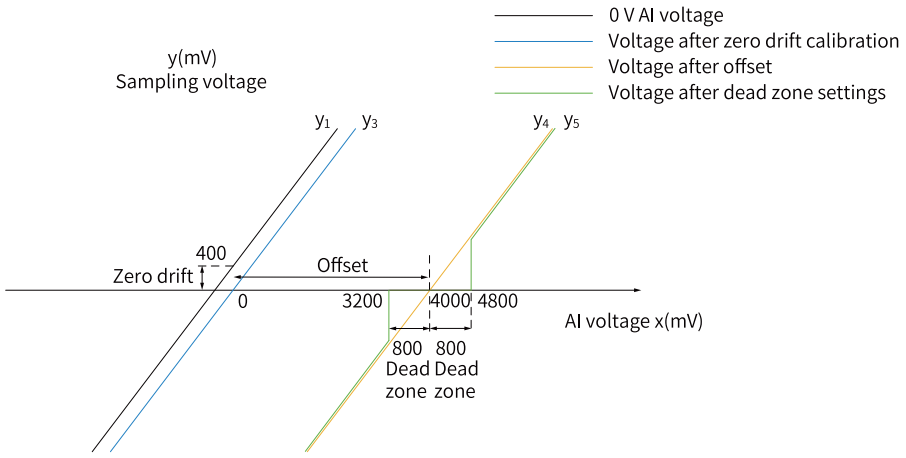


Figure 3-37 Example of sampling voltage and AI processing of servo drive

- **Filter:**
  The servo drive provides filter function for analog channels. Setting the filter time constant in H03.56 prevents motor reference fluctuation caused by unstable analog input voltage and eliminates motor malfunction caused by disturbing signals. The filter function cannot eliminate or suppress the zero drift or dead zone.

- **Zero drift calibration**
  It calibrates the analog output voltage offset relative to the actual input voltage 0 V.

  In the preceding figure, the analog output voltage without being processed by the servo drive is y_1. Take the filter time constant H03.51 = 0.00 ms as an example, and the sampling voltage after filter y_2 is the same as y_1.

  That is, when the actual input voltage x = 0, the output voltage y_1 = 400 mV. Therefore, the zero drift voltage is 400 mV.

  Set H03.54 to 400.0 (mV) manually. The sampling voltage after zero drift calibration is shown by y_3. $y_3 = y_1 - 400.0$

  Zero drift calibration can also be carried out by using the analog automatic tuning function in H0D-10.

- **Offset setting**
  It sets the actual input voltage corresponding to sampling voltage 0.

  Assume that the actual input voltage x = 4000 mV when the sampling voltage y_4 = 0. That is, the offset is 4000 mV.

  Set H03.50 to 4000 (mV) manually. The sampling voltage y_4 after offset = x - 4000 = y_3 - 4000.

- **Dead zone calibration**
  It sets the effective input voltage range when the sampling voltage of the servo drive is not 0.

  After the offset is set, if the sampling voltage is always 0 when the input voltage x is within 3200 mV to 4800 mV, the dead zone is 800 mV.

Set H03.53 to 800.0 (mV). The sampling voltage after dead zone calibration is shown as y_5:

$$y_5 = \begin{cases} 0 & 3200 \leqslant x \leqslant 4800 \\ y_4 & 4800 < x \leqslant 10000 \text{ or } -10000 \leqslant x < 3200 \end{cases}$$

– **Speed reference calculation**

After setting the zero drift, offset, and dead zone, set the speed reference corresponding to 10 V (10000 mV) in H03.80 (Speed corresponding to 10 V) to obtain the actual speed reference y_6:

$$y_6 = \frac{y_5}{10000} \times (\text{H03.80})$$

This value is used as the speed reference set via analog in the speed control mode.

The left figure below applies when no offset exists. The right figure below applies when offset exists. After all setting is completed correctly, view the sampling voltage of AI1 in H0b.21 or the speed reference corresponding to analog input in H0b.01.

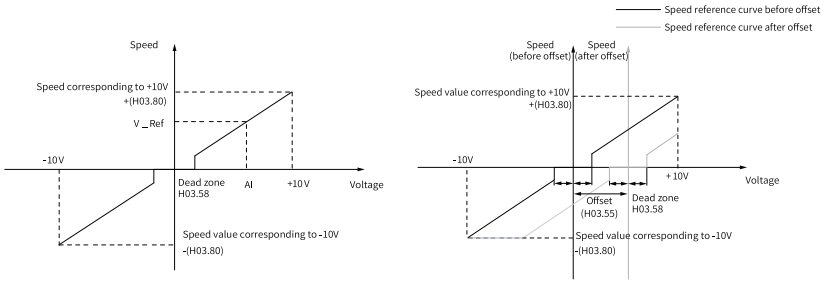


Figure 3-38 AI1 without offset (left) & AI1 after offset (right)

The relationship between the final speed reference y_6 and the input voltage x is:

$$y_6 = \begin{cases} 0 & B\text{-}C \leqslant x \leqslant B\text{+}C \\ x\text{-}B & B\text{+}C < x \leqslant 10000 \text{ or } -10000 \leqslant x < B\text{-}C \end{cases}$$

Where, B represents offset and C represents dead zone.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Setpoint	Default value	Unit	Change mode	Page
H03.50	2003-33h	Voltage-type AI1 offset	-5000 to +5000	0	mV	Real time	"H03_en.50" on page 601
H03.51	2003-34h	Voltage-type AI1 input filter time constant	0.00 to 655.35	2.00	ms	Real time	"H03_en.51" on page 601
H03.53	2003-36h	Voltage-type AI1 dead zone	0.0 to 1000.0	10.0	mV	Real time	"H03_en.53" on page 601
H03.54	2003-37h	Voltage-type AI1 zero drift	-500.0 to +500.0	0.0	mV	Real time	"H03_en.54" on page 601
H03.55	2003-38h	Voltage-type AI2 offset	-5000 to +5000	0	mV	Real time	"H03_en.55" on page 602
H03.56	2003-39h	Voltage-type AI2 input filter time constant	0.00 to 655.35	2.00	ms	Real time	"H03_en.56" on page 602

Parameter	Comm. address	Parameter name	Setpoint	Default value	Unit	Change mode	Page
H03.58	2003-3Bh	Voltage-type AI2 dead zone	0.0 to 1000.0	10.0	mV	Real time	"H03_en.58" on page 602
H03.59	2003-3Ch	Voltage-type AI2 zero drift	-500.0 to +500.0	0.0	mV	Real time	"H03_en.59" on page 602
H03.80	2003-51h	Speed corresponding to analog 10 V	0 to 10000	3000	[mm/s]/ [rpm]	At stop	"H03_en.80" on page 604
H0d.10	200d-0Bh	Automatic tuning of analog channel	0: No operation 1: Adjust AI1 2: Adjust AI2	0	-	At stop	"H0d_en.10" on page 720

- **Source of auxiliary speed reference B**

  The auxiliary speed reference B sources include digital setting, analog setting, and multi-speed references. Digital setting and multi-speed references produce the internal speed reference, and analog setting produces the external speed reference.

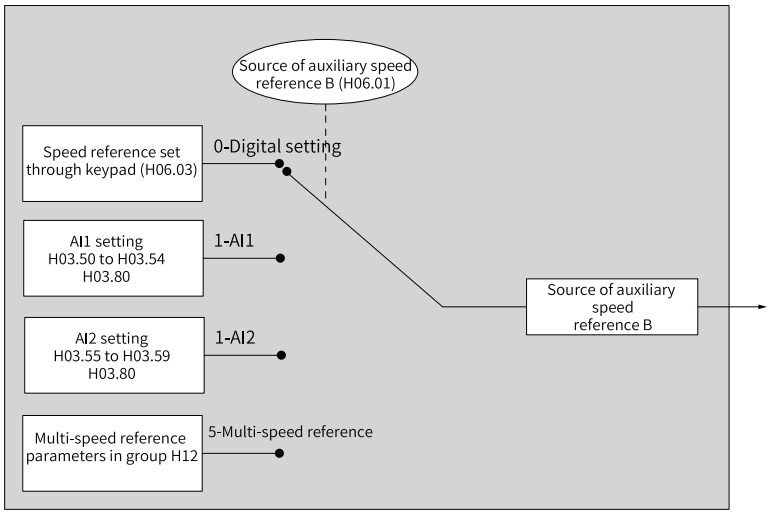


Figure 3-39 Source of auxiliary speed reference B

☆ Related parameters:

Parameter	Comm. address	Parameter name	Setpoint	Default value	Unit	Change mode	Page
H06.01	2006-02h	Source of auxiliary speed reference B	0: H06.03 1: AI1 2: AI2 5: Multi-speed reference	1	-	At stop	"H06_en.01" on page 623

The digital setting mode is the same as that of the main speed reference A source. The following part describes how to set auxiliary speed reference B via multi-speed reference.

The servo drive supports multi-speed running. The servo drive stores 16 speed references, and the maximum running speed and running time of each can be set. Four groups of acceleration/ deceleration time are optional. The setting flowchart is shown in the following figure.

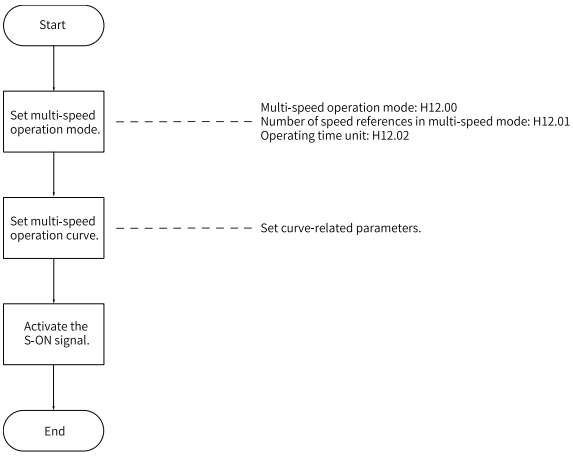


Figure 3-40 Multi-speed reference setting flowchart

1. Setting of multi-speed running mode

☆ Related parameters:

Parameter	Comm. address	Parameter name	Setpoint	Default value	Unit	Change mode	Page
H12.00	2012-01h	Multi-speed operation mode	0: Stop after running for one cycle (number of speeds defined by H12.01) 1: Cyclic operation (number of speeds defined by H12.01) 2: DI-based operation	1	-	At stop	"H12_en.00" on page 764
H12.01	2012-02h	Number of speed references in multi-speed mode	1 to 16	16	-	At stop	"H12_en.01" on page 765
H12.02	2012-03h	Operation time unit	0: s 1: min	0	-	At stop	"H12_en.02" on page 765

Assign an external DI terminal with FunIN.5: DIR-SEL to select the multi-speed running direction.

☆ Related parameters:

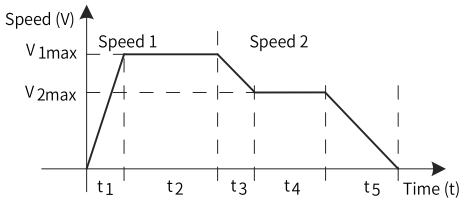
No.	Name	Function	Function
FunIN.5	DIR-SEL	Multi-reference direction	Inactive: Reference direction by default Active: Opposite to the reference direction

The following takes "H12.01 = 2" as an example to describe each mode.

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

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

Table 3–13 Description of individual operation

Mode description	Operating curve
• The drive stops after one cycle of operation. • The drive switches to the next position automatically.	 • V_{1max} and V_{2max} : reference values of speed 1 and speed 2 • t_1 : actual acceleration/deceleration time of speed 1 • t_3 , t_5 : actual acceleration/deceleration time of 2nd speed • Operating time = Time taken in switching from the last speed to current speed + Duration of constant-speed operation at current speed (For example, the operating time of speed 1 is the sum of $t_1 + t_2$, and the operating time of speed 2 is the sum of $t_3 + t_4$). • Do not set the operating time of a certain speed to 0. Otherwise, the drive skips this speed and switches to the next speed directly. • The speed reach signal is activated when the motor speed feedback reaches the maximum operating speed set for this speed. • If the servo ON signal becomes OFF during running of a certain speed, the servo motor stops according to the stop mode in H02.05.

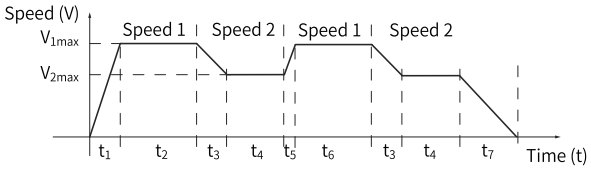
★Terms:

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

- Cyclic running (H12.00 = 1)
  Set H12.00 to 1 to select the cyclic operation mode.

  Set H12.01 and H12.02 based on the number of speeds and the operating time unit. Then set the reference value, operating time and acceleration/deceleration time for each speed. The drive executes the set speeds in a sequence from speed 1 to speed N (last speed). After all the speeds are executed, the drive jumps to speed 1 and repeats the preceding process.

Table 3–14 Description of cyclic operation

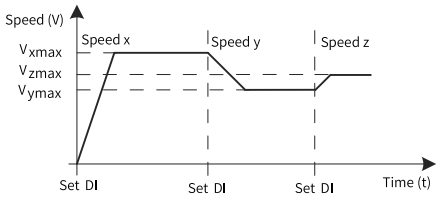
Mode description	Operating curve
• The drive starts from position 1 again after each cycle of operation. • The drive switches to the next position automatically. • The cyclic running state remains if the servo ON signal is active.	 • V_{1max} , V_{2max} : maximum values of the 1st and 2nd speeds • Operating time = Time taken in switching from the last speed to current speed + Duration of constant-speed operation at this speed. For example, the operating time of speed 1 is the sum of t_1 and t_2 , and the operating time of speed 2 is the sum of t_3 and t_4 . • Do not set the operating time of a certain speed to 0. Otherwise, the drive skips this speed and switches to the next speed directly. • The speed reach signal is activated when the motor speed feedback reaches the maximum operating speed set for this speed. • If the servo ON signal becomes OFF during running of a certain speed, the servo motor stops according to the stop mode in H02.05.

- DI switchover (H12.00 = 2)

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

  Set H12.01 and H12.02 based on the number of speeds to be executed and the operating time unit. Then, set the reference value, operating time and acceleration/deceleration time for each speed. The drive executes the speed references according to ON/OFF combination of the external DIs (CMDx).

Table 3–15 Descriptions of DI-based operation

Mode description	Operating curve
• The drive operates continuously as long as the S-ON signal is active. • The speed No. is determined by the DI logic. • The operating time of each speed is determined only by the interval time of speed switchover.	 • x and y: speed number (The relationship between the speed number and the DI logic is described below.) • The operating time is independent of the parameter setpoint. If the speed No. changes during operation, the drive switches to the new speed No. immediately. • The speed reach signal is activated when the motor speed feedback reaches the maximum operating speed set for this speed. • If the servo ON signal becomes OFF during running of a certain speed, the servo motor stops according to the stop mode in H02.05.

When the multi-speed operation mode is DI-based operation, assign DI functions 6 to 9 (multi-reference switchover) to four DIs and set the active logic of these DIs. In addition, assign FunIN.5 (DIR-SEL, direction selection in DI-based multi-speed operation) to a certain DI to switch the speed reference direction.

☆ Related parameters:

No.	Name	Function	Function
FunIN.5	DIR-SEL	Setting of multi-speed DI switchover running direction	Switches over the speed reference direction in multi-speed DI switchover mode. Inactive: Reference direction Active: Opposite to the reference direction
FunIN.6	CMD1	Multi-reference switchover 1	The speed No. is a 4-bit binary value. The relationship between the speed no. and CMD1 to CMD4 is shown in *"Table 3-16" on page 91*. The value of CMD is 1 upon active DI level and 0 upon inactive DI level.
FunIN.7	CMD2	Multi-reference switchover 2	
FunIN.8	CMD3	Multi-reference switchover 3	
FunIN.9	CMD4	Multi-reference switchover 4	

Table 3–16 Relationship between the segment No. and CMD1 to CMD4

CMD4	CMD3	CMD2	CMD1	Segment No.
0	0	0	0	1
0	0	0	1	2
...				
1	1	1	1	16

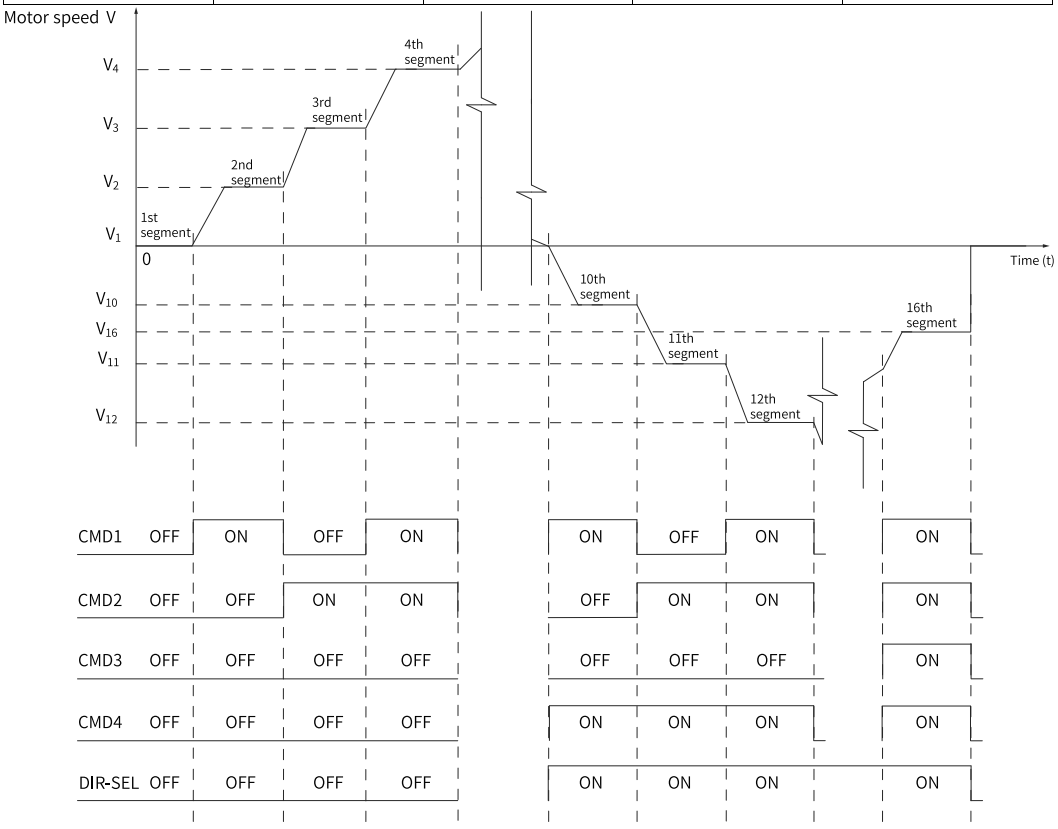


Figure 3-41 Example of multi-speed curve

2. Setting the multi-speed curve

The following takes the 1st speed as an example.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Setpoint	Default value	Unit	Change mode	Page
H12.03	2012-04h	Acceleration time 1	0 to 65535	10	ms	Real time	"H12_en.03" on page 766
H12.04	2012-05h	Deceleration time 1	0 to 65535	10	ms	Real time	"H12_en.04" on page 766
H12.09	2012-0Ah	Acceleration time 4	0 to 65535	150	ms	Real time	"H12_en.09" on page 767
H12.10	2012-0Bh	Deceleration time 4	0 to 65535	150	ms	Real time	"H12_en.10" on page 768
H12.20	2012-15h	1st speed reference	-10000 to +10000	0	[mm/s]/ [rpm]	Real time	"H12_en.20" on page 768
H12.21	2012-16h	Operation time of the 1st speed reference	0.0 to 6553.5	5.0	s(m)	Real time	"H12_en.21" on page 768
H12.22	2012-17h	Acceleration/ Deceleration and S-curve smoothing parameter time in speed 1	bit0 to bit7: Acceleration/ deceleration time 0: Zero acceleration/deceleration time 1: Acceleration/deceleration time 1 2: Acceleration/deceleration time 2 3: Acceleration/deceleration time 3 4: Acceleration/deceleration time 4 bit8-bit15: S curve smoothing parameter 1: Smoothing parameter 1 2: Smoothing parameter 2 3: Smoothing parameter 3 4: Smoothing parameter 4 5: Smoothing parameter 5 6: Smoothing parameter 6 7: Smoothing parameter 7 8: Smoothing parameter 8	256	-	Real time	"H12_en.22" on page 768

For speed references in multi-speed operation mode, besides the reference value and operating time, four groups of acceleration/deceleration time options are also available. There is no acceleration/deceleration time by default.

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

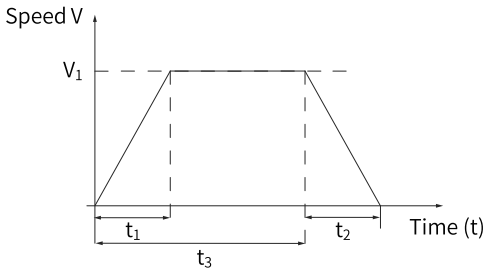


Figure 3-42 Example of multi-speed curve

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

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

The actual deceleration time t_2 is:

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

Operating time = Time taken in switching from the last speed to present speed + Duration of constant-speed operation at present speed (as shown by t_3 in the preceding figure)

- **A/B switchover**

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

  ☆ Related parameters:

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

- **Communication**

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

  ☆ Related parameters:

Parameter	Comm. address	Parameter name	Setpoint	Default value	Unit	Change mode	Page
H31.09	2031-0Ah	Speed reference set through communication	-9999.000 to 9999.000	0.000	[mm/s]/ [rpm]	Real time	"H31_en.09" on page 928

3.6.3 Ramp Function

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

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

Caution

- When the speed reference source is a digital setting, an analog voltage setting, or a jog speed, the acceleration time and deceleration time are set through parameters H06.05 and H06.06.
- When the speed reference source is a multi-speed reference, the acceleration time and deceleration time are set in parameter group H12. For details, see "*Parameter Description*" on page 569.

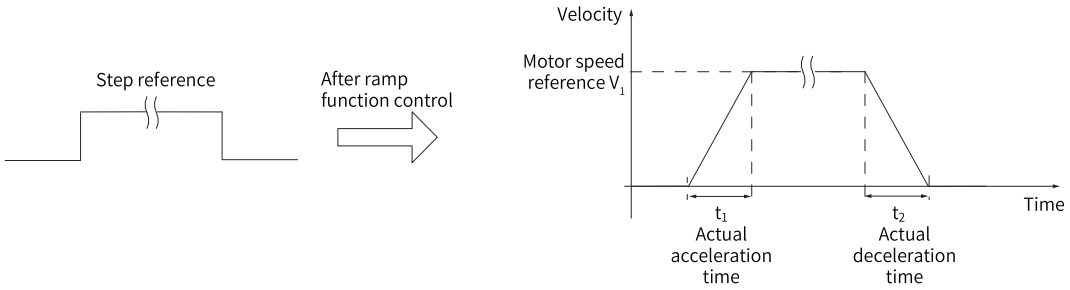


Figure 3-43 Ramp function definition

- H06.05: defines the time for the speed reference to change from 0 rpm to 1000 rpm.
- H06.06: defines the time for the speed reference to change from 1000 rpm to 0 rpm.

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

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

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

☆ Related parameters:

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H06.05	2006-06h	Ramp-up time of speed reference	0 to 65535	0	ms	Real time	"*H06_en.05*" on page 624
H06.06	2006-07h	Ramp-down time of speed reference	0 to 65535	0	ms	Real time	"*H06_en.06*" on page 624

3.6.4 Zero Clamp

Caution

- The zero speed clamp function is used in the system in which the host controller does not construct the position loop in speed control mode.
- If servo motor oscillation occurs in zero speed clamp state, adjust the position loop gain.

In the speed control mode, if FunIN.12 (ZCLAMP) is enabled, and the speed reference amplitude is smaller than or equal to the value of H06.15, the motor enters zero position clamp state. In this case, a position loop is built inside the drive and the speed reference is invalid.

The motor is clamped the minimum quantization error of the encoder. Even if it rotates due to external force, it will return to the zero position and be clamped.

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

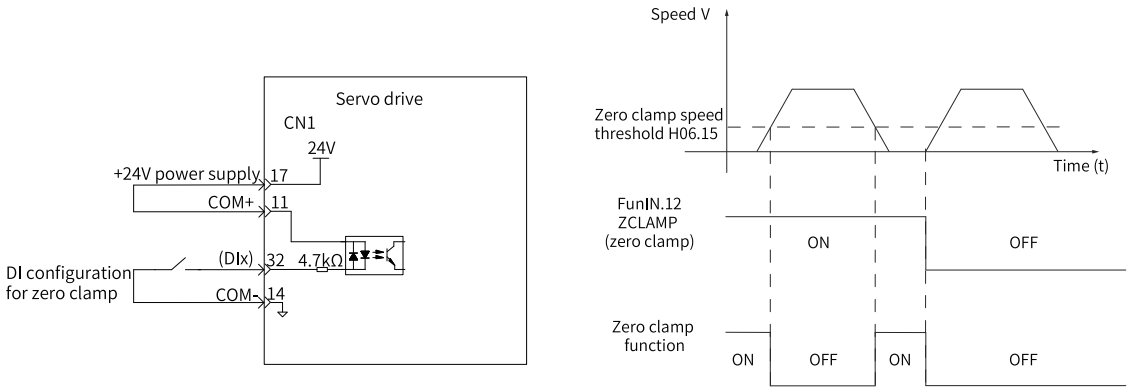


Figure 3-44 Wiring and waveform of zero clamp

☆Related parameters:

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
H06.15	2006-10h	Zero clamp speed threshold	0 to 10000	10	[mm/s]/ [rpm]	Real time	"H06_en.15" on page 627

☆ Related functions:

Code	Name	Description	Description
FunIN.12	ZCLAMP	Zero speed clamp	Inactive: Zero clamp disabled Active: Zero clamp enabled

3.6.5 Speed Reference Limit

Caution

When the actual speed of the motor exceeds H0A.08 (Overspeed threshold), E500.0 (Motor overspeed) occurs. For details of H0A.08, see " *Parameter Description*" *on page 569*. The speed reference limit must be lower than H0A.08.

In speed control mode, the sources of speed reference limit include:

- H06.07 specifies speed limit of speed reference in both forward and reverse directions. If speed reference exceeds the setting of H06-07, the speed reference will be limited as this value.
- H06.08 specifies the forward speed limit. If forward speed reference exceeds the setting of H06-08, the reference will be limited as this value.
- H06.09 specifies the reverse speed limit. If reverse speed reference exceeds the setting of H06-09, the reference will be limited as this value.
- The maximum motor speed varies with the actual motor model.

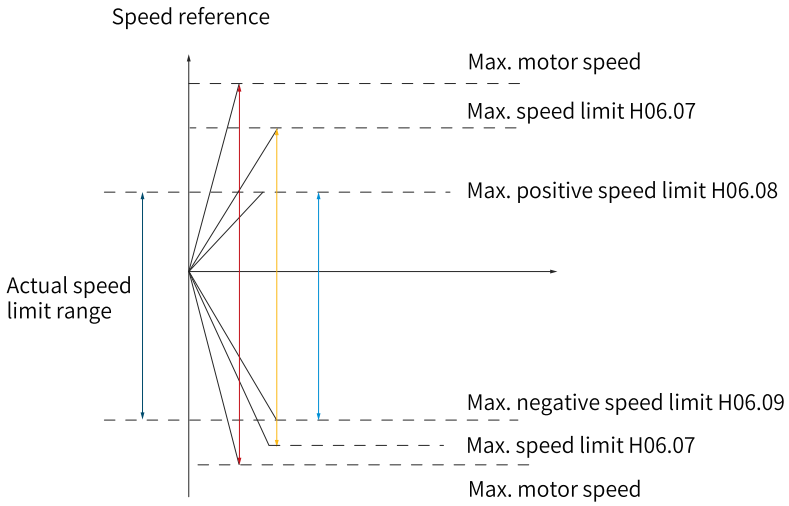


Figure 3-45 Example of speed reference limit

The actual motor speed limit meets the following requirements:

- |Forward speed limit| ≤ min {maximum motor speed, H06.07, H06.08}
- |Reverse speed limit| ≤ min {maximum speed of the motor, H06.07, H06.09}

☆ Related parameters:

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H06.07	2006-08h	Maximum speed limit	0 to 10000	7000	[mm/s]/ [rpm]	Real time	"H06_en.07" on page 625
H06.08	2006-09h	Forward speed threshold	0 to 10000	7000	[mm/s]/ [rpm]	Real time	"H06_en.08" on page 625
H06.09	2006-0Ah	Reverse speed threshold	0 to 10000	7000	[mm/s]/ [rpm]	Real time	"H06_en.09" on page 625

3.6.6 Speed-Related DO

Different DO signals are output to the host controller based on comparison between the speed feedback after filter and different thresholds. The related filter time is set in H0A.27.

Motor rotation DO signal

When the absolute value of the filtered actual motor speed reaches the value of H06.16 (Threshold of motor speed), the motor can be considered to be rotating. At this moment, the servo drive outputs the motor rotation signal (FunOUT.2: TGON) to confirm that the motor is rotating. When the absolute value of the actual motor speed after filter is smaller than the value of H06.16, the motor is considered not rotating.

Judgment on the motor rotation signal (FunOUT.2: TGON) is not influenced by the servo drive status and control mode.

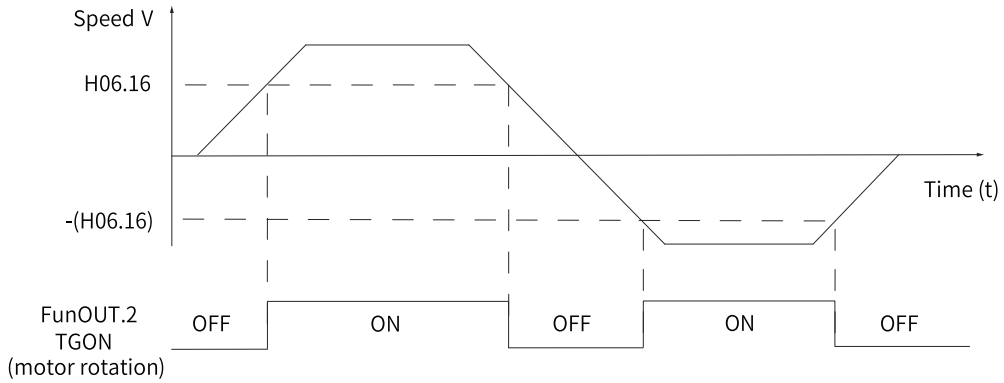


Figure 3-46 Waveform of motor rotation (TGON) signal

Note

In the preceding figure, ON indicates that the motor rotation DO signal is active. OFF indicates that the motor rotation DO signal is inactive.

☆ Related parameters:

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H06.16	2006-11h	Threshold of TGON (motor rotation) signal	0 [mm/s]/[rpm] to 1000 [mm/s]/[rpm]	20	[mm/s]/[rpm]	Real time	"H06_en.16" on page 627

Assign DO function 2 (FunOUT.2: TGON, motor rotation output) to a DO terminal of the servo drive and set the terminal logic.

☆ Related parameters:

Param.	Name	Function	Description
FunOUT.2	TGon	Motor rotation	Inactive: The absolute value of the filtered motor speed is lower than the setpoint of H06.16. Active. The absolute value of the filtered motor speed reaches the setpoint of H06.16.

3.7 Torque Control Mode

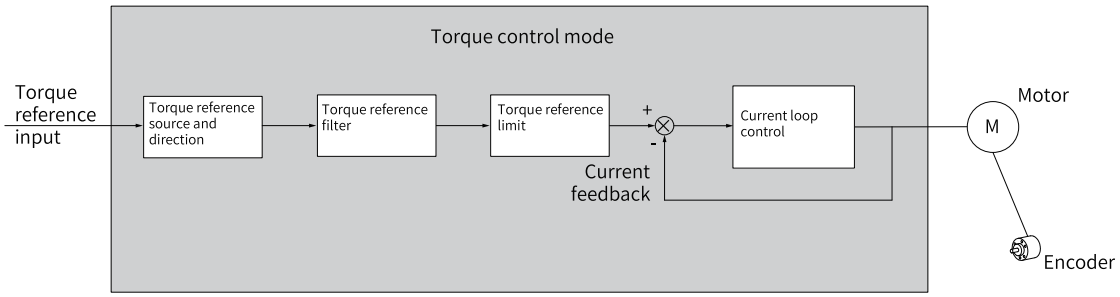


Figure 3-47 Block diagram of torque control mode

Set H02.00 (control mode selection) to 2 (torque control mode) through the keypad or the Inovance software tool to make the drive operate in the torque control mode. Set the drive parameters based on the mechanical structure and technical specifications. In the following diagram, the basic parameter settings are used to describe the torque control mode.

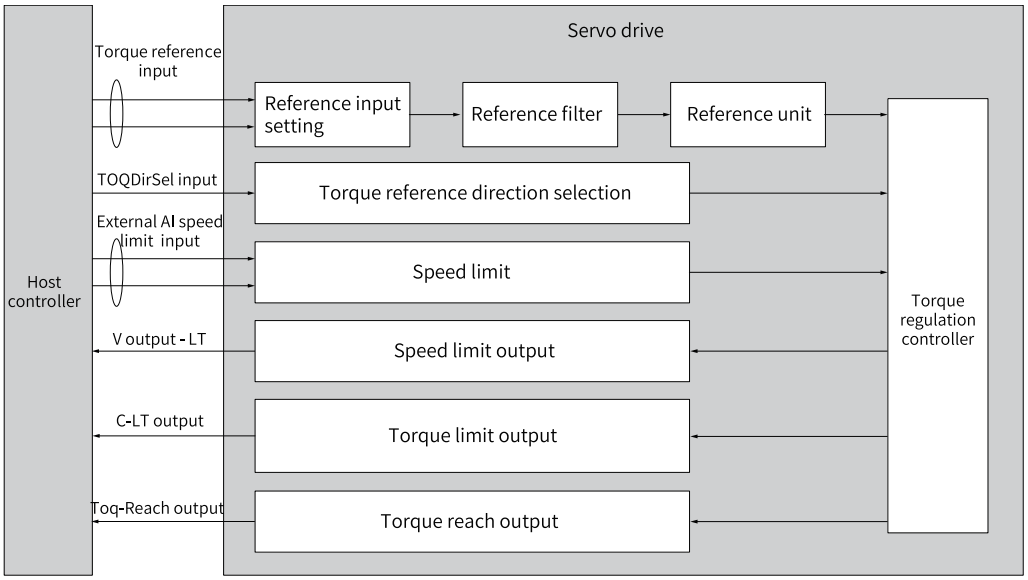


Figure 3-48 Signal exchange between the drive and the host controller

3.7.1 Function block diagram

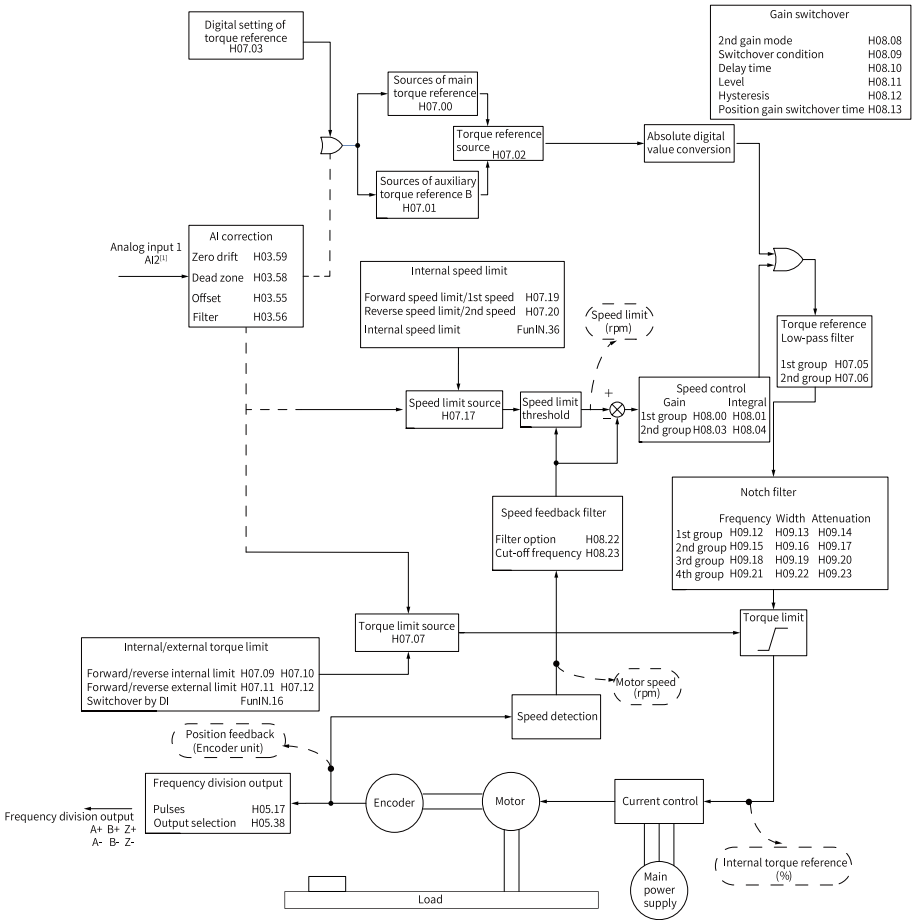


Figure 3-49 Block diagram of torque control

Note

[1]: When AI1 is used as the analog input, the corresponding parameters are H03.54 (zero drift), H03.53 (dead zone), H03.50 (offset), and H03.51 (filter).

3.7.2 Torque reference input

Torque reference source

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

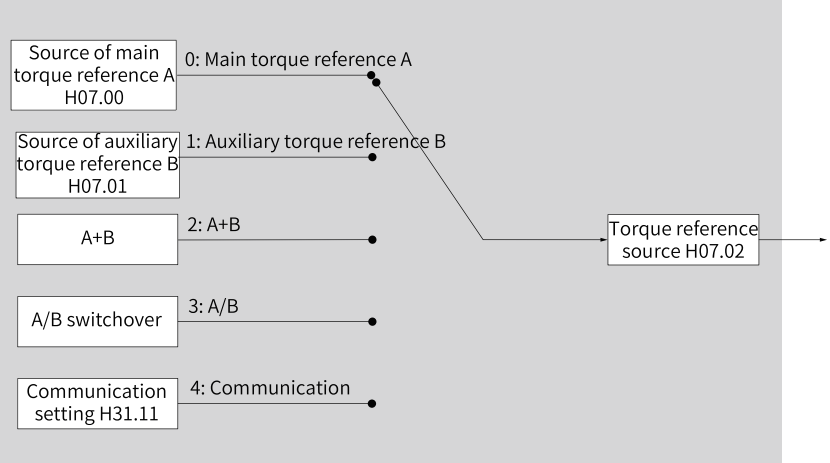


Figure 3-50 Selection of torque reference source

☆ Related parameters:

Parameter	Comm. address	Parameter name	Setpoint	Default value	Unit	Change mode	Page
H07.02	2007-03h	Torque reference source	0: Source of main torque reference A 1: Source of auxiliary torque reference B 2: Source of A+B 3: Switched between A and B 4: Communication	0	-	At stop	"H07_en.02" on page 637

- **Sources of main torque reference A**
  The sources of main torque reference A include digital setting and analog voltage setting. Digital setting produces the internal speed reference, and the analog voltage setting produces the external speed reference.

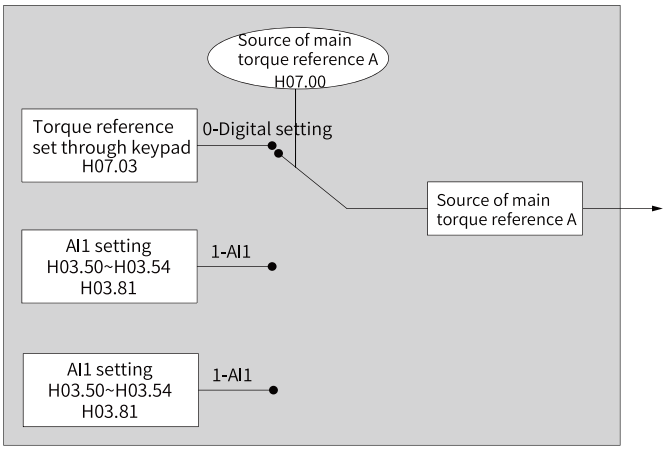


Figure 3-51 Description of main torque reference A sources

☆ Related parameters:

Parameter	Comm. address	Parameter name	Setpoint	Default value	Unit	Change mode	Page
H07.00	2007-01h	Sources of main torque reference A	0: H07.031 : AI1 2: AI2	0	-	At stop	"H07_en.00" on page 637

- **Digital setting**

  In digital setting, the torque reference is set in H07.03, which defines the percentage of the torque reference to the rated torque of the motor.

  ☆ Related parameters:

Parameter	Comm. address	Parameter name	Setpoint	Default value	Unit	Change mode	Page
H07.03	2007-04h	Torque reference set through operation panel	-400.0 to 400.0	0.0	%	Real time	"H07_en.03" on page 638

- **Analog voltage setting**

  The analog voltage signal output by the host controller or other devices is processed and then used as the torque reference.

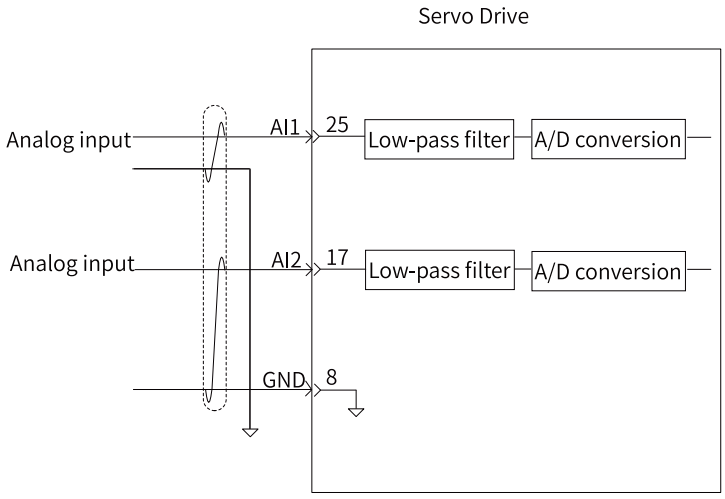
  Analog voltage input terminal:

  The servo drive provides two AIs: AI1 and AI2.

  AI1 voltage-type input: 16-bit, -10 V to +10 V; maximum allowable voltage: ± 12 VDC; input impedance: 74 kΩ.

  AI2 voltage-type input: 12-bit, -10 V to +10 V; maximum allowable voltage: ±12 VDC; input impedance: 74 kΩ.

  Analog input circuit:



Note

AI/AO terminals: AI1 corresponds to No. 25 pin, AI2 corresponds to No. 17 pin, and GND corresponds to No. 8 pin.

Procedure:

The following table takes AI1 as an example to describe the analog setting of the torque reference.

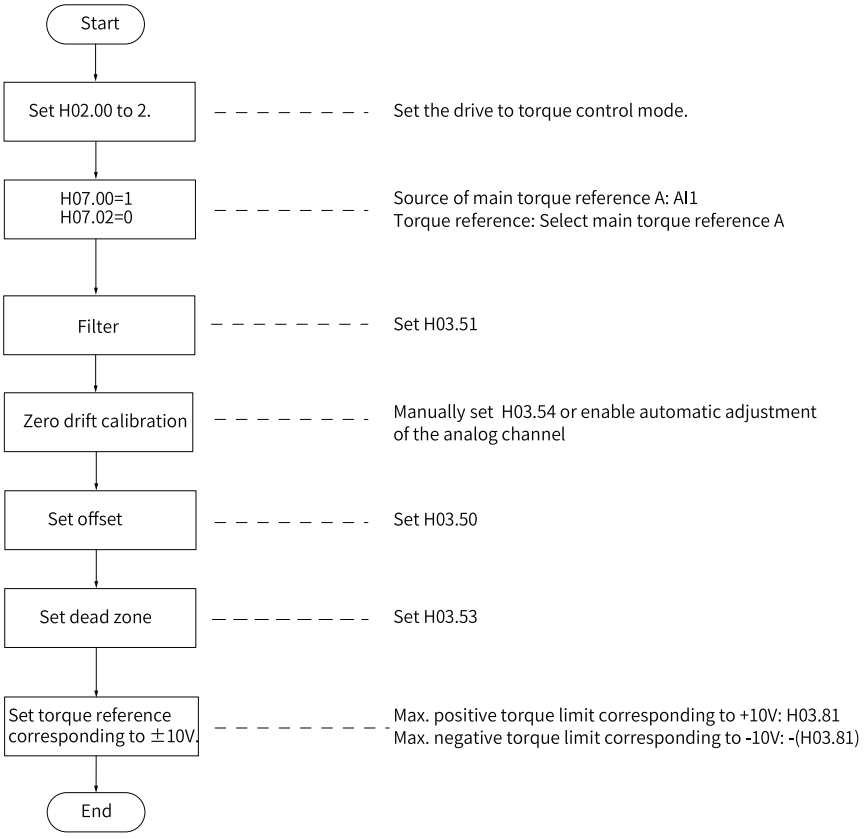


Figure 3-52 Flowchart of setting torque reference by analog voltage

★Terms:

- Zero drift: the value of the servo drive sampling voltage relative to GND when the input voltage of the analog channel is zero.
- Offset: the input voltage value of the analog channel when the sampling voltage is zero after zero drift calibration.
- Dead zone: the input voltage range of the analog channel when the sampling voltage is zero.

In the following figure, y_1 represents the unprocessed AO voltage, y_6 represents the final torque reference after being processed by the servo drive.

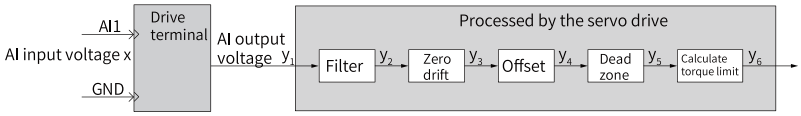


Figure 3-53 AI processing of servo drive

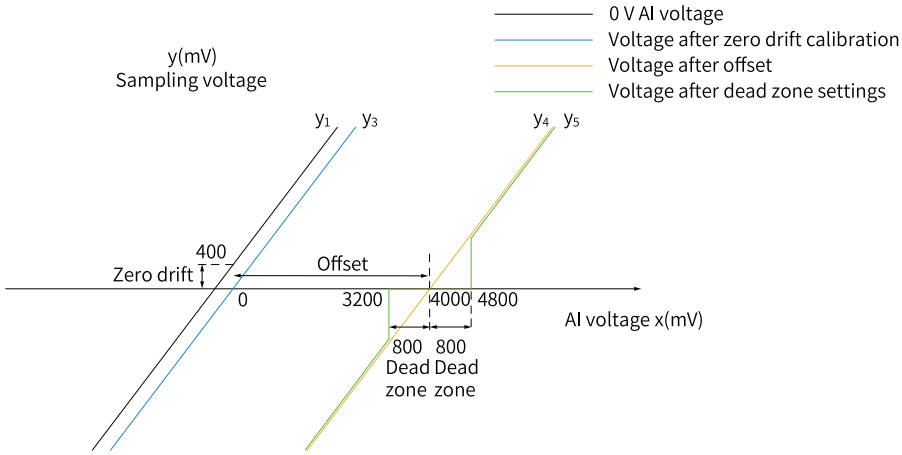


Figure 3-54 Example of sampling voltage and AI processing of servo drive

- **Filter:**
  The servo drive provides the analog channel filter function. Setting the filter time constant in H03.51 prevents motor reference fluctuation due to instable analog input voltage and eliminates motor malfunction due to signal interference. The filter function cannot eliminate or suppress the zero drift or dead zone.

- **Zero drift calibration**
  It calibrates the analog output voltage offset relative to the actual input voltage 0 V.

  In the preceding figure, the analog output voltage without being processed by the servo drive is y_1. Take the filter time constant H03.51 = 0.00 ms as an example, and the sampling voltage after filter y_2 is the same as y_1.

  That is, when the actual input voltage x = 0, the output voltage y_1 = 400 mV. Therefore, the zero drift voltage is 400 mV.

  Set H03.54 to 400.0 (mV) manually. The sampling voltage after zero drift calibration is shown by y_3. $y_3 = y_1 - 400.0$

  Zero drift can also be corrected automatically through H0d.10 (Automatic tuning of analog channels).

- **Offset setting**

  It sets the actual input voltage corresponding to sampling voltage 0.

  Assume that the actual input voltage x = 4000 mV when the sampling voltage $y_4 = 0$. That is, the offset is 4000 mV.

  Set H03.50 to 4000 (mV). The sampling voltage after offset $y_4 = x - 4000 = y_3 - 4000$

- **Dead zone calibration**

  It sets the effective input voltage range when the sampling voltage of the servo drive is not 0.

  After the offset is set, if the sampling voltage is always 0 when the input voltage x is within 3200 mV to 4800 mV, the dead zone is 800 mV.

  Set H03.53 to 800.0 (mV). The sampling voltage after dead zone calibration is shown as y_5:

$$y_5 = \begin{cases} 0 & 3200 \leqslant x \leqslant 4800 \\ y_4 & 4800 < x \leqslant 10000 \text{ or } -10000 \leqslant x < 3200 \end{cases}$$

- **Torque reference calculation**

  After setting the zero drift, offset, and dead zone, set the speed reference corresponding to 10 V (10000 mV) in H03.81 (Speed corresponding to 10 V) to obtain the actual torque reference y_6:

$$y_6 = \frac{y_5}{10000} x \ (\text{H03.81})$$

  This value is used as the torque reference set via analog in the torque control mode.

  The left figure below applies when no offset exists. The right figure below applies when offset exists. After proper settings, you can view the AI1 sampling voltage value through H0b.21 in real time or view the torque reference value corresponding to the input analog value through H0b.01.

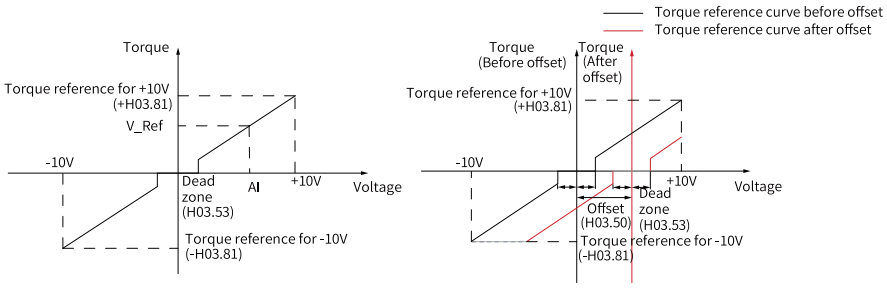


Figure 3-55 AI1 without offset (left) and AI1 after offset (right)

The relationship between the final torque reference y_6 and the input voltage x is:

$$y_6 = \begin{cases} 0 & B\text{-}C \leqslant x \leqslant B+C \\ x\text{-}B & B+C < x \leqslant 10000 \text{ or } -10000 \leqslant x < B\text{-}C \end{cases}$$

Where, B represents offset and C represents dead zone.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Setpoint	Default value	Unit	Change mode	Page
H03.50	2003-33h	Voltage-type AI1 offset	-5000 to +5000	0	mV	Real time	"H03_en.50" on page 601
H03.51	2003-34h	Voltage-type AI1 input filter time constant	0.00 to 655.35	2.00	ms	Real time	"H03_en.51" on page 601
H03.53	2003-36h	Voltage-type AI1 dead zone	0.0 to 1000.0	10.0	mV	Real time	"H03_en.53" on page 601
H03.54	2003-37h	Voltage-type AI1 zero drift	-500.0 to +500.0	0.0	mV	Real time	"H03_en.54" on page 601
H03.55	2003-38h	Voltage-type AI2 offset	-5000 to +5000	0	mV	Real time	"H03_en.55" on page 602
H03.56	2003-39h	Voltage-type AI2 input filter time constant	0.00 to 655.35	2.00	ms	Real time	"H03_en.56" on page 602
H03.58	2003-3Bh	Voltage-type AI2 dead zone	0.0 to 1000.0	10.0	mV	Real time	"H03_en.58" on page 602
H03.59	2003-3Ch	Voltage-type AI2 zero drift	-500.0 to +500.0	0.0	mV	Real time	"H03_en.59" on page 602
H03.81	2003-52h	Torque corresponding to analog 10 V	0.00 to 8.00	1.00	Multiplier	At stop	"H03_en.81" on page 604
H0d.10	200d-0Bh	Automatic tuning of analog channel	0: No operation 1: Adjust AI1 2: Adjust AI2	0	-	At stop	"H0d_en.10" on page 720

- **Sources of auxiliary torque reference B**
  The auxiliary torque reference B source is set in the same way as the main torque reference A source.

- **A/B switchover**
  When setting H07.02 (Torque reference source) to 3 (Switched between A and B), you need to assign FunIN.4 (DI-SEL) to the corresponding DI. The input signal of this DI determines which source (A or B) is active.

  ☆ Related parameters:

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

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

  ☆ Related parameters:

Parameter	Comm. address	Parameter name	Setpoint	Default value	Unit	Change mode	Page
H31.11	2031-0Ch	Torque reference set through communication	-100.000 to +100.000	0.000	%	Real time	"H31_en.11" on page 928

3.7.3 Torque Reference Filter

Caution

Pay attention to the responsiveness during setting as an excessively high setpoint lowers down the responsiveness.

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

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

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

☆Related parameters:

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
H07.05	2007-06h	Torque reference filter time constant 1	0.00 to 30.00	0.50	ms	Real time	"H07_en.05" on page 638
H07.06	2007-07h	Torque reference filter time constant 2	0.00 to 30.00	0.27	ms	Real time	"H07_en.06" on page 638

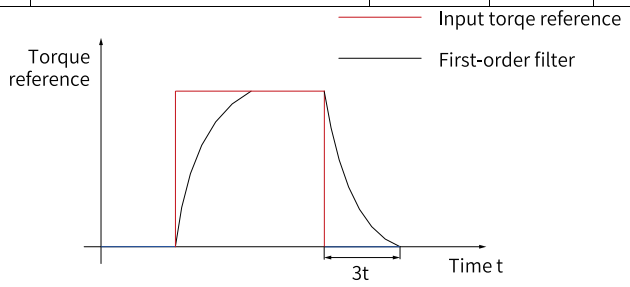


Figure 3-56 First-order filter for rectangular torque references

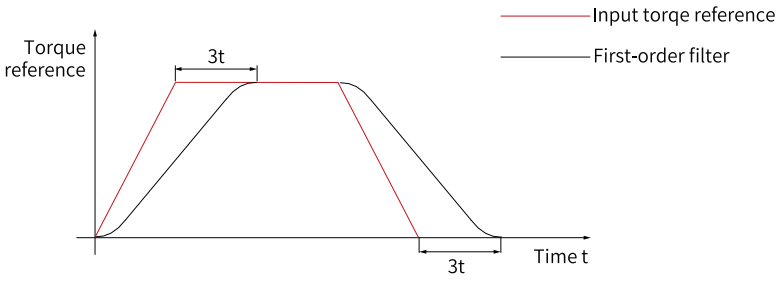


Figure 3-57 First-order filter for trapezoid torque references

Note

In the preceding figures, the letter "t" in "3t" refer to the torque reference filter time constant. Pay attention to the responsiveness when you set the constant because an excessively high setpoint decreases the responsiveness.

3.7.4 Torque Reference Limit

Caution

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

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

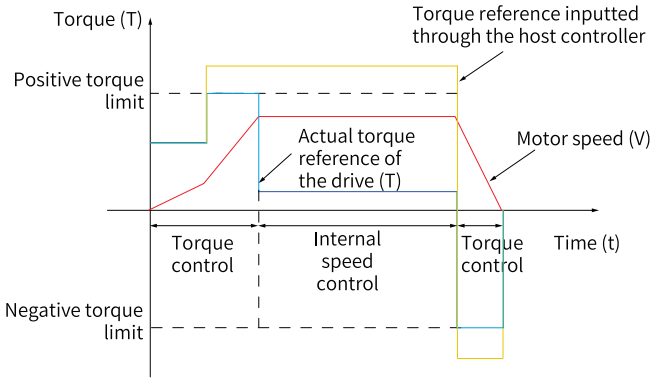


Figure 3-58 Torque reference and torque limit

When the absolute value of the torque reference input from the host controller or output by the speed regulator is higher than the absolute value of the torque reference limit, the actual torque reference of the drive is limited to the torque reference limit. Otherwise, the torque reference input from the host controller or output by the speed regulator is used.

Only one torque reference limit is valid at a moment. The positive/negative torque limit must be lower than or equal to the maximum torque of the drive and the motor and ±400.0% of the rated torque.

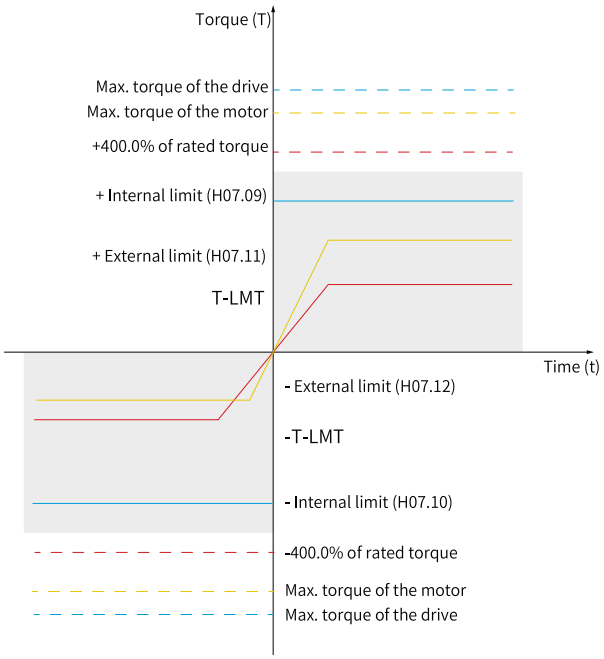


Figure 3-59 Torque limit example

Torque limit source

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

After the torque limit is set, the torque limit applies when the torque reference exceeds the limit. The torque limit must be set according to the load conditions. An excessively low limit may weaken the acceleration/deceleration ability of the motor, causing the actual motor speed to fall below the required value during operating at a constant torque.

☆ Related parameters:

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H07.07	2007-08h	Torque limit source	0: Positive/Negative internal torque limit 1: Internal or external limit as defined by DI 2: T_LMT limit 3: T_LMT or external limit used as torque limit as defined by DI (FunIN.16 or 17) 4: T_LMT or external limit used as torque limit as defined by DI (FunIN.16 or 17)	0	-	Real time	"*H07_en.07*" *on page 639*

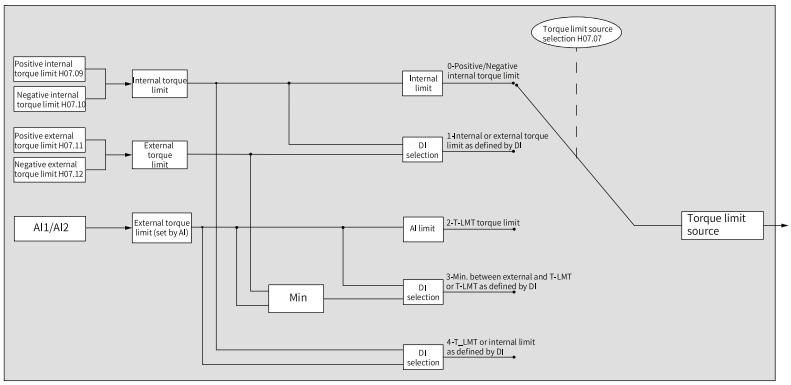


Figure 3-60 Torque limit source

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

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

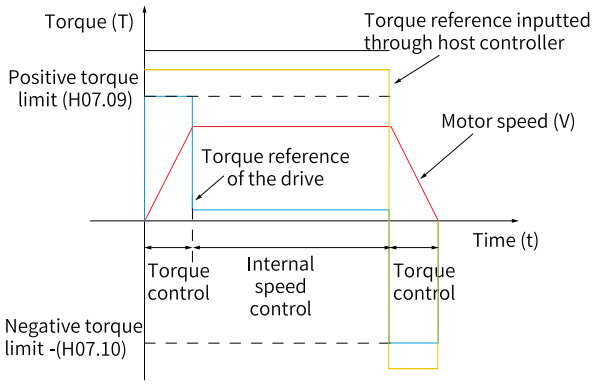


Figure 3-61 Torque limit curve (H07.07 = 0)

- H07.07 = 1 (Internal or external limit as defined by DI)
  The torque reference limit value is determined by the logic state of external DI signals. The positive torque limit is selected between H07.09 (Positive internal torque limit) and H07.11 (Positive external torque limit). The negative torque limit is selected between H07.10 (Negative internal torque limit) and H07.12 (Negative external torque limit).

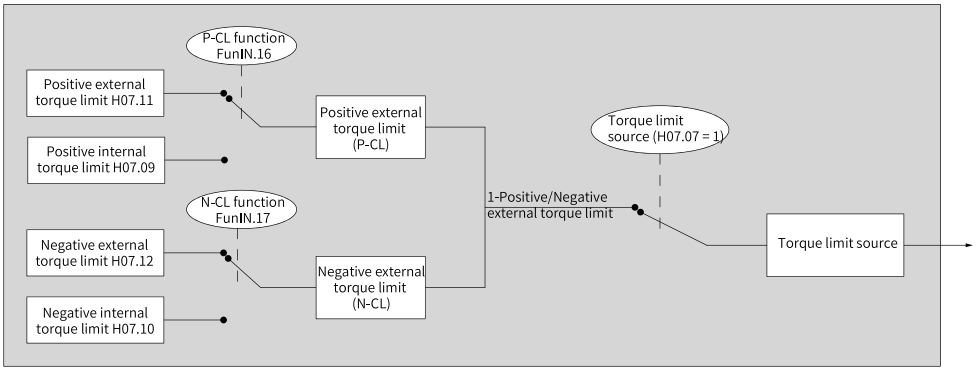
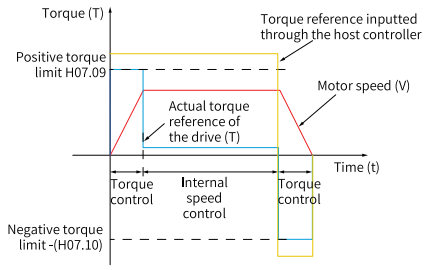
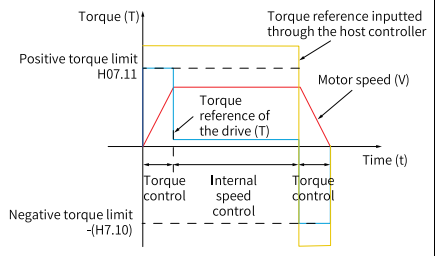
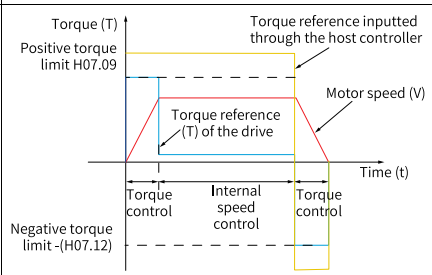
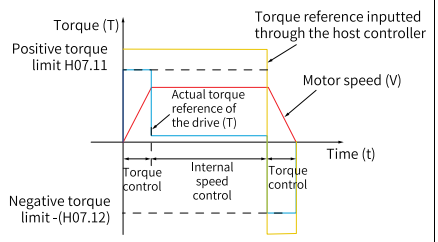


Figure 3-62 Torque limit source (H07.07 = 1)

Table 3–17 Description of H07.07 = 1

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

Assign function 16 (FunIN.16: P-CL, external positive torque limit) and function 17 (FunIN.17: N-CL, external negative torque limit) to two DI terminals of the servo drive respectively and set the terminal logics.

☆ Related parameters:

Param.	Name	Function	Description
FunIN.16	P-CL	Positive external torque limit	The torque limit source is switched based on H07.07 (Torque limit source). H07.07 = 1: Active: Positive external torque limit activated Inactive: Positive internal torque limit activated
FunIN.17	N-CL	Negative external torque limit	The torque limit source is switched based on H07.07 (Torque limit source). H07.07 = 1: Active: Negative external torque limit activated Inactive: Negative internal torque limit activated

☆ Related parameters:

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H07.09	2007-0Ah	Positive internal torque limit	0.0 to 400.0	350.0	%	Real time	"H07_en.09" on page 639
H07.10	2007-0Bh	Negative internal torque limit	0.0 to 400.0	350.0	%	Real time	"H07_en.10" on page 639
H07.11	2007-0Ch	Positive external torque limit	0.0 to 400.0	350.0	%	Real time	"H07_en.11" on page 640
H07.12	2007-0Dh	Negative external torque limit	0.0 to 400.0	350.0	%	Real time	"H07_en.12" on page 640

- H07.07 = 2 (T-LMT as torque limit)

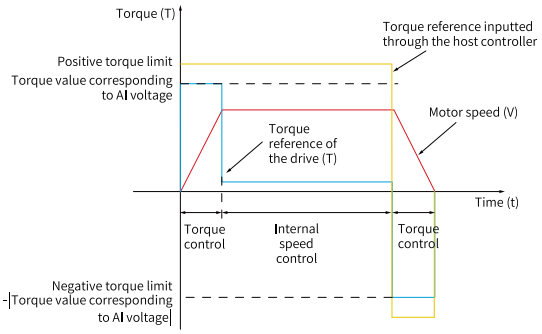


Figure 3-63 AI torque limit curve

- H07.07 = 3: T_LMT or external limit used as torque limit as defined by DI (FunIN.16 or 17)
  When the logic of the external DI signal (P-CL) is inactive, the positive torque limit is defined by the torque value corresponding to the input voltage of external AI. When the logic of the external DI signal (P-CL) is active, the positive torque limit is defined by the minimum of H07.11 and the AI value corresponding to the AI voltage.

  When the logic of the external DI signal (N-CL) is inactive, the negative torque limit is defined by the torque value corresponding to the external AI voltage. When the logic of the external DI signal (N-CL) .is active, the negative torque limit is defined by the minimum of H07.12 and the torque value corresponding to the AI voltage.

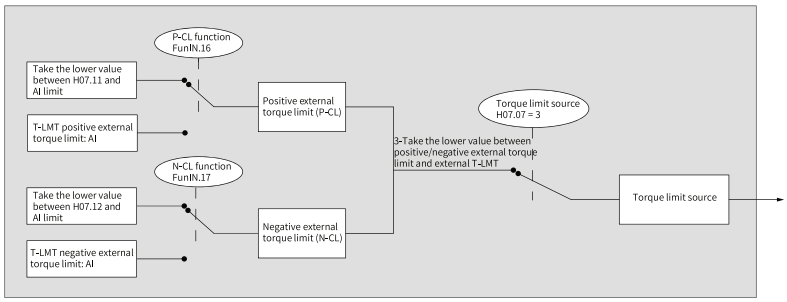
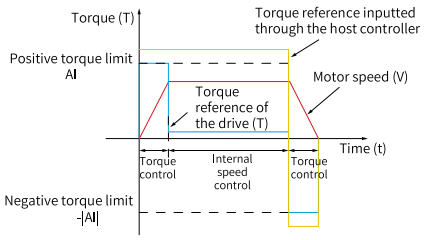
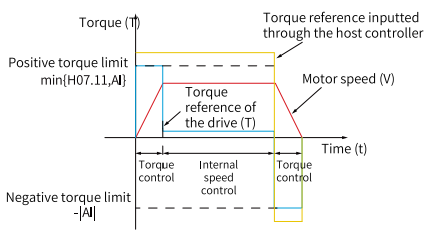
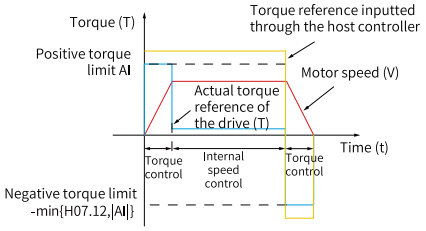
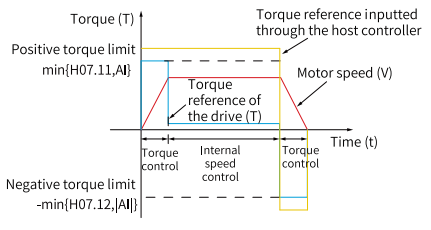


Figure 3-64 Torque limit source (H07.07 = 3)

Table 3–18 Description of H07.07 = 3

DI state		P-CL	
		OFF	ON
N-CL	OFF		
	ON		

- H07.07 = 4: T_LMT or internal limit used as torque limit as defined by DI

When the logic of the external DI signal (P-CL) is inactive, the positive torque limit is defined by H07.09. When the logic of the external DI (P-CL) is active, the positive torque limit is defined by the torque value corresponding to the AI voltage.

When the logic of the external DI signal (N-CL) is inactive, the negative torque limit is defined by H07.10. When the logic of the external DI-CL) is active, the negative torque limit is defined by the torque value corresponding to the AI voltage.

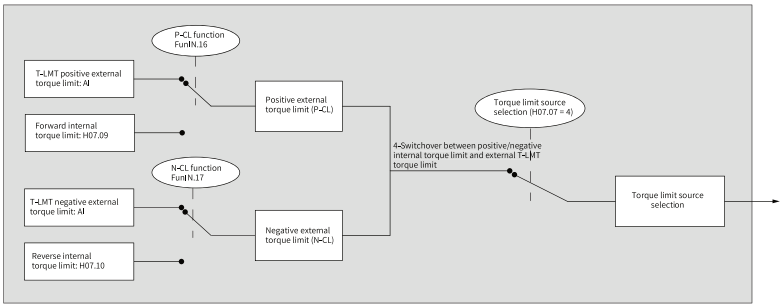
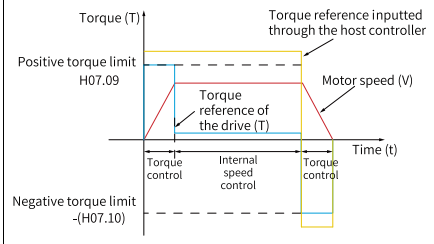
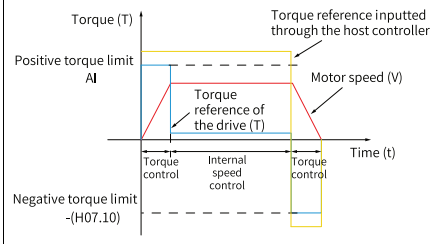
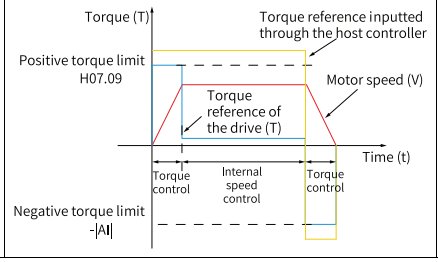
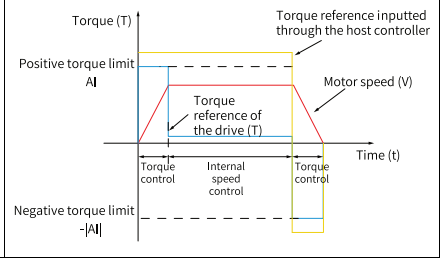


Figure 3-65 Torque limit source (H07.07 = 4)

Table 3–19 Description of H07.07 = 4

DI state		P-CL	
		OFF	ON
N-CL	OFF		
	ON		

☆ Related parameters:

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H07.09	2007-0Ah	Positive internal torque limit	0.0 to 400.0	350.0	%	Real time	"H07_en.09" on page 639
H07.10	2007-0Bh	Negative internal torque limit	0.0 to 400.0	350.0	%	Real time	"H07_en.10" on page 639
H07.11	2007-0Ch	Positive external torque limit	0.0 to 400.0	350.0	%	Real time	"H07_en.11" on page 640
H07.12	2007-0Dh	Negative external torque limit	0.0 to 400.0	350.0	%	Real time	"H07_en.12" on page 640

3.7.5 Speed Limit in Torque Control Mode

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

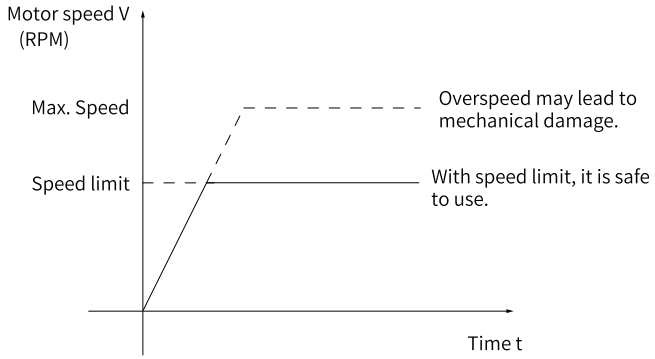


Figure 3-66 Speed limit in torque control mode

Define the speed limit source

In torque control mode, you can set the speed limit source in H07.17. After the speed limit is set, the actual motor speed will be limited. After reaching the speed limit, the motor keeps operating at the speed limit constantly. Set the speed limit based on the operating requirements of the load.

☆ Related parameters:

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H07.17	2007-12h	Speed limit source	0: Internal speed limit 1: V-LMT speed limit 2: H07.19 or H07.20 used as speed limit as defined by DI Note: Note: This parameter is active only when H02.00 is not set to 9.	0	-	Real time	*"H07_en.17" on page 640*

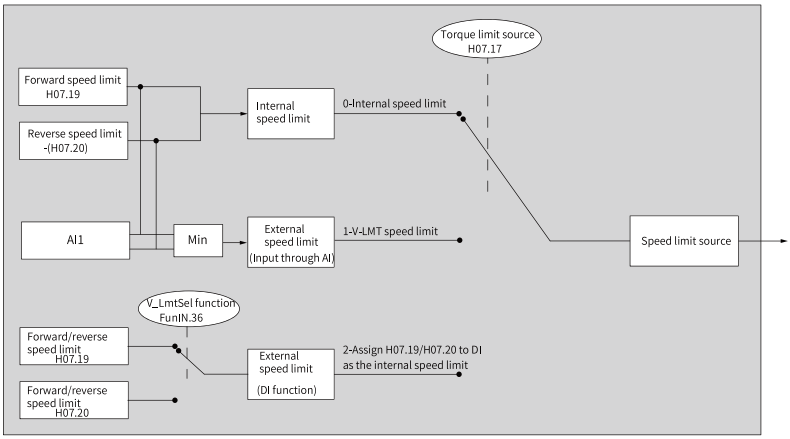


Figure 3-67 Speed limit source

- H07.17 = 0 (Internal speed limit)

The speed limit is determined only by H07.19 (Positive speed limit) and H07.20 (Negative speed limit).

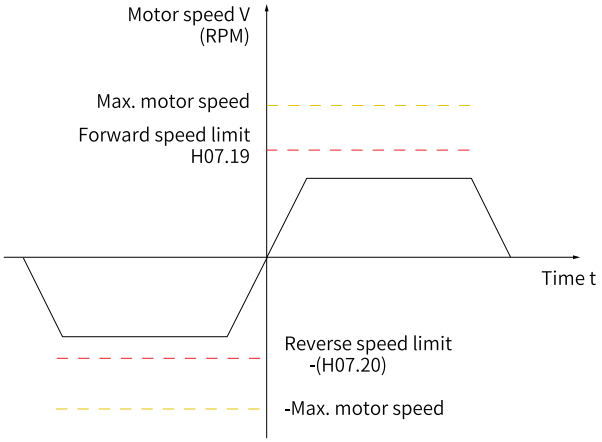


Figure 3-68 Speed limit curve (H07.17 = 0)

- H07.17 = 1 (V- LMT as speed limit)
  When the speed limit defined by AI is lower than the internal speed limit (H07.19/H07.20), the former applies. When the speed limit defined by AI is higher than the internal speed limit (H07.19/H07.20), the latter applies.

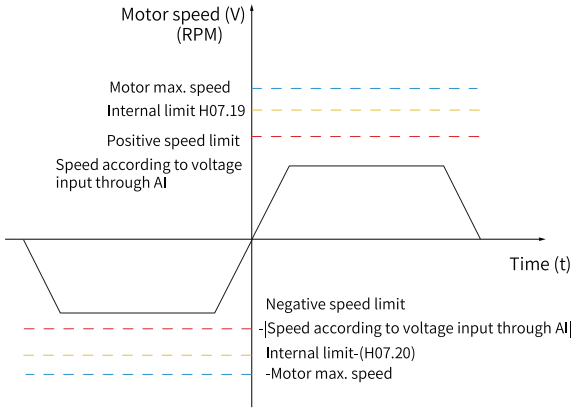


Figure 3-69 Speed limit curve (H07.17 = 1)

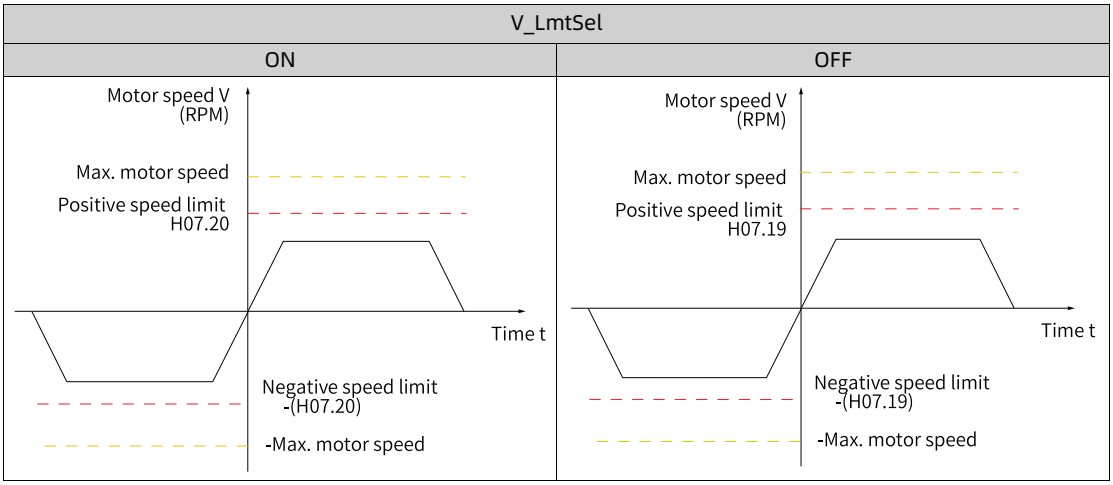
- H07.17 = 2 (H07.19 or H07.20 used as speed limit as defined by DI)
  H07.19 or H07.20 is used as the speed limit based on the logic of the DI.

  To use this function, set a DI terminal of the servo drive with function 36 (FunIN.36: V-LmtSel, internal speed limit source) and set the terminal logic.

  ☆ Related parameters:

Param.	Name	Function	Description
FunIN.36	V_LmtSel	Internal speed limit source	Inactive: H07.19 used as positive/negative internal speed limit Active: H07.20 used as positive/negative internal speed limit

Table 3–20 Descriptions of speed limit



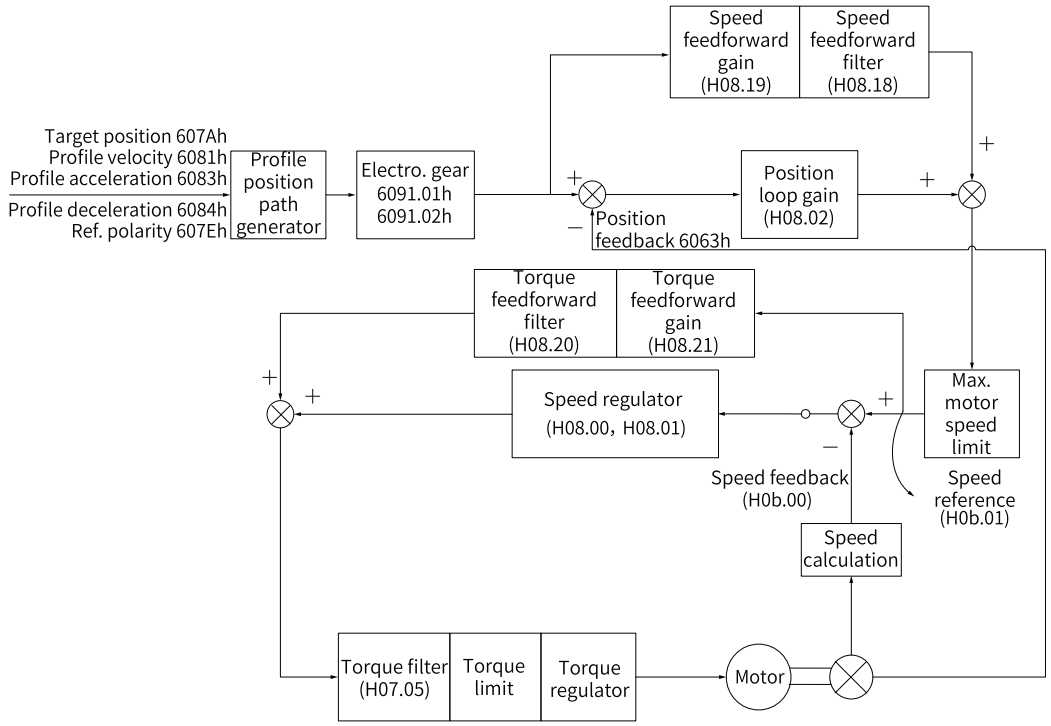
☆ Related parameters:

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H07.19	2007-14h	Positive speed limit/Speed limit 1 in torque control	0[mm/s]/[rpm] to 10000[mm/s]/[rpm]	3000	[mm/s]/[rpm]	Real time	"H07_en.19" on page 641
H07.20	2007-15h	Negative speed limit/Speed limit 2 in torque control	0[mm/s]/[rpm] to 10000[mm/s]/[rpm]	3000	[mm/s]/[rpm]	Real time	"H07_en.20" on page 641

3.8 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.

3.8.1 Function Block Diagram



3.8.2 Configuration Block Diagram

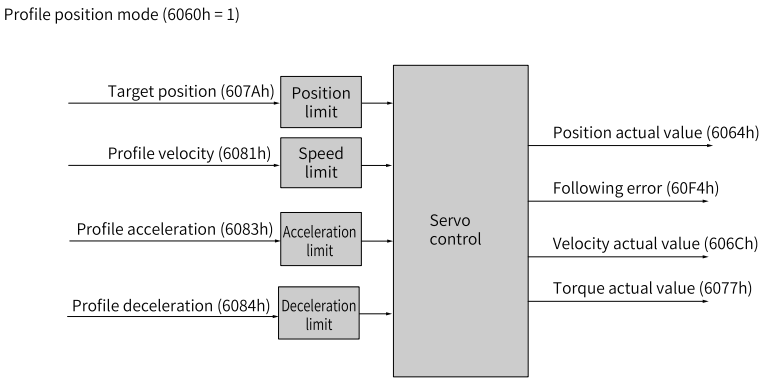


Figure 3-70 PP mode

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

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

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

Sequential mode:

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

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

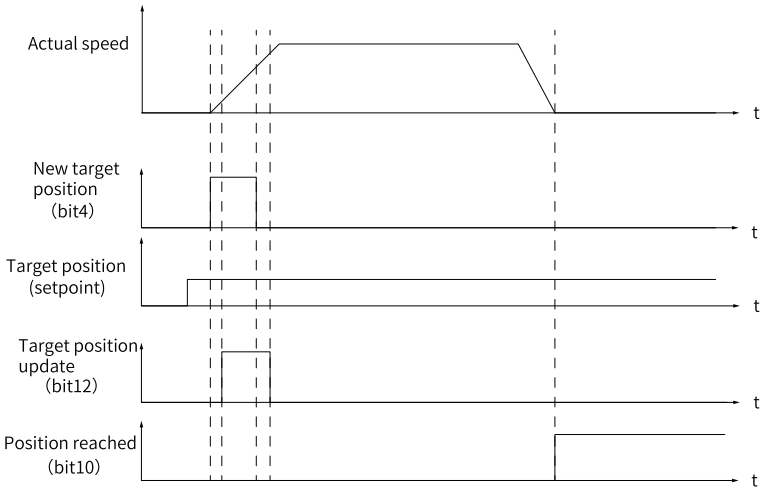
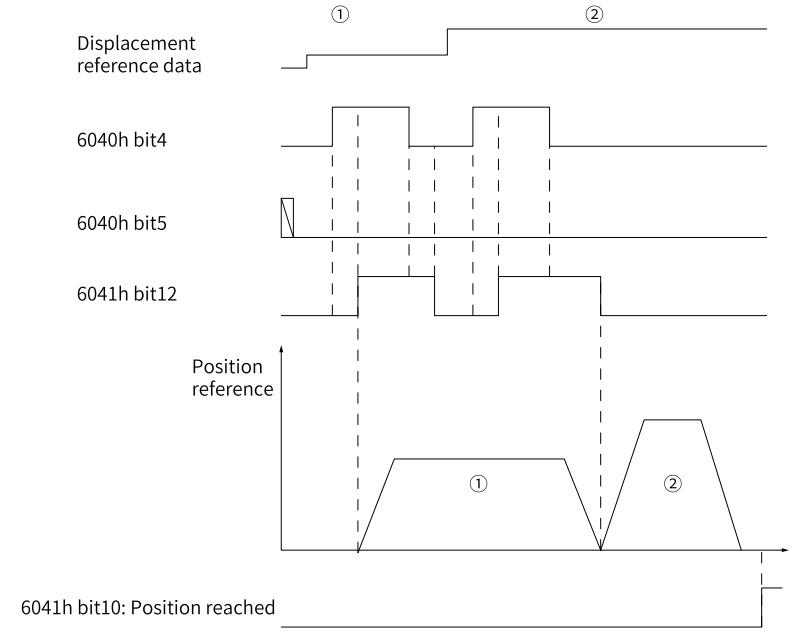


Figure 3-71 Sequence in sequential mode

Single-point mode:

The target position of present segment is in the process of positioning. After the new target position is prepared, the controller sets the new set-point bit to 1, and the servo drive performs positioning based on the new target position after the position reference of present segment is transmitted.

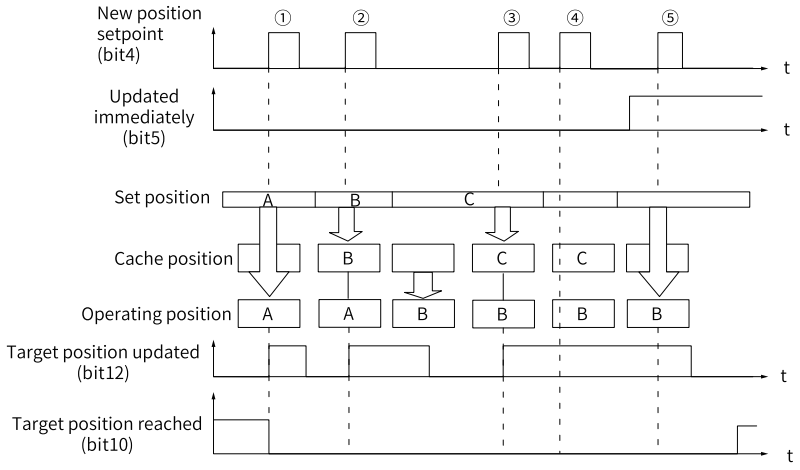
The sequence of bit4 (New set-point) of the control word and bit12 (Set-point acknowledge) of the status word is as follows.



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

Figure 3-72 Sequence in the single-point mode

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



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

3.8.3 Recommended Configuration

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

RPDO	TPDO	Remarks
6040h: control word	6041h: status word	Mandatory
607Ah: target position	6064h: position actual value	Mandatory
6081h: profile velocity	-	Mandatory
6083h: profile acceleration	-	Optional
6084h: profile deceleration	-	Optional
6060h: modes of operation	6061h: modes of operation display	Optional

3.8.4 Related Parameters

6040h Control word

Comm. address:	6040h	Effective mode:	Real time
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Real time
Access permission:	Read/write (RW)	Mapping:	RPDO

Range:

0x0 to 0xFFFF

Description:

For details, see the "Control Mode" section.

bit	Name		Description
0	Switch on	Switch on	1: Valid; 0: Invalid
1	Enable voltage	Enable voltage	1: Valid; 0: Invalid
2	Quick stop	Quick stop	0: Valid; 1: Invalid
3	Enable operation	Enable operation	1: Valid; 0: Invalid
4	New set-point	New set-point	0→1: Trigger new target position 1→0: Clear bit12 of the status word
5	Change set immediately	Change set immediately	0: Not immediately 1: Immediately
6	abs/rel	abs/rel	0: absolute position reference as target position 1: Relative position reference as target position
8	Halt	Halt	0: Keep running 1: Halt

6041h Status word

Comm. address:	6041h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Access permission: Read-only Mapping: TPDO

Range:

0x0 to 0xFFFF

Description:

For details, see the "Control Mode" section.

bit	Name		Description
0	Ready to switch on	Ready to switch on	1: Valid; 0: Invalid
1	Switch on	Switch on	1: Valid; 0: Invalid
2	Enable operation	Enable operation	1: Valid; 0: Invalid
3	Fault	Fault	1: Valid; 0: Invalid
4	Voltage enabled	Voltage enabled	1: Valid; 0: Invalid
5	Quick stop	Quick stop	0: Valid; 1: Invalid
6	Switch on disabled	Switch on disabled	1: Valid; 0: Invalid
7	Warning	Warning	1: Valid; 0: Invalid
8	Manufacturer-specific	Manufacturer-specific	Undefined
9	Remote	Remote	1: Active, control word effective 0: Inactive
10	Target reach	Target reach	0: Target position not reached 1: Target position reached
11	Internal limit active	Internal limit active	0: Position reference within the limit 1: Position reference beyond the limit
12	Set-point acknowledge	Set-point acknowledge	0: Acknowledged 1: Not acknowledged
13	Following error	Following error	0: No error 1: Excessive deviation
14	Manufacturer-specific	Manufacturer-specific	Undefined
15	Homing completed	Home find	0: Homing completed 1: Homing completed

☆ Related parameters:

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
6060h	6060h	Servo drive mode selection	1: Profile position (PP) mode 3: Profile speed (PV) mode 4: Profile torque (PT) mode 6: Homing mode (HM) 8: Cyclic synchronous position (CSP) mode 9: Cyclic synchronous velocity (CSV) mode 10: Cyclic synchronous torque (CST) mode	0	-	Real time	"6060h" on page 980
6061h	6061h	Operation mode display	1: Profile position (PP) mode 3: Profile speed (PV) mode 4: Profile torque (PT) mode 6: Homing mode (HM) 8: Cyclic synchronous position (CSP) mode 9: Cyclic synchronous velocity (CSV) mode 10: Cyclic synchronous torque (CST) mode	0	-	Read-only	"6061h" on page 981
6064h	6064h	Position feedback	-2147483648 to 2147483647 (encoder unit)	0	Reference unit	Read-only	"6064h" on page 982
6065h	6065h	Threshold of excessive position deviation	0 to 4294967295	219895614	Reference unit	Real time	"6065h" on page 982
6066h	6066h	Time lapse to trigger excessive position deviation	0 to 65535	0	ms	Real time	"6066h" on page 982
6067h	6067h	Position reach threshold	0 to 4294967295	46976	Reference unit	Real time	"6067h" on page 983
6068h	6068h	Position reach window time	0 to 65535	0	ms	Real time	"6068h" on page 983
607Ah	607Ah	Target position	-2147483648 to 2147483647 (encoder unit)	0	Reference unit	Real time	"607Ah" on page 986
607Eh	607Eh	Polarity	0x0 to 0xFF	0x0	-	Real time	"607Eh" on page 987
607Fh	607Fh	Maximum speed	0 to 4294967295	4294967295	Reference unit: /s	Real time	"607Fh" on page 988
6081h	6081h	Profile velocity	0 to 4294967295	111848106	Reference unit: /s	Real time	"6081h" on page 988

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
6083h	6083h	Profile acceleration	0 to 4294967295	4294967295	Reference unit/s²	Real time	"6083h" on page 988
6084h	6084h	Profile deceleration	0 to 4294967295	4294967295	Reference unit/s²	Real time	"6084h" on page 989

3.8.5 Related Function Settings

Note

In absolute position mode, the running direction of the servo is determined by the direction of the shortest relative displacement between the start absolute position and the target absolute position (607Ah).

Monitoring on positioning completion

Positioning completion: 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.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
6067h	6067h	Position window	0 to 4294967295	46976	Reference unit	Real time	"6067h" on page 983
6068h	6068h	Position window time	0 to 65535	0	ms	Real time	"6068h" on page 983

Note

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

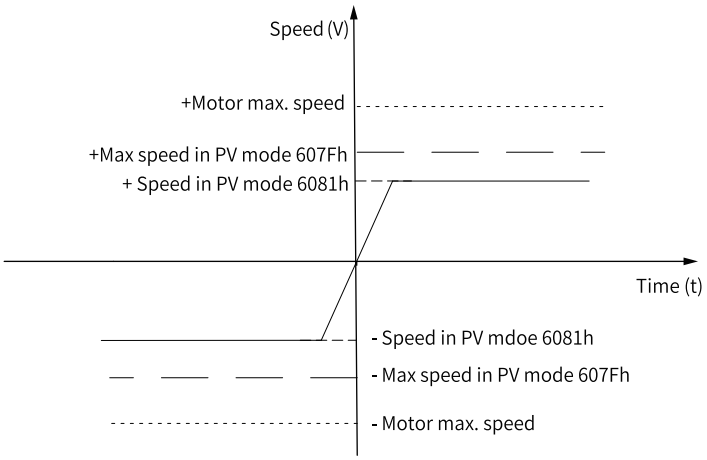
Position deviation monitoring function

☆Related parameters:

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
6065h	6065h	Following error window	0 to 4294967295	219895614	Reference unit	Real time	"6065h" on page 982
6066h	6066h	Excessive position deviation timeout	0 to 65535	0	ms	Real time	"6066h" on page 982

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.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
607Fh	607Fh	Max. speed	0 to 4294967295	4294967295	Reference unit/s	Real time	"607Fh" on page 988

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.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
6083h	6083h	Profile acceleration	0 to 4294967295	4294967295	Reference unit/s^2	Real time	"6083h" on page 988
6084h	6084h	Profile deceleration	0 to 4294967295	4294967295	Reference unit/s^2	Real time	"6084h" on page 989

Polarity

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

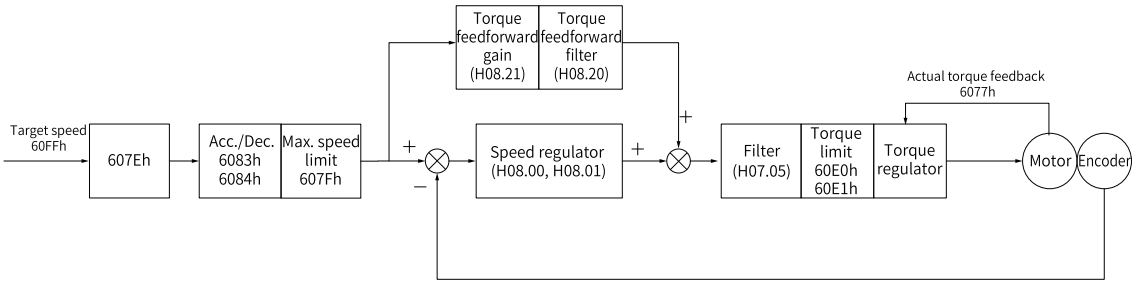
☆Related parameters:

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
607Eh	607Eh	Polarity	0x0 to 0xFF	0x0	-	Real time	"607Eh" on page 987

3.9 Profile Velocity (PV) Mode

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

3.9.1 Function Block Diagram



3.9.2 Configuration Block Diagram

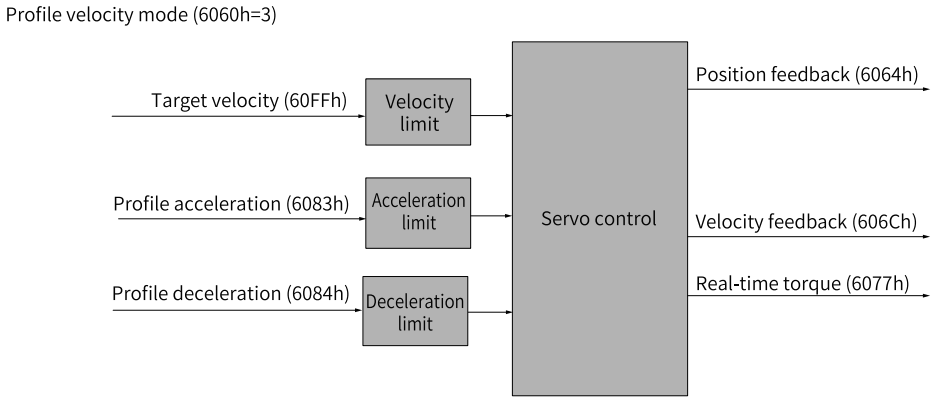


Figure 3-73 Configuration block diagram in PV mode

3.9.3 Recommended Configuration

The following table describes the basic configuration for the profile velocity (PV) mode.

RPDO	TPDO	Description
6040h: control word	6041h: status word	Mandatory
60FFh: target velocity	-	Mandatory
-	6064h: position actual value	Optional
-	606Ch: velocity actual value	Optional

RPDO	TPDO	Description
6083h: profile acceleration	-	Optional
6084h: profile deceleration	-	Optional
6060h: modes of operation	6061h: modes of operation display	Optional

3.9.4 Related Parameters

6040h **Control word**

Comm. address:	6040h	Effective mode:	Real time
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Real time
Access:	RW	Mapping:	RPDO

Range:

0x0 to 0xFFFF

Description:

Used to set the control command.

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

6041h **Status word**

Comm. address:	6041h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only
Access:	RO	Mapping:	TPDO

Range:

0x0 to 0xFFFF

Parameter 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 effective 0: Inactive

bit	Name	Description
10	Target reach	0: The target velocity is not reached. 1: The target velocity is reached.
11	Internal limit active	0: Position feedback within the limit 1: Position feedback beyond the limit
12	Speed	0: Speed is not 0 1: Speed is 0
13	N/A	N/A
14	Manufacturer-specific	Undefined
15	N/A	N/A

☆Related parameters:

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
606Ch	606Ch	Velocity actual value	-2147483648 to +2147483647	0	Reference unit/s	Read only	"606Ch" on page 983
606Dh	606Dh	Velocity window	0 to 65535	10	[mm/s]/[rpm]	Real time	"606Dh" on page 983
606Eh	606Eh	Velocity window time	0 to 65535	0	ms	Real time	"606Eh" on page 984
606Fh	606Fh	Zero speed signal threshold	0 to 65535	10	[mm/s]/[rpm]	Real time	"606Fh" on page 984
6070h	6070h	Velocity threshold time	0 to 65535	0	ms	Real time	"6070h" on page 985
607Eh	607Eh	Polarity	0x0 to 0xFF	0x0	-	Real time	"607Eh" on page 987
607Fh	607Fh	Max. speed	0 to 4294967295	4294967295	Reference unit/s	Real time	"607Fh" on page 988
6083h	6083h	Profile acceleration	0 to 4294967295	4294967295	Reference unit/s^2	Real time	"6083h" on page 988
6084h	6084h	Profile deceleration	0 to 4294967295	4294967295	Reference unit/s^2	Real time	"6084h" on page 989
60FFh	60FFh	Speed reference in PV/CSV mode	-2147483648 to +2147483647	0	Reference unit/s	Real time	"60FFh" on page 1000

3.9.5 Related Function Settings

Monitoring on speed reach status

This function serves to check whether the speed reference of the servo drive is consistent with the motor speed feedback.

☆Related parameters:

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
606Dh	606Dh	Velocity window	0 to 65535	10	[mm/s]/ [rpm]	Real time	"606Dh" on page 983
606Eh	606Eh	Velocity window time	0 to 65535	0	ms	Real time	"606Eh" on page 984

Monitoring on zero speed

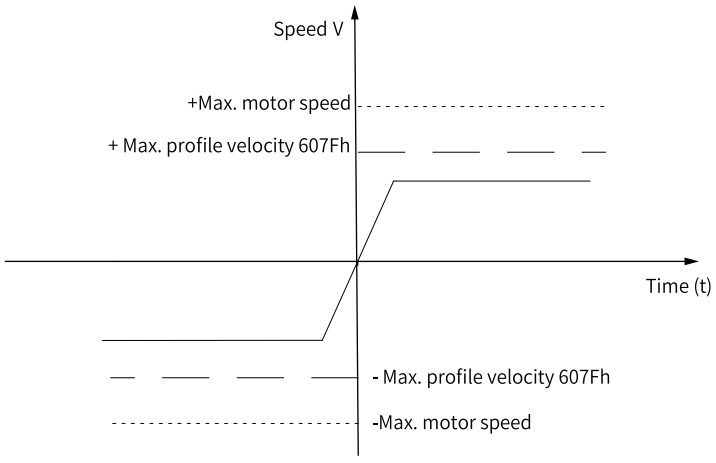
It is used to check whether the absolute value of motor speed feedback is lower than the set threshold. If yes, the motor is considered to be close to standstill (zero speed). Bit12 of 6041h is set to 1.

☆Related parameters:

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
606Fh	606Fh	Zero speed signal threshold	0 to 65535	10	[mm/s]/ [rpm]	Real time	"606Fh" on page 984
6070h	6070h	Velocity threshold time	0 to 65535	0	ms	Real time	"6070h" on page 985

Speed limit

In PV mode, 607Fh can be used to limit the maximum speed in forward/reverse running, but its value cannot exceed the max. allowable speed of the motor.



☆Related parameters:

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
607Fh	607Fh	Max. speed	0 to 4294967295	4294967295	Reference unit/s	Real time	"607Fh" on page 988

Acceleration and deceleration limits

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

☆Related parameters:

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
60C5h	60C5h	Maximum acceleration	0 to 4294967295	4294967295	Reference unit/s^2	Real time	"60C5h" on page 996
60C6h	60C6h	Maximum deceleration	0 to 4294967295	4294967295	Reference unit/s^2	Real time	"60C6h" on page 996

Polarity

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

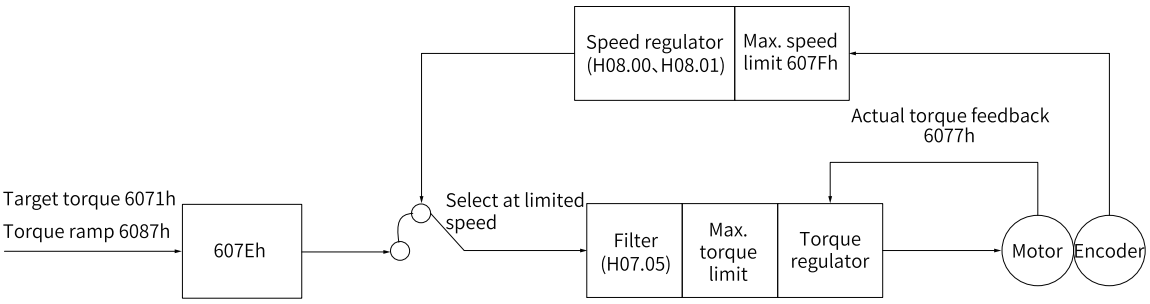
☆Related parameters:

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
607Eh	607Eh	Polarity	0x0 to 0xFF	0x0	-	Real time	"607Eh" on page 987

3.10 Profile Torque (PT) Mode

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

3.10.1 Function Block Diagram



3.10.2 Configuration Block Diagram

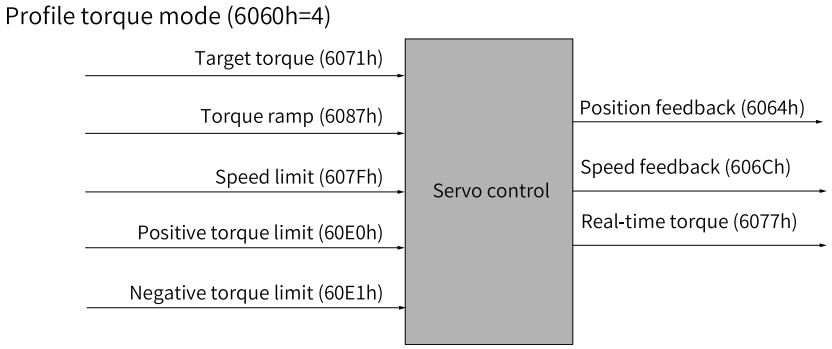


Figure 3-74 Configuration block diagram in PT mode

3.10.3 Recommended Configuration

The following table describes the basic configuration for the profile torque (PT) mode.

RPDO	TPDO	Description
6040h: control word	6041h: status word	Mandatory
6071h: target torque	-	Mandatory
6087h: torque slope	-	Optional
-	6064h: position actual value	Optional
-	606Ch: velocity actual value	Optional
-	6077h: torque actual value	Optional
6060h: modes of operation	6061h: modes of operation display	Optional

3.10.4 Related Parameters

6040h **Control word**

Comm. address:	6040h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Real time
Access permission:	Read/write (RW)	Mapping:	RPDO

Range:

0x0 to 0xFFFF

Parameter Description

For details, see the "Control Mode" section.

bit	Name		Description
0	Switch on	Switch on	1: Valid; 0: Invalid
1	Enable voltage	Enable voltage	1: Valid; 0: Invalid
2	Quick stop	Quick stop	0: Valid; 1: Invalid
3	Enable operation	Enable operation	1: Valid; 0: Invalid
8	Halt	Halt	0: Keep present operating state; 1: Halt

6041h **Status word**

Comm. address:	6041h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only
Access permission:	Read-only	Mapping:	TPDO

Range:

0x0 to 0xFFFF

Parameter Description

For details, see the "Control Mode" section.

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

☆ Related parameters:

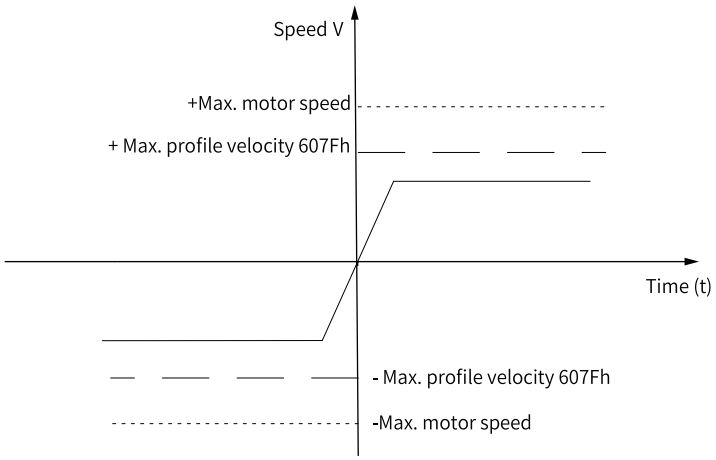
Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H07.17	2007-12h	Speed limit source	0: Internal speed limit 1: V-LMT speed limit 2: H07.19 or H07.20 used as speed limit as defined by DI	0	-	Real time	"H07_en.17" on page 640
6060h	6060h	Servo drive mode selection	1: Profile position (PP) mode 3: Profile speed (PV) mode 4: Profile torque (PT) mode 6: Homing mode (HM) 8: Cyclic synchronous position (CSP) mode 9: Cyclic synchronous velocity (CSV) mode 10: Cyclic synchronous torque (CST) mode	0	-	Real time	"6060h" on page 980
6061h	6061h	Operation mode display	1: Profile position (PP) mode 3: Profile speed (PV) mode 4: Profile torque (PT) mode 6: Homing mode (HM) 8: Cyclic synchronous position (CSP) mode 9: Cyclic synchronous velocity (CSV) mode 10: Cyclic synchronous torque (CST) mode	0	-	Read-only	"6061h" on page 981
6071h	6071h	Target torque	Range: -4000 to 4000 Actual value range: -400.0% to 400.0% Note: Actual value = Reference value × Unit	0	0.10%	Real time	"6071h" on page 985
6072h	6072h	Maximum torque reference	Range: 0 to 4000 Actual value range: 0.0% to 400.0% Note: Actual value = Reference value × Unit	3500	0.10%	Real time	"6072h" on page 985
6074h	6074h	Torque reference	Range: -4000 to 4000 Actual value range: -400.0% to 400.0% Note: Actual value = Reference value × Unit	0	0.10%	Read-only	"6074h" on page 985
6077h	6077h	Torque actual value	Range: -4000 to 4000 Actual value range: -400.0% to 400.0% Note: Actual value = Reference value × Unit	0	0.10%	Read-only	"6077h" on page 986
607Eh	607Eh	Polarity	0x0 to 0xFF	0x0	-	Real time	"607Eh" on page 987

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
607Fh	607Fh	Maximum speed	0 to 4294967295	4294967295	Reference unit: /s	Real time	"607Fh" on page 988
6087h	6087h	Torque slope	Range: 0 to 4294967295 Actual value range: 0.0%/s to 429496729.5%/s Note: Actual value = Reference value × Unit	4294967295	0.1%/s	Real time	"6087h" on page 989
60E0h	60E0h	Positive torque limit	Range: 0 to 4000 Actual value range: 0.0% to 400.0% Note: Actual value = Reference value × Unit	3000	0.10%	Real time	"60E0h" on page 998
60E1h	60E1h	Negative torque limit	Range: 0 to 4000 Actual value range: 0.0% to 400.0% Note: Actual value = Reference value × Unit	3000	0.10%	Real time	"60E1h" on page 998

3.10.5 Related Function Settings

Speed limit in torque control mode

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

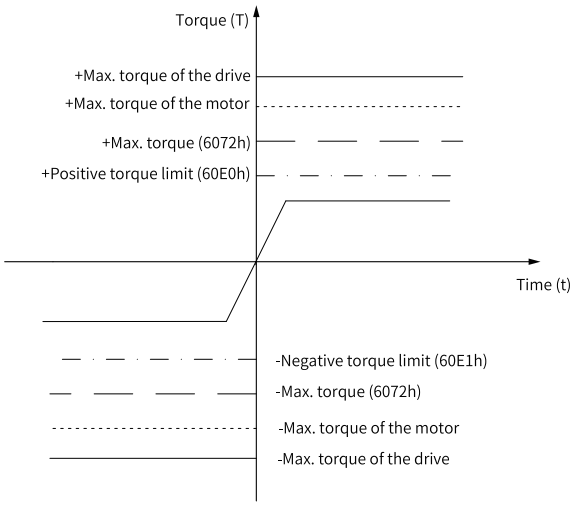


☆ Related parameters:

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
607Fh	607Fh	Maximum speed	0 to 4294967295	4294967295	Reference unit: /s	Real time	"607Fh" on page 988

Torque limit

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



☆ Related parameters:

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
6072h	6072h	Maximum torque reference	Range: 0 to 4000 Actual value range: 0.0% to 400.0% Note: Actual value = Reference value × Unit	3500	0.10%	Real time	"6072h" on page 985
60E0h	60E0h	Positive torque limit	Range: 0 to 4000 Actual value range: 0.0% to 400.0% Note: Actual value = Reference value × Unit	3000	0.10%	Real time	"60E0h" on page 998
60E1h	60E1h	Negative torque limit	Range: 0 to 4000 Actual value range: 0.0% to 400.0% Note: Actual value = Reference value × Unit	3000	0.10%	Real time	"60E1h" on page 998

Torque reference polarity

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

☆ Related parameters:

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
607Eh	607Eh	Polarity	0x0 to 0xFF	0x0	-	Real time	"607Eh" on page 987

3.11 Homing Mode (HM)

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

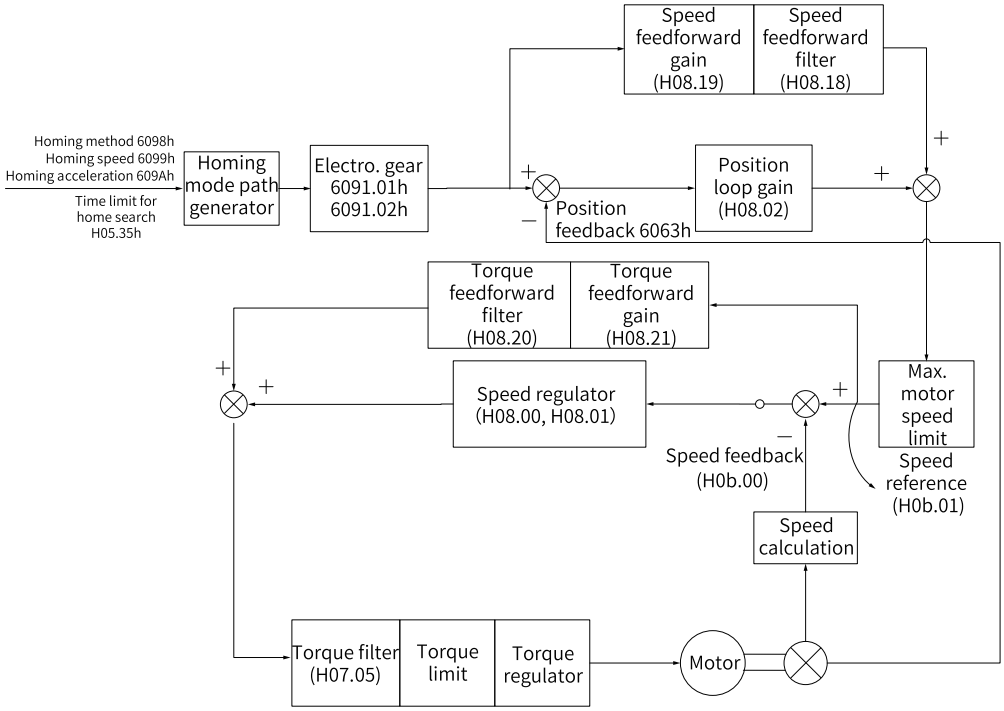
- Mechanical home: a fixed position on the machine, which corresponds to a certain home switch or the motor Z signal.
- Mechanical zero: absolute zero point on the machine

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

Mechanical home = Mechanical zero + 607C (home offset)

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

3.11.1 Function Block Diagram



3.11.2 Configuration Block Diagram

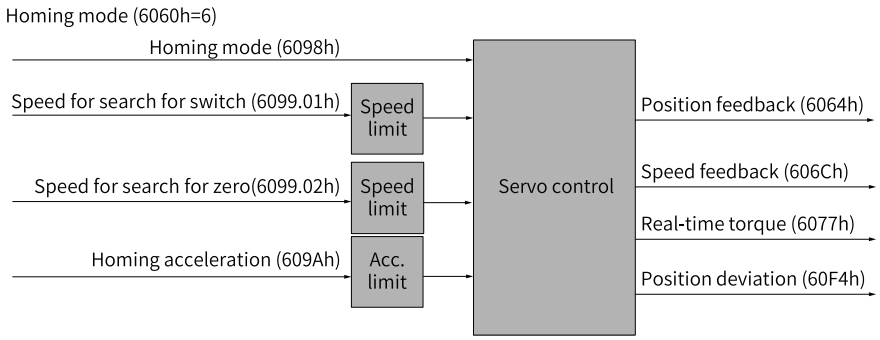


Figure 3-75 HM mode

3.11.3 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

3.11.4 Related Parameters

6040h **Control word**

Comm. address:	6040h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Real time
Access permission:	Read/write (RW)	Mapping:	RPDO

Range:

0x0 to 0xFFFF

Parameter Description

For details, see the "Control Mode" section.

bit	Name		Description
0	Switch on	Switch on	1: Valid; 0: Invalid
1	Enable voltage	Enable voltage	1: Valid; 0: Invalid
2	Quick stop	Quick stop	0: Valid; 1: Invalid
3	Enable operation	Enable operation	1: Valid; 0: Invalid

bit	Name		Description
4	Enable homing	Enable homing	0→1: Start, 1→0: Stop
8	Halt	Halt	0: Keep present operating state; 1: Halt

6041h **Status word**

Comm. address:	6041h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only
Access permission:	Read-only	Mapping:	TPDO

Range:

0x0 to 0xFFFF

Parameter Description

For details, see the "Control Mode" section.

bit	Name		Description
0	Ready to switch on	Ready to switch on	1: Valid; 0: Invalid
1	Switch on	Switch on	1: Valid; 0: Invalid
2	Enable operation	Enable operation	1: Valid; 0: Invalid
3	Fault	Fault	1: Valid; 0: Invalid
4	Voltage enabled	Voltage enabled	1: Valid; 0: Invalid
5	Quick stop	Quick stop	0: Valid; 1: Invalid
6	Switch on disabled	Switch on disabled	1: Valid; 0: Invalid
7	Warning	Warning	1: Valid; 0: Invalid
8	Manufacturer-specific	Manufacturer-specific	Undefined
9	Remote	Remote	1: Active, control word effective 0: Inactive
10	Target reach	Target reach	1: Home is found or homing is interrupted or failed 0: Disabled or home is not found[1]
11	Internal limit active	Internal limit active	0: Position reference within the limit 1: Position reference beyond the limit
12	Homing attained	Homing attained	0: Homing not attained 1: Homing attained
13	Homing error	Homing error	0: No error 1: Homing error occurred
15	Homing completed	Home find	0: Homing completed 1: Homing completed

Note

[1]: Set bit10 to 1 for N-type models.

☆ Related parameters:

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
6060h	6060h	Servo drive mode selection	1: Profile position (PP) mode 3: Profile speed (PV) mode 4: Profile torque (PT) mode 6: Homing mode (HM) 8: Cyclic synchronous position (CSP) mode 9: Cyclic synchronous velocity (CSV) mode 10: Cyclic synchronous torque (CST) mode	0	-	Real time	"6060h" on page 980
6061h	6061h	Operation mode display	1: Profile position (PP) mode 3: Profile speed (PV) mode 4: Profile torque (PT) mode 6: Homing mode (HM) 8: Cyclic synchronous position (CSP) mode 9: Cyclic synchronous velocity (CSV) mode 10: Cyclic synchronous torque (CST) mode	0	-	Read-only	"6061h" on page 981
6065h	6065h	Threshold of excessive position deviation	0 to 4294967295	219895614	Reference unit	Real time	"6065h" on page 982
6066h	6066h	Time lapse to trigger excessive position deviation	0 to 65535	0	ms	Real time	"6066h" on page 982
607Ch	607Ch	Home offset	-2147483648 to 2147483647 (encoder unit)	0	Reference unit	Real time	"607Ch" on page 986
607Fh	607Fh	Maximum speed	0 to 4294967295	4294967295	Reference unit: /s	Real time	"607Fh" on page 988
6098h	6098h	Homing method	-3 to 35	1	-	Real time	"6098h" on page 990
6099.01h	6099-01h	Speed during search for deceleration point signal	0 to 4294967295	111848106	Reference unit: /s	At stop	"6099_en.01h" on page 992
6099.02h	6099-02h	Speed of homing signal	0 to 4294967295	11184810	Reference unit: /s	At stop	"6099_en.02h" on page 992
609Ah	609Ah	Homing acceleration	0 to 4294967295	4294967295	Reference unit/s²	Real time	"609Ah" on page 992
60C5h	60C5h	Maximum acceleration	0 to 4294967295	4294967295	Reference unit/s²	Real time	"60C5h" on page 996

3.11.5 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.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
H05.35	2005-24h	Home search time limit	0 to 65535	10000	-	Real time	"H05_en.35" on page 615

Actual position calculation method

After homing, the calculation method for current mechanical position can be set in 607Ch.

☆Related parameters:

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
607Ch	607Ch	Home offset	-2147483648 to +2147483647	0	Reference unit	Real time	"607Ch" on page 986

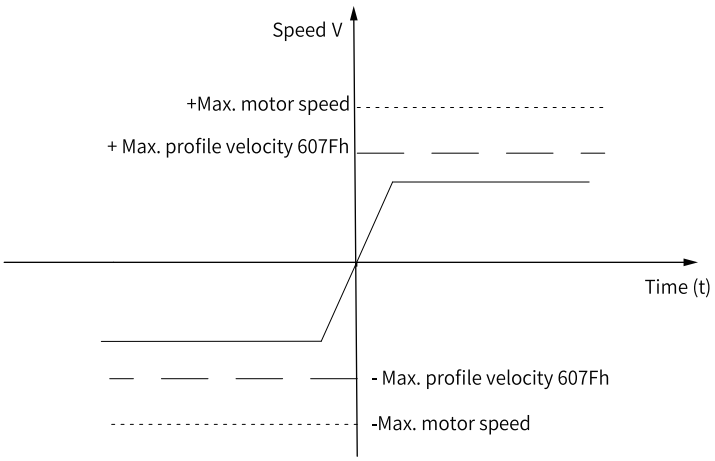
Position deviation monitoring function

☆Related parameters:

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
6065h	6065h	Following error window	0 to 4294967295	219895614	Reference unit	Real time	"6065h" on page 982
6066h	6066h	Excessive position deviation timeout	0 to 65535	0	ms	Real time	"6066h" on page 982

Speed limit

In the homing mode, 607Fh can be used to limit the maximum speed in forward/reverse running, but its value cannot exceed the maximum permissible speed of the motor.



☆Related parameters:

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
607Fh	607Fh	Max. speed	0 to 4294967295	4294967295	Reference unit/s	Real time	"607Fh" on page 988

Acceleration limit

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

☆Related parameters:

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
60C5h	60C5h	Maximum acceleration	0 to 4294967295	4294967295	Reference unit/s^2	Real time	"60C5h" on page 996

3.11.6 Homing Operation

Note

Threshold for torque homing:

- 6098h = 3: When the motor hits the hardware position limit, the torque feedback reaches the limit value (H05.58). After the motor stops, the first Z signal is searched in the reverse direction as the home.
- 6098h = -2/-1: The limit is the minimum value among H05.58 (Threshold in limit-triggered homing), 6072h (Maximum torque reference), 60E0h (Positive torque limit), and 60E1h (Negative torque limit).

Note: In the figure, "H" represents high speed 6099.01h, "L" represents low speed 6099.02h, and "-" represents reverse run.

6098h = 1

Mechanical home: motor Z signal

Deceleration point: negative limit switch

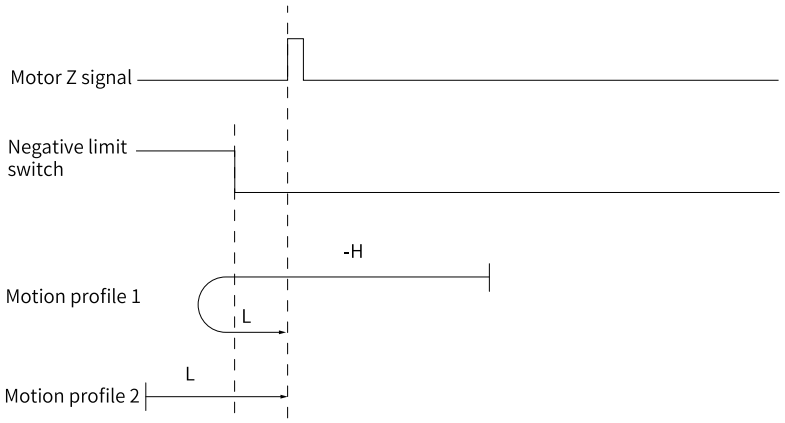


Figure 3-76 Motor running curve and speed in mode 1

- Motion profile 1: Deceleration point signal inactive at startup in homing mode.
- Motion profile 2: Deceleration point signal active at startup in homing mode.

6098h = 2

Home: Z signal

Deceleration point: positive limit switch

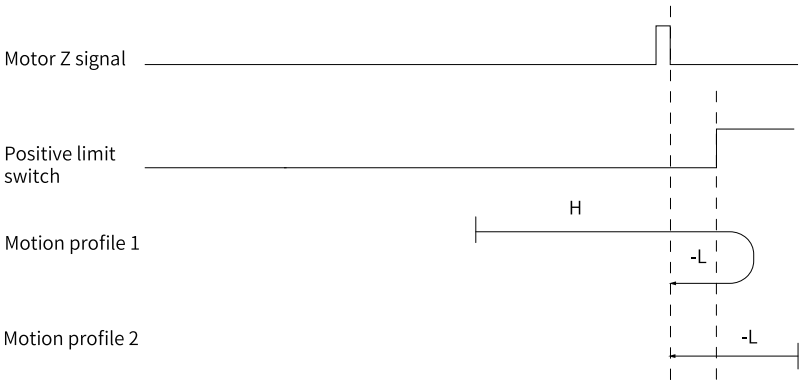


Figure 3-77 Motor running curve and speed in mode 2

- Motion profile 1: Deceleration point signal inactive at startup in homing mode.
- Motion profile 2: Deceleration point signal active at startup in homing mode.

6098h = 3

Home: Z signal

Deceleration point: home switch (HW)

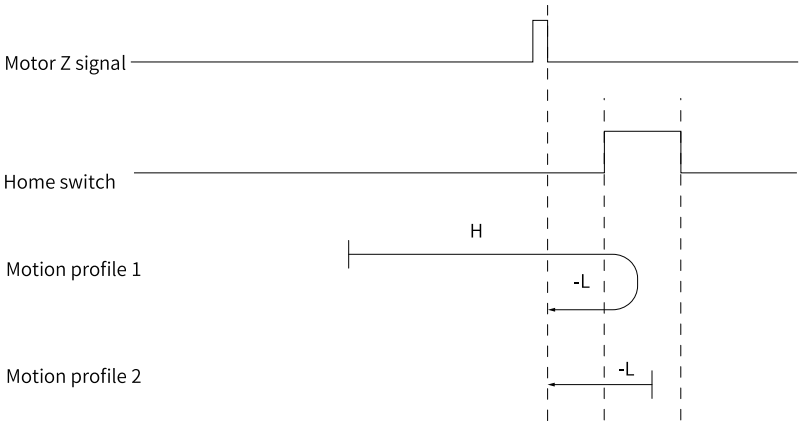


Figure 3-78 Motor running curve and speed in mode 3

- Motion profile 1: Deceleration point signal inactive at startup in homing mode.
- Motion profile 2: Deceleration point signal active at startup in homing mode.

6098h = 4

Home: Z signal

Deceleration point: home switch (HW)

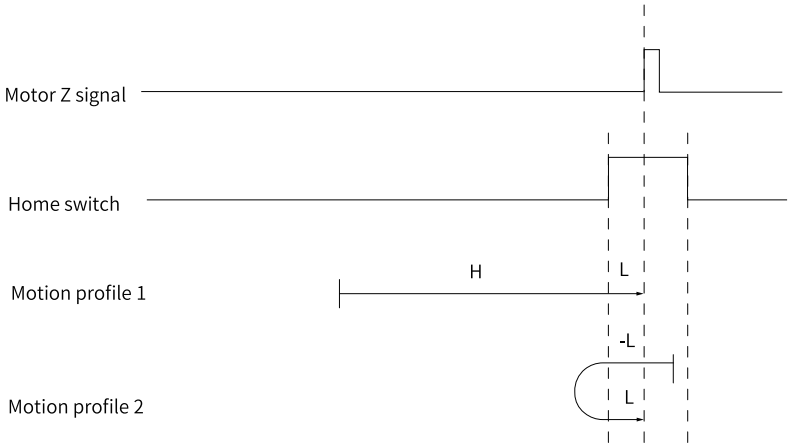


Figure 3-79 Motor running curve and speed in mode 4

- Motion profile 1: Deceleration point signal inactive at startup in homing mode.
- Motion profile 2: Deceleration point signal active at startup in homing mode.

6098h = 5

Home: Z signal

Deceleration point: home switch (HW)

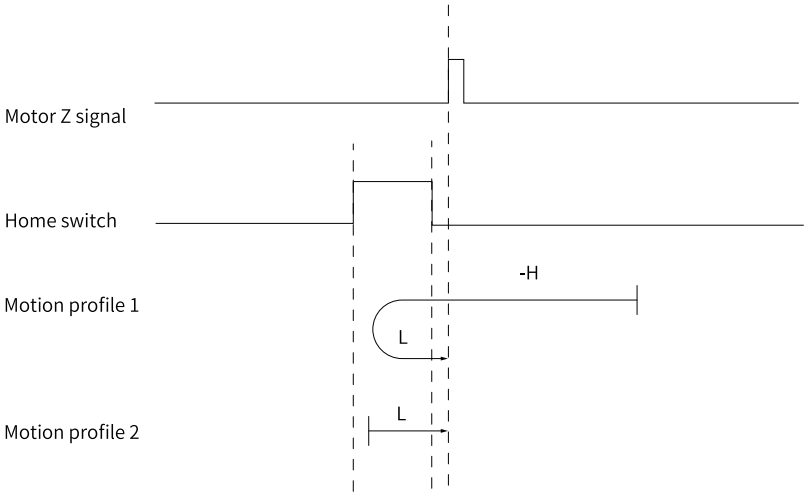


Figure 3-80 Motor running curve and speed in mode 5

- Motion profile 1: Deceleration point signal inactive at startup in homing mode.
- Motion profile 2: Deceleration point signal active at startup in homing mode.

6098h = 6

Home: Z signal

Deceleration point: home switch (HW)

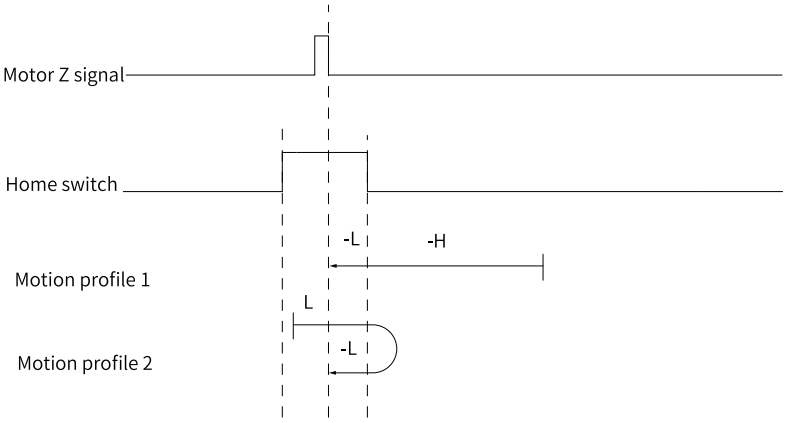


Figure 3-81 Motor running curve and speed in mode 6

- Motion profile 1: Deceleration point signal inactive at startup in homing mode.
- Motion profile 2: Deceleration point signal active at startup in homing mode.

6098h = 7

Home: Z signal

Deceleration point: home switch (HW)

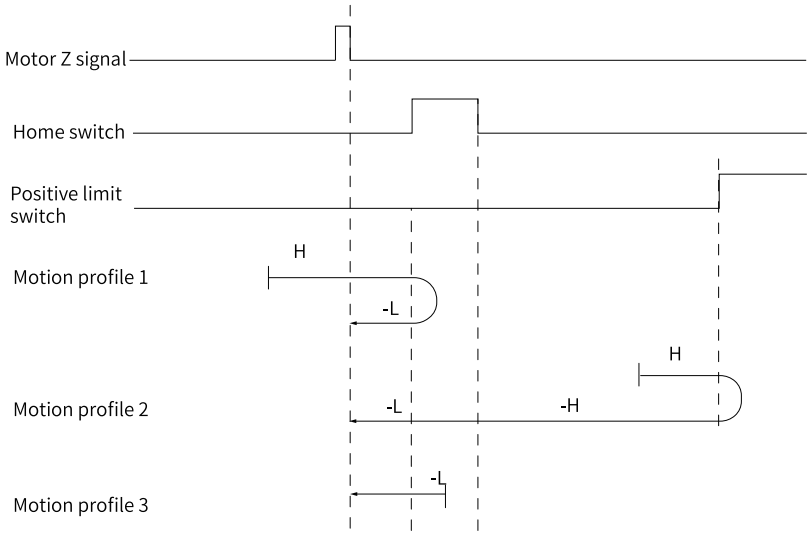


Figure 3-82 Motor running curve and speed in mode 7

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

6098h = 8

Home: Z signal

Deceleration point: home switch (HW)

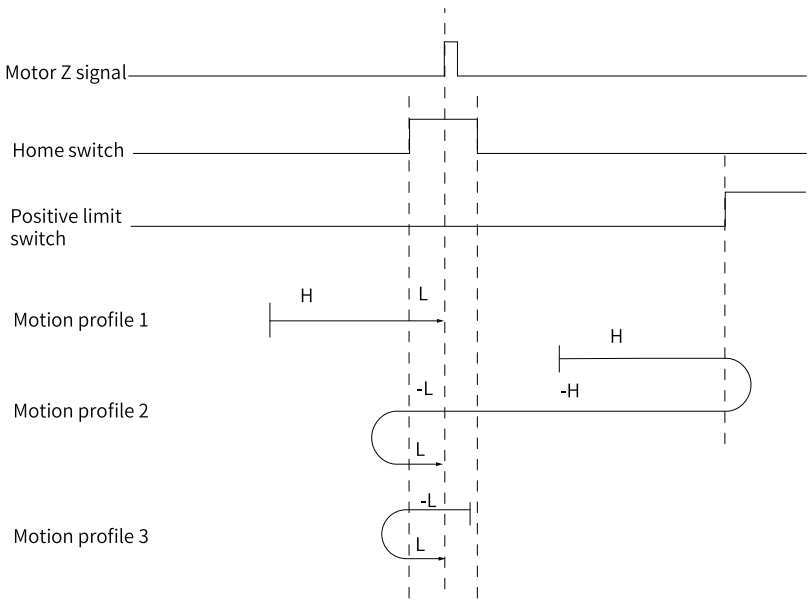


Figure 3-83 Motor running curve and speed in mode 8

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

6098h = 9

Home: Z signal

Deceleration point: home switch (HW)

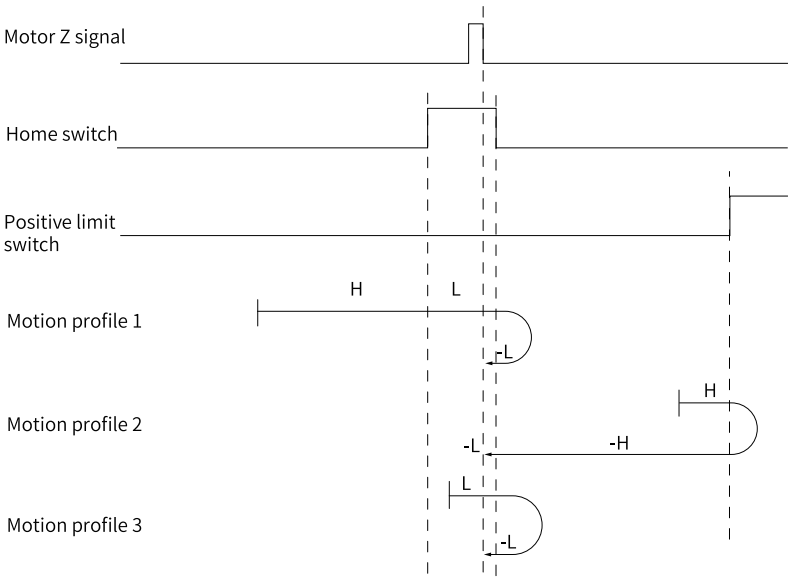


Figure 3-84 Motor running curve and speed in mode 9

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

6098h = 10

Home: Z signal

Deceleration point: home switch (HW)

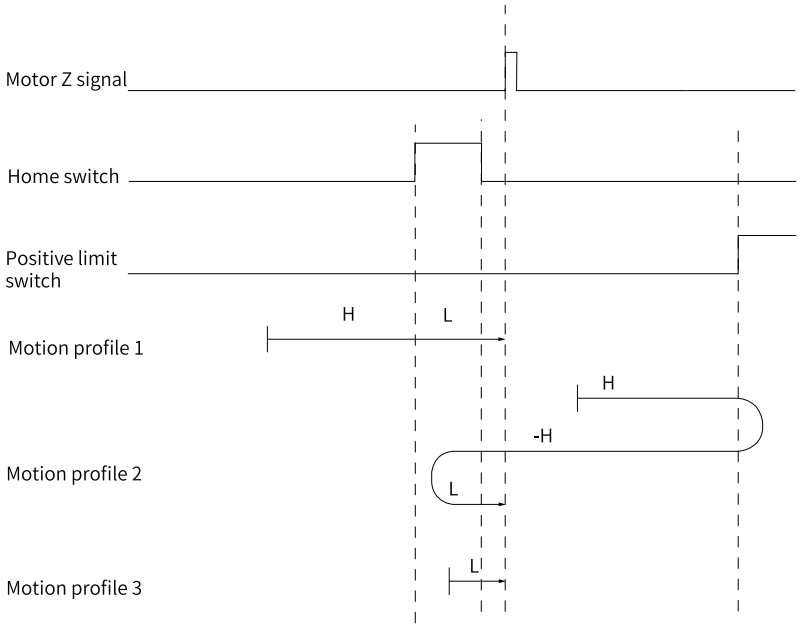


Figure 3-85 Motor running curve and speed in mode 10

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

6098h = 11

Home: Z signal

Deceleration point: home switch (HW)

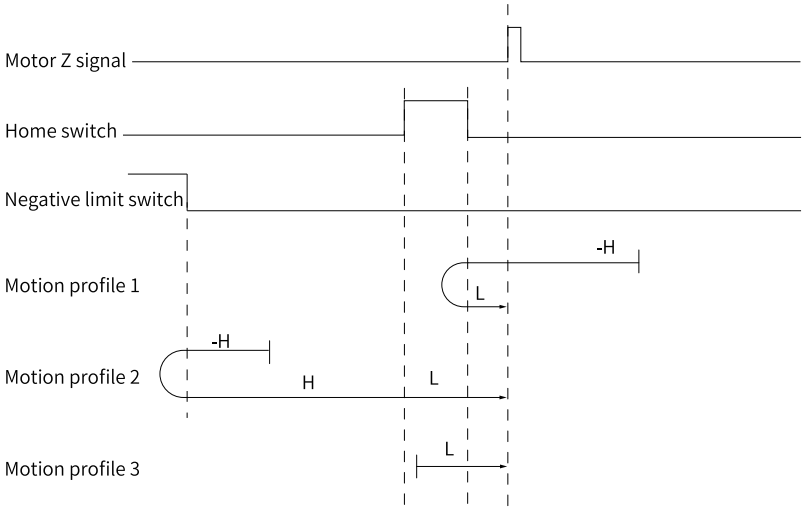


Figure 3-86 Motor running curve and speed in mode 11

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

6098h = 12

Home: Z signal

Deceleration point: home switch (HW)

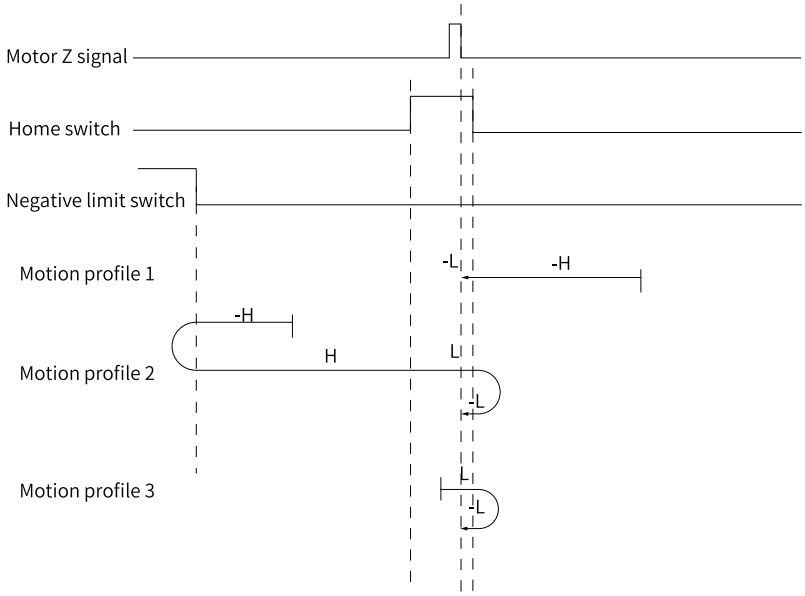


Figure 3-87 Motor running curve and speed in mode 12

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

6098h = 13

Home: Z signal

Deceleration point: home switch (HW)

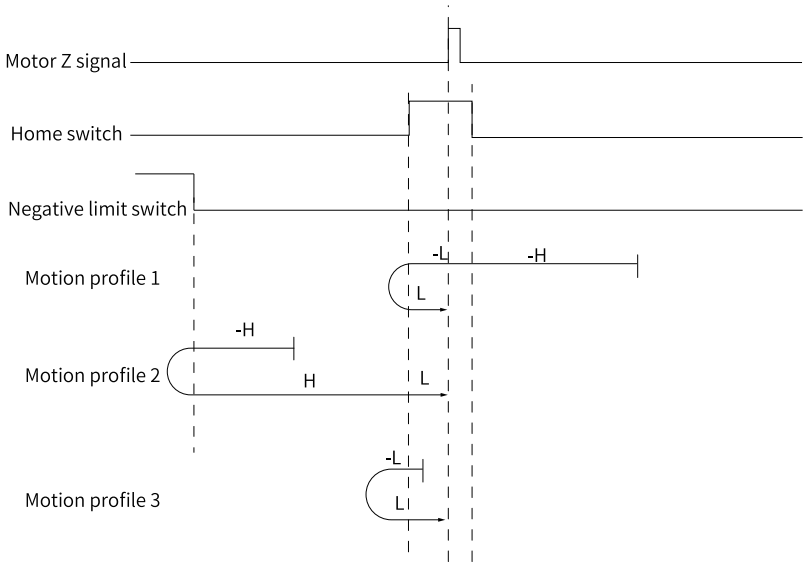


Figure 3-88 Motor running curve and speed in mode 13

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

6098h = 14

Home: Z signal

Deceleration point: home switch (HW)

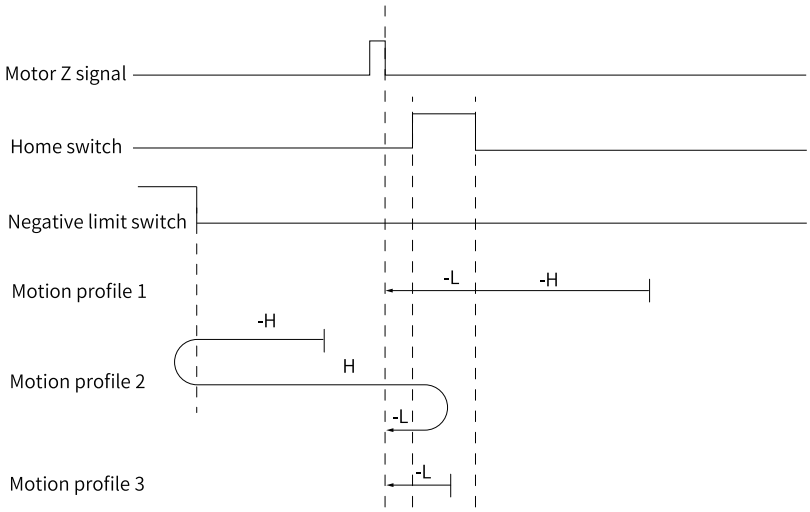


Figure 3-89 Motor running curve and speed in mode 14

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

6098h = 17

Home: negative limit switch

Deceleration point: negative limit switch

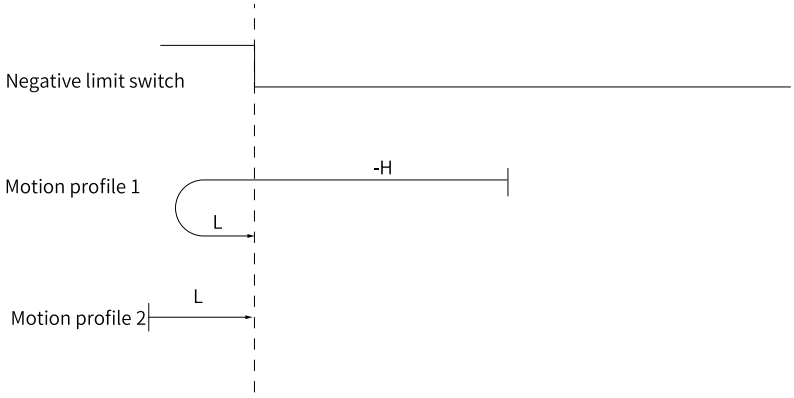


Figure 3-90 Motor running curve and speed in mode 17

- Motion profile 1: Deceleration point signal inactive at startup in homing mode.
- Motion profile 2: Deceleration point signal active at startup in homing mode.

6098h = 18

Home: positive limit switch

Deceleration point: positive limit switch

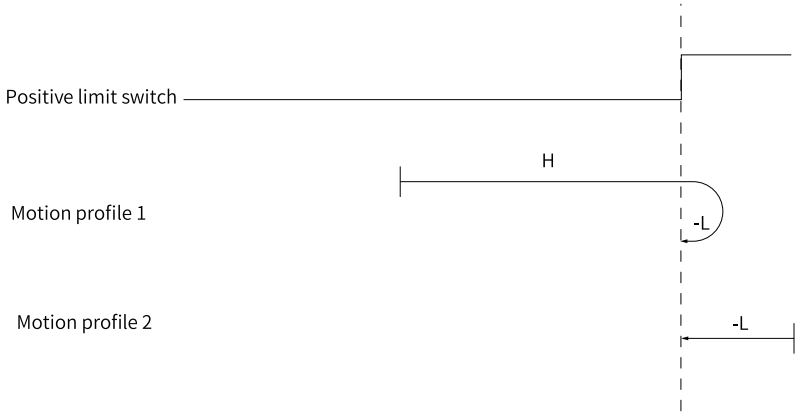


Figure 3-91 Motor running curve and speed in mode 18

- Motion profile 1: Deceleration point signal inactive at startup in homing mode.
- Motion profile 2: Deceleration point signal active at startup in homing mode.

6098h = 19

Home: home switch (HW)

Deceleration point: home switch (HW)

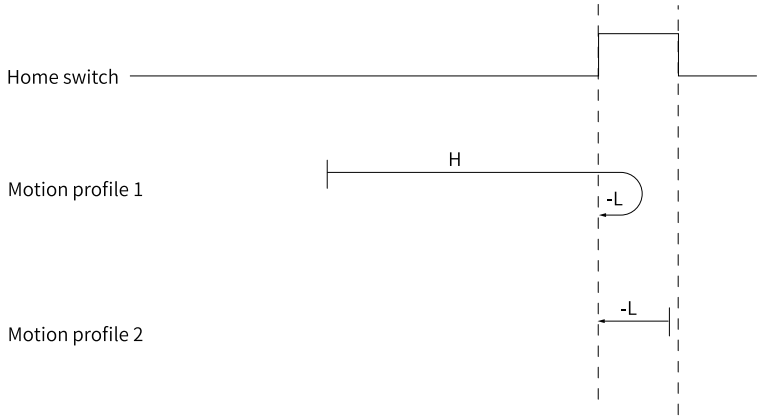


Figure 3-92 Motor running curve and speed in mode 19

- Motion profile 1: Deceleration point signal inactive at startup in homing mode.
- Motion profile 2: Deceleration point signal active at startup in homing mode.

6098h = 20

Home: home switch (HW)

Deceleration point: home switch (HW)

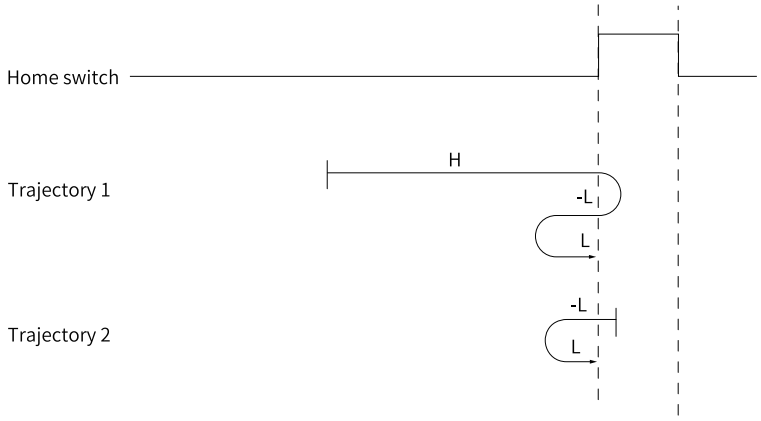


Figure 3-93 Motor running curve and speed in mode 20

- Motion profile 1: Deceleration point signal inactive at startup in homing mode.
- Motion profile 2: Deceleration point signal active at startup in homing mode.

6098h = 21

Home: home switch (HW)

Deceleration point: home switch (HW)

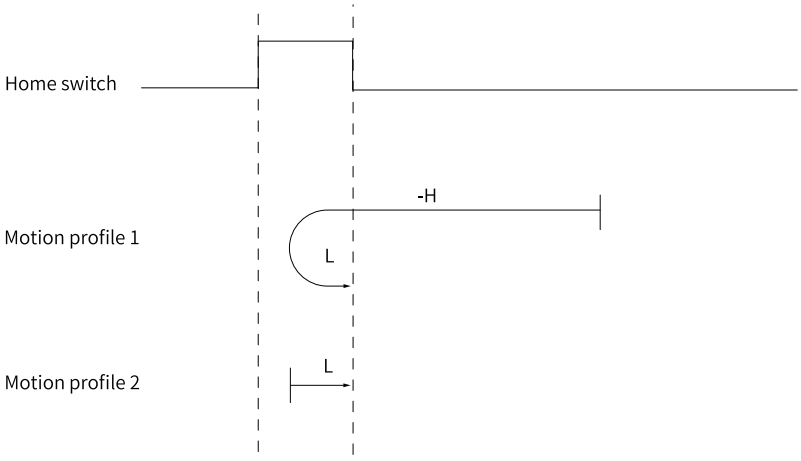


Figure 3-94 Motor running curve and speed in mode 21

- Motion profile 1: Deceleration point signal inactive at startup in homing mode.
- Motion profile 2: Deceleration point signal active at startup in homing mode.

6098h = 22

Home: home switch (HW)

Deceleration point: home switch (HW)

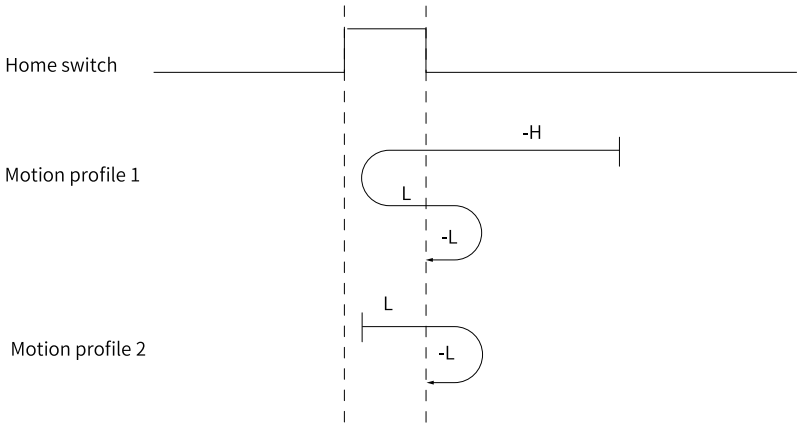


Figure 3-95 Motor running curve and speed in mode 22

- Motion profile 1: Deceleration point signal inactive at startup in homing mode.
- Motion profile 2: Deceleration point signal active at startup in homing mode.

6098h = 23

Home: home switch (HW)

Deceleration point: home switch (HW)

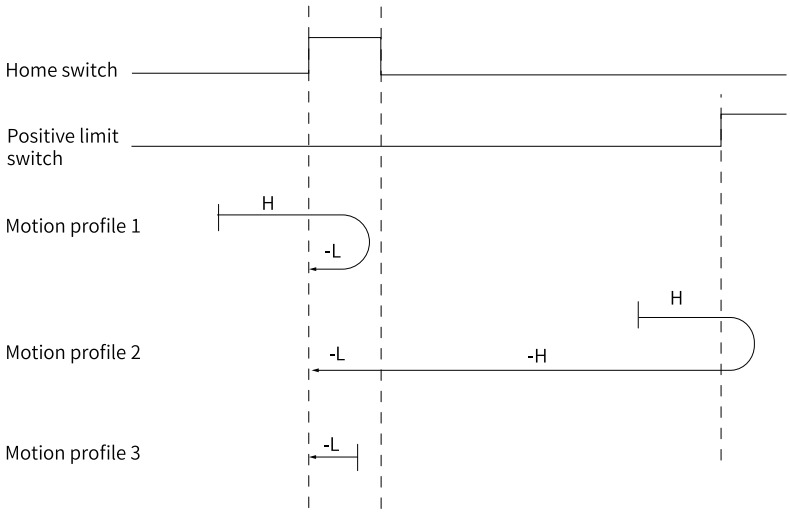


Figure 3-96 Motor running curve and speed in mode 23

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

6098h = 24

Home: home switch (HW)

Deceleration point: home switch (HW)

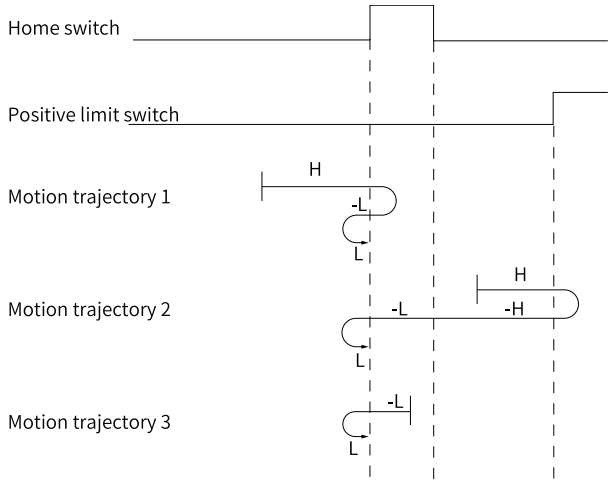


Figure 3-97 Motor running curve and speed in mode 24

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

6098h = 25

Home: home switch (HW)

Deceleration point: home switch (HW)

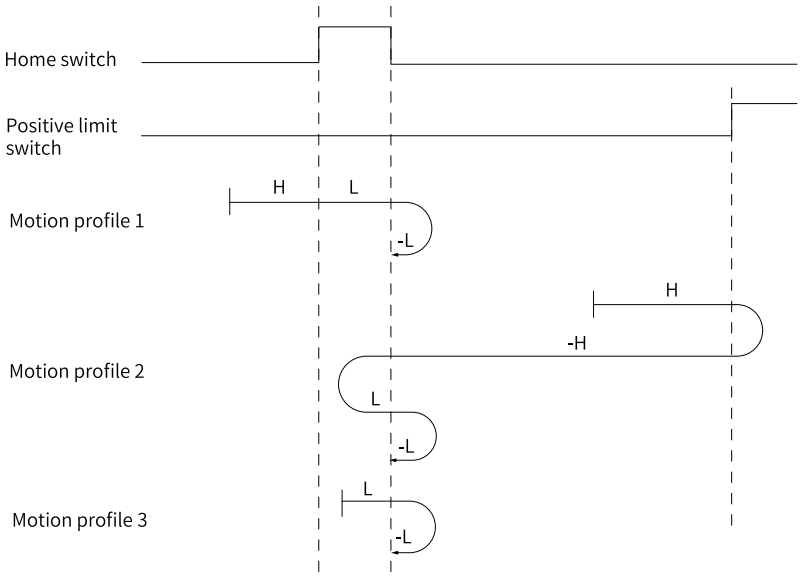


Figure 3-98 Motor running curve and speed in mode 25

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

6098h = 26

Home: home switch (HW)

Deceleration point: home switch (HW)

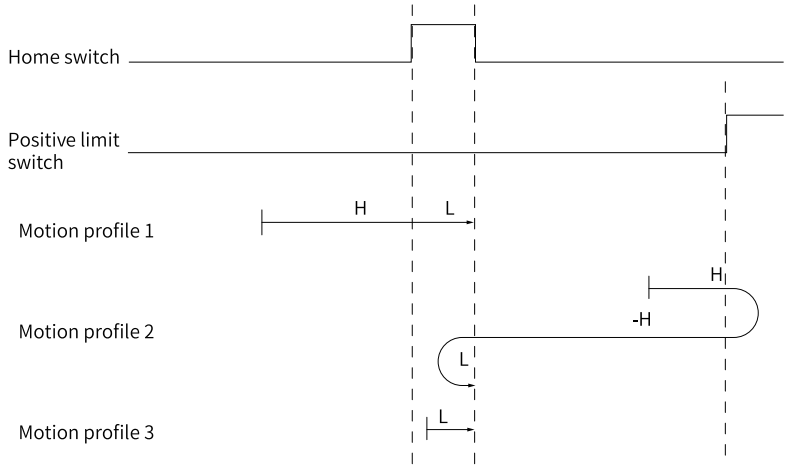


Figure 3-99 Motor running curve and speed in mode 26

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

6098h = 27

Home: home switch (HW)

Deceleration point: home switch (HW)

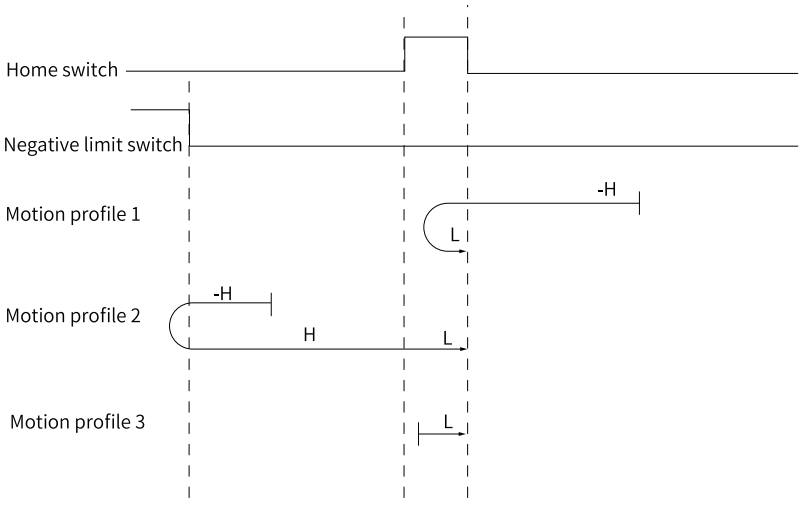


Figure 3-100 Motor running curve and speed in mode 27

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

6098h = 28

Home: home switch (HW)

Deceleration point: home switch (HW)

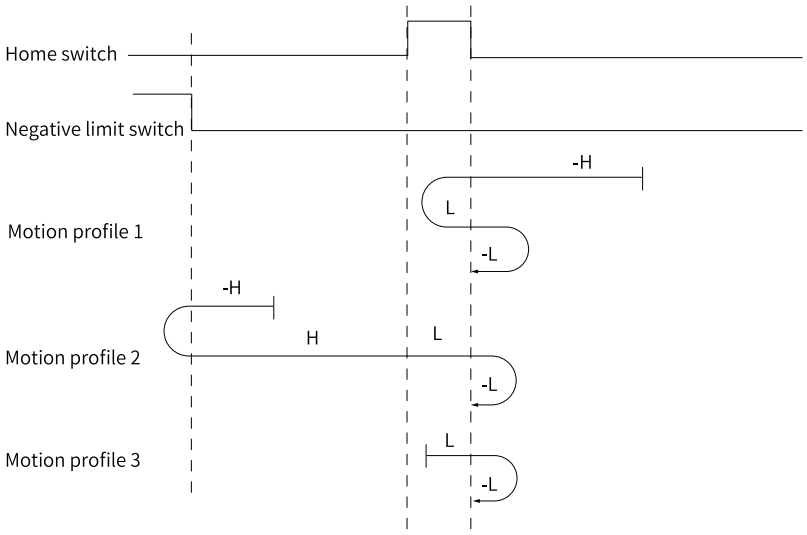


Figure 3-101 Motor running curve and speed in mode 28

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

6098h = 29

Home: home switch (HW)

Deceleration point: home switch (HW)

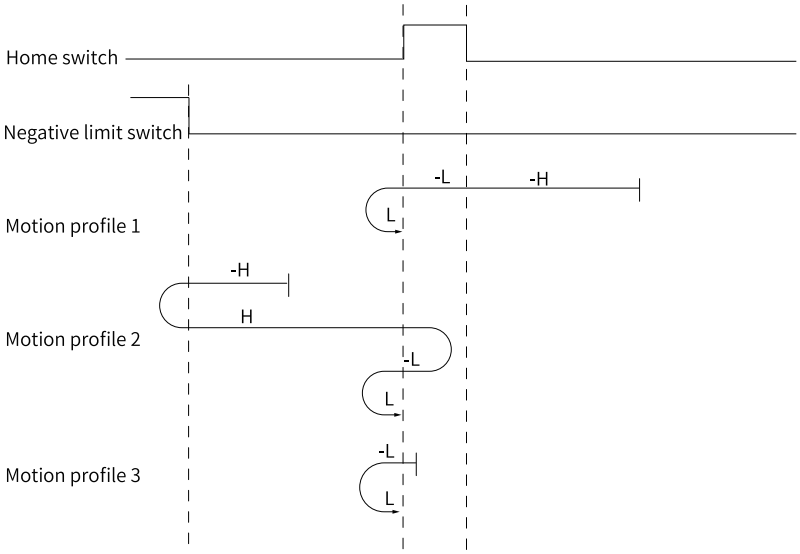


Figure 3-102 Motor running curve and speed in mode 29

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

6098h = 30

Home: home switch (HW)

Deceleration point: home switch (HW)

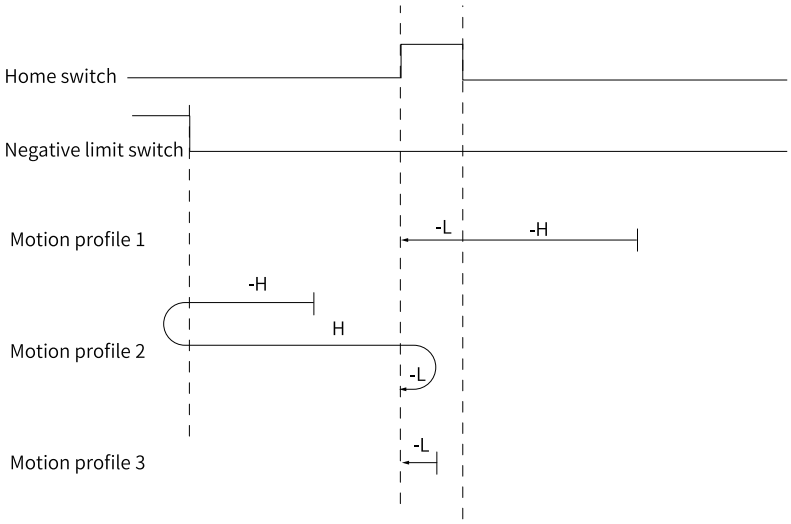


Figure 3-103 Motor running curve and speed in mode 30

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

6098h = 31 and 32

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

6098h = 33/34

Home: Z signal

Deceleration point: none

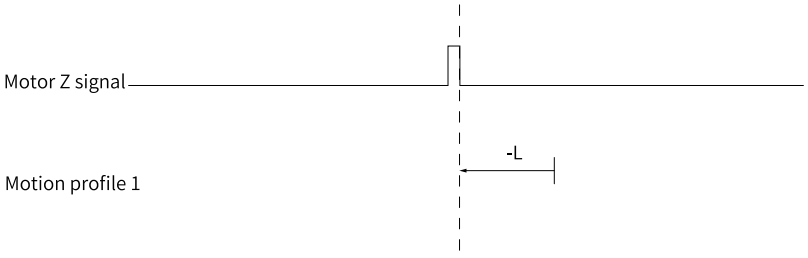


Figure 3-104 Motor running curve and speed in mode 33

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

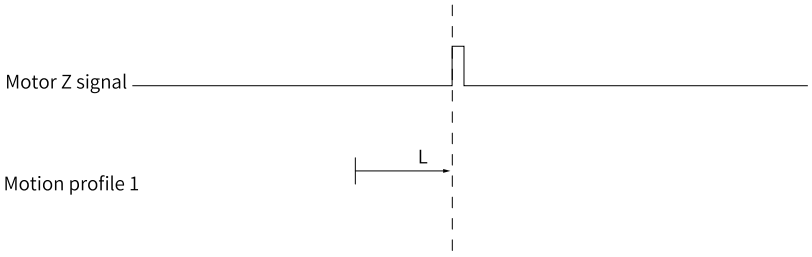


Figure 3-105 Motor running curve and speed in mode 34

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

6098h = 35

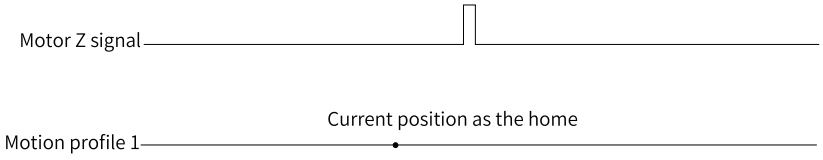


Figure 3-106 Motor running curve and speed in mode 35

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

6098h = -1

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

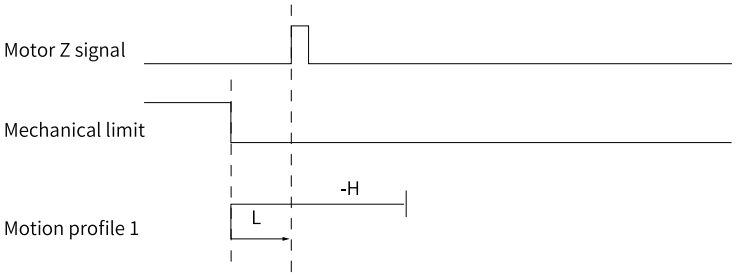


Figure 3-107 Motor running curve and speed in mode -1

6098h = -2

The servo motor runs in the forward direction at a high speed first. If the torque reaches the limit and the speed is near zero when the motor hits the mechanical limit, and such status persists, it indicates that the motor reaches the mechanical limit position. In this case, the motor runs in the reverse direction at a low speed and stops at the first Z signal after reaching the rising edge.

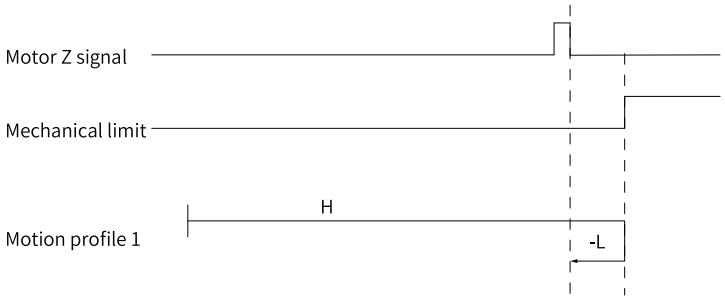


Figure 3-108 Motor running curve and speed in mode -2

6098h = -3

Home: Z signal

Deceleration point: none

- If the single-turn position is close to the reverse home, the homing profile is motion profile 1.
- If the single-turn position is close to the forward home, the homing profile is motion profile 2.

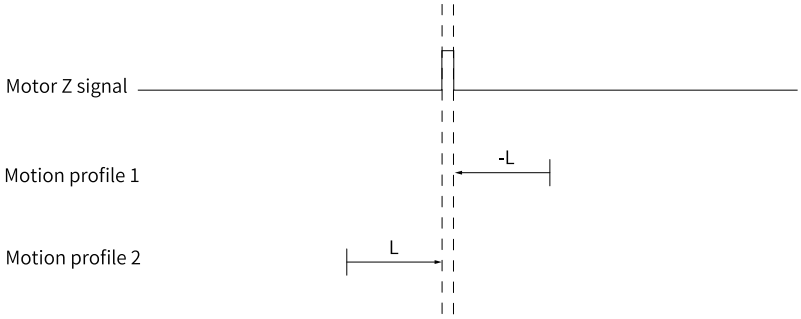


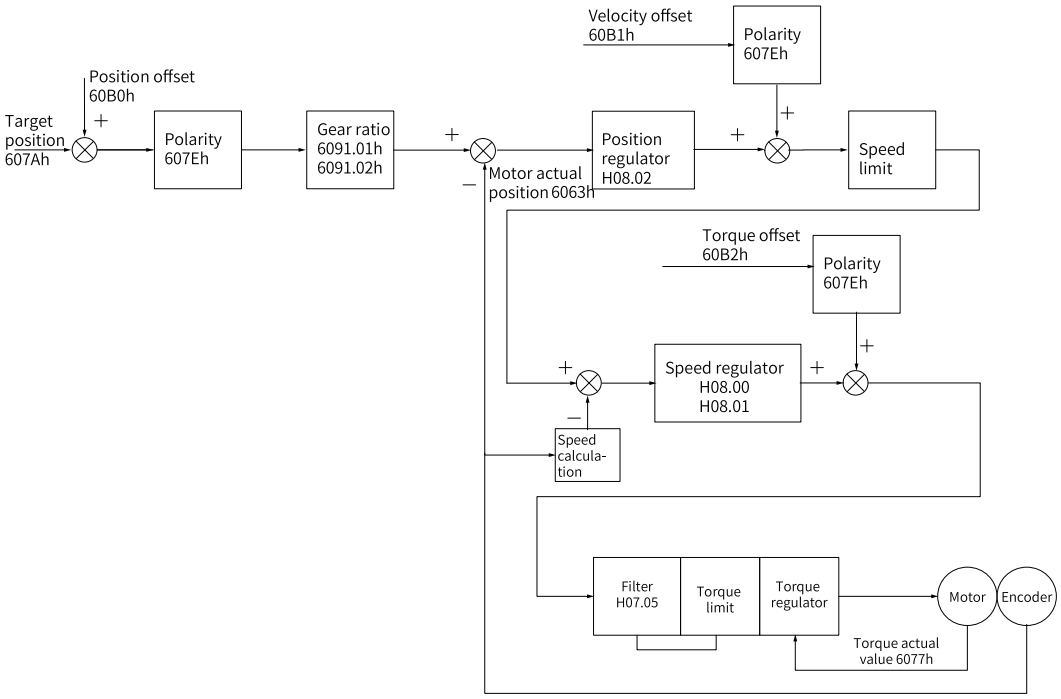
Figure 3-109 Motor running curve and speed in mode -3

- Motion profile 1: The motor runs in the reverse direction at a low speed and stops at the first Z signal.
- Motion profile 2: The motor runs in the forward direction at a low speed and stops at the first Z signal.

3.12 Cyclic Synchronous Position (CSP) Mode

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

3.12.1 Function Block Diagram



3.12.2 Configuration Block Diagram

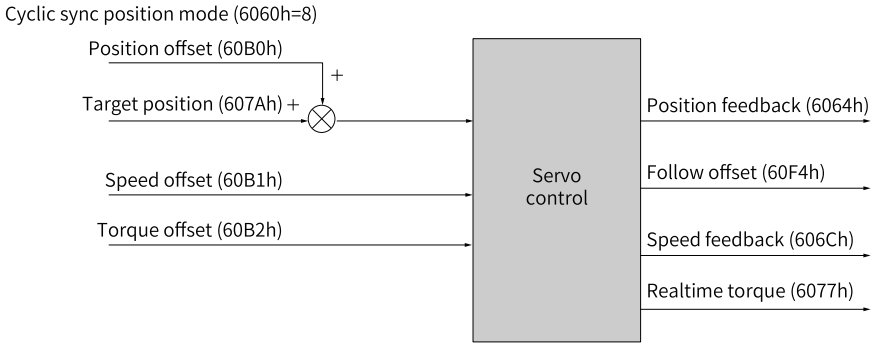


Figure 3-110 Cyclic synchronous position mode

3.12.3 Recommended Configuration

RPDO	TPDO	Remark
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

3.12.4 Related Parameters

6040h **Control word**

Comm. address: 6040h

Effective mode: Real time

Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Real time

Range:
0x0 to 0xFFFF
Parameter description
Used to set the control command.

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

The CSP mode only supports absolute position references.

6041h **Status word**

Comm. address:	6041h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFF
Parameter 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	Following error	0: Excessive position deviation not reported 1: Excessive position deviation reported
14	Manufacturer-specific	Undefined
15	Home find	0: Home not found 1: Home found

☆Related parameters:

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
6060h	6060h	Modes of operation	1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 8: Cyclic synchronous position (CSP) mode 9: Cyclic synchronous velocity (CSV) mode 10: Cyclic synchronous torque (CST) mode	0	-	Real time	"6060h" on page 980
6061h	6061h	Operation mode display	1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 8: Cyclic synchronous position (CSP) mode 9: Cyclic synchronous velocity (CSV) mode 10: Cyclic synchronous torque (CST) mode	0	-	Read only	"6061h" on page 981
6064h	6064h	Position actual value	-2147483648 to +2147483647	0	Reference unit	Read only	"6064h" on page 982
6065h	6065h	Following error window	0 to 4294967295	219895614	Reference unit	Real time	"6065h" on page 982
6066h	6066h	Excessive position deviation timeout	0 to 65535	0	ms	Real time	"6066h" on page 982
606Ch	606Ch	Velocity actual value	-2147483648 to +2147483647	0	Reference unit/s	Read only	"606Ch" on page 983
6077h	6077h	Torque actual value	Setting range: -4000 to +4000 Actual value range: -400.0% to +400.0% Note: Actual value = Reference value x Unit	0	0.10%	Read only	"6077h" on page 986
607Ah	607Ah	Target position	-2147483648 to +2147483647	0	Reference unit	Real time	"607Ah" on page 986
607Eh	607Eh	Polarity	0x0 to 0xFF	0x0	-	Real time	"607Eh" on page 987
60B0h	60B0h	Position offset	-2147483648 to +2147483647	0	Reference unit	Real time	"60B0h" on page 993
60B1h	60B1h	Velocity offset	-2147483648 to +2147483647	0	Reference unit/s	Real time	"60B1h" on page 993

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
60B2h	60B2h	Torque offset	Setting range: -4000 to +4000 Actual value range: -400.0% to +400.0% Note: Actual value = Reference value x Unit	0	0.10%	Real time	"60B2h" on page 993
60F4h	60F4h	Following error actual value	-2147483648 to +2147483647	0	Reference unit	Read only	"60F4h" on page 998

3.12.5 Related Function Settings

Position deviation monitoring function

☆Related parameters:

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode	Page
6065h	6065h	Following error window	0 to 4294967295	219895614	Reference unit	Real time	"6065h" on page 982
6066h	6066h	Excessive position deviation timeout	0 to 65535	0	ms	Real time	"6066h" on page 982

Position reference polarity

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

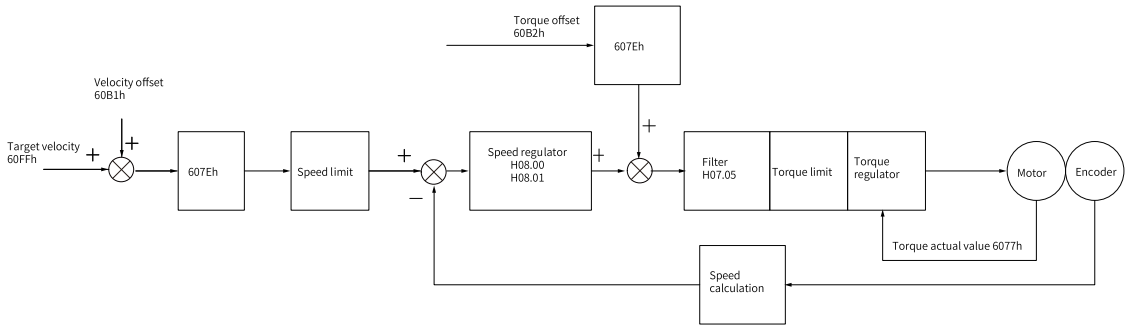
☆Related parameters:

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode	Page
607Eh	607Eh	Polarity	0x0 to 0xFF	0x0	-	Real time	"607Eh" on page 987

3.13 Cyclic Synchronous Velocity Mode (CSV)

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

3.13.1 Function Block Diagram



3.13.2 Configuration Block Diagram

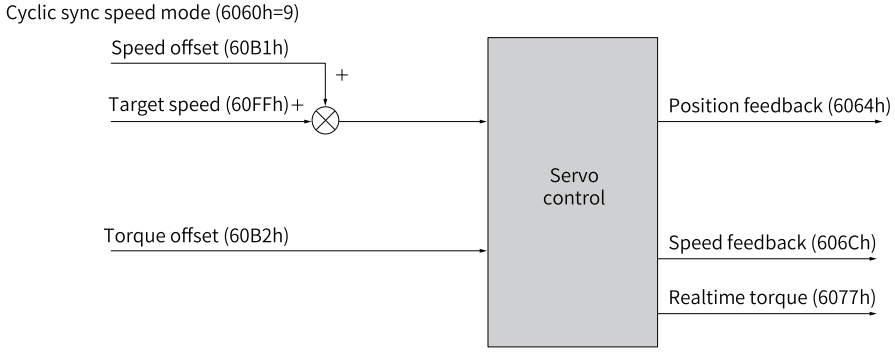


Figure 3-111 Cyclic synchronous velocity (CSV) mode

3.13.3 Recommended Configuration

Basic configurations are as follows.

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

3.13.4 Related Parameters

6040h **Control word**

Comm. address:	6040h	Effective mode:	Real time
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Real time

Range:
0x0 to 0xFFFF

Parameter description:
Used to set the control command.

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

6041h **Status word**

Comm. address:	6041h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFF
Parameter 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	Enable voltage	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	N/A	N/A

☆Related parameters:

Param.	Add.	Name	Value range	Default value	Unit	Change mode	Page
6060h	6060h	Modes of operation	1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 8: Cyclic synchronous position (CSP) mode 9: Cyclic synchronous velocity (CSV) mode 10: Cyclic synchronous torque (CST) mode	0	-	Real time	"6060h" on page 980
6061h	6061h	Operation mode display	1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 8: Cyclic synchronous position (CSP) mode 9: Cyclic synchronous velocity (CSV) mode 10: Cyclic synchronous torque (CST) mode	0	-	Read only	"6061h" on page 981
6064h	6064h	Position actual value	-2147483648 to +2147483647	0	Reference unit	Read only	"6064h" on page 982
606Ch	606Ch	Velocity actual value	-2147483648 to +2147483647	0	Reference unit/s	Read only	"606Ch" on page 983
6077h	6077h	Torque actual value	Setting range: -4000 to +4000 Actual value range: -400.0% to +400.0% Note: Actual value = Reference value x Unit	0	0.10%	Read only	"6077h" on page 986
607Eh	607Eh	Polarity	0x0 to 0xFF	0x0	-	Real time	"607Eh" on page 987
60B1h	60B1h	Velocity offset	-2147483648 to +2147483647	0	Reference unit/s	Real time	"60B1h" on page 993
60B2h	60B2h	Torque offset	Setting range: -4000 to +4000 Actual value range: -400.0% to +400.0% Note: Actual value = Reference value x Unit	0	0.10%	Real time	"60B2h" on page 993
60FFh	60FFh	Speed reference in PV/CSV mode	-2147483648 to +2147483647	0	Reference unit/s	Real time	"60FFh" on page 1000

3.13.5 Related Function Settings

Velocity reference polarity

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

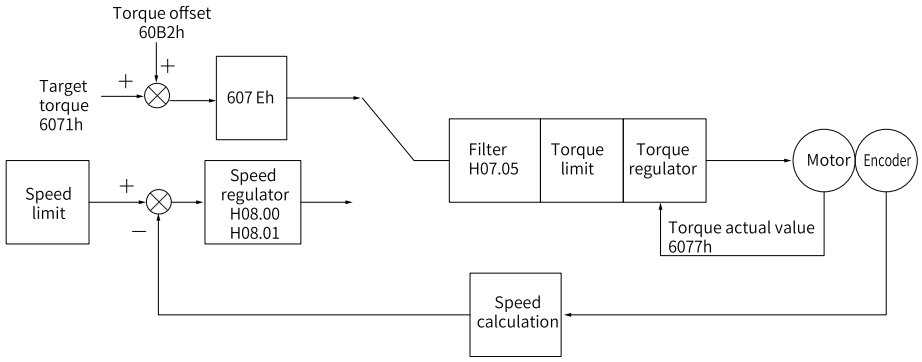
☆Related parameters:

Param.	Comm. address	Name	Value range	Default value	Unit	Change mode	Page
607Eh	607Eh	Polarity	0x0 to 0xFF	0x0	-	Real time	"607Eh" on page 987

3.14 Cyclic Synchronous Torque Mode (CST)

In CST mode, the host controller sends the target torque to the drive through cyclic synchronization. The drive executes torque control.

3.14.1 Function Block Diagram



3.14.2 Configuration Block Diagram

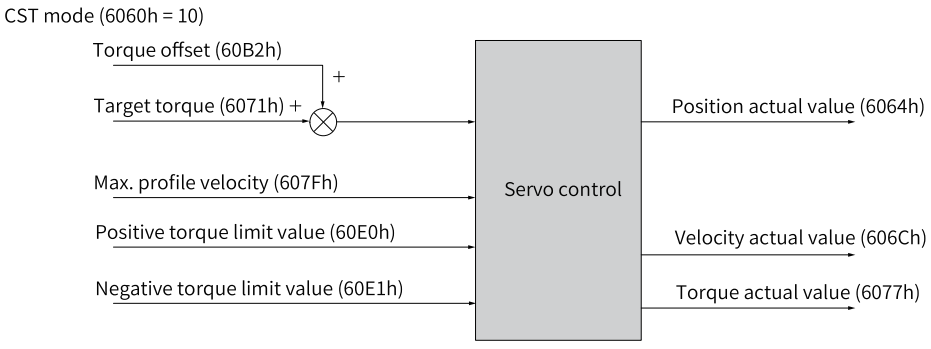


Figure 3-112 Cyclic synchronous torque (CST) mode

3.14.3 Recommended Configuration

Basic configurations are as follows.

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

3.14.4 Related Parameters

6040h **Control word**

Comm. address:	6040h	Effective mode:	Real time
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Real time

Range:

0x0 to 0xFFFF

Parameter description:

Used to set the control command.

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

6041h **Status word**

Comm. address:	6041h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFF

Parameter 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

bit	Name	Description
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	N/A	N/A

☆Related parameters:

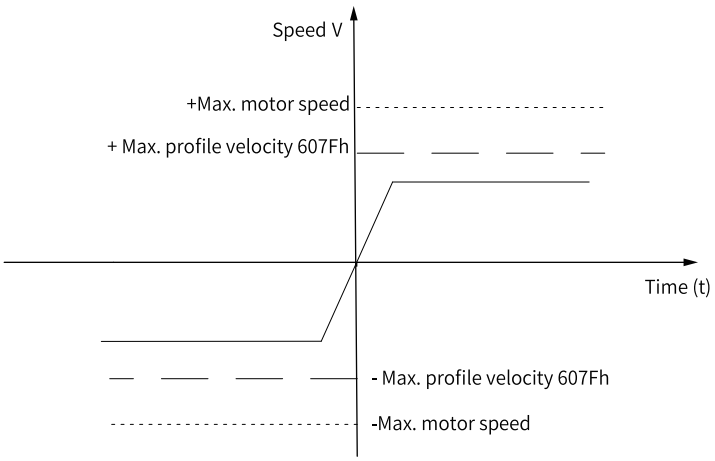
Param.	Add.	Name	Value range	Default value	Unit	Change mode	Page
6060h	6060h	Modes of operation	1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 8: Cyclic synchronous position (CSP) mode 9: Cyclic synchronous velocity (CSV) mode 10: Cyclic synchronous torque (CST) mode	0	-	Real time	"6060h" on page 980
6061h	6061h	Operation mode display	1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 8: Cyclic synchronous position (CSP) mode 9: Cyclic synchronous velocity (CSV) mode 10: Cyclic synchronous torque (CST) mode	0	-	Read only	"6061h" on page 981
6071h	6071h	Target torque	Setting range: -4000 to +4000 Actual value range: -400.0% to +400.0% Note: Actual value = Reference value x Unit	0	0.10%	Real time	"6071h" on page 985
6072h	6072h	Maximum torque reference	Setting range: 0 to 4000 Actual value range: 0.0% to 400.0% Note: Actual value = Reference value x Unit	3500	0.10%	Real time	"6072h" on page 985

Param.	Add.	Name	Value range	Default value	Unit	Change mode	Page
6074h	6074h	Torque reference	Setting range: -4000 to +4000 Actual value range: -400.0% to +400.0% Note: Actual value = Reference value x Unit	0	0.10%	Read only	"6074h" on page 985
6077h	6077h	Torque actual value	Setting range: -4000 to +4000 Actual value range: -400.0% to +400.0% Note: Actual value = Reference value x Unit	0	0.10%	Read only	"6077h" on page 986
607Eh	607Eh	Polarity	0x0 to 0xFF	0x0	-	Real time	"607Eh" on page 987
607Fh	607Fh	Maximum speed	0 to 4294967295	4294967295	Reference unit/s	Real time	"607Fh" on page 988
60B2h	60B2h	Torque offset	Setting range: -4000 to +4000 Actual value range: -400.0% to +400.0% Note: Actual value = Reference value x Unit	0	0.10%	Real time	"60B2h" on page 993
60E0h	60E0h	Positive torque limit	Setting range: 0 to 4000 Actual value range: 0.0% to 400.0% Note: Actual value = Reference value x Unit	3000	0.10%	Real time	"60E0h" on page 998
60E1h	60E1h	Negative torque limit	Setting range: 0 to +4000 Actual value range: 0.0% to +400.0% Note: Actual value = Reference value x Unit	3000	0.10%	Real time	"60E1h" on page 998

3.14.5 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.

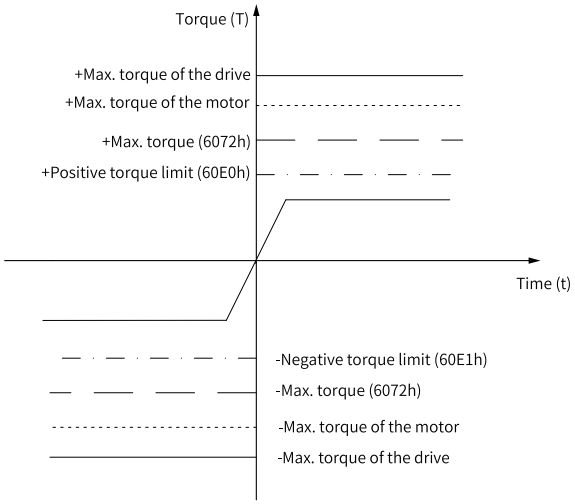


☆Related parameters:

Param.	Add.	Name	Value range	Default value	Unit	Change mode	Page
607Fh	607Fh	Max. speed	0 to 4294967295	4294967295	Reference unit/s	Real time	"607Fh" on page 988

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.	Add.	Name	Value range	Default value	Unit	Change mode	Page
6072h	6072h	Maximum torque reference	Setting range: 0 to 4000 Actual value range: 0.0% to 400.0% Note: Actual value = Reference value x Unit	3500	0.10%	Real time	"6072h" on page 985
60E0h	60E0h	Positive torque limit	Setting range: 0 to 4000 Actual value range: 0.0% to 400.0% Note: Actual value = Reference value x Unit	3000	0.10%	Real time	"60E0h" on page 998
60E1h	60E1h	Negative torque limit	Setting range: 0 to 4000 Actual value range: 0.0% to 400.0% Note: Actual value = Reference value x Unit	3000	0.10%	Real time	"60E1h" on page 998

Torque reference polarity

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

☆Related parameters:

Param.	Add.	Name	Value range	Default value	Unit	Change mode	Page
607Eh	607Eh	Polarity	0x0 to 0xFF	0x0	-	Real time	"607Eh" on page 987

4 Common Functions

4.1 Absolute System

4.1.1 Overview

- Servo motor:
  The absolute encoder detects the motor position within one revolution and counts the number of revolutions. For example, a 26-bit encoder whose resolution is 67108864 (2^{26}) PPR records the 26-bit multi-turn data. The absolute system integrated with the absolute encoder works in absolute position linear mode or absolute position rotating mode. These modes apply to position control, speed control, and torque control modes. The absolute encoder with a battery can back up data when the servo drive is powered off. This enables the servo drive to calculate the absolute mechanical position upon power-on again. Therefore, the homing operation is not required.

  To match the absolute encoder with the SV680N-INT series servo drives, set H00.00 (Motor code) to 14102 (Inovance 26-bit absolute encoder). Set H02.01 (Absolute system selection) according to the actual condition. E731.0 (Encoder battery failure) will occur upon initial power-on of the battery. Set H0d.20 (Absolute encoder reset function) to 1 to reset E731.0 before performing the homing operation.

- For direct-drive motors:
  The absolute encoder system in direct-drive motors is divided into absolute position linear mode and incremental mode, and can be used in position control, speed control, and torque control modes. After the absolute mode is enabled, the drive calculates the mechanical absolute position based on the absolute position feedback from the encoder after power-off and power-on, eliminating the need to re-perform the homing operation. Set H02.01 (Absolute system selection) according to the actual motor.

Note

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

Table 4–1 Absolute modes supported by the motors of SV680N-INT

Type	Incremental mode	Absolute position linear mode	Absolute position rotation mode	Single-turn absolute mode
DDL motor + ABZ Incremental encoder (with TTL signal)	√	×	×	×
DDL motor + Inovance incremental encoder	√	×	×	×
DDL motor + Analog encoder + Inovance T5 interpolator	√	×	×	×
DDL motor + BiSS-C encoder	√	√[1]	×	×

Type	Incremental mode	Absolute position linear mode	Absolute position rotation mode	Single-turn absolute mode
DDL motor + SSI encoder	√	√[1]	×	×
DDL motor + EnDat 2.2 encoder	√	√[1]	×	×
DDR motor+ABZ incremental encoder (with TTL signal)	√	×	×	×
DDR motor + Inovance absolute encoder	√	×	×	√
DDR motor + Analog encoder + Inovance T5 interpolator	√	×	×	×
DDR motor + BiSS-C encoder	√	×	×	√
DDR motor + SSI encoder	√	×	×	√
DDR motor + EnDat 2.2 encoder	√	×	×	√
Servo motor + ABZ incremental encoder (with TTL signal)	√	×	×	×
Servo motor + Inovance absolute encoder	√	√	√	√
Servo motor + Analog encoder + Inovance T5 interpolator	√	×	×	×
Servo motor + BiSS-C encoder	√	×	×	√
Servo motor + EnDat 2.2 encoder	√	×	×	√
Servo motor + Nikon absolute encoder	√	√	√	√
Servo motor + TAMAGAWA absolute encoder	√	√	√	√
Servo motor + SSI encoder	√	×	×	√

Note

[1]:

- Check whether the absolute mode is supported by the encoder used.
- When setting H02.01 (Absolute mode), check the preceding table to specify a proper value. If the absolute mode is not supported by the encoder, E122.0 will be reported.

4.1.2 Related Parameters

Absolute encoder system settings

Set H00.00 to select the motor encoder to be used, and select the absolute position mode in H02.01.

☆ Related parameters:

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H00.00	2000-01h	Motor code	20000: Linear motor - Pulse encoder 14203: Linear motor - BiSS-C encoder 14206: Linear motor - SSI encoder 14207: Linear motor - EnDat 2.2 encoder 14202: Linear motor - Inovance communication-type 23-bit encoder 14205: Linear motor - Inovance T5 interpolator 20001: DDR motor - Pulse encoder 14210: DDR motor - Inovance T5 interpolator 14201: DDR Motor - Inovance communication-type 23-bit encoder 14211: DDR motor - BiSS-C encoder 14212: DDR motor - EnDat 2.2 encoder 14213: DDR motor - SSI encoder 20002: Rotary motor - Pulse encoder 14000: Rotary motor - Inovance communication-type 20-bit encoder 14101: Rotary motor - Inovance communication-type 23-bit encoder 14102: Rotary motor - Inovance communication-type 26-bit encoder 14020: Rotary motor - Harmonic 20-bit encoder - 2.5 M baud rate 14021: Rotary motor - Harmonic 17-bit encoder - 2.5 M baud rate 14022: Rotary motor - Harmonic 17-bit encoder - 4 M baud rate 14120: Rotary motor - Nikon 20-bit encoder - 2.5 M baud rate 14121: Rotary motor - Nikon 17-bit encoder - 2.5 M baud rate 14122: Rotary motor - Nikon 17-bit encoder - 4 M baud rate 14130: Rotary motor - TAMAGAWA 17-bit encoder 14131: Rotary motor - TAMAGAWA 23-bit encoder 14140: Rotary motor - EnDat2.2 encoder 14150: Rotary motor - SSI encoder 14160: Rotary motor - BiSS-C encoder	14102	-	At stop	"H00_en.00" on page 569
H00.08	2000-09h	Bus encoder type	0 to 65535	0	-	At stop	"H00_en.08" on page 571

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H02.01	2002-02h	Absolute system selection	0: Incremental mode 1: Absolute position linear mode 2: Absolute position rotating mode 3: Absolute position linear mode (encoder overflow not reported) 4: Absolute position single-turn mode	0	-	At stop	"H02_en.01" on page 581

Note

In the absolute position mode, the system detects the motor code automatically to check whether the motor used is configured with an absolute encoder. If not, E122.0 (Product mismatch in the absolute position mode) occurs.

Encoder feedback data

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

☆ Related parameters:

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H0b.70	200b-47h	Number of absolute encoder revolutions	-32768 to 32767	0	Rev	Read-only	"H0b_en.70" on page 711
H0b.71	200b-48h	Position of absolute encoder within one turn	0 to 2147483647	0	Encoder unit	Read-only	"H0b_en.71" on page 712
H0b.77	200b-4Eh	Encoder position (low 32 bits)	0 to 4294967295 (encoder unit)	0	Encoder unit	Read-only	"H0b_en.77" on page 712
H0b.79	200b-50h	Encoder position (high 32 bits)	-2147483648 to 2147483647 (encoder unit)	0	Encoder unit	Read-only	"H0b_en.79" on page 712

Absolute position linear mode

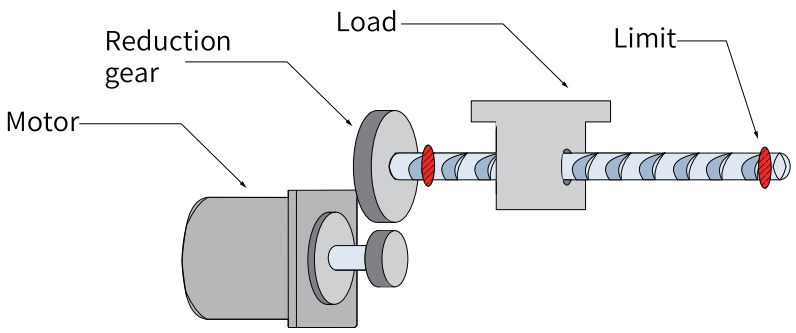


Figure 4-1 Application of the linear mode of the servo motor

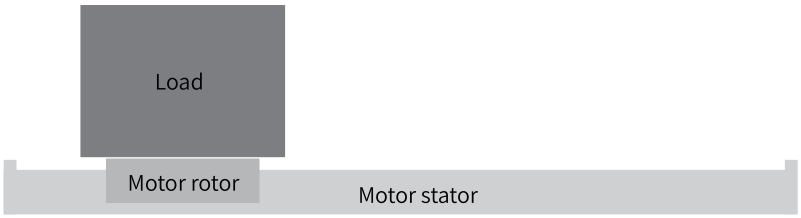


Figure 4-2 Application of the linear mode of the servo motor

SV680-INT supports DDL motors, BiSS-C encoders, and EnDat 2.2 encoders, and is applicable to the absolute position linear mode.

Assume that the electronic gear ratio is (B÷A), the mechanical absolute position (H0b.58 and H0b.60) is P_M, the absolute position counter (H0b.07) indicates the current mechanical absolute position (instruction unit), and H0b.07 = P_M ÷ (B÷A).

The data range of the number of revolutions for the absolute encoder is -32768 to 32767. If data overflows, E735.0 (Encoder multi-turn counting overflow) occurs. In this case, set H0d.20 to 2 (Reset multi-turn data), and then perform homing again. In special occasions, you can set H0A.36 to 1 to mute E735.0 or use absolute position linear mode 2.

☆ Related parameters:

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H05.36	2005-25h	Mechanical home offset	-2147483648 to 2147483647 (encoder unit)	0	Reference unit	Real time	"H05_en.36" on page 615
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	0	-	Real time	"H05_en.46" on page 617
H0b.07	200b-08h	Absolute position counter	-2147483648 to 2147483647 (encoder unit)	0	Reference unit	Read-only	"H0b_en.07" on page 700
H0b.58	200b-3Bh	Mechanical absolute position (low 32 bits)	0 to 4294967295 (encoder unit)	0	Encoder unit	Read-only	"H0b_en.58" on page 710
H0b.60	200b-3Dh	Mechanical absolute position (high 32 bits)	-2147483648 to 2147483647 (encoder unit)	0	Encoder unit	Read-only	"H0b_en.60" on page 710

Absolute position rotation mode

This mode is mainly applicable to the scenario where the load traveling range is not restricted and the number of unidirectional revolutions of the motor is smaller than 32767 upon power failure, as the rotating load shown in the following figure.

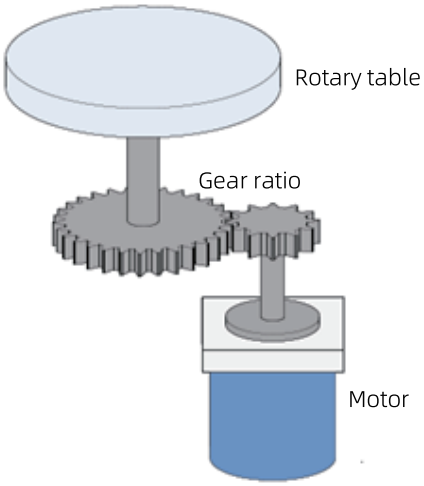
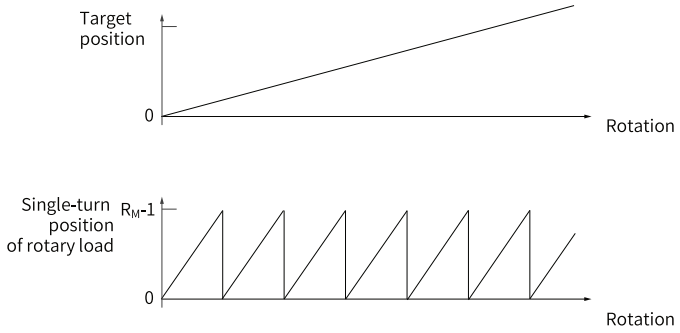
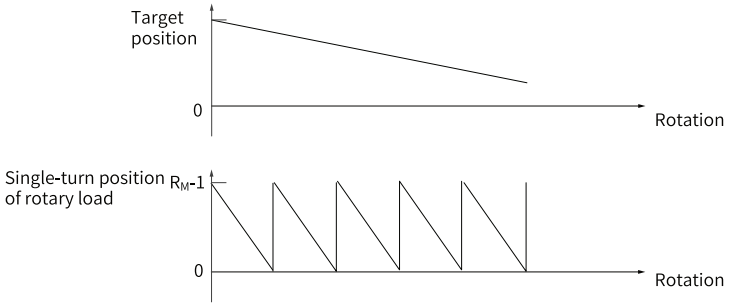


Figure 4-3 Application of the linear mode

When the single-turn position range of the rotary load is set to 0 to (R_M-1) (R_M: the number of encoder pulses corresponding to one revolution of load) and the gear ratio is 1:1, the relationship between the target position and the change in rotary load single-turn position when the motor rotates forward:



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



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

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

Related parameters:

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H05.50	2005-33h	Mechanical gear ratio in absolute position rotation mode (numerator)	1 to 65535	1	-	At stop	"H05_en.50" on page 619
H05.51	2005-34h	Mechanical gear ratio in absolute position rotation mode (denominator)	1 to 65535	1	-	At stop	"H05_en.51" on page 619
H05.52	2005-35h	Pulses per revolution of the load in absolute position rotation mode (low 32 bits)	0 to 4294967295 (encoder unit)	0	Encoder unit	At stop	"H05_en.52" on page 619
H05.54	2005-37h	Pulses per revolution of the load in absolute position rotation mode (high 32 bits)	0 to 4294967295 (encoder unit)	0	Encoder unit	At stop	"H05_en.54" on page 619
H0b.81	200b-52h	Single-turn position of the rotating load (low 32 bits)	0 to 4294967295 (encoder unit)	0	Encoder unit	Read-only	"H0b_en.81" on page 712
H0b.83	200b-54h	Single-turn position of the rotating load (high 32 bits)	-2147483648 to 2147483647 (encoder unit)	0	Encoder unit	Read-only	"H0b_en.83" on page 713
H0b.85	200b-56h	Single-turn position of the rotating load (reference unit)	0 to 4294967295	0	Reference unit	Read-only	"H0b_en.85" on page 713

Single-turn absolute mode

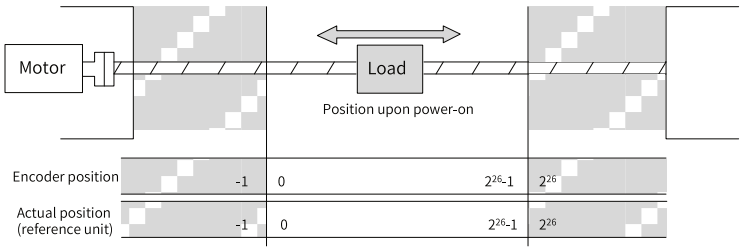
This mode applies to scenarios where the load travel range is within the single-turn range of the encoder. In this case, the absolute encoder needs no battery as it records the single-turn data only.

- Target position input range
  If a 26-bit absolute encoder is used in the single-turn absolute mode, the drive operates in the position control mode, and the electronic gear ratio is 1:1, then:

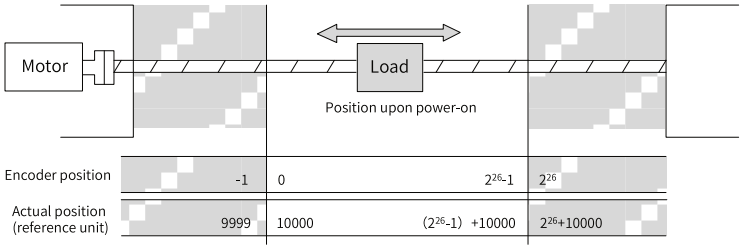
  When H05.36 (Mechanical home offset) is set to 0, the target position range is 0 to (2^{26}-1).

  After homing is completed, the target position range is H05.36 to (2^{26}-1+ H05.36).

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



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



4.1.3 Precautions for Using the Battery Box

This section applies only to Inovance servo motors.

E731.0 (Encoder battery fault) occurs when the battery is connected for the first time. Set H0d.20 to 1 to reset the fault first before performing absolute encoder system operations.

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

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

1. Power on the servo drive and make it stay in the non-operational state.
2. Replace the battery.
3. After the drive resets E730.0 (Encoder battery alarm) automatically. If no other alarm occurs, you can 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.	Comm. address	Name	Setpoint	Default value	Unit	Change mode:	Page
H0d.20	200d-15h	Absolute encoder reset	0: No operation 1: Reset fault 2: Reset fault and multi-turn data 3: Reset Inovance secondary encoder fault 4: Reset Inovance secondary encoder fault and multi-turn data	0	-	At stop	"H0d_en.20" on page 721

Note

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

4.2 Full Closed-loop

Note

For fully closed-loop functions, the safety speed and position-related functions only support safety speed and position monitoring on the internal encoder. Safety speed and position monitoring on external encoders are not supported.

4.2.1 Fully Closed-loop Parameter Settings

After setting basic gain parameters, check that the servo drive operates properly without overshoot and stops without generating unexpected noise. When basic operating conditions are met, set the closed-loop parameters based on the following procedure.

1. **Set the external encoder feedback type.**

   Set H0F.03 based on the external encoder type.

Note

- SV680-INT supports five types of secondary encoders, including ABZ incremental encoders (with TTL signals), Inovance communication encoders, BiSS-C encoders, SSI encoders, and EnDat 2.2 encoders. Note that BiSS-C encoders, SSI encoders, and EnDat 2.2 encoders are not applicable to fully closed-loop rotary motors.
- After enabling fully closed-loop function, perform jogging 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 the ABZ incremental encoder with TTL signals but without Z signals, set H0F.22 to 1 to disable detection on phase Z.

Note

- BiSS-C encoder:
  - The BiSS-C encoder generally has a data bit and an error bit. You can obtain their data lengths in the corresponding encoder user guide. The data length of the error bit is usually 2 bits.
  - You can obtain the communication frequency and recovery time from the encoder user guide.
  - CRC is used.
  - You need to configure the communication frequency (baud rate) and recovery time (from the first falling edge of the clock signal to the first rising edge of the data signal).
- SSI encoder:
  - The SSI encoder generally has a data bit and an error bit. You can obtain their data lengths in the corresponding encoder user guide.
  - Parity check is used.
  - You need to configure the communication frequency (baud rate) and recovery time (from the first falling edge of the clock signal to the first rising edge of the data signal).
- EnDat2.2 encoder:
  - You need to set the data length for the EnDat2.2 encoder.
  - You need to configure the communication frequency (baud rate) and recovery time (from the first falling edge of the clock signal to the first rising edge of the data signal).

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.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H0F.01	200F-02h	Fully closed-loop encoder application mode	0: Operating in the standard direction 1: Operating in the reverse direction	0	-	Real time	"H0F_en.01" on page 731

   The following describes how to confirm the operating direction of the external encoder.

   Enter the JOG mode, and perform jogging at low speed in one direction. Observe the value of H0F.18 (Feedback pulse counter of internal encoder) and H0F.20 (Feedback pulse counter of external). If these two values change in the same way (increase or decrease simultaneously), set H0F.01 to 0. Otherwise, set H0F.01 to 1.

Note

- Perform necessary trial run of the motor. For details, see "6.18.1 Pre-operation Inspection" on page 424.
- Set H0F-01 to a proper value. If H0F-01 is set improperly, runaway accident may occur.

3. **Determine the resolution of external encoder (external encoder pulses per revolution).**

   Rotate the motor and observe the value of H0F.18 (Feedback pulse counter of internal encoder) to confirm the motor has rotated for a full turn. Then calculate the variation of H0F.20 (Feedback pulse counter of external encoder), and incorporate this value into H0F.04.

   ☆ Related parameters:

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H0F.04	200F-05h	Number of fully closed-loop encoder pulses per revolution	1 to 2147483647	10000	-	At stop	"H0F_en.04" on page 732

Caution

- Suppose the values of H0F.18 and H0F.20 before the motor rotates are X_1 and Y_1 respectively, and their values change to X_2 and Y_2 after the motor rotates, then the following formula applies:

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

- The calculation result must be a positive value. If it is a negative value, it indicates H0F.01 is set improperly. In this case, check the value of H0F.01 again.
- Set H0F.04 properly. If H0F.04 is set to a wrong value, EB02.0 (Position deviation too large in fully closed-loop mode) may occur when the drive is operating.

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

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

For details about how to set the electronic gear ratio, see *"3.2 Conversion Factor" on page 28*. The gear ratio is calculated as follows: assuming the full closed-loop device control requirement is: for every X_1 pulse commands sent by the host computer, the corresponding external mechanical displacement is Y_1.

Then, perform the following operations:

a. Step 1: Set the electronic gear ratio to 1:1.

b. The host computer sends X_2 pulses, and the measured external mechanical displacement is Y_2. The electronic gear ratio fulfills the needs.

Note

- To set the fully closed-loop electronic gear ratio in internal/external closed-loop position switchover mode, set the electronic gear switchover switch (Gear_Sel) to the external closed-loop state.
- This method also applies to internal closed-loop mode. In the internal closed-loop mode, ensure the present state is internal closed-loop state.
- Set the electronic gear ratio correctly. Failure to comply will result in mechanical deviation.

5. **Set the alarm threshold.**

Set H0F.08 and H0F.10 as follows:

- Set H0F.08 (Excessive deviation in compound control)

  Set H0F.08 (Excessive deviation in compound control) defines the position deviation threshold at which the servo drive detects fault EB02.0, indicating that the position deviation is excessive. The unit of H0F.08 is one reference unit (same as one external encoder unit).

  ☆ Related parameters:

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H0F.08	200F-09h	Excessive deviation threshold in compound control mode	0 to 2147483647	1000	-	Real time	"H0F_en.08" on page 733

For example, if H0F.08 is set to 1000, EB02.0 (Excessive position deviation in fully closed-loop mode) will be output if the deviation between the mechanical displacement driven by the motor and the mechanical displacement (compound deviation) measured by the external encoder exceeds the displacement corresponding to 1000 external encoder pulses.

Note

- If it is set to 0, EB02.0 (Position deviation too large in fully closed loop) will not be output.
- H0F.08 must be set to a value (such as H0F.04 x H0F.10 x 50%) lower than H0F.04 x H0F.10. Otherwise, EB02.0 cannot be outputted.

- Set H0F.10 (Clear deviation in compound control)
  The value of H0F.10 indicates the revolutions to be ran by the motor per deviation clear in the compound control mode.

  ☆ Related parameters:

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H0F.10	200F-0Bh	Deviation clear in compound control	0 to 100	1	Rev	Real time	"H0F_en.10" on page 734

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

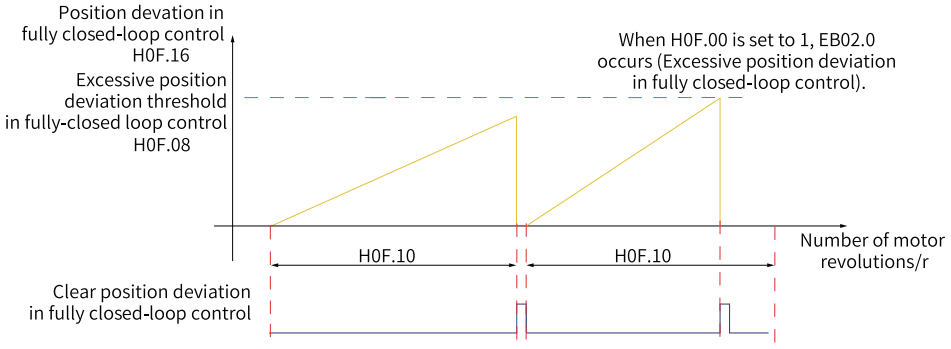


Figure 4-4 Position deviation cleared in fully closed-loop mode

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.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H0F.13	200F-0Eh	Compound vibration suppression filter time	0.0 to 6553.5	0.0	ms	At stop	"H0F_en.13" on page 734

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.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H0F.25	200F-1Ah	Set the source of touch probe Z signal in fully closed-loop mode.	0: Motor Z signal 1: External feedback Z signal	0	-	Real time	"H0F_en.25" on page 736

H0F.25 (Source of touch probe Z signal in fully closed-loop mode) defines the source of the Z signal during homing in fully closed-loop mode. Setpoint 0 indicates that the Z signal of the inner loop is used as the source and setpoint 1 indicates that the Z signal of the outer loop is used as the source. When the Z signal of the outer loop is used as the source, ensure that the Z signal is wired correctly. Otherwise, the 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.

4.2.2 Encoder Parameter Settings

4.2.2.1 BiSS-C encoder

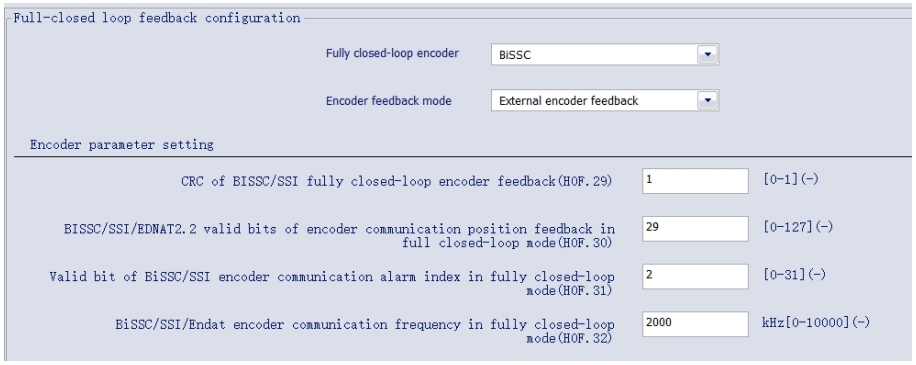
Configuration example

1. Connect the BiSS-C encoder to the CN7 terminal and connect a 23-bit Inovance encoder to the CN2 terminal.
2. Obtain the encoder parameters from the encoder guide, for example:

Data length (H00.43)	Single-turn data length (H00.39)	Status word bit (H00.44)	Whether CRC is bit-inverted (H00.54)	Communication rate (H34.08)
36-bit	24-bit	2-bit	Bit-inverted	120 kHz to 2500 kHz

Note: When using an encoder to match a linear motor, you do not need to set the single-turn data length (H00.39), but you need to check and set the encoder resolution (H00.49).

3. Configure the drive parameters based on the encoder parameters:



4. After writing the parameters to the servo, reset the drive through the software to configure the BiSS-C encoder as a fully-closed loop encoder.
5. Run the motor for one revolution through manual pushing or jogging.
6. Because the encoder resolution (single-turn data length) is 24-bit, the theoretical position change of the motor is 2^{24} = 16,777,216. Read the actual position from the H0F.20 parameter in the backend software. If the actual position is close to the theoretical value, it indicates that the encoder parameters have been configured correctly.

For details about troubleshooting, see *"13.3 FAQ About Encoder Configuration" on page 1178*.

Error bit detection

On the primary or fully closed loop encoder, the fault detection function can be implemented using the F0 and F1 alarm index bits in the standard frame format. Related parameters:

Parameter	Description
H0F.33	Defines the time between the first falling edge and the first rising edge of the clock signal for EnDat 2.2 and SSI encoders.
H0F.35	Enables detection on status bits of the BiSS-C protocol by FPGA software. 0: Disable 1: Enable
H0F.36	Polarity check. A value of 0 indicates positive parity. A value of 1 indicates negative parity.
H0F.28	Displays the BiSS-C or SSI status word.

Alarm description:

- When the error bit detection function is enabled, it can determine whether the encoder is in an alarm state.
- If the detected error bit status differs from the preset status, bit 7 of parameter H0F.40 will be set.
- If 50 consecutive error bit data anomalies are detected, alarm 770.7 will be triggered.

Troubleshooting

If a communication error (770 fault) occurs, you can identify the cause of error by checking H0F.40.

Bit	Definition	Value range	Bit description
0	Communication timeout on the fully-closed loop serial encoder.	0 to 1	0: Normal 1: Fault
1	Not assigned	-	-
2	CRC errors on the fully closed-loop serial encoder.	0 to 1	0: Normal 1: Fault
3 to 10	Not assigned	-	-
7	Single-turn resolution calculation error on the fully closed-loop serial encoder.	0 to 1	0: Normal 1: Fault
11 to 12	Reserved	-	-
13	Counting increment error on the fully closed-loop serial encoder.	0 to 1	0: Normal 1: Fault
14 to 15	Reserved	-	-

For details about troubleshooting, see *"13.3 FAQ About Encoder Configuration" on page 1178*.

4.2.2.2 SSI encoder

Configuration example

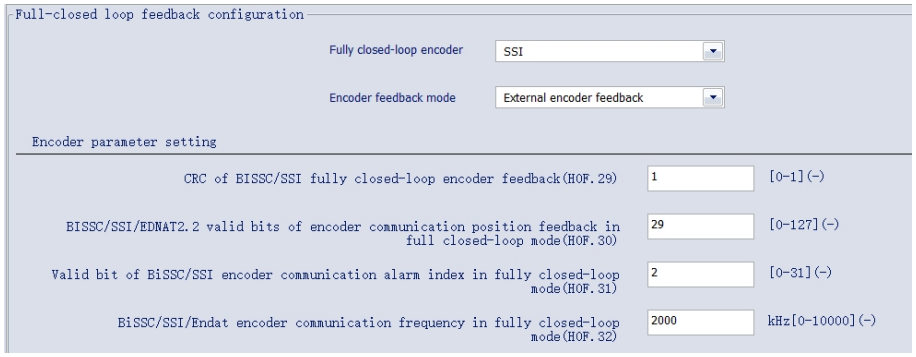
1. Connect the SSI encoder to the CN7 terminal and connect a 23-bit Inovance encoder to the CN2 terminal.
2. Obtain the encoder parameters from the encoder guide, for example:

Data length (H00.43)	Encoder resolution (H00.49)	Status word bit (H00.44)	Whether CRC is bit-inverted (H00.54)
26bit	1 μm/pulse	0bit	Bit-inverted

Communication rate (H34.08)	Restoration time (H34.07)	With or without parity bit (H34.03)	Code system selection (H34.04/H34.05)	Parity check (H34.06)
2000 K	0.5 μs	None	Binary code	None

Note: When using an encoder to match a rotary motor, you do not need to set the encoder resolution (H00.49), but you need to check and set the single-turn data length (H00.39).

3. Configure the drive parameters based on the encoder parameters:



4. After writing the parameters to the servo, reset the drive through the software to configure the SSI encoder as a fully-closed loop encoder.
5. Run the linear motor through manual pushing or jogging. The total travel of this linear motor model is about 520 mm.

6. According to the encoder guide, the encoder resolution is 1 μm/pulse. Therefore, the theoretical calculation for a travel distance of 520 mm corresponds to a position change of 520 × 1000 ÷ 1 = 520,000. Read the actual position from the H0F.20 parameter in the backend software. If the actual position is close to the theoretical value, it indicates that the encoder parameters have been configured correctly.

Other parameters

When configuring the SSI encoder as a fully closed-loop encoder, you can temporarily retain the default values of other parameters. However, if the position feedback data shows anomalies, such as gibberish, set the following parameters according to the encoder guide:

Parameter	Definition
H0F.51	Defines whether the encoder has a parity check bit.
H0F.52	Selects a code system for the position data of the fully closed-loop SSI encoder.
H0F.53	Selects a code system for the SSI encoder status words.
H0F.54	Enables or disables SSI encoder parity check.

Troubleshooting

If a communication error (770 fault) occurs, you can identify the cause of error by checking H0F.40.

Bit	Definition	Value range	Bit description
0	Communication timeout on the fully-closed loop serial encoder.	0 to 1	0: Normal 1: Fault
1	Not assigned	-	-
2	CRC errors on the fully closed-loop serial encoder.	0 to 1	0: Normal 1: Fault
3 to 10	Not assigned	-	-
7	Single-turn resolution calculation error on the fully closed-loop serial encoder.	0 to 1	0: Normal 1: Fault
11 to 12	Reserved	-	-
13	Counting increment error on the fully closed-loop serial encoder.	0 to 1	0: Normal 1: Fault
14 to 15	Reserved	-	-

For details about troubleshooting, see *"13.3 FAQ About Encoder Configuration" on page 1178*.

4.2.2.3 EnDat Encoder

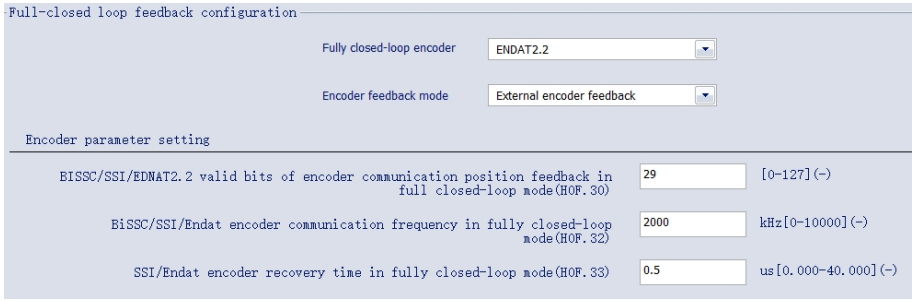
Configuration example

1. Connect the EnDat 2.2 encoder to CN7, and connect a 23-bit Inovance encoder to CN2.
2. Obtain encoder parameters from the encoder guide, for example:

Data length (H00.43)	Encoder resolution (H00.49)	Restoration time (H34.07)	Frequency set through communication (H34.08)
36-bit	0.001 μm/p	0.5 μs	4000 kHz

Note: When using an encoder with a rotary motor, you do not need to set the encoder resolution (H00.49), but query and set the single-turn data length (H00.39).

3. Configure the drive parameters based on the encoder parameters:



4. After writing the function parameters to the servo, perform a reset operation in the software tool to set the EnDat 2.2 encoder as a fully closed-loop encoder.
5. Manually push or jog the linear motor for a distance of approximately 100 mm.
6. According to the encoder guide, if the encoder resolution is 0.001 μm/p, the theoretical position change is 100 × 1000/0.001 = 100000000. The actual position can be read from parameter H0F.20 in the software tool. If the position is close to the theoretical value, the configuration is valid.

Troubleshooting

If a communication error (770 fault) occurs, check H0F.40 to locate the issue.

Bit	Description	Value range	Bit description
0	EnDat encoder communication timeout error	0 to 1	0: Normal 1: Fault
1	EnDat No.1 fault	0 to 1	
2	EnDat encoder CRC check error	0 to 1	
3	EnDat No.2 fault	0 to 1	
4	EnDat fault information 1	0 to 1	
5	EnDat fault information 2	0 to 1	
6 to 8	Not assigned	-	-
9	EnDat additional data 1 CRC error	0 to 1	0: Normal 1: Fault
10	EnDat additional data 2 CRC error	0 to 1	
11 to 12	Reserved	-	-
13	Serial encoder counting increment error in fully closed-loop mode	0 to 1	0: Normal 1: Fault
14	EnDat No.3 fault 1	0 to 1	
15	EnDat No.3 fault 2	0 to 1	

For details about troubleshooting, see *"13.3 FAQ About Encoder Configuration" on page 1178*.

4.2.3 Enabling Fully Closed-loop Settings

After setting the 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:

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H03.02	2003-03h	DI1 function selection	0: No assignment 1: Servo ON 2: Alarm reset signal 5: Multi-reference direction 6: Multi-reference switchover CMD1 7: Multi-reference switchover CMD2 8: Multi-reference switchover CMD3 9: Multi-reference switchover CMD4 14: Positive limit switch 15: Negative limit switch 16: Positive external torque limit 17: Negative external torque limit 18: Forward jog 19: Reverse jog 24: Electronic gear ratio selection 28: Multi-position reference selection 31: Home switch 34: Emergency stop 36: Internal speed limit 38: Probe 1 39: Probe 2 40: Enable multi-speed 46: Enable process segment 47: Process segment reference switchover 1 48: Process segment reference switchover 2 49: Process segment reference switchover 3 50: Process segment reference switchover 4 51: Event-triggered process segment 1 52: Event-triggered process segment 2 53: Event-triggered process segment 3 54: Event-triggered process segment 4 55: Pause process segment 56: Gantry torque alignment 57: Enable gantry DI alignment 58: Clear gantry DI alignment 59: Enable gantry synchronization	14	-	Real time	"H03_en.02" on page 592
H0F.00	200F-01h	Encoder feedback mode	0: Internal encoder feedback 1: External encoder feedback 2: Switchover between inner/outer loop	0	-	Real time	"H0F_en.00" on page 731

Note

To switch between inner and outer loops, you need to set H0F.00 to 2, rather than changing it to 0 or 1 in realtime.

4.3 Software Position Limit

Function description

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

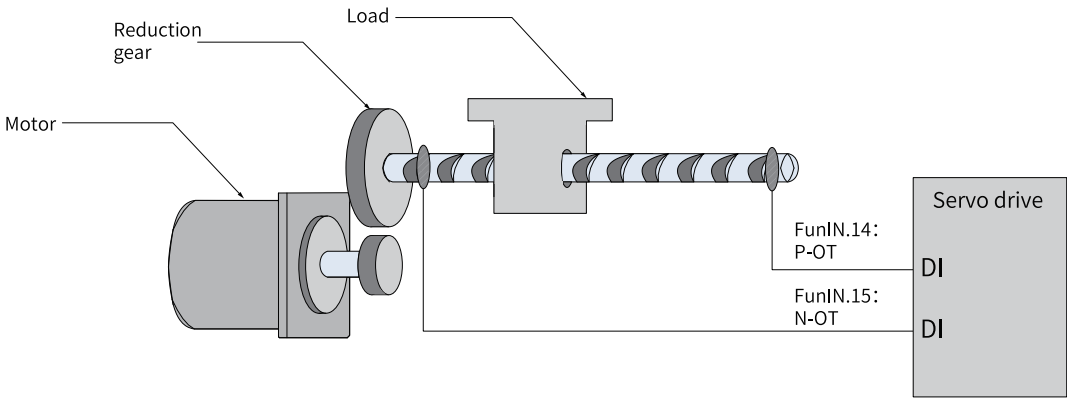


Figure 4-5 Installation of limit switches

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 a alarm and stops immediately. Software position limit is available both in the absolute position mode and the incremental position mode. To use the software position limit in the incremental position mode, set H0A.01 (Software position limit) to 2 (Enabled after homing) first, and then perform homing upon power-on before applying software position limit.

Table 4–2 Comparison between the hardware position limit and software position limit

Hardware position limit		Software position limit	
1	Restricted to linear motion and single-turn rotational motion.	1	Applicable to both the linear motion and the rotational motion.
2	Requires an external mechanical limit switch.	2	Hardware wiring is not required, preventing malfunction due to poor cable connection.
3	Suffered from the risk of mechanical slip.	3	Internal position comparison can prevent malfunction due to mechanical slip.
4	Unable to sense or detect an overtravel fault after power-off.		

Related objects

☆Related parameters:

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
H0A.00	200A-01h	Power input phase loss protection	0: Enable 1: Disable	0	-	Real time	"H0A_en.00" on page 679
H0A.41	200A-2Ah	Positive position of software position limit	-2147483648 to +2147483647	2147483647	Encoder unit	At stop	"H0A_en.41" on page 687
H0A.43	200A-2Ch	Negative position of software position limit	-2147483648 to +2147483647	-2147483648	Encoder unit	At stop	"H0A_en.43" on page 688

Communication mode:

- When H0A.01 is set to 0 (Absolute position limit not enabled), the software position limit is not enabled.
- When H0A.01 is set to 1 (Absolute position limit enabled), the software position limit is enabled immediately after the drive is powered on. The software position limit is 607D.01h (Minimum position limit) and 607D.02h (Maximum position limit). Ensure that 607D.01h (Minimum position limit) is lower than or equal to 607D.02h (Maximum position limit). If 607D.01h (Minimum position limit) is set to a value higher than 607D.02h (Maximum position limit), the drive reports EE09.0 (Software position limit setting error).
- If H0A.01 is set to 2 (Absolute position limit enabled after homing), 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 (Maximum position limit) 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.

Non-communication mode:

- When H0A.01 is set to 0 (Absolute position limit not enabled), the software position limit is not enabled.
- When H0A.01 (Absolute position limit enable) is set to 1, software position limit is enabled immediately upon power-on. When the value of the absolute position counter (H0b.07) is higher than the value of H0A.41, E950.0 (Forward overtravel alarm) occurs and the drive stops accordingly.
  When the value of the absolute position counter (H0b.07) is lower than the value of H0A.43, E952.0 (Reverse overtravel alarm) occurs and the drive stops accordingly.
- If H0A.01 is set to 2 (Absolute position limit enabled after homing), software position limit is not enabled after homing upon power-on. When the value of the absolute position counter (H0b.07) is higher than the value of H0A.41 after homing, E950.0 (Forward overtravel alarm) occurs and the drive stops accordingly. When the value of the absolute position counter (H0b.07) is lower than the value of H0A.43 after homing, E952.0 (Reverse overtravel 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.

4.4 Software Reset

Function description

The software reset function applies when power cycling of the drive is not allowed on the application site.

Related objects

☆Related parameters:

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
H0d.00	200d-01h	Software reset	0: No operation 1: Enable	0	-	At stop	"H0d_en.00" on page 718

4.5 Motor Protection

Motor overload protection

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

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

Set the motor overload protection gain (H0A.04) to adjust the report time of fault E620.0. Use the default value of H0A.04 in general conditions, however, in case of one of the following situations, modify H0A.04 based on the actual heating condition.

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

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

Caution

Take caution when hiding the motor overload fault as it may damage the motor.

☆Related parameters:

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
H0A.04	200A-05h	Motor overload protection gain	50 to 300	100	-	Real time	"H0A_en.04" on page 680
H0A.26	200A-1Bh	Motor overload detection	0: Show motor overload alarm (E909.0) and fault (E620.0) 1: Mask motor overload alarm (E909.0) and fault (E620.0)	0	-	Real time	"H0A_en.26" on page 684

Over-temperature protection upon motor stall

When the motor is stalled, the motor speed is nearly 0 rpm at high current input. In this case, the motor can be overheated significantly. The motor is capable of operating upon stall in an allowable period of time, exceeding of which can damage the motor due to overtemperature. To prevent such risks, the drive offers motor overtemperature protection to protect the motor from being damaged by overtemperature.

You can set the time for reporting E630.0 (Motor stall over-temperature fault) by setting the time threshold for motor overtemperature protection (H0A.32). The motor overtemperature protection function is enabled by default (H0A.33 = 1).

Caution

- To prevent damages to the motor, take caution when you use the motor stall over-temperature protection function.
- Use the dedicated motor for the drive. Failure to comply can result in short circuits caused by aging of insulation.

☆Related parameters:

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
H0A.32	200A-21h	Time threshold for overtemperature protection upon motor stall	10 to 65535	200	ms	Real time	"H0A_en.32" on page 685
H0A.33	200A-22h	Stall overtemperature protection	0: Disabled 1: Enabled	1	-	Real time	"H0A_en.33" on page 685

Motor overspeed protection

An excessively high speed may damage the motor or machine. Motor overspeed protection is used to protect the motor in case of overspeed, preventing the motor or machine from being damaged due to overtemperature.

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

Caution

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

☆Related parameters:

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
H0A.08	200A-09h	Overspeed fault threshold	0 to 20000	0	[mm/s]/ [rpm]	Real time	"H0A_en.08" on page 680
H0A.12	200A-0Dh	Runaway protection	0: Disable 1: Enable runaway protection scheme 1 2: Enable runaway protection scheme 2	1	-	At stop	"H0A_en.12" on page 681

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

4.6 DI Filter Time

Function description

The drive provides eight physical DI terminals, in which DI1 to DI3 are normal DI terminals, and DI4 to DI5 are high-speed DI terminals. Assign the function of touch probe to DI4 or DI5 to guarantee precision.

When regular functions, excluding touch probes, are assigned to DIs, the filter time of these DIs is set in H03.60 to H03.64. Ensure the effective level hold time of the DI assigned with regular function is above 0.5 ms. Otherwise, the DI function may not be responded to.

When a high-speed DI is assigned with the touch probe function, the filter time of this DI is defined by H0A.19 and H0A.20. Ensure the effective level hold time of the high-speed DI is longer than the filter time.

Related objects

The drive provides two high-speed DIs with input signal frequency up to 4 kHz. When the DI signal is being disturbed, set the filter time in H0A.19 and H0A.20.

☆ Related parameters:

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H03.60	2003-3Dh	DI1 filter time	0.00 to 500.00	3.00	ms	Real time	"H03_en.60" on page 603
H03.61	2003-3Eh	DI2 fitter time	0.00 to 500.00	3.00	ms	Real time	"H03_en.61" on page 603
H03.62	2003-3Fh	DI3 filter time	0.00 to 500.00	3.00	ms	Real time	"H03_en.62" on page 603
H03.63	2003-40h	DI4 fitter time	0.00 to 500.00	3.00	ms	Real time	"H03_en.63" on page 604
H03.64	2003-41h	DI5 filter time	0.00 to 500.00	3.00	ms	Real time	"H03_en.64" on page 604
H0A.19	200 A-14h	Filter time constant of touch probe 1	0.00 to 6.30	2.00	μs	Real time	"H0A_en.19" on page 682
H0A.20	200 A-15h	Filter time constant of touch probe 2	0.00 to 6.30	2.00	μs	Real time	"H0A_en.20" on page 683

4.7 EtherCAT-forced DO Function

Description

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

1. Status unchanged: The servo status switches to the non-OP status and the forced DO status stays unchanged.
2. Initialization status: No forced DO is generated when the servo drive is in the non-OP status. When the network switches to the operational (OP) status, the forced DO is determined by 60FE.01h and 60FE.02h.

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

Related objects

The following table describes some related parameter settings.

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H04.23	2004-18h	EtherCAT-forced DO logic in non-OP status	bit 0: DO1 0: Status unchanged 1: No output bit 1: DO2 0: Status unchanged 1: No output bit2 to bit15: N/A	0	-	Real time	"H04_en.23" on page 607

Descriptions for the setpoints are shown in "Table 4-3" on page 194*Description of setpoints*.

Table 4–3 Description of setpoints

Value range	Function
0	Status of DO1 and DO2 is unchanged in the nonoperational status
1	No output in DO1 and status of DO2 unchanged in the non-operational status
2	No output in DO2 and status of DO1 unchanged in the non-operational status
3	No output in DO1 and DO2 in the nonoperational status

Setting method

1. Assign DO function 31 (EtherCAT-forced DO) to the DO to be controlled forcibly by EtherCAT, and then set the bit of H04.23 as needed to select the forced DO status in the non-OP status.
2. Configure 60FE.01h/60FE.02h as RPDO, and operate on bit16 to bit18 to control the DO.

4.8 Position Comparison

Function description

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

Note

1. During position comparison, the position comparison function is executed again when any of the comparison start point, stop point, and comparison mode are modified.
2. When you use the position comparison output function, it is recommended to set the logic of position comparison DO to 0-Normally Open (NO).

- Set the DO logic to 0-NO (the corresponding DO optocoupler switches from OFF to ON upon position comparison traversal) to achieve a response of 10 μs.
- Set the DO logic to 1-Normally Closed (NC) (the corresponding DO optocoupler switches from ON to OFF upon position comparison traversal) to achieve a response within 300 μs.

The following table describes the specifications of position comparison output.

Specifications of position comparison output		Description
Trigger output	Output terminal	DO or ABZ/OCZ signal
	Logic	The effective level of DO is defined by the DO logic in group H04.
		The effective level of ABZ/OCZ output is defined by H18.06.
	Pulse width	The pulse output width is defined by H18.05.
	Delay compensation	Defined by H18.14 and used to compensate for hardware output delay.
Comparison source	Motor encoder feedback	Supported
	Pulse feedback fully closed-loop (ABZ)	Supported
	Communication-type fully closed-loop	Supported
Comparison value	Number of comparison points	40 points, signed 32-bit integer
Comparison attribute	Attribute of comparison point	Defines the attribute of the comparison point.
		Defines the output terminal for comparison.

Related objects

When position comparison is enabled, you can assign FunOUT.25 (Position comparison) to any one of the two DOs. The DO you select will be used to output the position comparison output signal. You can also use the ABZ/OCZ signal as the position comparison output terminal by setting H18.16.

Position comparison output parameters:

Param.	Name	Description
H18: Position comparison output		
H18.00	Position comparison output selection	0: Disable 1: Enable (rising edge-triggered)
H18.01	Position comparison output feedback source	0: Motor encoder feedback 1: Fully closed-loop feedback
H18.02	Position comparison resolution[1]	Defines the number of pulses per revolution. For example, if H18.02 is set to 1, the number of pulses per revolution is 2^{23}. 0: 24-bit 1: 23-bit 2: 22-bit 3: 21-bit 4: 20-bit 5: 19bit 6: 18bit 7: 17bit
H18.03	Position comparison mode	0: Individual comparison 1: Cyclic comparison 2: Fixed cyclic comparison

Param.	Name	Description
H18: Position comparison output		
H18.04	Current position as zero	0: Disable 1: Enable (rising edge-triggered) Note: This function needs to be used when the comparison state is inactive, otherwise the comparison logic may malfunction.
H18.05	Position comparison output width	Defines the active pulse width of the DO when the comparison point is reached. The value range is 0.1 to 204.7 (in ms).
H18.06	Position comparison output ABZ polarity	bit0: OCZ output logic 0: Positive, output high level upon active logic 1: Negative, output low level upon active logic bit1: Z port output logic 0: Positive, output high level upon active logic 1: Negative, output low level upon active logic bit2: A/B output logic 0: Positive, output high level upon active logic 1: Negative, output low level upon active logic
H18.07	Start point of position comparison	Activated when H18.00 is set to 1 again.
H18.08	End point of position comparison	Activated when H18.00 is set to 1 again.
H18.09	Current state of position comparison	0: No comparison; n: Waiting for the comparison point N
H18.10	Real-time position of position comparison	Displays the current comparison position value Value range: -2^{31} to $(2^{31} - 1)$
H18.12	Zero offset of position comparison	Defines the offset value after current position is taken as the zero point Value range: -2^{31} to $+2^{31} - 1$
H18.14	Position comparison output delay compensation	Comparison delay compensation time: -12 us to +12 us
H18.15	Number of fixed mode cycles	1 to 65535
H18.16	ABZ output function setting	bit0: OCZ output function 0: Frequency-division output 1: Position comparison bit1: Z port output function 0: Frequency-division output 1: Position comparison bit2: A/B port output function 0: Frequency-division output 1: Position comparison
H18.17	Number of completed fixed modes	Alias range: 0 to 65535

Note

[1]: When the source of position comparison is full closed-loop feedback, it is only effective for Inovance encoders.

Param.	Name	Description
H19: Target position parameters		
H19.00	Target value of position comparison 1	Defines the target value of position comparison 1. Value range: -2^{31} to $2^{31} - 1$
H19.02	Attribute value of position comparison 1	Attribute setting of position comparison point 1 bit0: 1: Current position changing from "less than" to "more than" the comparison point enabled 0: None bit1: 1: Current position changing from "more than" to "less than" the comparison point enabled 0: None bit2 to bit6: N/A bit7: 1: DO1 output enable 0: None bit8: 1: DO2 output enable 0: None bit9: 1: DO3 output enable 0: None bit10: 1: DO4 output enable 0: None bit11: 1: DO5 output enable 0: None bit12: 1: Frequency-division A output enabled 0: None bit13: 1: Frequency-division B output enabled 0: None bit14: 1: Frequency-division C output enabled 0: None bit15: 1: Frequency-division OCZ output enable 0: None
H19.03	Target value of position comparison 2	Defines the target value of position comparison 2. Value range: -2^{31} to $2^{31} - 1$
H19.05	Attribute value of position comparison 2	Defines the attribute value of position comparison 2. Value range: Same as H19.02
...	...	...

Param.	Name	Description
H19: Target position parameters		
H19.117	Target value of position comparison 40	Defines the target value of position comparison 40. Value range: -2^{31} to 2^{31} - 1
H19.119	Attribute value of position comparison 40	Defines the attribute value of position comparison 40. Value range: Same as H19.02

Function operation

1. Description

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

- Position comparison switch
  When the value of H18.00 (Position comparison switch) changes from 0 to 1, position comparison starts and the value of H18.09 (Current state of position comparison) is updated to the start point of position comparison. When the value of H18.00 changes to 0, position comparison stops and the current comparison state will be cleared.
- Position comparison resolution
  The comparison resolution defines the number of pulses per revolution. Given the maximum and minimum limits on the target position (defined by group H19), you can reset the resolution when data overflow occurs on the comparison value. For example, when H18.02 is set to 7, the maximum value of the target position is 2^{31} - 1, and the motor rotates $(2^{31} - 1)/2^{17}$ turns. For SV670NS-INT servo drives, H18.02 (Position comparison output resolution) is invalid in the position comparison function when a DDL motor is used.

Note

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

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

  The real-time position feedback in the individual comparison mode is an absolute value, which means it is an accumulative value based on preceding comparison points, which cannot be cleared automatically.
- Cyclic comparison mode
  In the cyclic comparison mode, position comparison will not be switched off when the comparison end point is reached, and current position comparison value will be reset as the start point for position comparison. After comparison of each point is done, the real-time position feedback (H18.10) will be cleared and counted again for cyclic comparison. In the

cyclic comparison mode, the target position is a relative (incremental) value. Each time a comparison point is reached, the real-time position feedback is cleared and counted again for comparison with the new target.

- Fixed cyclic comparison
  In fixed cyclic comparison mode, the comparison process works in the same way as the cyclic comparison mode. The number of cycles is defined by H18.15. After the set number of cycles are done executing, comparison will be disabled automatically.
- Position comparison output width
  When the position comparison conditions are fulfilled, the servo drive outputs DO active level signal. The width of the active signal can be set in H18.05 (value range: 1 to 2047 x 0.1 ms).

  When position comparison DO is active, the comparison logic is suspended and no comparison will be performed. In this case, ensure the operating time between two target points is larger than the output width of DO.
- Target value of position comparison
  There are 40 target values for position comparison. The target value and attribute value of position comparison must be updated to parameters in group H19 in advance.

Note

Set the target position properly. overflow comparison (H18.10) is not supported in the position comparison mode.

- Start point for comparison
  The start point indicates the position of the first comparison point. For example, if the start point is set to 5, the comparison starts from position comparison 5.
- End point for comparison
  The end point indicates the position of the last comparison point. For example, if the end point is set to 7, the comparison stops or restarts from the start point after position comparison 7 is reached.
- Zero offset of position comparison
  The value of H18-10 (Real-time position feedback) will be changed to the offset value defined by H18-12 (Zero offset of position comparison) at the rising edge (0 → 1) of H18-04 (Present position as zero).

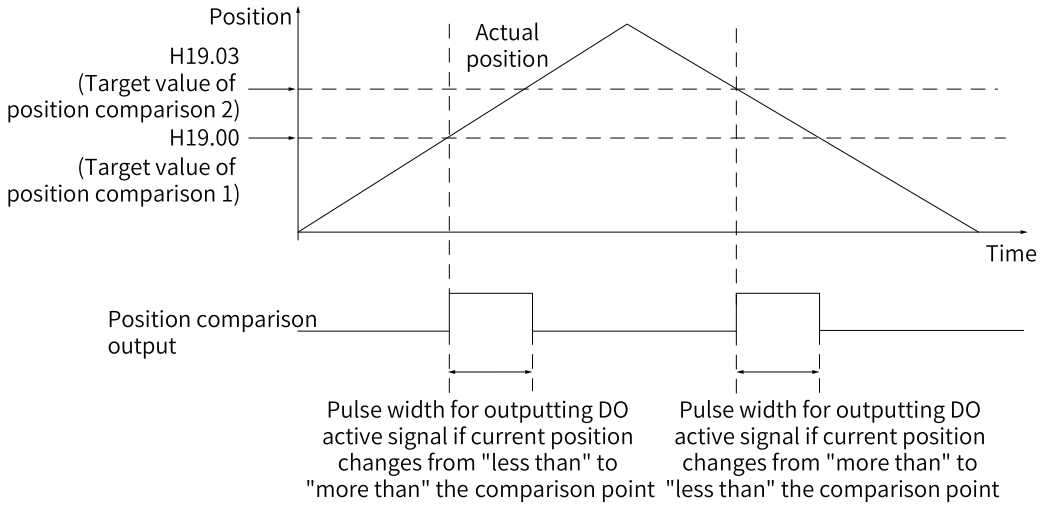
Note

Check whether zero offset needs to be set before enabling position comparison output. Otherwise, comparison error may occur.

---

2. Function operation

- When the position feedback of the encoder passes the target position comparison points, the output width of the output terminal is defined by H18.05 (Position comparison output width).

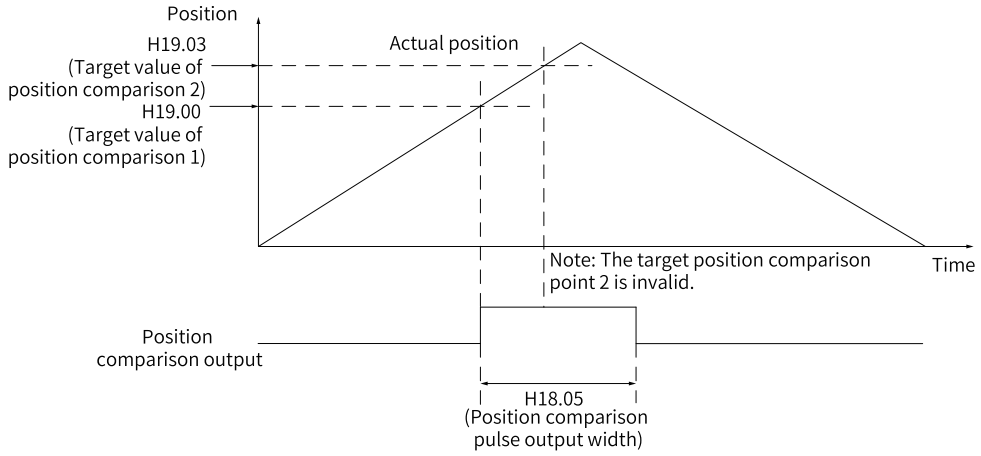


When the attribute of the comparison point is set to "bit0 = 1" (Output DO active signal if current position changes from "less than" to "more than" the comparison point), the DO outputs the position comparison signal when the axis passes the target position comparison point with position changing from "less than" to "more than" the comparison point position.

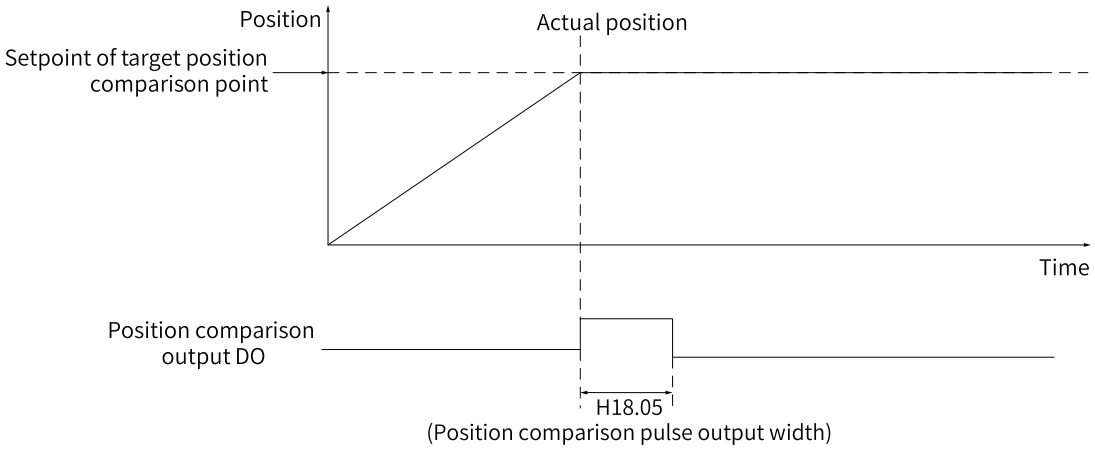
When the attribute of the comparison point is set to "bit1 = 1" (Output DO active signal if current position changing from "more than" to "less than" the comparison point), the DO outputs the position comparison signal when the axis passes the target position comparison point with position changing from "more than" to "less than" the comparison point position.

When the attribute of the comparison point is set to "bit0/bit1 = 1" (Output DO active signal in both situations), the DO outputs the position comparison signal when the position feedback passes the target position comparison point.

- When multiple position comparison values are set, no comparison will be performed once the position comparison output terminal is active. Therefore, ensure the operating time between two position comparison points is larger than the pulse output width.
  As shown in the following figure, comparison is not performed when the position changing from "more than" to "less than" the comparison point position. This is because the operating time between the two comparison points is lower than the pulse output width.



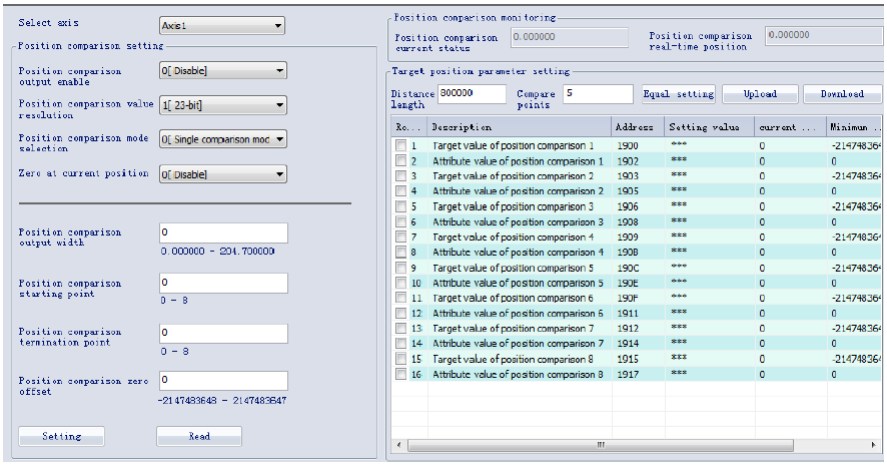
- Pulses will be outputted only once when the stop position is the same with the target value of position comparison, as shown in the following figure.



3. Interface of the software tool

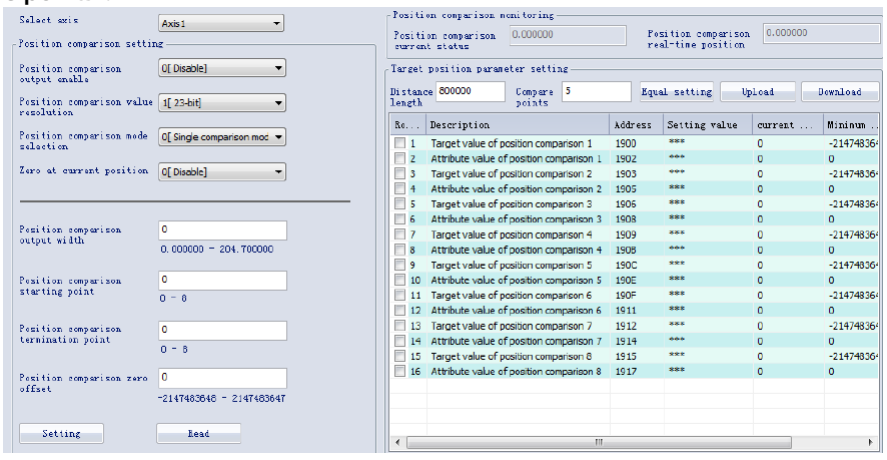
- Individual comparison mode

  a. Set H18.03 (Position comparison mode) to 0 (Individual position comparison).



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

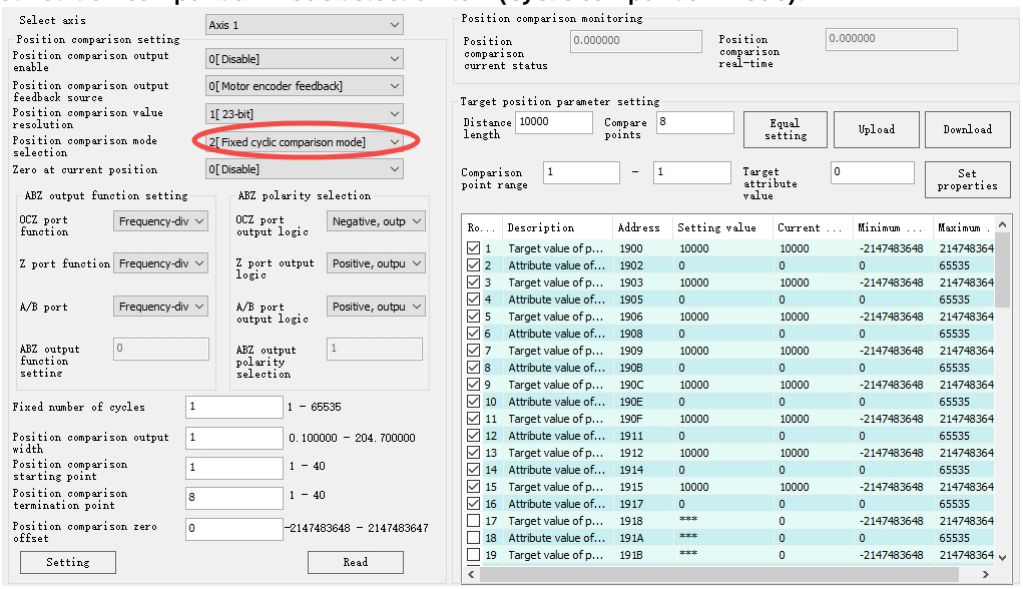
  c. After clicking **Equal setting**, the target value of the first point is updated to "**Distance length** x 1/**Compare points**", the target value of the second point is updated to "**Distance length** x 2/**Compare points**", and the target value of the Nth point is updated to "**Distance length**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



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

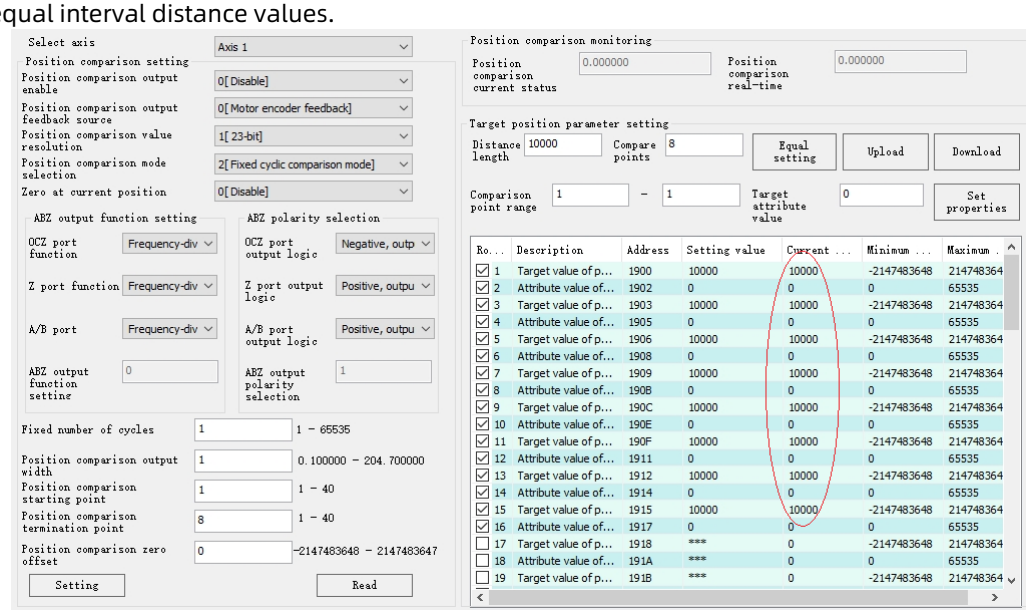
- Cyclic comparison mode/Fixed cyclic comparison mode

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



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

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



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

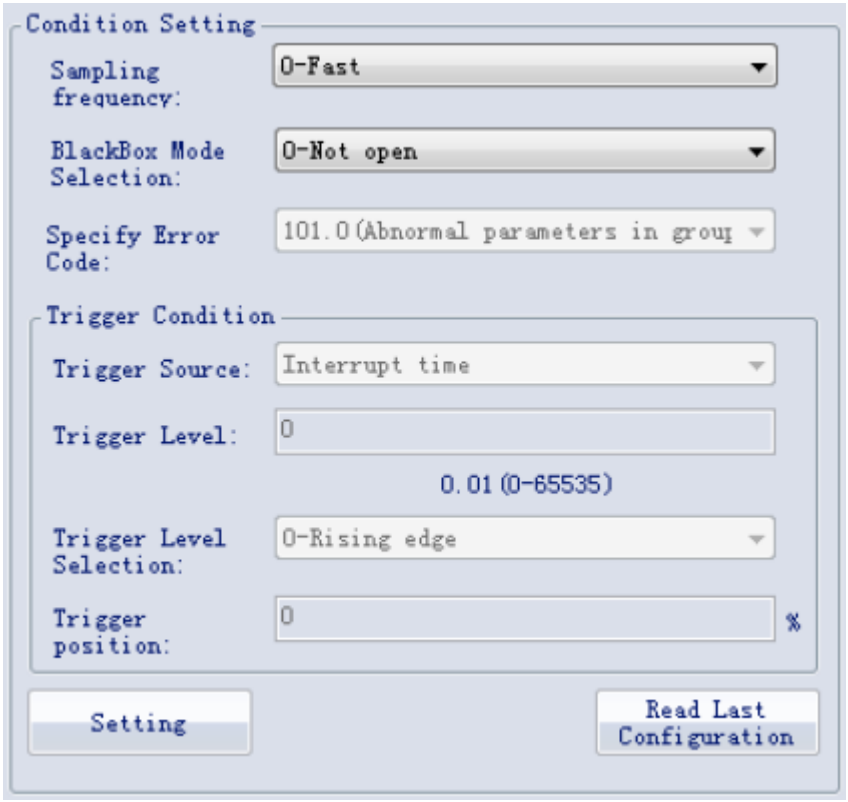
4.9 Black Box

Function description

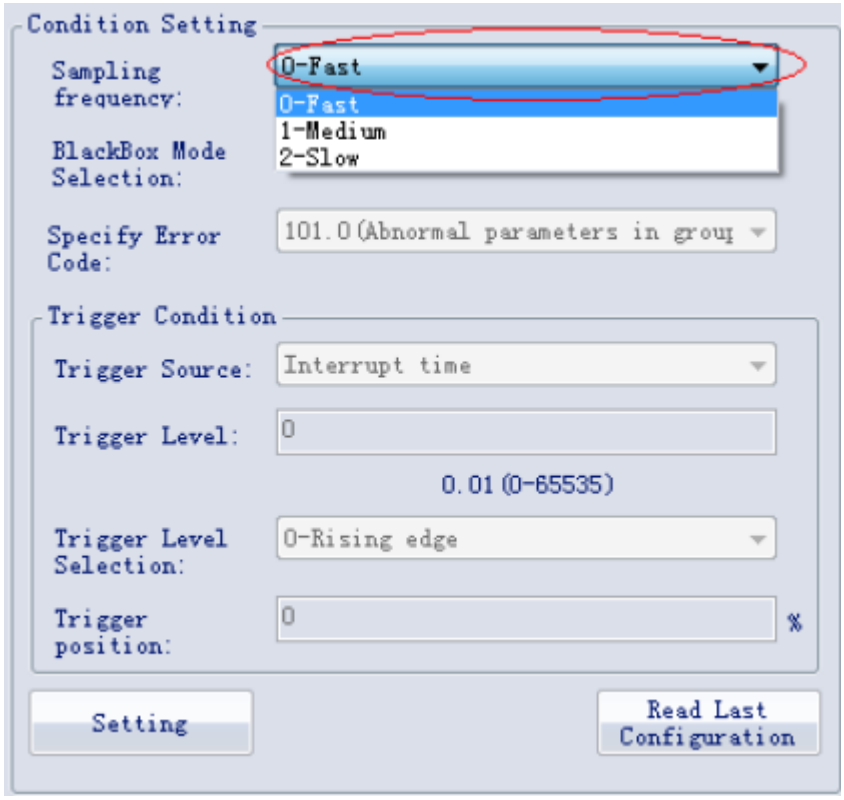
The black box function is used to capture and save the data generated upon occurrence of faults or under designated conditions. Such data can be read and uploaded by users through the software tool to facilitate troubleshooting. You can set H32.45 to configure the black box channel, facilitating root cause analysis for different types of issues. Assume that the real-time target speed (60FF)/ electrical angle channel is used. When H32.45 is set to 0, the real-time target absolute position (607A) is collected. When H32.45 is set to 1, the electrical angle is collected.

The black box is enabled by default. It is triggered upon occurrence of a fault or a sampling frequency of 16k. The black box function will be automatically turned off after it is being triggered, and automatically turned on upon fault reset or power cycling.

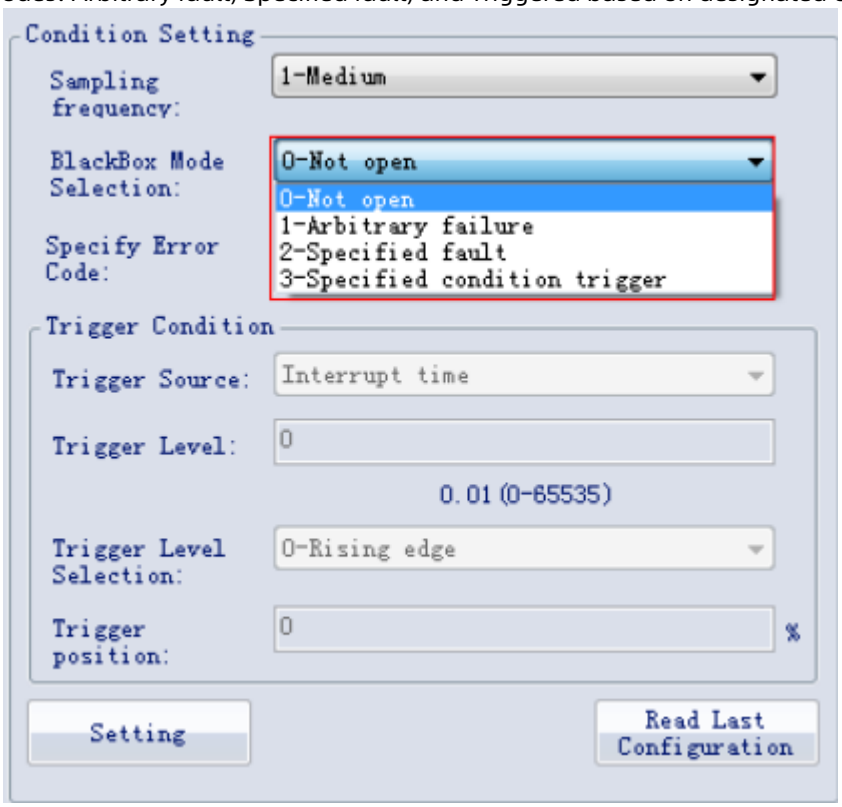
Triggering the black box



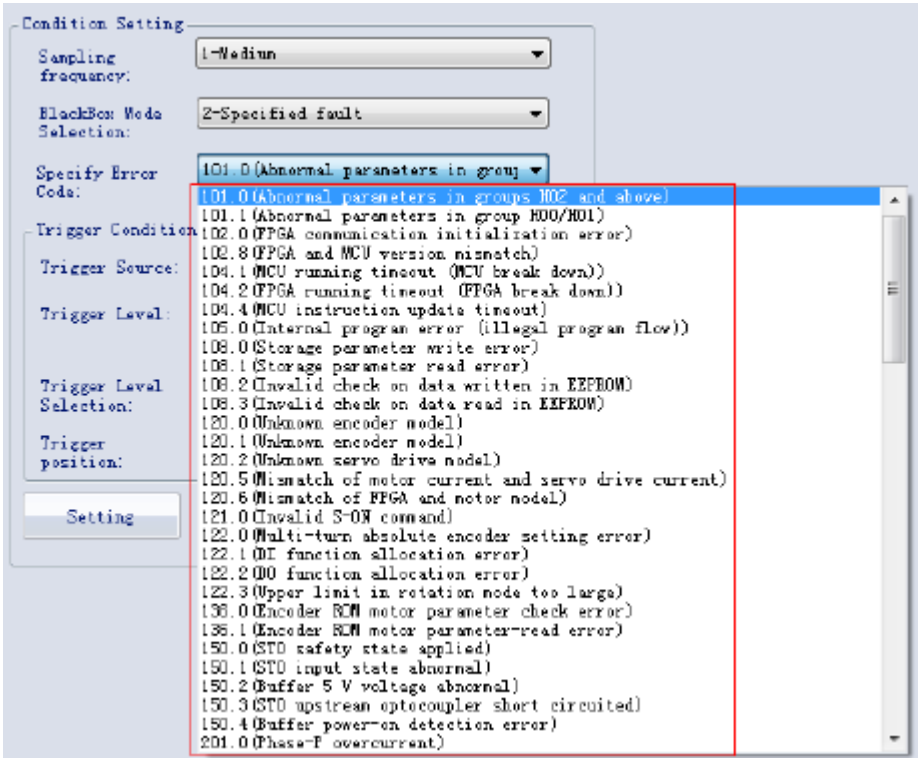
1. Sampling frequency: including three sampling frequencies, namely 16k (fast), 4k (medium), and 0.5k (slow).



2. Black box modes: Arbitrary fault, Specified fault, and Triggered based on designated condition.



3. Select a fault from the drop-down list, as shown below.



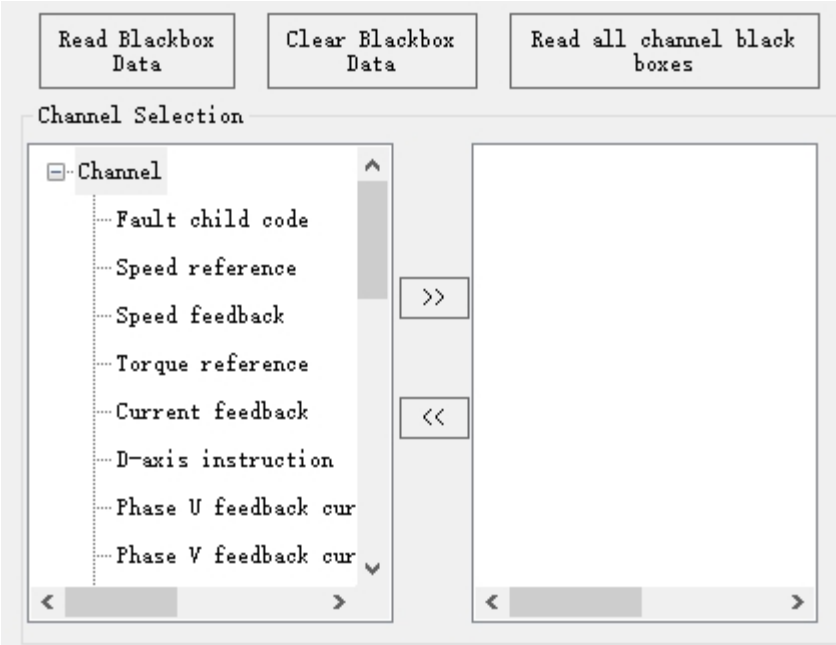
4. The Trigger Condition includes Trigger Source, Trigger Level, and Trigger Level Selection, as shown below.



5. Trigger position 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 data from the black box

You can select the black box channels (4 channels at most) by clicking >> or <<, or read data from all channels by clicking Read all, and then click "Save" to save the waveform files.



4.10 Touch Probe Function

Description

The touch probe function is the same as the position latch function. Position feedback sources include motor position and full closed-loop feedback. This feature latches the position information (reference unit) when an DI signal or Z signal changes.

SV680N-INT provides two touch probes for recording the positions of two probe signals at the rising edge and falling edge, which means four positions can be latched.

When a DI is used to trigger the touch probe, the relationship between the DI logic and the touch probe edge is shown in the following table. The touch probe is supported only by high-speed DIs.

Table 4–4 Description of bit3 of H0A.40

bit3 of H0A.40	Touch probe edge	DI logic	DI switch
0	Rising edge	Normally open (NO)	OFF→ON
		Normally closed (NC)	ON→OFF
	Falling edge	Normally open (NO)	ON→OFF
		Normally closed (NC)	OFF→ON
1	Rising edge	NO/NC	OFF→ON
	Falling edge	NO/NC	ON→OFF

When a DI is used to trigger the touch probe, you can set the filter window of the touch probe signal in H0A.19 and H0A.20.

The DI touch probe supports hardware action delay compensation to compensate for the precision loss incurred by ON/OFF delay of the DI. Related parameters are shown in the following table.

Parameter		Description
H0A.40	bit1	Touch probe rising edge compensation: 1: Enabled, 0: Disabled
	bit2	Touch probe falling edge compensation: 1: Enabled, 0: Disabled
H0A.53		DI probe DI ON compensation time (DI OFF→ON)
H0A.54		DI probe DI OFF compensation time (DI ON→OFF)

To shorten the hardware delay to about 7 μs, it is recommended to set the touch probe latch through the ON-edge of the DI.

There are three Z touch probe triggers: motor Z signal, frequency-division output Z signal, and fully closed-loop Z signal, as shown in the following table.

Feedback source	Parameter	Description
Motor encoder	H05.41.bit2 = 0, motor Z signal	The Z touch probe is triggered by the motor Z signal.
	H05.41.bit2 = 1, frequency-division output Z signal	The Z touch probe is triggered by the frequency-division output Z signal, including the multi-turn Z signal.
Fully closed-loop feedback	H0F.25 = 0, motor Z signal	When there is no Z signal input in the pulse-type fully closed-loop mode, you can trigger the touch probe through the motor Z signal to latch external position feedback.
	H0F.25 = 1, fully closed-loop Z signal	When there is Z signal input in the pulse-type fully closed-loop mode, you can trigger the touch probe latch function through the fully closed-loop Z signal.

Parameter	Comm. address	Function	Value range	Default value	Unit	Change mode	Page
60B8h	60B8h	Touch probe mode	0x0 to 0xFFFF	0x0	-	Real time	"60B8h" on page 993
60B9h	60B9h	Probe status	0x0 to 0xFFFF	0x0	-	Read-only	"60B9h" on page 994
60BAh	60BAh	Position value at probe 1 rising edge	-2147483648 to +2147483647	0	Reference unit	Read-only	"60BAh" on page 995
60BBh	60BBh	Position value at probe 1 falling edge	-2147483648 to +2147483647	0	Reference unit	Read-only	"60BBh" on page 995
60BCh	60BCh	Position value of probe 2 rising edge	-2147483648 to +2147483647	0	Reference unit	Read-only	"60BCh" on page 996
60BDh	60BDh	Position value of probe 2 falling edge	-2147483648 to +2147483647	0	Reference unit	Read-only	"60BDh" on page 996
60D5h	60D5h	Touch probe 1 rising edge counter	0x0 to 0xFFFF	0x0	-	Read-only	"60D5h" on page 997
60D6h	60D6h	Touch probe 1 falling edge counter	0x0 to 0xFFFF	0x0	-	Read-only	"60D6h" on page 997

Parameter	Comm. address	Function	Value range	Default value	Unit	Change mode	Page
60D7h	60D7h	Touch probe 2 rising edge counter	0x0 to 0xFFFF	0x0	-	Read-only	"60D7h" on page 997
60D8h	60D8h	Touch probe 2 falling edge counter	0x0 to 0xFFFF	0x0	-	Read-only	"60D8h" on page 997

Procedure

Example:

Use DI5 to trigger the touch probe. Background: touch probe 1 rising edge, continuous latching

Perform the following steps:

1. Set the function of DI5 (H03.10 = 38). Set the DI5 logic to NO (H03.11 = 0).
2. Set the touch probe function in 60B8h.

☆ Related parameters:

Parameter	Comm. address	Function	Value range	Default value	Unit	Change mode	Page
60B8h	60B8h	Touch probe mode	0x0 to 0xFFFF	0x0	-	Real time	"60B8h" on page 993

Assignment of each bit of the touch probe function (60B8h) is shown in the following table.

bit	Name	Description
0	Touch probe 1 enable 0: Disable 1: Enable	bit 0 to bit 5: settings related to touch probe 1 When a DI is used to trigger the touch probe function, the DI source cannot be changed once the touch probe function is enabled. For absolute encoders, Z signal refers to the zero point of the single-turn motor position feedback.
1	Touch probe 1 trigger mode 0: Single trigger mode (Latches the position at the first trigger event.) 1: Continuous trigger mode	
2	Touch probe 1 trigger signal selection 0: DI signal 1: Z signal	
3	N/A	
4	Touch probe 1 rising edge 0: Latching at rising edge disabled 1: Latching at rising edge enabled	
5	Touch probe 1 falling edge 0: Latching at falling edge disabled 1: Latching at falling edge enabled	
6 to 7	N/A	-

bit	Name	Description
8	Touch probe 2 function selection 0: Disable 1: Enable	bit 8 to bit 13: settings related to touch probe 2
9	Touch probe 2 trigger mode 0: Single trigger mode (Latches the position at the first trigger event.) 1: Continuous trigger mode	
10	Touch probe 2 trigger signal selection 0: DI signal 1: Z signal	
11	N/A	
12	Touch probe 2 rising edge 0: Latching at rising edge disabled 1: Latching at rising edge enabled	
13	Touch probe 2 falling edge 0: Latching at falling edge disabled 1: Latching at falling edge enabled	
14 to 15	N/A	-

In this example, 60B8h is set to 0x0013.

3. Read the touch probe status in 60B9h.

☆ Related parameters:

Parameter	Comm. address	Function	Value range	Default value	Unit	Change mode	Page
60B9h	60B9h	Probe status	0x0 to 0xFFFF	0x0	-	Read-only	"60B9h" on page 994

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

bit	Name	Description
0	Touch probe 1 enable 0: Disable 1: Enable	bit 0 to bit 2: status of touch probe 1
1	Touch probe 1 rising edge value 0: No rising edge value latched 1: Rising edge value latched	
2	Touch probe 1 falling edge value 0: No falling edge value latched 1: Falling edge value latched	
3 to 5	N/A	-
6 to 7	Trigger count of the touch probe when the function of touch probe 1 is set to continuous sampling	Trigger count (0 to 3) of the touch probe when the function of touch probe 1 is set to continuous sampling

bit	Name	Description
8	Touch probe 2 function: 0: Disable 1: Enable	bit 8 to bit 10: status of touch probe 2
9	Touch probe 2 rising edge value 0: No rising edge value latched 1: Rising edge value latched	
10	Touch probe 2 falling edge value 0: No falling edge value latched 1: Falling edge value latched	
11 to 13	N/A	-
14 to 15	Trigger count of the touch probe when the function of touch probe 2 is set to continuous sampling	Trigger count (0 to 3) of the probe when the function of probe 2 is set to continuous sampling

In this example, you can read bit1 of 60B9h to check whether the touch probe 1 rising edge value is latched.

4. Read the latch position of the touch probe

The four position values of the touch probe are recorded in 60BAh to 60BDh.

In this example, if the function of the position latch at the positive edge of touch probe 1 is executed, you can read the position value in 60Bah (Touch probe 1 positive edge, reference unit). The latching count can be read in 60D5h.

Illustration

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

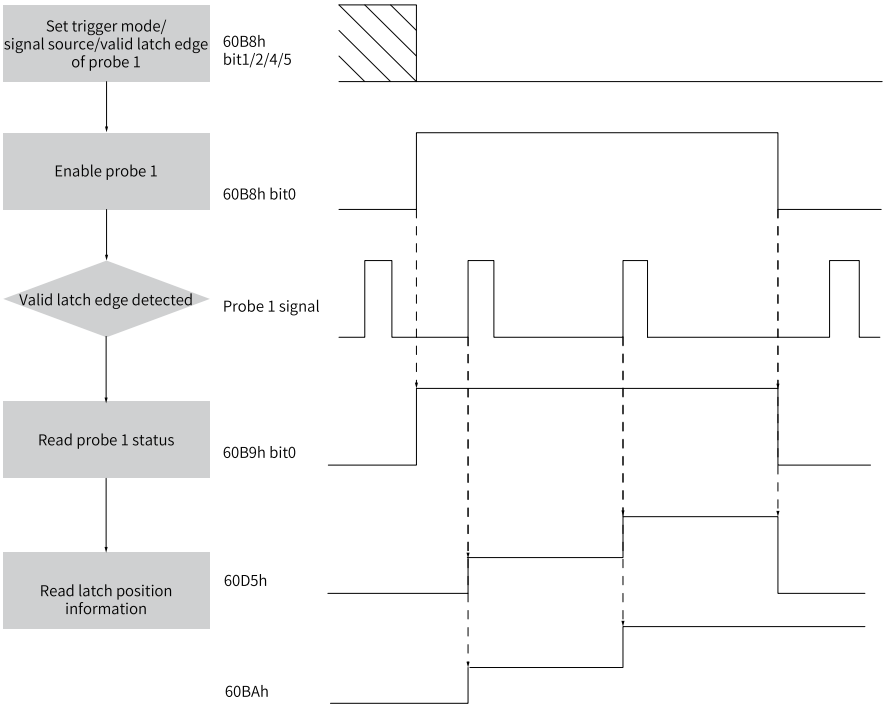


Figure 4-6 Procedure for using the touch probe

4.11 SEMI F47 Voltage Drop

Function

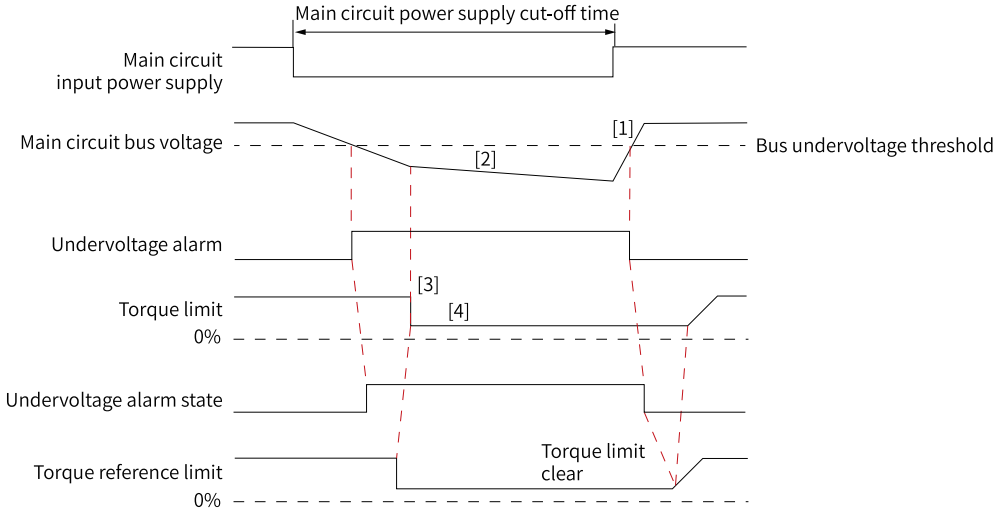
When the DC voltage of the main circuit of the drive is lower than the undervoltage threshold due to instantaneous power failure or temporary low power supply voltage of the main circuit, E971.0 is reported to limit the output current. E971.0 can be masked through bit1 of H0A.88.

With combination of this function and H0A.84 (instantaneous power outage holding time), the drive can continue to run when the power supply voltage decreases, even if the alarm is reported.

Function description

This function can be executed by the instruction issued by the host controller or the servo drive. You can choose through H0A.81 (enable voltage drop protection).

- **When executed by the host controller (H0A.81 = 1)**
  After receiving the undervoltage alarm (E971.0), the host controller limits the torque, and removes torque limit after receiving the E971.0 signal (Alarm cleared).



Note

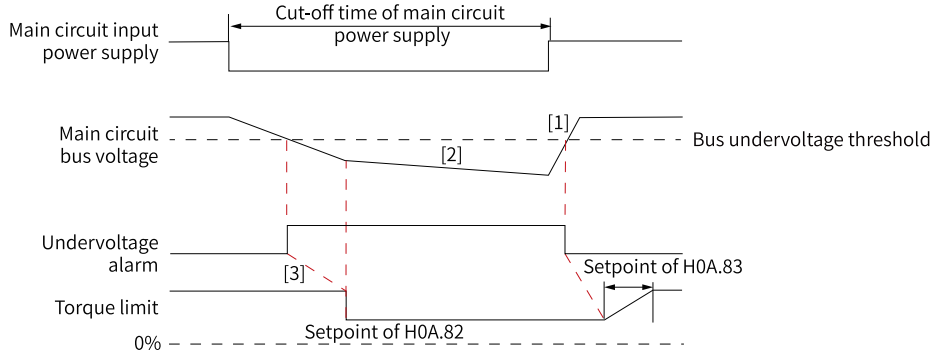
- [1]: After the main circuit power supply is restored, the bus voltage of the main circuit rises.
- [2]: By limiting the output torque, you can reduce the bus voltage of the main circuit gently.
- [3]: Torque limiting starts.
- [4]: Limit torque after an undervoltage warning is received.

  - When H07.07 = 0:
    For SV680N-INT: The forward torque limit is the smaller value between 60E0h and 6072h. The reverse torque limit is the smaller value between 60E1h and 6072h.
  - When H07.07 is set to 1, the torque reference limit is determined by the logic of the external DI signal.
    For SV680N-INT: The forward torque limit is selected between min{60E0h,6072h} and H07.11 (Forward external torque limit). The reverse torque limit is selected between min{60E1h, 6072h} and H07.12 (Reverse external torque limit).

- When H07.07=2, you select AI1 or AI2 as the torque limit input source for T-LMT through H07.08.
- When H07.07 = 3:
  DI-PCL (Forward external torque limit) is ineffective, and the forward limit is determined by AI input. DI-PCL (Forward external torque limit) is effective, and the forward limit is determined by the smaller one between H07.11. The torque corresponding to AI input voltage.

  DI-NCL (Reverse external torque limit) is ineffective, and the reverse limit is determined by AI input. DI-NCL (Reverse external torque limit) is effective, and the reverse limit is determined by the smaller one between H07.12 and the torque corresponding to AI input voltage.
- When H07.07 = 4:
  For SV680N-INT:
  - DI-PCL (Forward external torque limit) is ineffective, and the forward limit is determined by min{60E0h,6072h}. DI-PCL (Forward external torque limit) is effective, and the forward limit is determined by the AI input voltage.
  - DI-NCL (Reverse external torque limit) is ineffective, and the reverse limit is determined by min{60E1h,6072h}. DI-PCL (Forward external torque limit) is effective, and the reverse limit is determined by the AI input battery.

- **When executed by the drive (H0A.81 = 2)**
  According to the undervoltage E971.0 alarm, apply the torque limit inside the servo drive; After receiving the undervoltage alarm clear signal, the torque limit value is controlled in the servo drive according to the set time.



Note

- [1]: After the main circuit power supply is restored, the bus voltage of the main circuit rises.
- [2]: By limiting the output torque, you can reduce the bus voltage of the main circuit gently.
- [3]: Torque limiting starts.

- **The E971.0 undervoltage alarm is not detected (H0A.81 = 0)**
  Voltage drop does not trigger the E971. 0 alarm, but the E410.0 alarm.

Related parameters

Param.	Comm. address	Name	Value	Default	Unit	Change mode
H0A.81	200A-52h	Voltage drop protection selection	0: Not detect 1: Torque limit executed through the host controller 2: Local torque limit of the drive	0	-	At stop
H0A.82	200 A-53h	Voltage drop torque limit	0.0 to 100.0	50.0	%	Real time
H0A.83	200 A-54h	Torque limit cancellation time	0 to 1000	100	ms	Real time
H0A.84	200 A-55h	Hold time of instantaneous power failure	20 to 50000	1000	ms	Real time

Note

- This function is suitable for instantaneous power outage with the voltage and time specified by SEMI F47. If the voltage and time beyond this range, a standby power supply is needed.
- When the power supply of the main circuit is restored, use the torque limit of the host controller or servo drive to set the torque, so as to avoid the output torque being greater than the commanded acceleration torque.
- When used on vertical axes, do not limit the torque below the holding torque.
- This function is to limit the torque within the capacity of the powered off servo drive, and is not applicable to all load conditions or operating conditions. The parameter to be set may vary with the actual device.
- After you set H0A.84, the time from disconnecting the power supply to stopping the motor power will become longer. You can power off the motor immediately through the input and output of servo ON input signal.

4.12 Accuracy Compensation

4.12.1 Accuracy Compensation Function

The accuracy compensation function is applicable only to DDL and DDR motors.

In precision mechanical and electrical scenarios (such as silicon crystals, semiconductors, and TP), a high absolute control accuracy is required. However, excessive deviation can occur between the actual motor position and encoder position feedback due to the direct-drive motor errors (such as parallelism/flatness/concentricity of motor installation, thermal deformation of materials, and design tolerances), encoder errors (such as grating scale design tolerances, non-uniform grating line process, thermal deformation of the scale, and insufficient parallelism/concentricity in the assembly of the scale and read head), and errors caused by motor abrasion due to long-term operation. In actual applications, the drive can use only the position information fed back by the encoder as the basis for motor position control. In this case, incorrect position feedback can result in inaccurate absolute control of the direct-drive motor.

Therefore, the SV680N-INT series servo drive is equipped with the accuracy compensation function for calibrating the physical accuracy of the motor, as shown in *"Figure 4-7" on page 214* .

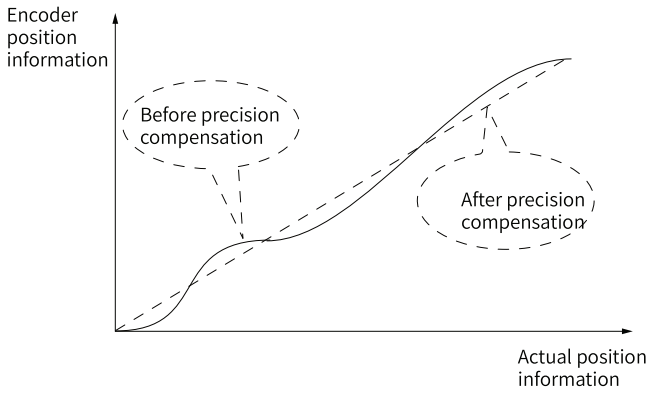


Figure 4-7 Accuracy compensation effect

Basic principle: The accuracy error compensation table is obtained by using external high-precision distance/angle measurement devices. During the application phase, real-time compensation is performed on the current position based on this table to obtain calibrated position information.

The accuracy compensation function is applicable to different encoder types and motor types, as shown below.

No.	Application
1	DDL accuracy compensation application with ABZ incremental encoder (TTL signal)
2	DDL accuracy compensation application with Inovance incremental encoder
3	DDL accuracy compensation application with BiSS-C absolute encoder
4	DDL accuracy compensation application with SSI encoder
5	DDL accuracy compensation application with EnDat 2.2 encoder
6	DDR accuracy compensation application with ABZ incremental encoder (TTL signal)
7	DDR accuracy compensation application with Inovance incremental encoder
8	DDR accuracy compensation application with BiSS-C absolute encoder
9	DDR accuracy compensation application with SSI encoder
10	DDR accuracy compensation application with EnDat 2.2 encoder

Regardless of the accuracy compensation application method, this function involves the accuracy compensation table acquisition stage and real-time accuracy compensation stage. You can use the accuracy compensation module in the software tool to perform corresponding operations.



The following describes a DDL motor with ABZ incremental encoder (TTL signal) as an example, which also applies to a DDL motor with Inovance communication incremental encoder.

Preparation

1. Acquire the accuracy compensation data table, as described in *“Figure 4-8” on page 215* . The accuracy compensation data table includes the linear motor ①, encoder ②, drive ③, controller ④, PC ⑤, and laser interferometer with matching measurement lens.

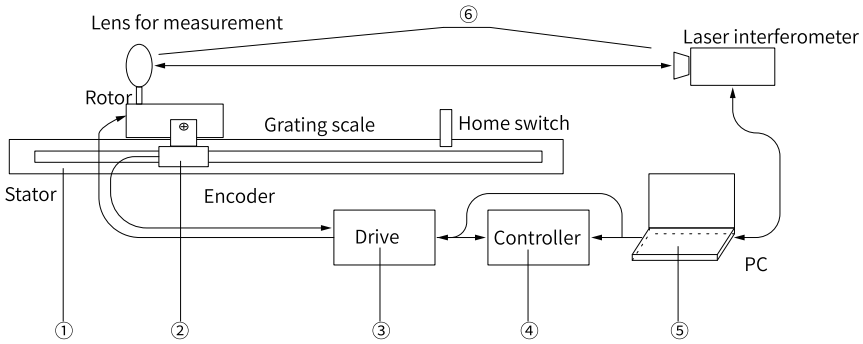


Figure 4-8 Structure of accuracy compensation table

2. Apply accuracy compensation control, as shown in *"Figure 4-9" on page 215* . This stage involves the encoder ①, linear motor ②, drive ③, and controller ④.

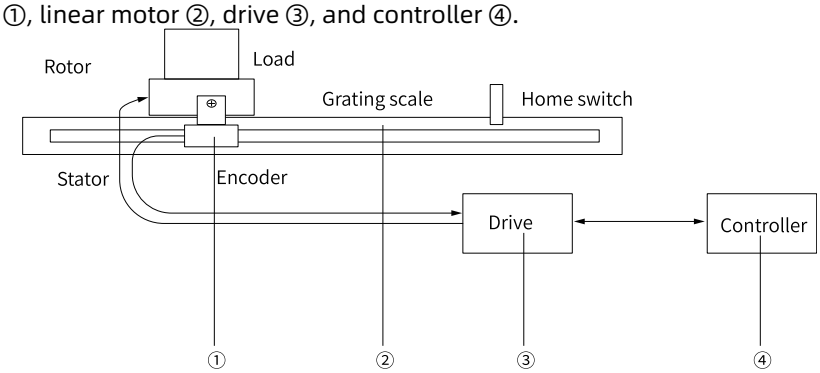


Figure 4-9 Structure of linear motor operation accuracy compensation

---

Note

That basically also applies to DDR, except that you need to use an angle measuring laser interferometer rather than a laser ranging interferometer.

Accuracy compensation table acquisition

- In this stage, you can obtain the accuracy compensation data table for subsequent accuracy compensation control. The schematic diagram and flowchart are shown in *"Figure 4-10" on page 215* *"Figure 4-11" on page 216* .

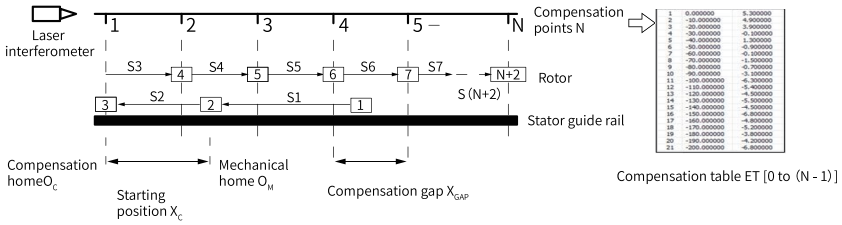


Figure 4-10 Schematics for accuracy compensating table acquisition

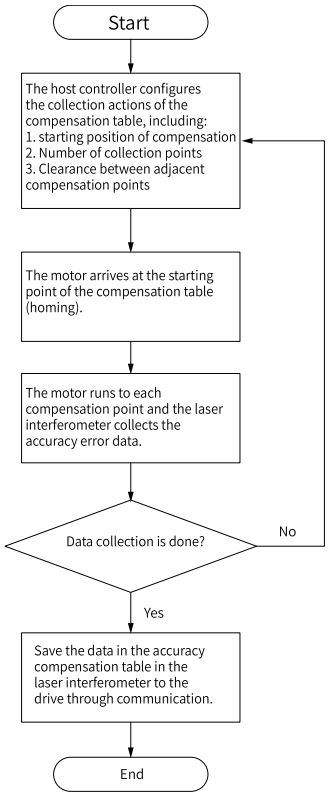
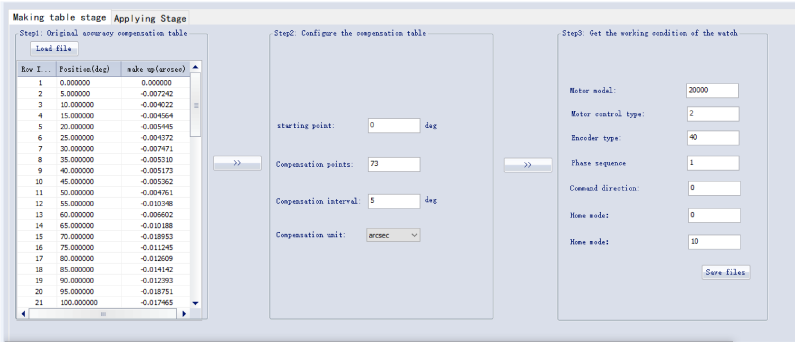


Figure 4-11 Flowchart for accuracy compensating table acquisition

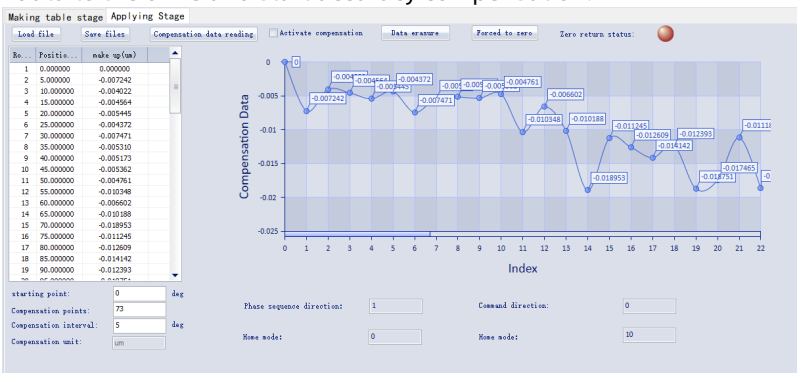
The following shows detailed procedure.

- S1: Controller (or use the accuracy compensation operation control of the PR module in the software tool) that used to control the linear motor to perform homing from any position at power-on to the mechanical home (O_M).
- S2: The controller drives the linear motor from the mechanical home (O_M) to the compensation home O_C, which is the base point of the compensation coordinate system. The displacement distance starts from the compensation start position X_{OCOM}.
- S3: The laser interferometer performs base point calibration at the compensation home O_C and acquires the compensation deviation at the first compensation point. After the deviation data is obtained, the controller drives the linear motor to the next compensation point according to the compensation interval X_{GAP}.
- S4 to S (N+2): The laser interferometer obtains deviation data at the current compensation point. After the deviation data is obtained, the controller continues to drive the linear motor according to the compensation interval X_{GAP} to the next position. This process is repeated until the Nth compensation point is obtained, which forms the compensation table ET [0 to (N - 1)].
- S (N+3): Open the applicable software tool, connect the drive, choose "Accuracy compensation > Making table stage", and then operate as shown below to pre-process the accuracy compensation error table obtained by the laser interferometer.

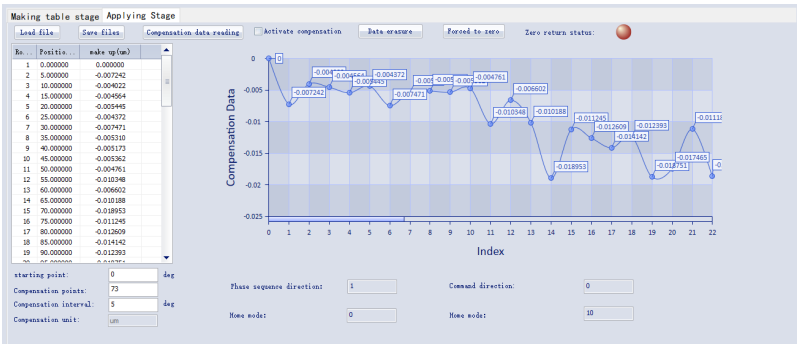


Application stage (accuracy compensation table sent to the drive and enabled)

- S1: Open the applicable software tool, connect the drive, choose "Accuracy compensation > Making table stage", and then operate as shown below to send the pre-processed accuracy compensation data to the drive and start accuracy compensation.



Functions of other keys on this interface are shown below.



- S2: When the accuracy compensating table is received by the drive, E941.0 is reported, indicating that the compensating table will be activated at next power-on. Power off and on again and perform angle auto-tuning and homing. After angle auto-tuning and homing operations are completed, accuracy compensation is started. Drive the motor rotor to move within the effective compensation range. If the index of the row No. in the loading file changes accordingly, the accuracy compensation function is working properly.

Ro...	Positio...	make up(um)
1	0.000000	0.000000
2	5.000000	-0.007242
3	10.000000	-0.004022
4	15.000000	-0.004564
5	20.000000	-0.005445
6	25.000000	-0.004372
7	30.000000	-0.007471
8	35.000000	-0.005310
9	40.000000	-0.005173
10	45.000000	-0.005362
11	50.000000	-0.004761
12	55.000000	-0.010348
13	60.000000	-0.006602
14	65.000000	-0.010188
15	70.000000	-0.018953
16	75.000000	-0.011245
17	80.000000	-0.012609
18	85.000000	-0.014142
19	90.000000	-0.012393

Application of other encoder and motor types

Table 4–5 Instructions for DDL or DDR application with BiSS-C/SSI/EnDat 2.2 encoders

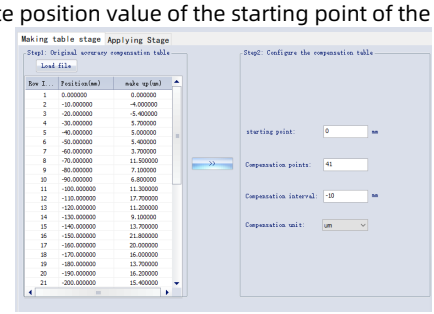
Comparison with the DDL motor equipped with ABZ incremental encoder (TTL signal)	
Preparation	Same
Table acquisition stage	• Homing not required • The start position is the absolute position value of the starting point of the laser interferometer. 
Application stage	The accuracy compensation table received by the drive is activated automatically at next power-on, without the need for homing.

Table 4–6 Application of the DDR motor with ABZ incremental encoder (TTL signal) or Inovance incremental encoder

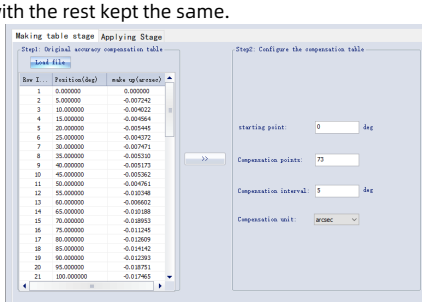
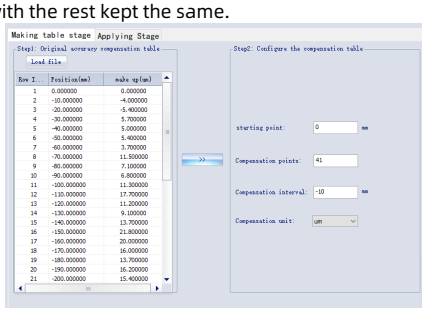
Comparison with the DDL motor equipped with ABZ incremental encoder (TTL signal)	
Preparation	The laser interferometer changes from distance measurement to angle measurement.
Table acquisition stage	The unit changes to deg and arcsec, with the rest kept the same. 
Application stage	Same

Table 4–7 Application of the DDR motor equipped with Inovance absolute encoder

Comparison with the DDL motor equipped with ABZ incremental encoder (TTL signal)	
Preparation	The laser interferometer changes from distance measurement to angle measurement.
Table acquisition stage	Homing not required The start position is the absolute position value of the starting point of the laser interferometer. The unit changes to deg and arcsec, with the rest kept the same. 
Application stage	Same

Note

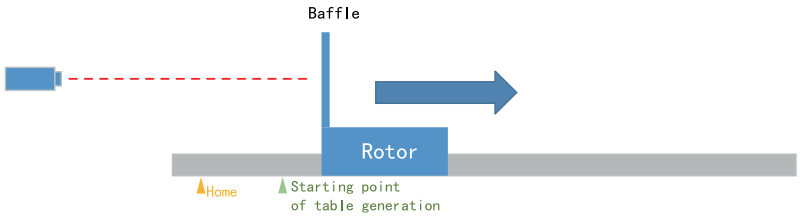
- The accuracy compensation function has the same accuracy compensation effect for frequency-division output.
- In DDR application mode, the maximum angle corresponding to the compensation points is allowed to be less than one revolution (that is, the calibration points × calibration interval ≤ 360 degrees), but it cannot be higher than one revolution. Otherwise, logic confusion can occur.

4.12.2 Application Cases

This example provides a setting method. Adjust the specific parameters according to actual accuracy requirements.

Case 1

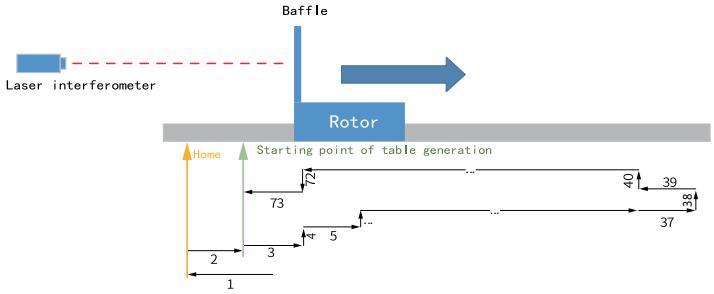
Assume that the effective stroke of a linear motor rotor is 1 m, the resolution of a quadrature pulse encoder is 0.1 μm/pulse, the home locates near the limit switch at the left limit position (forward when from left to right), and the starting position of table generation is 10 cm near the forward direction of the home. The following formula apply when table generation is required every 5 cm from the starting position.



Home offset: 10 cm = 100000 μm = 100000 μm/(0.1 μm/pulse) = 1000000 pulse

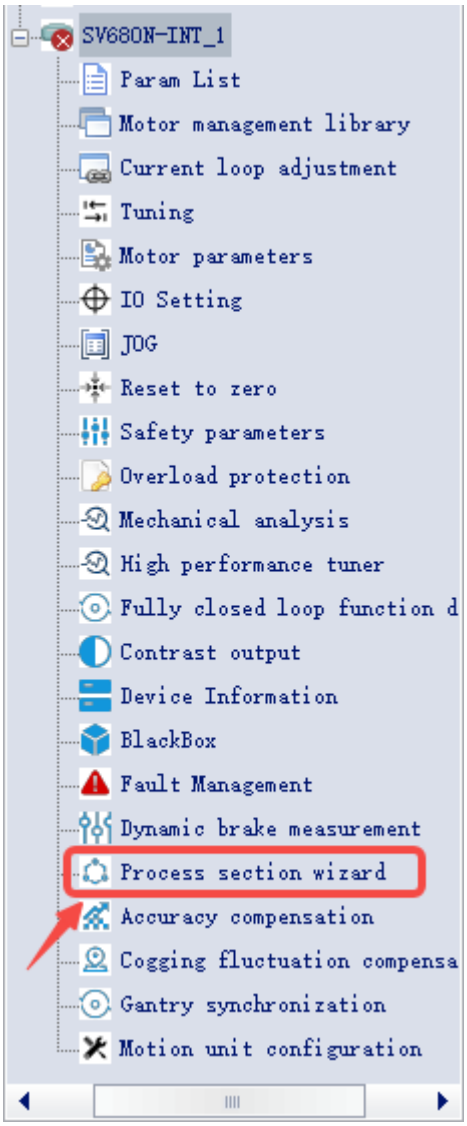
Segments of table generation: (1 m - 0.1 m)/0.05 m = 18 segments

Incremental calculation of single-segment operation: 5 cm = 50,000 μm = 50,000 μm/(0.1 μm/pulse) = 500,000 pulse

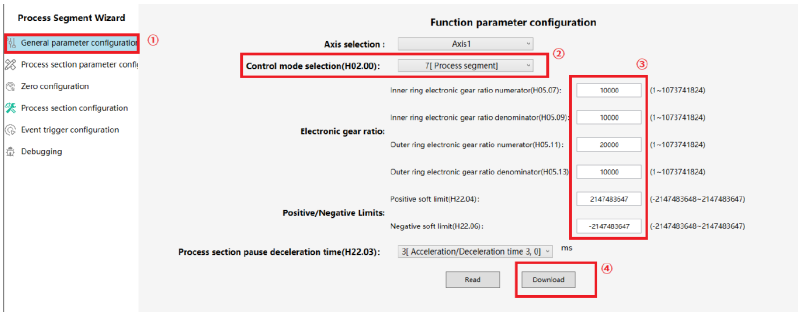


Setting procedure for accuracy compensation table generation

1. The operation is performed in process segment mode.

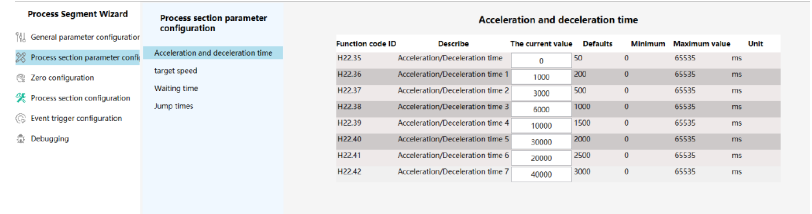


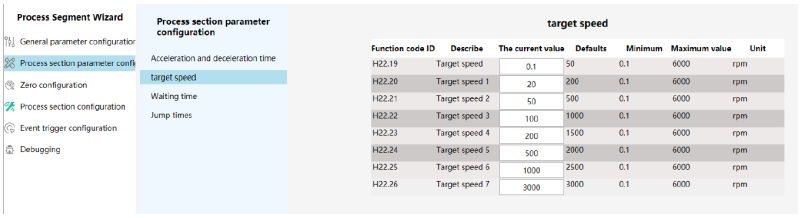
2. Set the basic parameters.



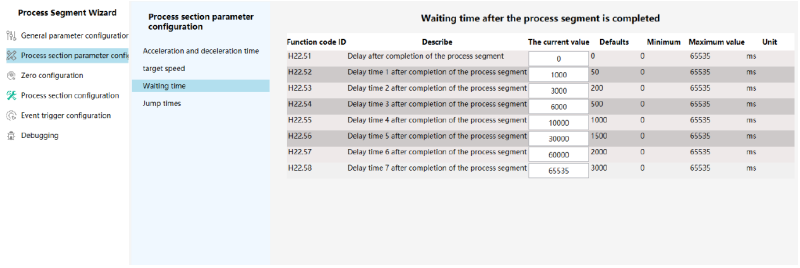
3. Set process segment parameters according to actual conditions.

a. Use default values of acceleration and target speed and click "Jump count".

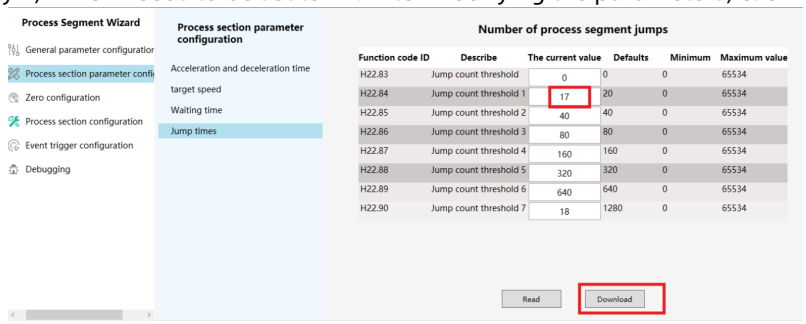




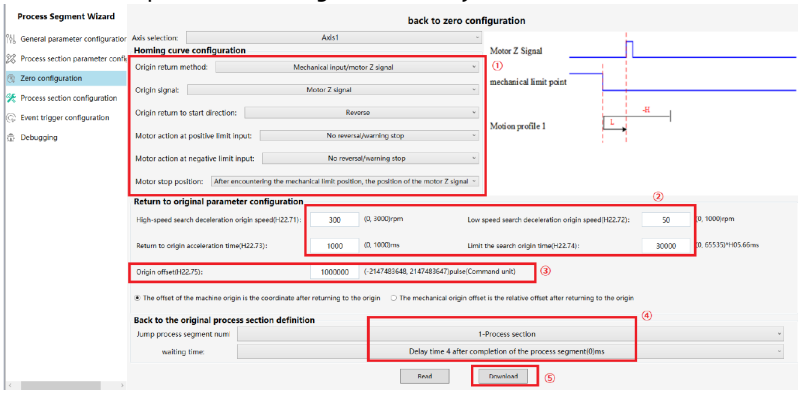
b. The waiting time can be changed. In case 1, the waiting time is set to 10s.



c. The number of segments is 18, with the last jump included, so the jump count needs to be subtracted by 1, which needs to be set to 17. After modifying the parameters, click "Download".

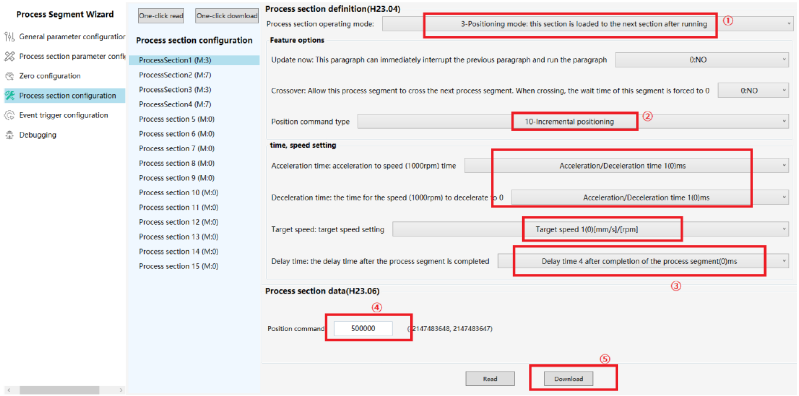


4. Configure homing parameters. Because the left limit switch is the home, you need to locate the limit switch in the reverse direction, and configure the homing speed. In case 1, the homing offset is set to 1000000 (home offset calculated above), and the jump process segment is set to process segment 1, the delay time is set to 10s. Click "Download" after the parameters are set. Note: The waiting position is the first point for table generation by the laser interferometer.

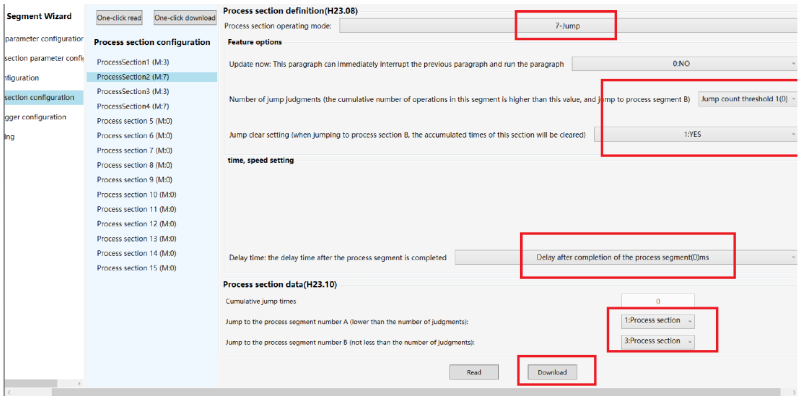


5. Configure process segment parameters.

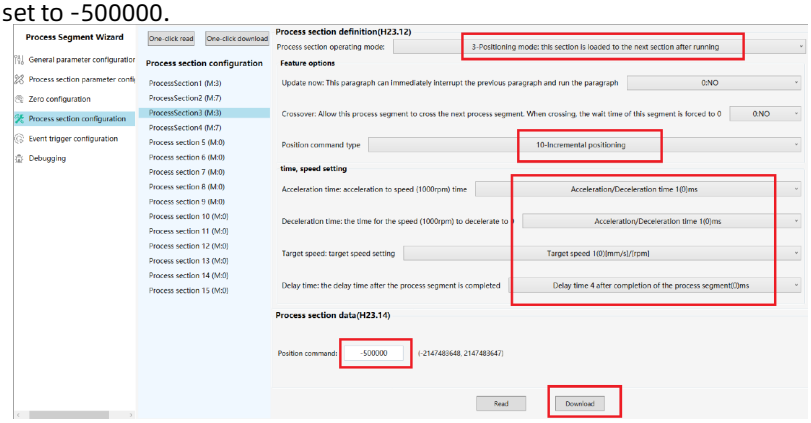
a. Select mode 3 for process segment 1 and incremental mode for position reference. Set the target speed and the delay time to 10s. Set the position reference to 50000 pulse, and click "Download" after the parameters are set.



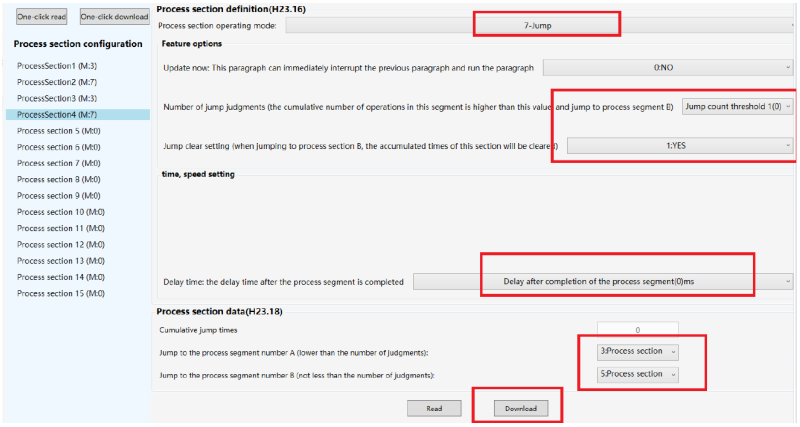
b. The process segment 2 is configured to jump at mode 7. Set the Jump judgment count to 17 as set previously. And set "Jump clear setting" to "Yes". Set the jump delay time to 0 ms (as single-segment operation has been delayed 10s), set "Jump to process segment A" to process segment 1 and execute cyclically. Set "Jump to process segment B" to process 3. Click "Download" after the parameters are set.



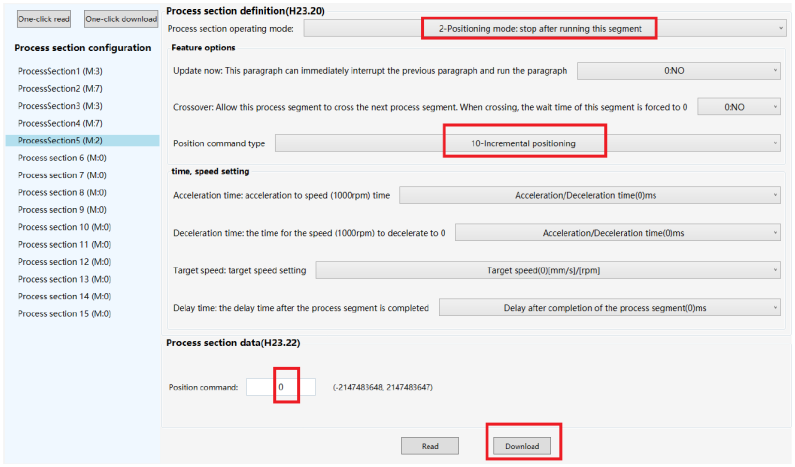
c. The setting for process segment 3 is the same as the process segment 1, except that the position reference is set to -500000.



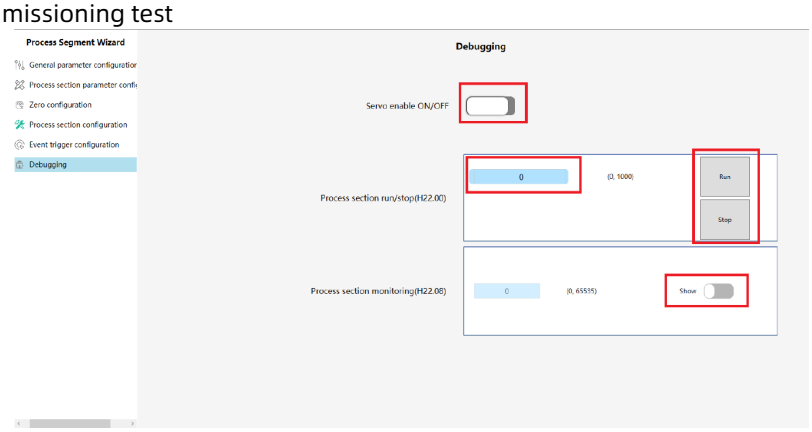
d. The setting for process segment 4 is as follows. Note that the jump condition for process segment 4 differs from that for process segment 2.



e. Set process segment 5 to "Positioning mode: Stop when this segment is done running" and the position type to "Incremental positioning". Set the reference to 0. Click "Download" after the parameters are set.



6. Perform commissioning test

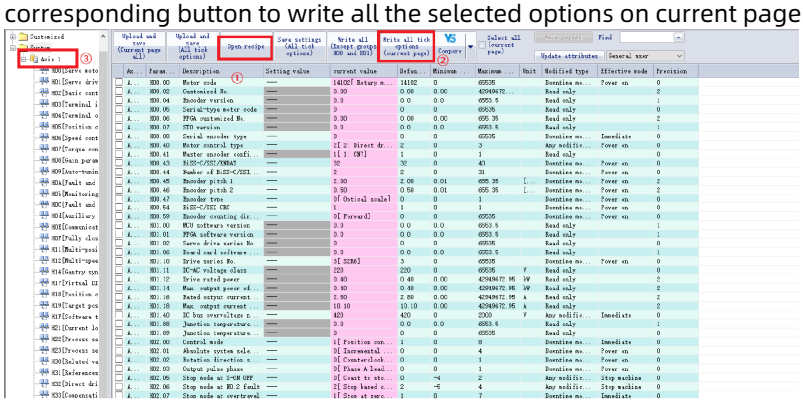


Simple setting procedure for accuracy compensation table generation

1. Click "Parameter list".

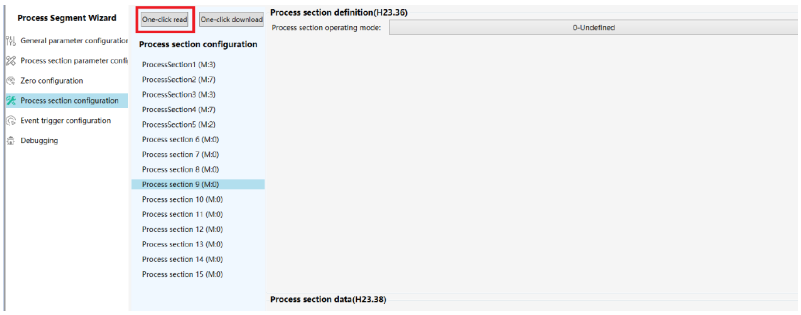


2. Click "Open parameter file", select the parameter file below, click "Left axis 1", and click the corresponding button to write all the selected options on current page.



The parameters are provided below. You can download all parameters to the drive and perform commissioning directly.

3. Enter the process section page, click "One-click Read," and all parameters will be available.

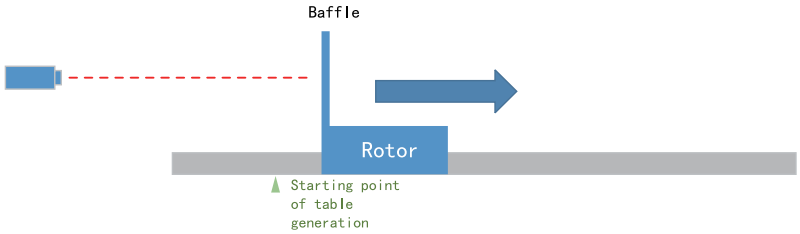


4. Perform the commissioning test.

SV680-INT accuracy compensation table - Process segment case 1.inoparam

Case 2

Assume that the effective stroke of a linear motor rotor is 1 m, the resolution of a BiSS-C absolute encoder is 0.1 μm/pulse, the home is not available (forward when from left to right), the starting position of table generation is 1000000 away from absolute position, and the remaining length is 0.9 m. The following formula apply when table generation is required every 5 cm from the starting position.

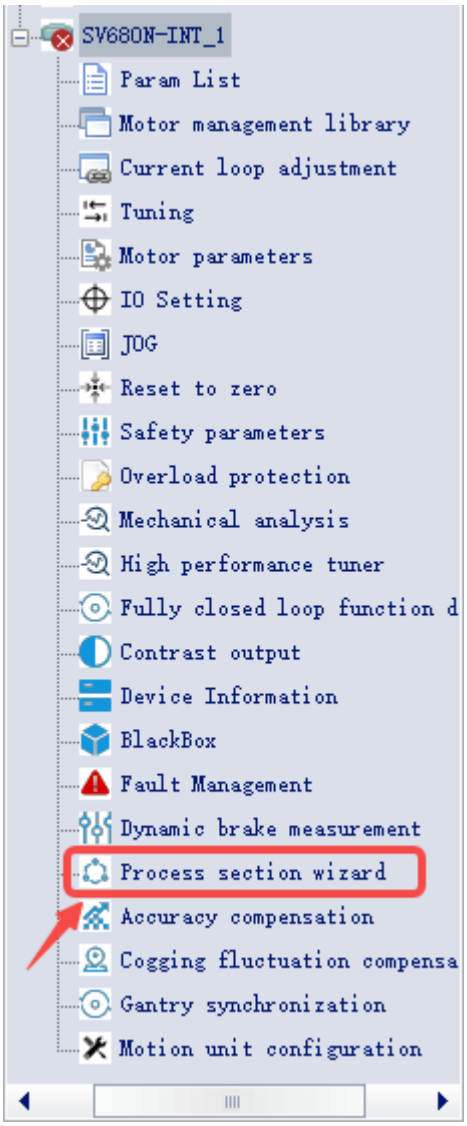


Segments of table generation: 0.9 m/0.05 m = 18 segments

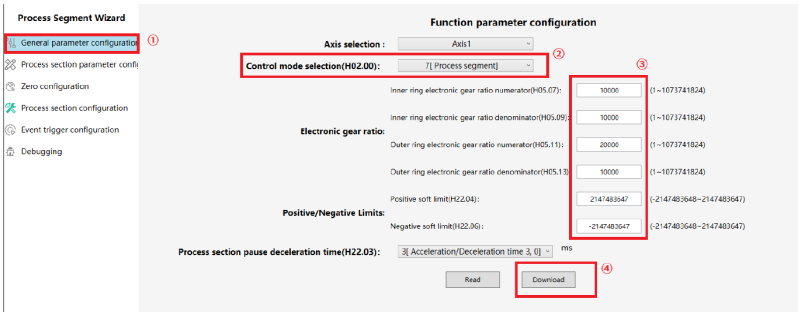
Incremental calculation of single-segment operation: 5 cm = 50,000 μm = 50,000 μm/(0.1 μm/pulse) = 500,000 pulse

Setting procedure for accuracy compensation table generation

1. The operation is performed in process segment mode.

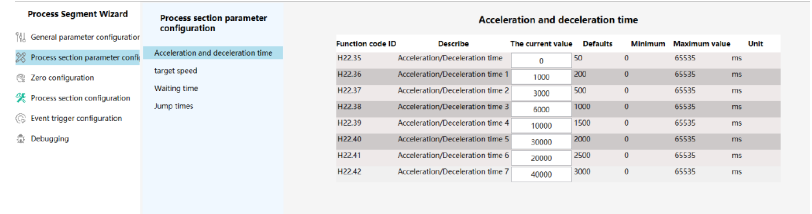


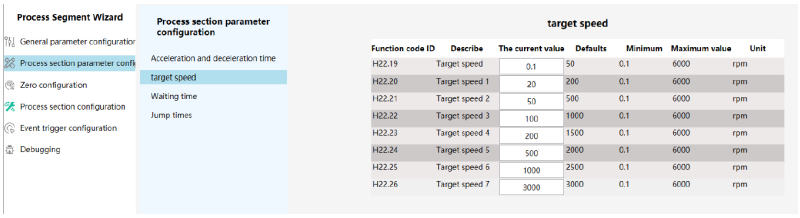
2. Set the basic parameters.



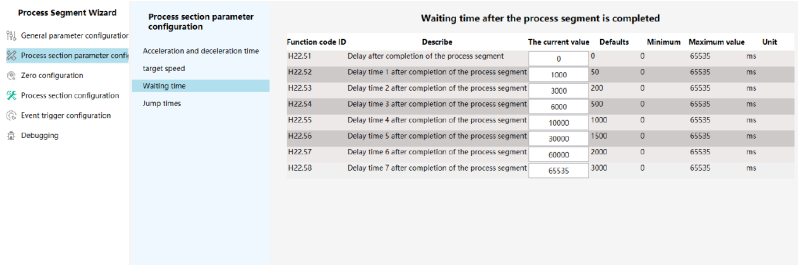
3. Set process segment parameters according to actual conditions.

a. Use default values of acceleration and target speed and click "Jump count".

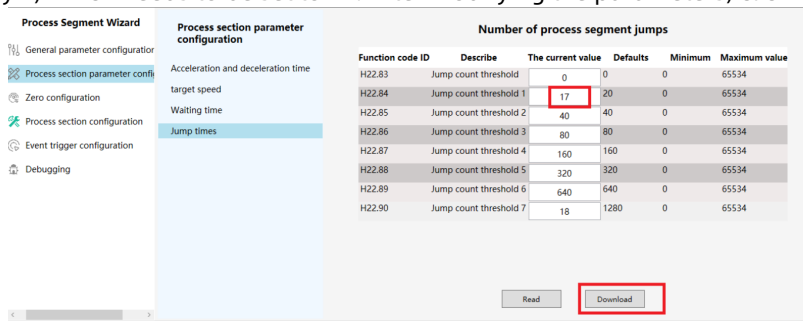




b. The waiting time can be changed. In case 1, the waiting time is set to 10s.



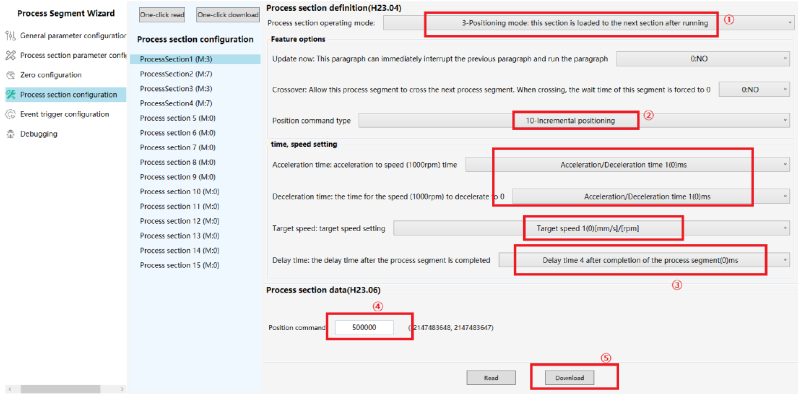
c. The number of segments is 18, with the last jump included, so the jump count needs to be subtracted by 1, which needs to be set to 17. After modifying the parameters, click "Download".



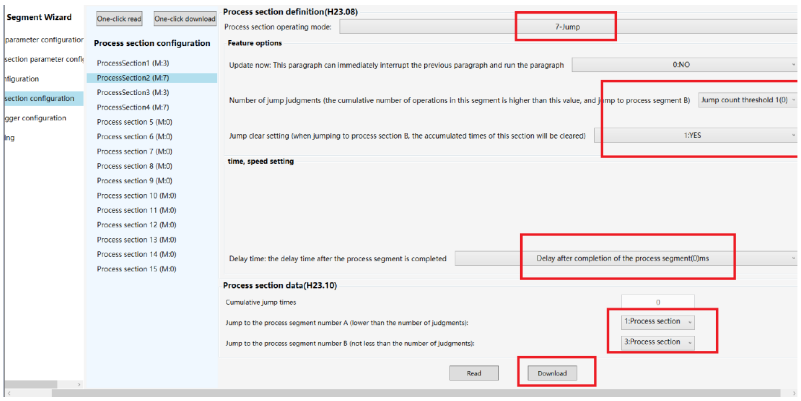
4. Configure process segment parameters.

Use the previous parameters to configure process segments 1 to 5.

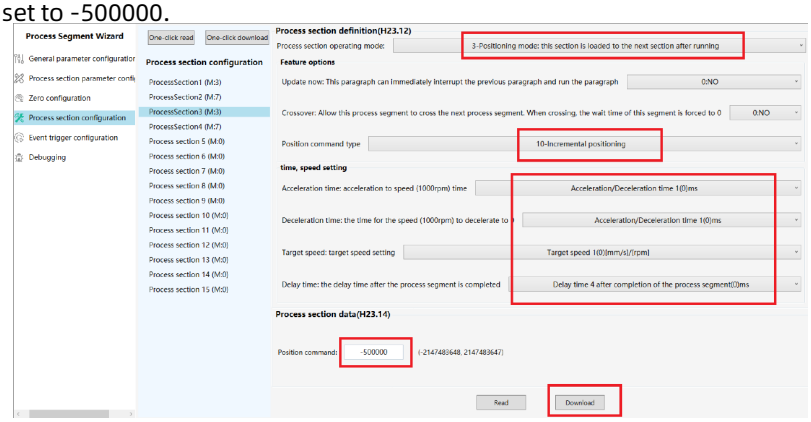
a. Select mode 3 for process segment 1 and incremental mode for position reference. Set the target speed and the delay time to 10s. Set the position reference to 50000 pulse, and click "Download" after the parameters are set.



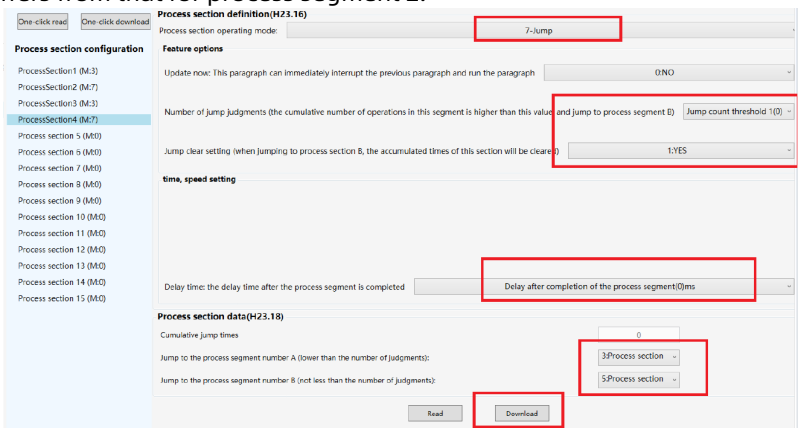
b. The process segment 2 is configured to jump at mode 7. Set the Jump judgment count to 17 as set previously. And set "Jump clear setting" to "Yes". Set the jump delay time to 0 ms (as single-segment operation has been delayed 10s), set "Jump to process segment A" to process segment 1 and execute cyclically. Set "Jump to process segment B" to process 3. Click "Download" after the parameters are set.



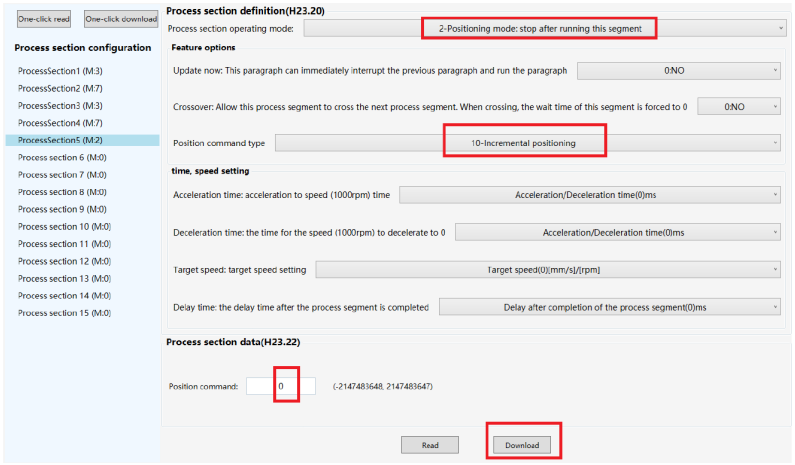
c. The setting for process segment 3 is the same as the process segment 1, except that the position reference is set to -500000.



d. The setting for process segment 4 is as follows. Note that the jump condition for process segment 4 differs from that for process segment 2.



e. Set process segment 5 to "Positioning mode: Stop when this segment is done running" and the position type to "Incremental positioning". Set the reference to 0. Click "Download" after the parameters are set.



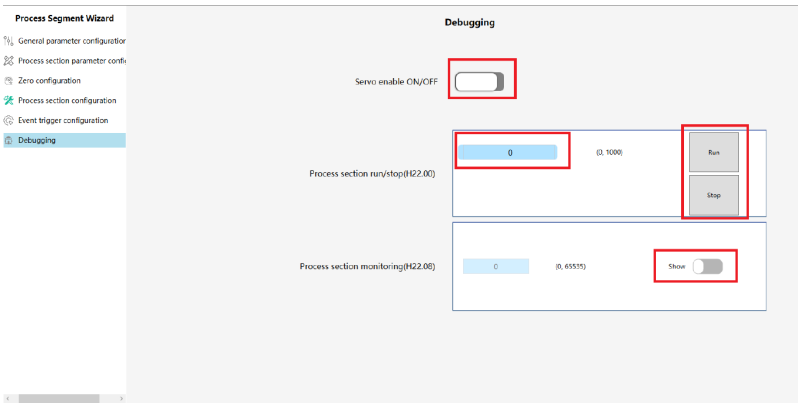
f. Configure process segment 6.



g. Configure process segment 7 and jump once.

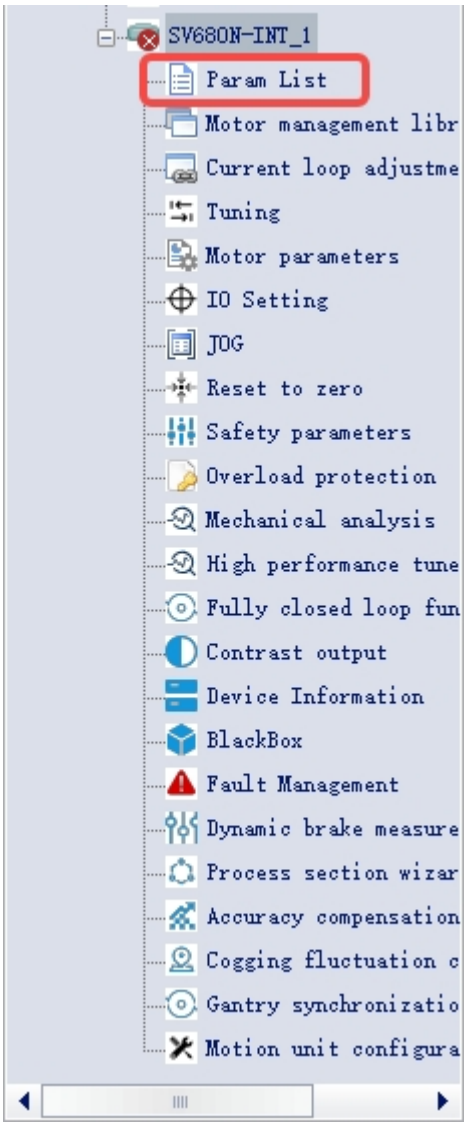


5. Perform the commissioning test.

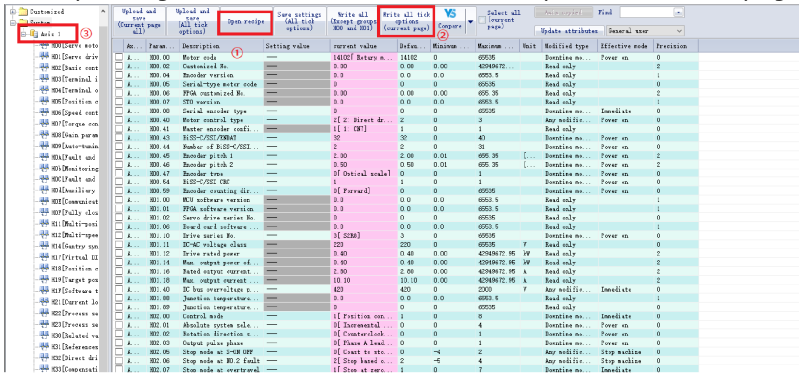


Simple setting procedure for accuracy compensation table generation

1. Click "Parameter list".



2. Click "Open parameter file", select the parameter file below, click "Left axis 1", and click the corresponding button to write all the selected options on current page.

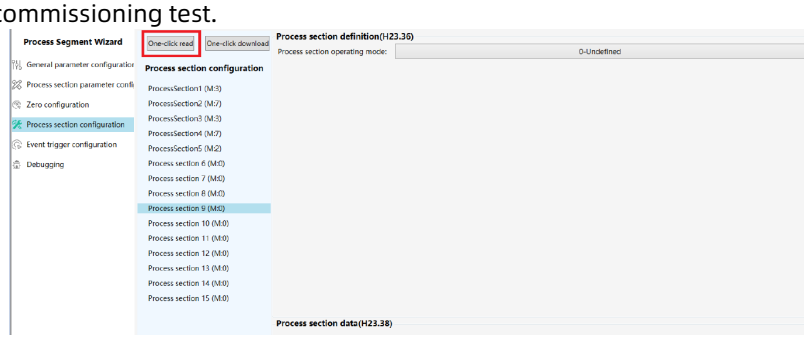


The parameters are provided below. You can download all parameters to the drive and perform commissioning directly.

3. Enter the process section page, click "One-click Read," and all parameters will be available.

SV680-INT accuracy compensation table - Process segment case 1.inoparam

4. Perform the commissioning test.



4.13 Quadrant Friction Compensation

Function description

The quadrant friction compensation function is designed to compensate the large delay in motor speed feedback due to large static friction of the mechanical system when the motor changes its direction. In actual machining (such as circular machining), the system friction during motor direction change will cause quadrant protrusion, resulting in quadrant marks on the workpiece surface.

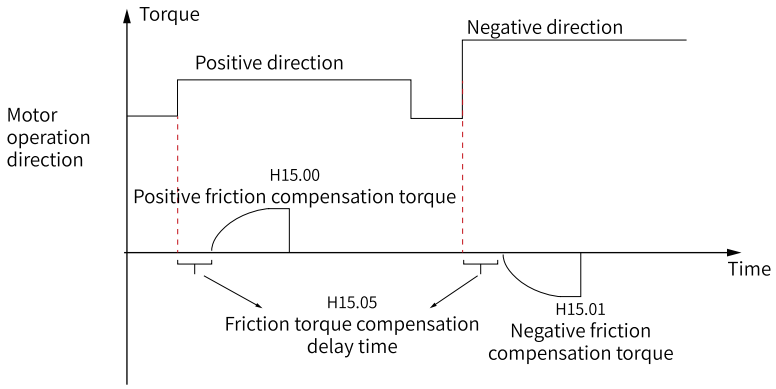
Note

Quadrant friction compensation is effective only in position mode.

Related parameters

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H15.00	2015-01h	Positive friction compensation torque	0.0 to 50.0	0.0	%	Real time	"H15_en.00" on page 796
H15.01	2015-02h	Negative friction compensation torque	0.0 to 50.0	0.0	%	Real time	"H15_en.01" on page 796
H15.02	2015-03h	Positive friction torque filter time constant	0.10 to 100.00	0.10	ms	Real time	"H15_en.02" on page 796
H15.03	2015-04h	Negative friction torque filter time constant	0.10 to 100.00	0.10	ms	Real time	"H15_en.03" on page 796
H15.04	2015-05h	Friction torque compensation speed reference source	0: Position reference 1: Model speed 2: Speed feedback 3: Observed speed 4: Speed reference	0x2	-	Real time	"H15_en.04" on page 796
H15.05	2015-06h	Friction torque compensation delay time	0.00 to 300.00	0.00	ms	Real time	"H15_en.05" on page 797
H15.06	2015-07h	Friction torque compensation effective speed threshold	0.0 to 20.0	0.1	rpm	Real time	"H15_en.06" on page 797

How it works



Parameter settings:

H15.00 and H15.01 are used to set the friction compensation torque in the positive and negative directions.

H15.02 and H15.03 are used to set the filter time of the positive/negative friction compensation torque. The smaller the parameter value, the faster the friction compensation torque reaches the set friction torque.

H15.04 is used to set the position or speed signal for detecting motor direction change. H15.06 is used to set the minimum speed threshold when the speed signal is used as the signal source for detecting direction change. When H15.04 is set to 0x00 (Position reference), H15.06 can be skipped.

H15.05 is used to set the delay time between the time when motor detects the direction change and the start time of friction compensation torque output.

4.14 Backlash Compensation

Function description

The backlash compensation function is used to compensate poor positioning performance after the motor direction is reversed when the mechanic is loose or experiences backlash.

Note

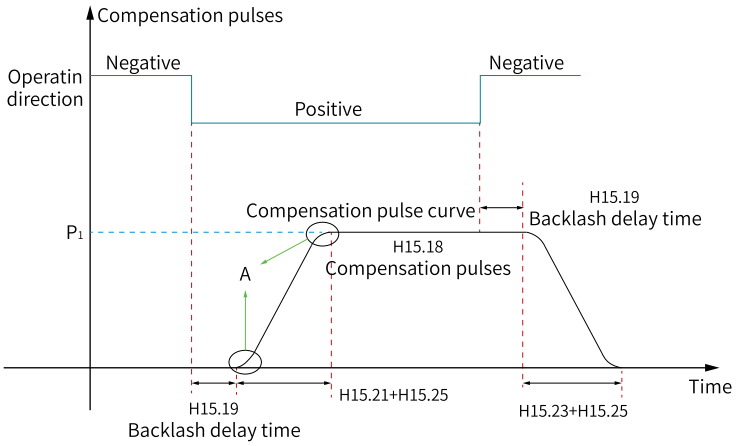
Backlash compensation is effective only in position mode.

Related parameters

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H15.15	2015-10h	Backlash compensation	0: Disable 1: Ramp	0	-	Real time	*"H15_en.15" on page 797*
H15.16	2015-11h	Backlash compensation speed reference source	0: Position reference 1: Model speed 2: Speed feedback 3: Observed speed 4: Speed reference	4	-	Real time	*"H15_en.16" on page 798*
H15.17	2015-12h	Minimum speed threshold of backlash compensation	0.0 to 20.0	2.0	rpm	Real time	*"H15_en.17" on page 798*
H15.18	2015-13h	Number of pulses of backlash compensation	0 to 65535	0	p	Real time	*"H15_en.18" on page 798*
H15.19	2015-14h	Backlash delay time	0.0 to 300.0	0.0	ms	Real time	*"H15_en.19" on page 798*
H15.21	2015-16h	Positive backlash compensation time	0.1 to 300.0	0.1	ms	Real time	*"H15_en.21" on page 799*

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H15.23	2015-18h	Negative backlash compensation Date	0.1 to 300.0	0.1	ms	Real time	"H15_en.23" on page 799
H15.25	2015-1Ah	Filter time constant of average backlash compensation value	0.0 to 50.0	0.0	ms	At stop	"H15_en.25" on page 799

How it works



Parameter settings:

1. Set H15.15 to 1 to enable backlash compensation.
2. Set H15.16 and H15.17 to select the position or speed signal used to detect motor direction reverse and the minimum speed threshold for detecting direction reverse.
   Note: If H15.16 is set to 0x00 (Position reference), H15.17 can be skipped. Otherwise, H15.17 must be set.
3. Settings of H15.18, H15.19, H15.21, H15.23, and H15.25 are shown in the preceding figure. Where:

   H15.18 is used to set the number of backlash compensation pulses. Set the parameter according to the actual backlash.

   H15.19 is used to set the delay time between the time when direction reverse is detected by the servo and the start time of backlash compensation.

   H15.21 and H15.23 are used to set the time between the start time of backlash compensation in the positive and negative directions and the time when backlash compensation reaches the set number of pulses. The smaller the parameter value, the faster the backlash compensation speed.

   H15.25 is used to smooth the backlash compensation curve. For details, see the section marked by A in the preceding figure.

5 Gantry Synchronization

In the industrial production field, gantry synchronization is widely applied to high-end technology devices. The gantry structure provides a stable motion platform for high-precision and highly-coordinated motion. Gantry synchronization enables high-response co-ordinated control.

5.1 Function Wiring

The wiring of gantry synchronization is shown in *"Figure 5-1" on page 236* . Axis X1 is connected to drive X1, axis X2 is connected to drive X2, the crossbeam axis is connected to drive Y, and drive X1 and drive X2 communicate with each other over an RS485 bus. The motor model and drive model are consistent between axis X1 and axis X2.

X1 is the master axis of the gantry and receives control signals from the host controller. The gantry synchronization function obtains information such as encoder feedback from the paired axis over RS485 communication. The information is used to calculate the internal loop compensation.

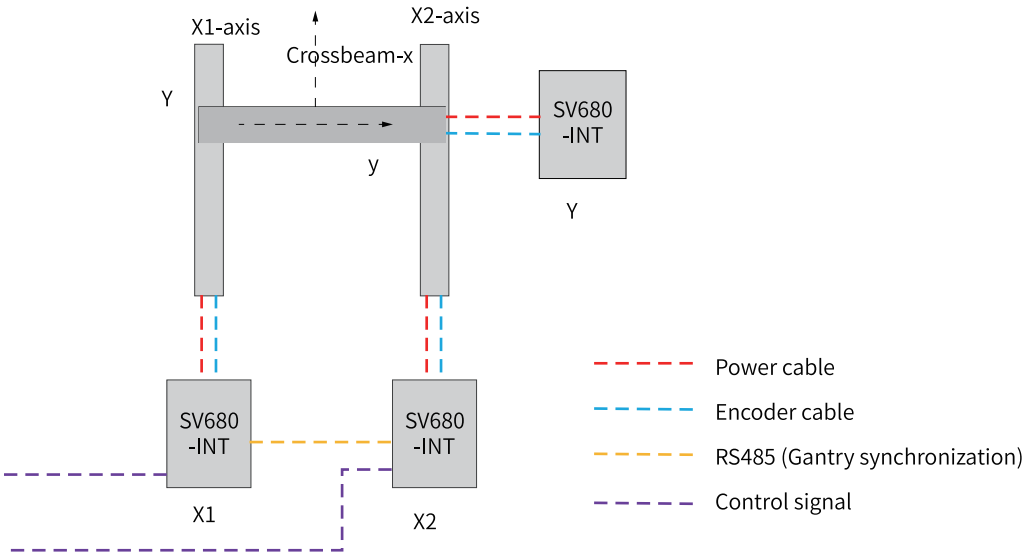
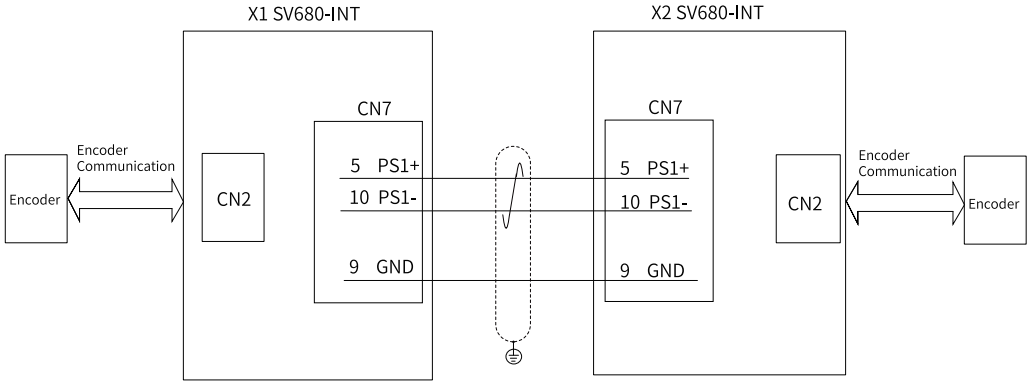


Figure 5-1 Wiring of gantry synchronization

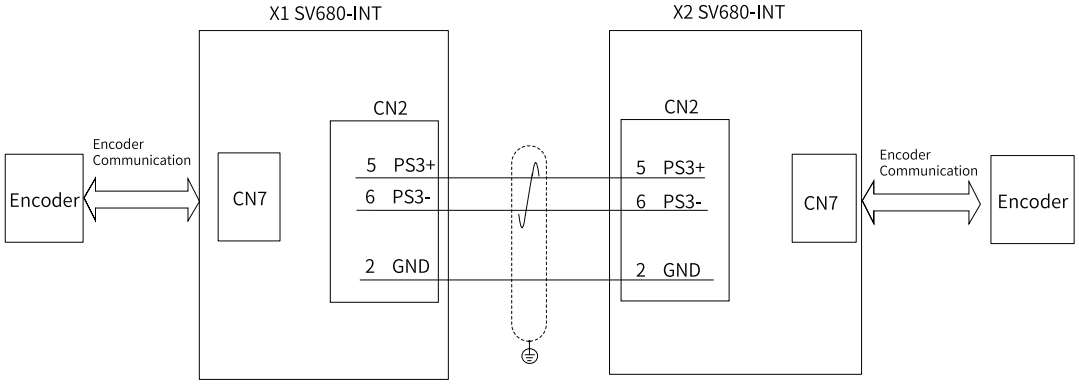
When SV680-INT works with a third-party motor, the motor is connected to terminal CN7 of the primary encoder by default. When SV680N-SINT works with an Inovance motor, the motor is connected to terminal CN2 of the primary encoder. You can set H32.01 = 1 to switch between encoder terminals. By default, H32.01 is set to 0.

The gantry communication port of SV680-INT is opposite to the primary encoder terminal. If the primary encoder is connected to CN2, gantry communication must uses CN7. Vice versa.

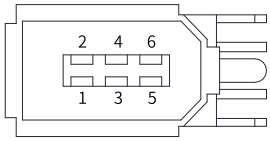
- If the primary encoder is connected to Cn2, gantry communication must be connected to the following pins:



- If the primary encoder is connected to CN7, gantry communication must be connected to the following pins:



The function assignment of CN2 and CN7 for gantry communication is as follows:



Encoder signal terminal CN2 (drive side)

Figure 5-2 Layout of terminal pins

Table 5–1 Terminal pin descriptions

Pin No.	Assignment	Description
1	5 V	5 V power supply (load current lower than 200 mA)
2	GND	5 V power supply ground (load current lower than 200 mA)
3	PS4+/CLK+	1. PS+ signal of the secondary encoder 2. CLK+ signal of the communication encoder
4	PS4-/CLK-	
5	PS3+/DATA+	1. PS± signals of the primary encoder 2. DATA± signals of the communication encoder 3. Gantry synchronization signal
6	PS3-/DATA-	
Housing	PE	Shield

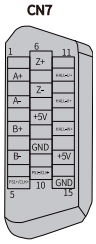


Figure 5-3 Layout of CN7 terminal pins

Pin No.	Terminal assignment	Terminal description	Pin No.	Terminal assignment	Terminal description
1	A+	Encoder pulse phase A ±	9	GND	Power supply reference ground
2	A-		10	PS1-/DATA-	1. PS- signal of the primary encoder 2. DATA- signal of the communication encoder 3. Gantry synchronization signal
3	B+	Encoder pulse phase B ±	11	HALL_U+	Hall signal U
4	B-		12	HALL_V+	Hall signal V
5	PS1+/DATA+	1. PS+ signal of the primary encoder 2. DATA+ signal of the communication encoder 3. Gantry synchronization signal	13	HALL_W+	Hall signal W
6	Z+	Encoder pulse phase Z ±	14	PS2+/CLK+	1. PS+ signal of the second encoder 2. CLK+ signal of the communication encoder
7	Z-		15	PS2-/CLK-	
8	+5 V	Encoder 5 V power supply (load current lower than 200 mA)	Housing	PE	Shield

Note

Hall signals support only 3.3 V voltage input.

5.2 Gantry Commissioning Solutions

Gantry structure types and gantry synchronous control solutions

Table 5–2 Gantry structure type

Gantry structure type	Structure
Rigid gantry	The two axes are connected by a rigid crossbeam. Large gantry synchronization deviations are not allowed. Excessive deviations may cause stuck axes.
Flexible gantry	The two axes are connected by a flexible crossbeam, allowing a certain degree of synchronization deviation between the two axes.
Virtual gantry	The two axes are independent of each other, without a crossbeam, allowing synchronization deviation between the two axes and yaw axis control.

SV680N-INT supports the following two gantry control solutions, which are applicable to different gantry structure types.

Table 5–3 Gantry synchronous control solution

Gantry synchronous control solution	Description	Applicable gantry
Solution 1	When the master axis receives an external position reference, both the master and slave axes follow the position reference. The slave axis eliminates synchronous control deviations to maintain consistency with the master axis.	Rigid gantry Flexible gantry Virtual gantry
Solution 2[1]	The master axis receives an external position reference and follows the position reference. The slave axis eliminates synchronous control deviations to maintain consistency with the master axis. The slave axis can receive position references to enable differential control of the two axes, allowing them to move toward each other.	Rigid gantry only

Note

[1]: The display value of the master axis (H0b.17/6064) for gantry solution 2 is (Master axis position feedback + Slave axis position feedback) ÷ 2, The display value of the slave axis (H0b.17/6064) is (Slave axis position feedback - Slave axis position feedback) ÷ 2.

Limits

The following limits apply to the SV680N-INT series gantry in synchronous control scenarios.

No.	Requirements	Limits
1	The motor models and specifications must be the same.	Differential gantry axis control structures are not supported.
2	The encoder models and specifications must be the same.	
3	A Hall sensor is required.	
4	The driver models and specifications must be the same.	

Commissioning precautions

1. Unlike single-axis servo commissioning, the commissioning of the gantry synchronous control function also requires key parameters of both axes to remain the same. Otherwise, functional anomalies may occur. The following table lists the parameters that must be the same between the two axes. When modifying parameters for one axis, it is recommended to update the corresponding parameters of the other axis to ensure that the parameters are the same between the two axes. For details, see *"Table 5-4 Parameter setting requirements" on page 240*.

Table 5-4 Parameter setting requirements

Requirement	Parameter type	Parameter
Parameter settings must be the same	Motor and encoder parameters	Group H00 parameters
	Servo drive parameters	Group H01 parameters
	Basic functions	Control mode selection: H02.00 Absolute system selection: H02.01 Stop mode: H02.05 to H02.08, and H02.17 to H02.18 Dynamic braking delay: H02.20 Electronic gear ratio: H05.02, H05.07, H05.09, H05.11, H05.13, 6091h Brake parameters: H02.09 to H02.12, and H02.16 Ramp to stop: 6084h, 6085h
	Reference limits	Speed reference limits: H07.17, H06.08, H06.09 Torque limits: H07.07, and H07.09 to H07.12
	Gain parameters	Loop gain: H08.00, H08.01, H08.02, H08.62 Loop feedforward: H08.18, H08.19, H08.20, H08.21
	Filters	Position reference filter: H05.04, H05.06, H05.70 Speed feedforward smoothing filter: H06.13 Torque reference low-pass filter: H07.05, H07.06, H07.37, H07.38, H07.36 Speed measurement method and speed feedback filter: H08.25, H08.22, H08.23

2. Unlike single-axis servo commissioning, enabling the gantry synchronous control function will make some usability functions unavailable. User settings will be invalid for unsupported functions. The following table describes whether usability functions are supported after the gantry synchronous control function is enabled. For details, see *"Table 5-5 Solution 1 Table of supported usability functions" on page 241* and *"Table 5-6 Solution 2 Table of supported usability functions" on page 242*.

Table 5–5 Solution 1 Table of supported usability functions

No.	Function	Support by master axis	Master and slave axis setting	Support by slave axis
1	Single-parameter auto-tuning	Supports STune1-8	Slave axis automatically follows master axis	Supports STune1-8
2	Speed feedforward	Supported	Slave axis must follow main axis	Supported
3	Torque feedforward	Supported	Slave axis must follow main axis	Supported
4	External feedforward	Supported	Slave axis must follow main axis	Supported
5	Model control	Supported	Slave axis must follow main axis	Supported
6	QFC control	Supported	Slave axis must follow main axis	Supported
7	Speed observer	Supported	Slave axis must follow main axis	Supported
8	Disturbance compensator	Supported	Set this parameter according to the actual condition	Supported
9	PDFF control	Supported	Slave axis must follow main axis	Supported
10	Gain switchover	Supported	Slave axis must follow main axis	Supported
11	Motor torque ripple compensation	Supported	Set this parameter according to the actual condition	Supported
12	Encoder pitch fluctuation suppression	Supported	Set this parameter according to the actual condition	Supported
13	Adaptive notch	Supported	Set this parameter according to the actual condition	Supported
14	Online inertia auto-tuning	Supported	Slave axis must follow main axis	Supported
15	Offline inertia auto-tuning	Not supported	Recommended setting for dual-axis after single-axis tuning is complete: (a-1)÷2	Not supported
16	Gravity compensation	Supported	Set this parameter according to the actual condition	Supported
17	Friction compensation	Supported	Set this parameter according to the actual condition	Supported
18	Low-frequency resonance suppression 1 at the mechanical end	Supported	Slave axis must follow main axis	Supported
19	Low-frequency resonance suppression function 2/3 at the mechanical end	Supported	Slave axis must follow main axis	Supported
20	Field weakening	Supported	Slave axis must follow main axis	Supported

Table 5–6 Solution 2 Table of supported usability functions

No.	Function	Support by master axis	Support by slave axis
1	Single-parameter auto-tuning	Supports STune1-6	STune1 (stiffness table) only
2	Speed feedforward	Supported	Not supported
3	Torque feedforward	Supported	Not supported
4	External feedforward	Supported	Not supported
5	Model control	Supported	Not supported
6	QFC control	Supported	Not supported
7	Speed observer	Not supported	Not supported
8	Disturbance compensator	Supported	Supported
9	PDFF control	Supported	Supported
10	Gain switchover	Supported	Not supported
11	Motor torque ripple compensation	Supported	Supported
12	Encoder pitch fluctuation suppression	Supported	Supported (speed feedback only)
13	Adaptive notch	Supported	Supported
14	Online inertia auto-tuning	Supported	Not supported
15	Offline inertia auto-tuning	Not Supported (manually divide the auto-tuning result by 2 and rewrite the result)	Not Supported (manually divide the auto-tuning result by 2 and rewrite the result)
16	Gravity compensation	Supported	Supported
17	Friction compensation	Supported	Supported (speed feedback only)
18	Low-frequency resonance suppression 1 at the mechanical end	Supported	Not supported
19	Low-frequency resonance suppression function 2/3 at the mechanical end	Supported	Not supported
20	Field weakening	Supported	Supported

5.3 Gantry Commissioning Procedure

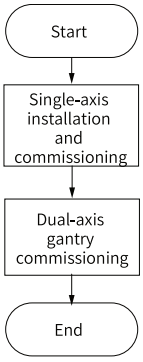


Figure 5-4 Overall procedure

5.4 Single-axis Installation and Commissioning Instructions

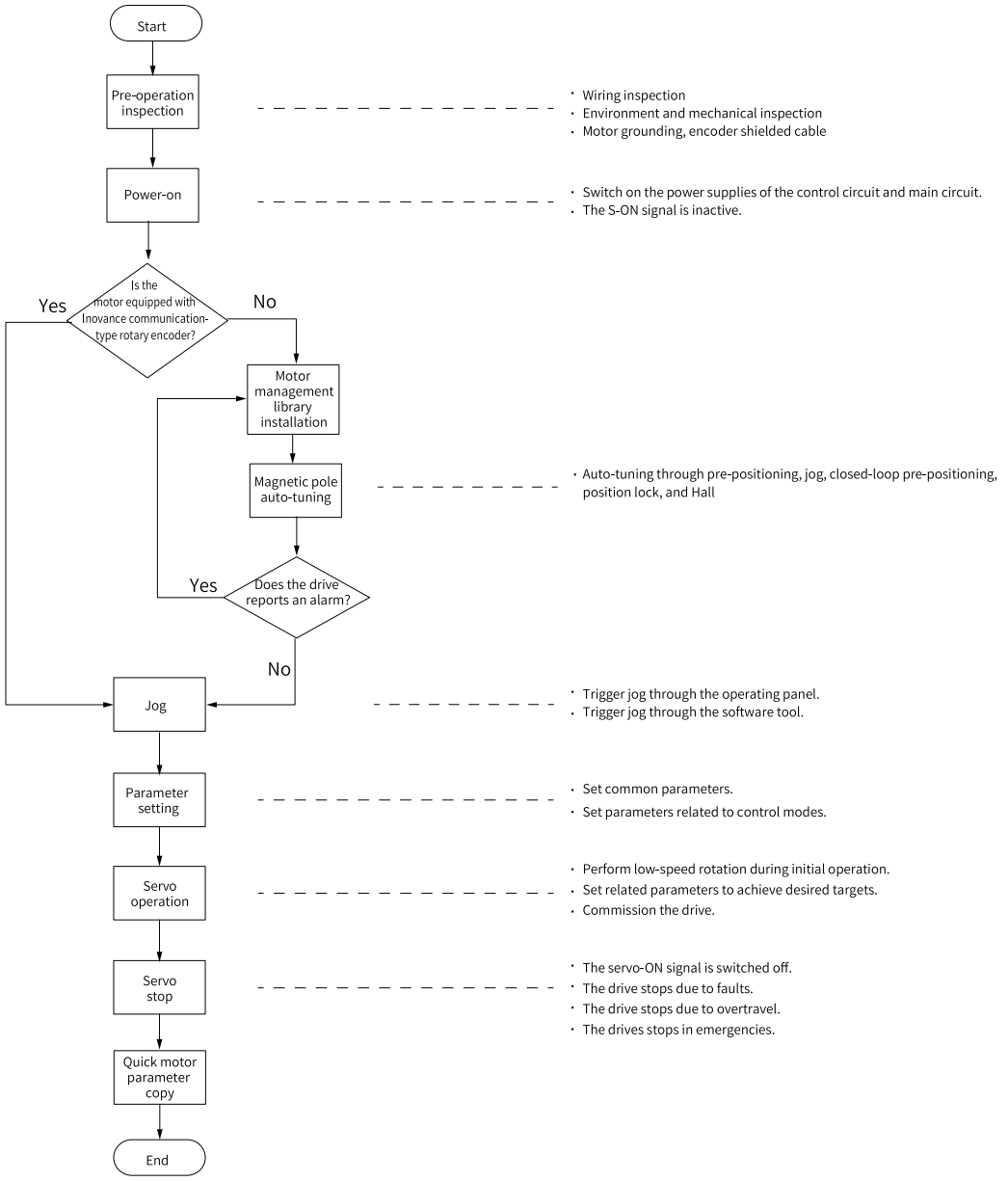


Figure 5-5 Commissioning flowchart of the drive

Refer to the preceding flowchart to complete the single-axis installation and commissioning for the master axis and slave axis separately. Make sure that both axes can operate as normal.

5.5 Dual-axis Gantry Commissioning Instructions

The commissioning process varies depending on the selected gantry synchronous control scheme.

Caution

- During the initial commissioning of Gantry Scheme 2, it is recommended to set the loop control gain parameters (H08.00, H08.02) of the slave axis to 0 and the integral time constant (H08.01) to 512 before commissioning. During commissioning, set H09.00 of the slave axis to 1, and then manually increase the stiffness level (H09.01) of the slave axis from 0 gradually. If the stiffness level for the slave axis is too high, faults such as runaway may occur.
- When the gantry synchronization function is enabled, if only the master axis triggers the safety function, the slave axis will not automatically synchronize with the corresponding safety action. To make both the master and slave axes respond to safety functions, send the safety function commands to the master and slave axes at the same time. If the safe torque off (STO) terminals are integrated into the servo drive (CN6), when the master axis triggers the STO function, the slave axis will decelerate and stop in coordination with the master axis. However, the stop action only implements the coordinated stop logic between the master and slave axes and does not meet the SIL3 safety level requirement. Therefore, it cannot be used as a safety circuit.

5.5.1 Commissioning Procedure for Gantry Synchronization Control Scheme 1

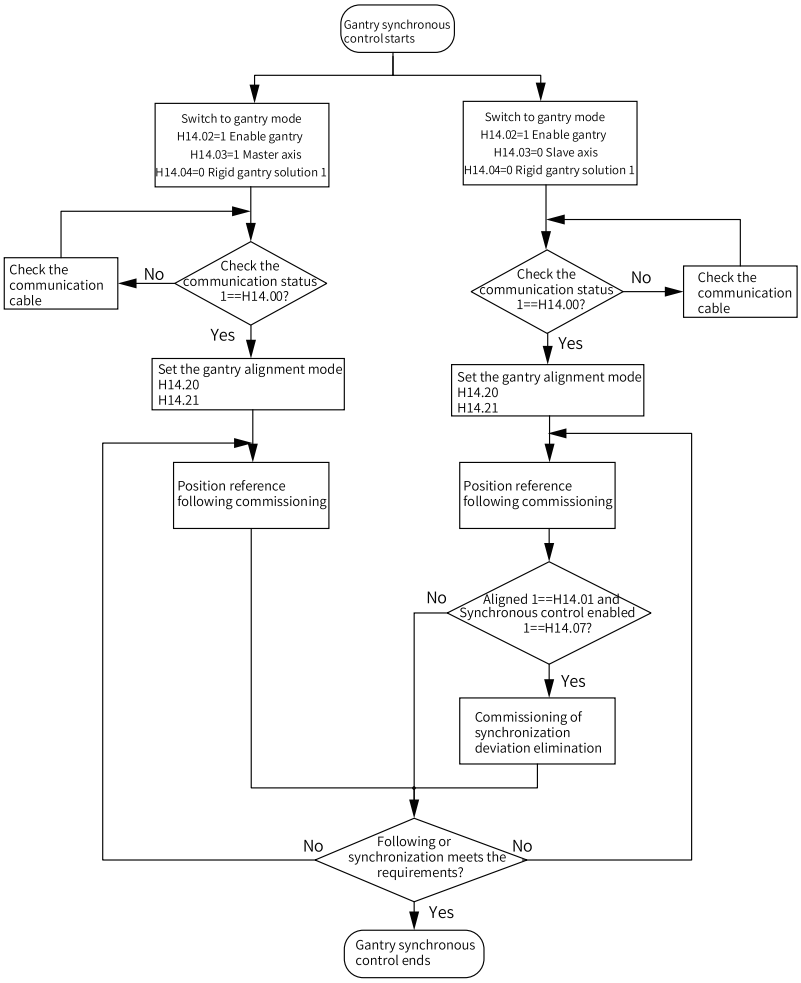


Figure 5-6 Commissioning procedure for gantry synchronization control scheme 1

Gantry synchronization direction

The single-axis running direction is already set during single-axis installation and commissioning. For details, see *"5.4 Single-axis Installation and Commissioning Instructions" on page 243*. This

section describes how to set the running direction for communication data between the two axes of the gantry, ensuring consistent direction of the synchronization control data between the two axes.

Gantry alignment

The gantry synchronization function and position deviation alarm function become effective only after gantry alignment is completed. Gantry alignment is configured in H14.21. When both axes are aligned and are in the Run state, the slave axis can perform synchronization deviation elimination to align its position with the master axis. At this moment, monitoring and alerting on excessive synchronization deviations are activated.

If H14.20 is set to 1, alignment is performed based on the position of both axes after power-on, before the alignment condition is met.

- In scenarios where only a single axis uses a photoelectric sensor, the alignment method is as follows:
  - **Align the position between the axes upon power-on**: Set H14.20 of both axes to 1. This mode uses the position upon power-on of both axes as the alignment reference for synchronization. When a deviation exists between the two axes after power-on, the slave axis starts to eliminate the deviation upon the first power-on. At this moment, no gantry alignment DO is generated. This method can be used together with other alignment methods. H14.01 and the corresponding DO will not be set to 1 if only this condition is met.
  - **Align the position when both axes are enabled each time**: Set H14.21 of both axes to 3. This mode uses the position when both axes are in the Run state as the alignment reference for synchronization. Each time both axes are disabled, the axes exit the gantry alignment mode.
  - **Torque ramp alignment**: Set H14.21 of both axes to 2. Alignment is enabled when H14.26 is set to DI-enable or when both axes are in the Run state. For details, see parameters H14.26 to H14.33.
- In scenarios where both axes use a photoelectric sensor, the alignment method is as follows: **Use a non-absolute encoder**: Set H14.21 of both axes to 0, aligning the position based on the home of both axes. Alternatively, set H14.71 of both axes to 1, and set the deviation threshold in H14.72. Deviation auto-tuning can be set in H14.25. For details, see section "Homing alignment (H14.21=0)".

The following section describes the gantry alignment modes (H14.21).

1. **Homing alignment (H14.21=0)**
   Instructions on gantry homing

   During gantry homing, both the master axis and slave axis limit switches (photoelectric and hard limits) are active.

   - Rigid gantry: Supports all existing homing methods. The homing trajectory of the master axis is consistent with the original planned trajectory. For details about the rigid gantry homing trajectory, see *"3.11.6 Homing Operation" on page 139*.
   - Flexible gantry: Supports only the following homing methods. For details about the flexible gantry homing trajectory, see *"5.7 Flexible Gantry Homing Trajectory" on page 252*.
     - 402 homing: Set the corresponding parameter to -2, -1, 1, 2, 7, 11, 23, 24, 25, 26, 27, 28, 29, and 30.

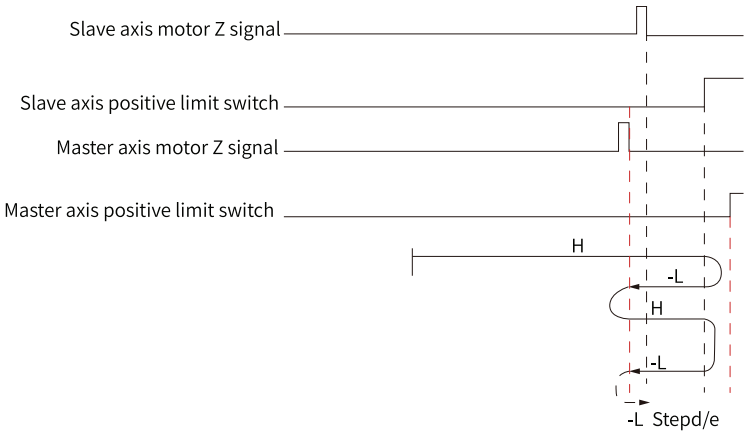
Note

If a homing mode other than the above-mentioned ones is set, starting homing will trigger E601.4 (gantry homing mode error).

- Flexible gantry homing procedure
  Limit switches or home switches for the flexible gantry must be installed on both axes. The procedure is as follows.

  a. When starting flexible gantry homing, if the two axes are not aligned, the automatic torque alignment function (H14.18) is enabled. The homing trajectory applies when alignment is completed. Otherwise, the homing trajectory applies regardless of whether alignment is completed.
  b. Both axes move simultaneously. First, the home of the master axis is searched. At this stage, the trajectory is consistent with the original planned trajectory. After the home of the master axis is found, the system reverses the direction at a high speed. When the deceleration point or limit switch is reached, both axes reverse the direction to search for the home of the slave axis.
  c. After the home of the slave axis is found, both axes move simultaneously to the home position of the master axis. If the gantry homing function is not enabled (H14.71 = 0) for the slave axis, homing is complete. In gantry mode 1, if H14.71 of the slave axis is 1 and the gantry deviation compensation (H14.72) of the slave axis is 0, proceed to step d. Otherwise, proceed to step e. In gantry mode 2, when H14.71 of the slave axis is 2, perform step f.
  d. The slave axis moves independently to the slave axis home.
  e. The slave axis moves independently according to the set deviation to the corresponding position (H14.72 = Slave axis home position - Master axis home position).
  f. Both axes first move to the common home center, then return to their individual home positions.

  Taking the SV680-INT -2 homing trajectory 1 as an example:



- Gantry homing torque alignment and deviation learning
  - Torque alignment
    For a flexible gantry, if you enable torque pre-alignment before homing (H14.18 = 1), after homing is triggered, the slave axis automatically performs torque pre-alignment. After pre-alignment is completed, H14.18 is reset, and homing starts as normal.

- Deviation learning
  - For a flexible gantry, if you enable the torque alignment learning function (H14.25 = 1 for both axes, H14.71 = 0) to learn the deviation between the master and slave axis homes, after flexible gantry homing is completed, the slave axis automatically performs torque alignment. After alignment is completed, the deviation between the master and slave axis homes is automatically learned and written into the gantry deviation compensation value (H14.72), and parameter H14.25 is reset.
  - For a flexible gantry, if you enable the home deviation learning function (H14.25 = 2 and H14.71 = 0) for the master and slave axes, after the flexible gantry completes homing, it automatically learns the master-slave home deviation and writes it into the gantry deviation compensation value (H14.72), then resets parameter H14.25.

2. **Torque alignment (H14.21 = 2)**
   Gantry torque alignment method:

   Keep the master axis stationary. After limiting torque on the slave axis, move the slave axis forwards and backwards. Use the bisection method based on the limit positions of the forward and backward operations to determine the alignment reference between the slave and master axes.

   Procedure:

   a. Set parameter H14.21 to 2. At this moment, the gantry master axis remains stationary while the slave axis moves forwards and backwards after torque limiting.
   b. Torque alignment must be set according to the master axis parameter H14.26. If H14.26 is set to Enable, first switch on the drive servo, then set H14.26 to 1. Otherwise, torque alignment cannot be activated.
   c. The alignment torque, number of alignment attempts, alignment speed, and other parameters for gantry torque alignment can all be set in the slave axis parameters H14.27 to H14.33.

      - H14.27 sets the maximum torque reference. If the mechanical structure allows, it is recommended to set a larger value. During measurement, the torque reference during constant-speed operation equals the resultant force of friction and mechanical coupling elastic force.
      - H14.28 sets the number of forward and reverse cycles. It is recommended to perform multiple measurements to ensure result accuracy.
      - H14.29 sets the alignment speed.
      - H14.31 sets the alignment acceleration time. Do not set the acceleration time to a large value, so that the motor can maintain a constant speed during zero speed detection.
      - H14.32 sets the motor zero-speed detection threshold. It is the mechanical limit to detect whether the current torque reference is reached during alignment. The value of H14.32 must be greater than the speed ripple value when the drive is enabled but stationary.

3. **Enable alignment (H14.21 = 3)**
   When parameter H14.21 is set to 3 and the enable signal serves as the alignment reference, each time both axes are enabled, the position of both axes at this moment serves as the alignment reference.

4. **DI alignment (H14.21 = 4)**

The gantry establishes or cancels the alignment reference based on the master axis DI signal. When parameter H14.21 is set to DI alignment, the gantry alignment reference is determined by the positions of both axes when the master axis receives the DI signal. The two axes of the gantry can cancel this alignment reference by using another DI signal.

5. **Alignment at power-on (H14.20 = 1)**
   Perform alignment based on the position at power-on of both axes. The position is used as the alignment reference. After setting parameter H14.20 to 1, alignment is performed based on the position at power-on of both axes. The position is used as the alignment reference. When a deviation exists between the two axes after power-on, the slave axis will start to move upon the first power-on to eliminate the deviation between the two axes. Exit the alignment reference when the alignment state reaches H14.21.

6. **Absolute alignment (H14.04=0, H14.21=0, H14.51=1)**
   Alignment is performed based on the absolute position of the master axis. The position serves as the alignment reference.

   a. Encoder mode: H02.01 of both axes must be set to the absolute mode.
   b. Alignment reference: Set H14.21 to 0 and H14.51 to 1 for both axes. Upon each power-on, alignment is performed based on the absolute position of the master axis. This position serves as the alignment reference, directly enabling alignment. H14.35 (Gantry position deviation) displays the current position deviation between the master and slave axes. After switch-on, the slave axis will first move to the absolute position of the master axis. Ensure that the absolute zero of both axes are at the same position.

Excessive gantry synchronization deviation alarm

To prevent mechanical failure caused by unsynchronized positions or torque between the two gantry axes, the gantry function includes two alarm modes: excessive gantry position deviation alarm and excessive gantry torque deviation alarm. These alarm modes can be set according to the actual conditions as needed.

- Set H14.47 to 1 to enable the excessive gantry position deviation alarm, and set the deviation threshold and allowable over-limit duration in H14.45 and H14.44. When the position deviation between the master and slave axes exceeds the threshold and persists for the specified time duration, both axes trigger the excessive gantry position deviation alarm.
- Set H14.50 to 1 to enable the excessive gantry torque deviation alarm, and set the torque deviation threshold and allowable over-limit duration in H14.48 and H14.49. When the torque deviation between the master and slave axes exceeds the threshold and persists for the specified time duration, both axes trigger the excessive gantry torque deviation alarm.

Commissioning of gantry synchronization deviation elimination

The gantry synchronization function operates in master-slave mode. Synchronization deviation compensation control for the master axis is ineffective, and can be set only in H14.07 of the slave axis. It can be set to Enable or DI-enabled (59). In this case, the slave axis follows the master axis. The synchronization function works as follows.

- When the gantry alignment marker is 1, after both axes changes from disabled to enabled, the slave axis moves to the alignment position with the master axis. When both axes are enabled, the

slave axis moves to the alignment position with the master axis when the gantry alignment marker changes from 0 to 1. The alignment speed and acceleration speed are set in H14.13 and H14.14, respectively.

- The synchronization deviation is eliminated by adjusting the synchronization deviation elimination gain in H14.08 to H14.11, ensuring axis synchronization.

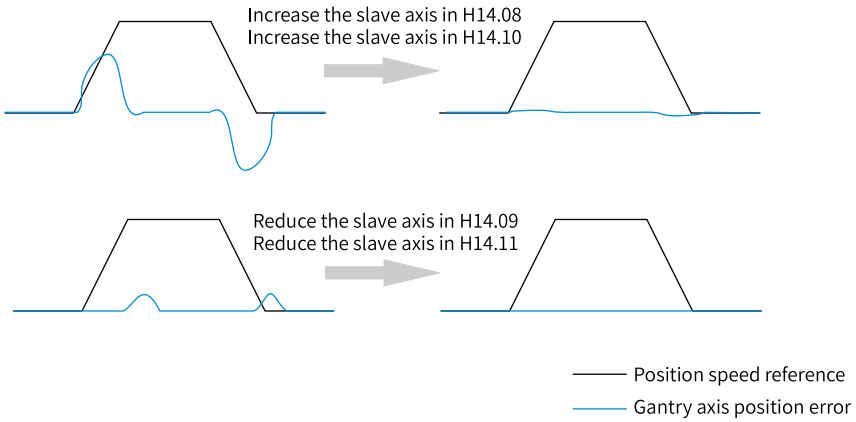


Figure 5-7 Curve of changes before and after commissioning

5.5.2 Commissioning procedure for gantry synchronization control solution 2

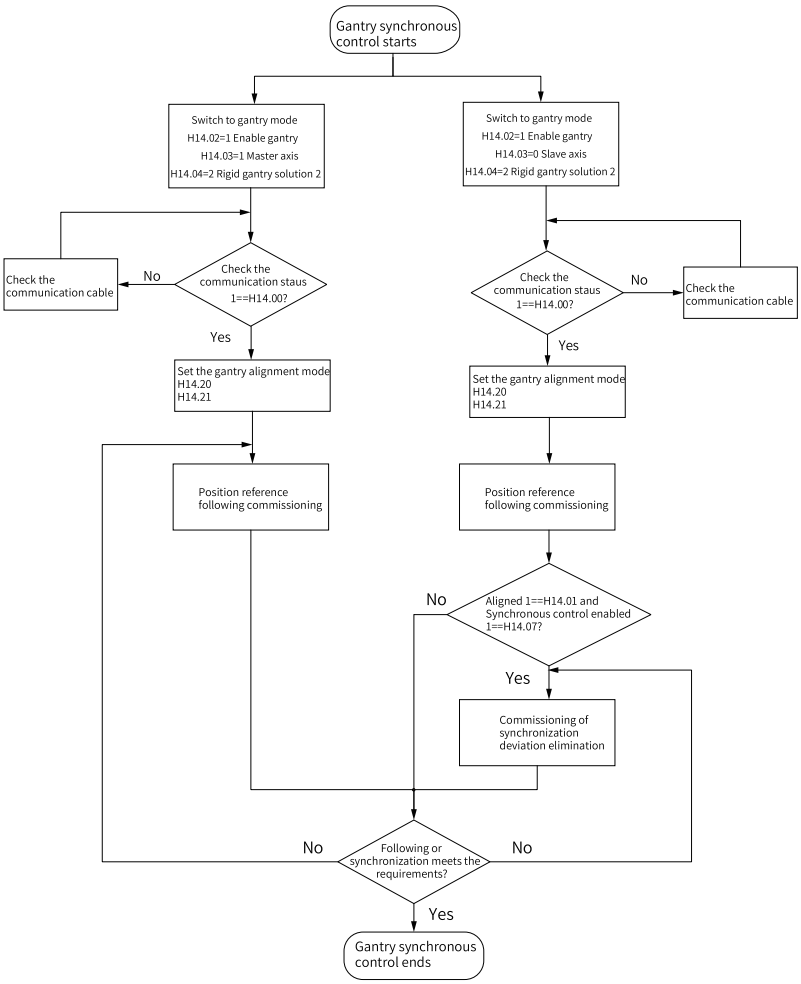


Figure 5-8 Commissioning procedure for gantry synchronization control solution 2

Gantry synchronization direction

For details, see *" Gantry synchronization direction" on page 244*.

Gantry alignment

For details, see *" Gantry alignment" on page 245*.

Note

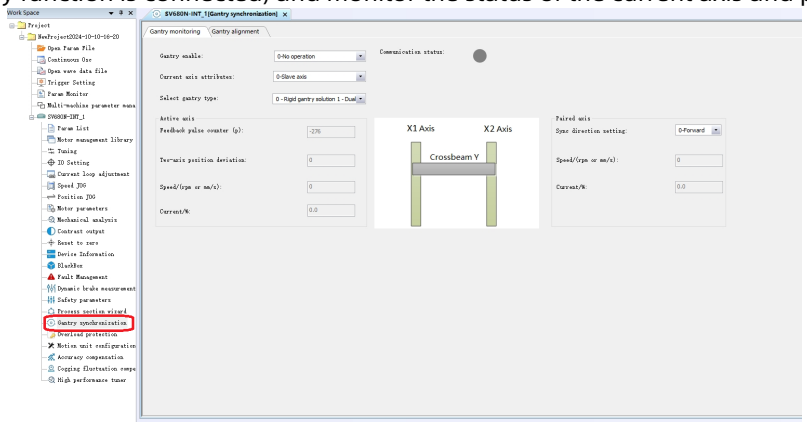
The torque alignment mode (including the torque skew alignment mode) and the absolute position alignment mode are not supported.

Commissioning of gantry synchronization deviation elimination

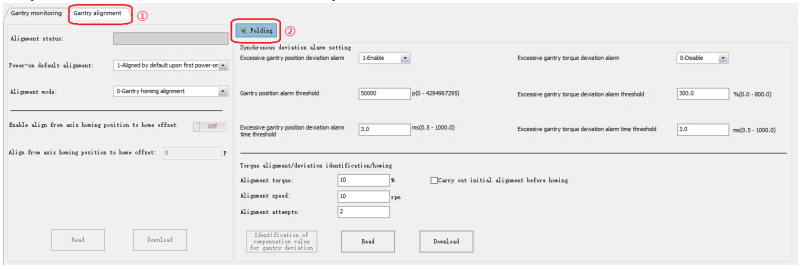
Gantry synchronization solution 2 applies to the slave axis to eliminate the deviation when the slave axis synchronizes with the master axis. Synchronization deviation control must be set in H14.07 of the slave axis. This is different from solution 1, which is set in H08.00 to H08.02. When H08.00= H08.02=0 and H08.01=512, synchronization deviation elimination is disabled.

Gantry commissioning through the host controller

1. Click "Gantry synchronization" in the "Work Space" pane. Enable the gantry function, configure the gantry axis attributes, and select a gantry control mode. Check the communication status to verify that the gantry function is connected, and monitor the status of the current axis and pairing axis.



2. On the "Gantry alignment" tab, select an alignment mode, such as homing, torque, upon enabling, and DI. Configure the torque alignment/deviation auto-tuning/homing pre-alignment parameters (alignment torque, alignment speed, and alignment times), and configure the synchronization position deviation and torque deviation alarm.



5.6 Gantry Applications in Fully-closed Mode

Based on on-site application requirements, to ensure high-accuracy tracking at the load end, when both the fully closed-loop and gantry modes are set (H0F.00=1, H14.02=1), gantry synchronization can be implemented based on the load position. Note:

1. When the gantry is in fully closed-loop mode, the gantry mechanical attributes can be set only to the Scheme 1 mode (H14.04 = 0 or 1).
2. In gantry fully closed-loop mode, the encoder feedback mode can be set only to external encoder feedback (H0F.00=1), and switchover between internal and external loops is not supported.
3. In gantry fully-closed loop mode, both the master and slave axes must have the fully-closed loop function enabled. Gantry systems do not support unilateral fully-closed loops.
4. In gantry fully-closed loop mode, external encoders currently can only be ABZ incremental and Inovance communication encoders. BiSS-C, SSI, and EnDat 2.2 encoders are not supported.
5. When the gantry is in fully closed-loop mode, the settings of H0F.04, H0F.10, and H0F.13 for the master and slave axes must be consistent.

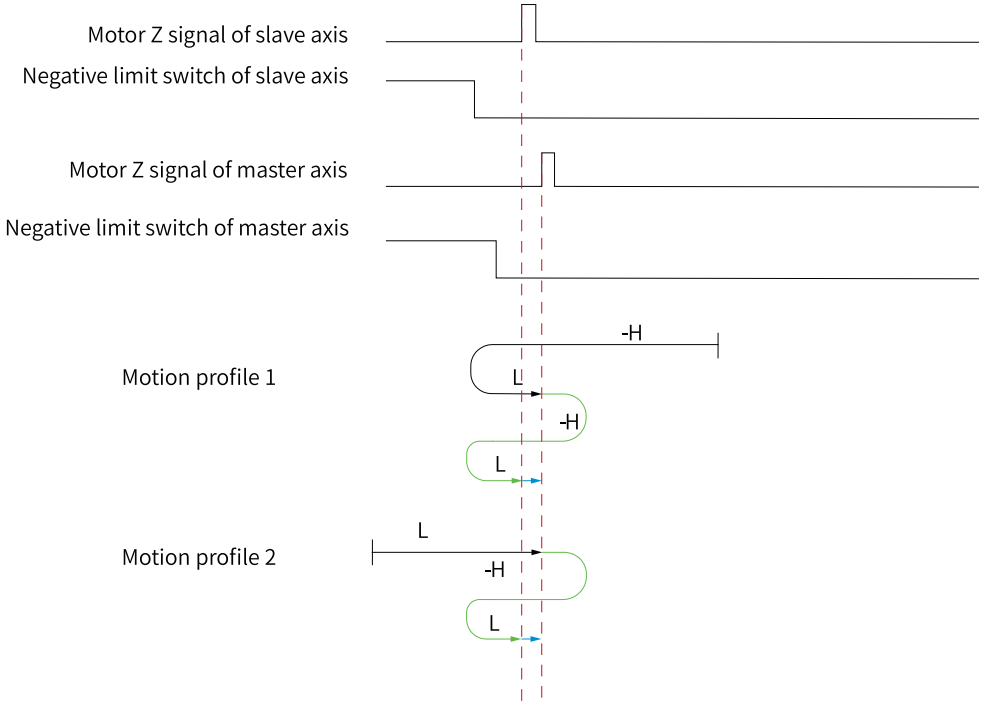
5.7 Flexible Gantry Homing Trajectory

- The black trajectory represents the trajectory through which the master axis searches for the home signal. The green trajectory represents the trajectory through which the slave axis searches for the home signal. The blue trajectory represents the trajectory through which the master axis returns to the home.
- After the master axis finds the home signal, it starts to search for the home signal of the slave axis in reverse direction at a high speed.
- After the slave axis finds the home signal, it continues to move to the home of the master axis.

6098 = 1

Home: motor Z signal

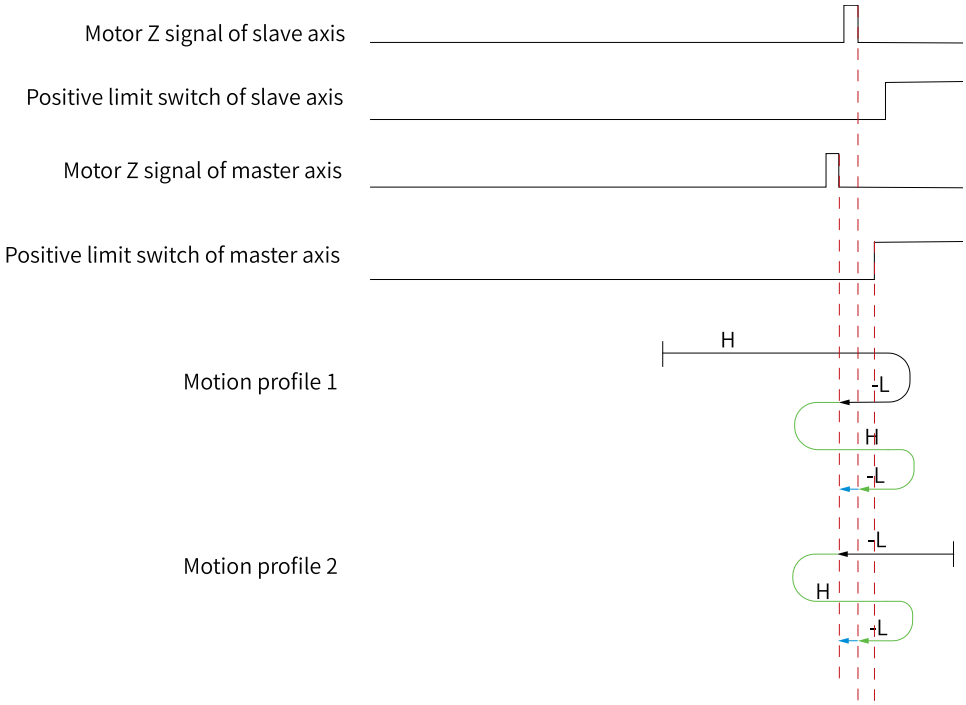
Deceleration point: negative limit switch



6098 = 2

Home: motor Z signal

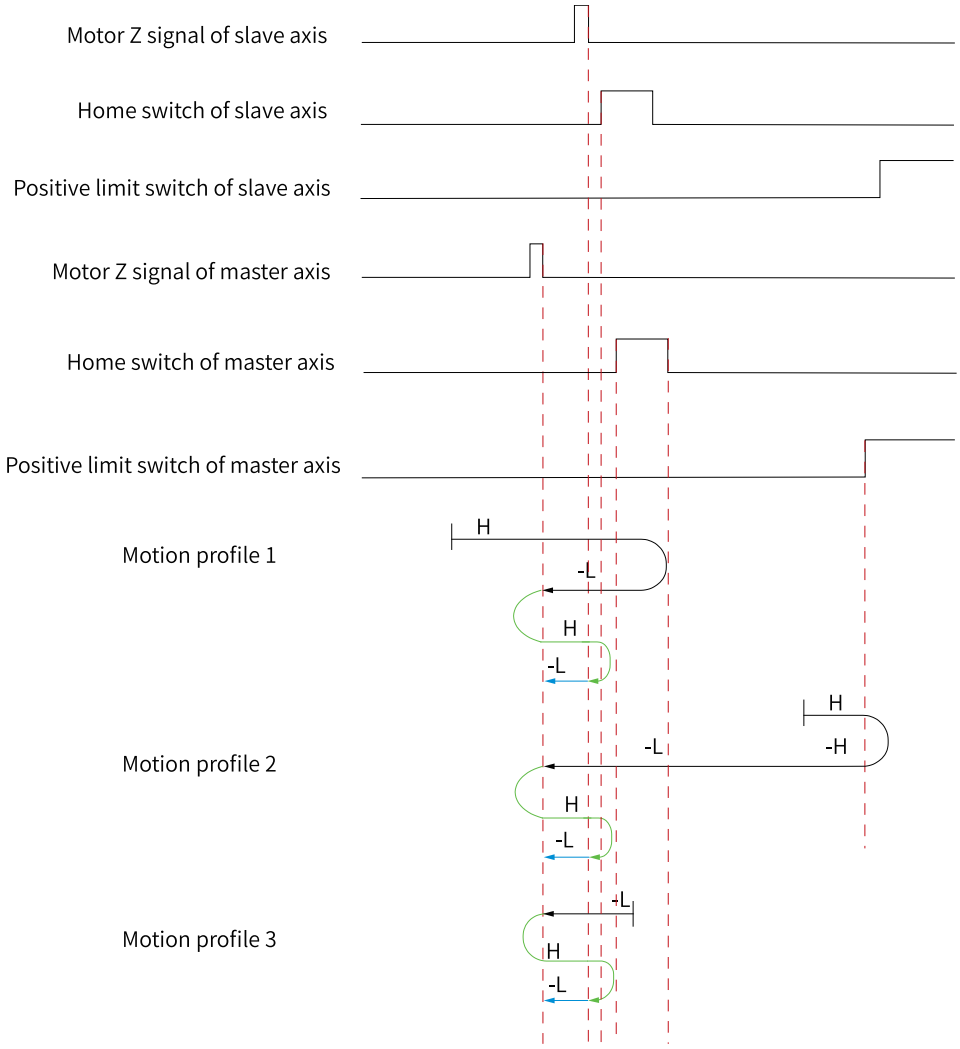
Deceleration point: positive limit switch



6098 = 7

Home: motor Z signal

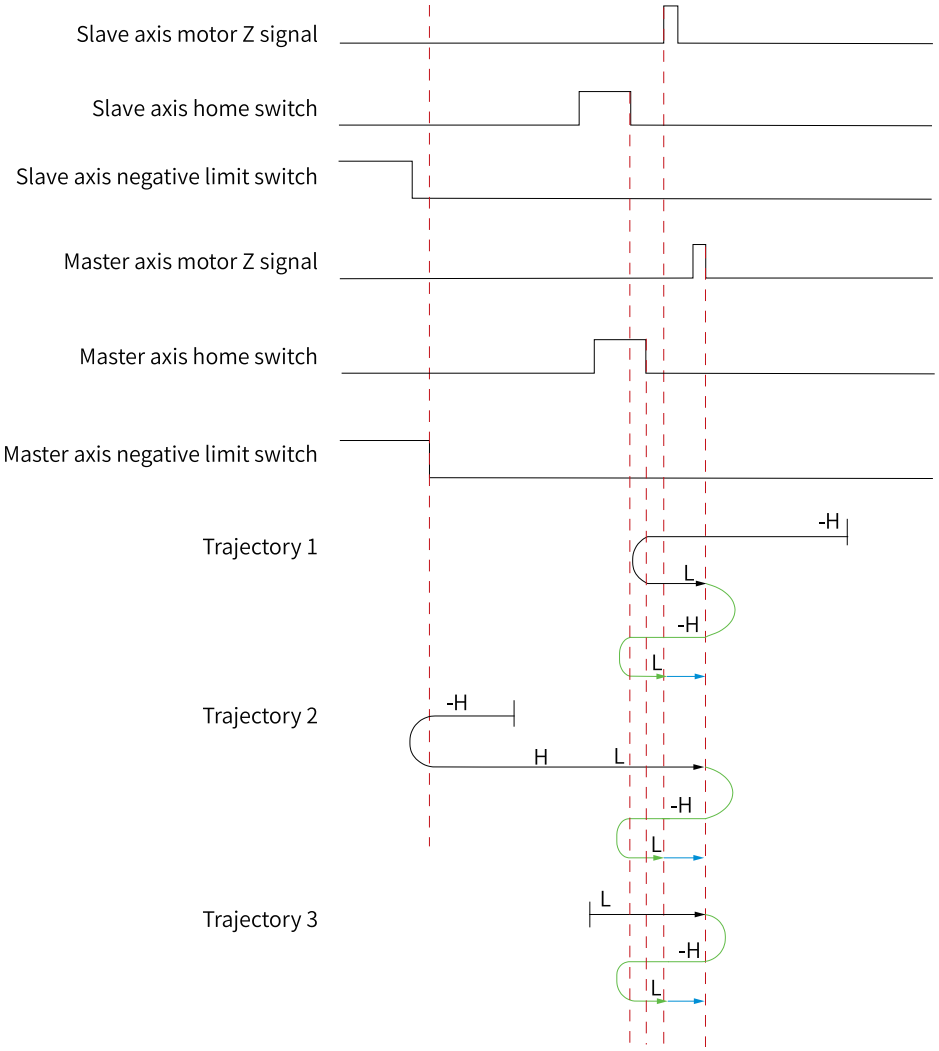
Deceleration point: home switch (HW)



6098 = 11

Home: motor Z signal

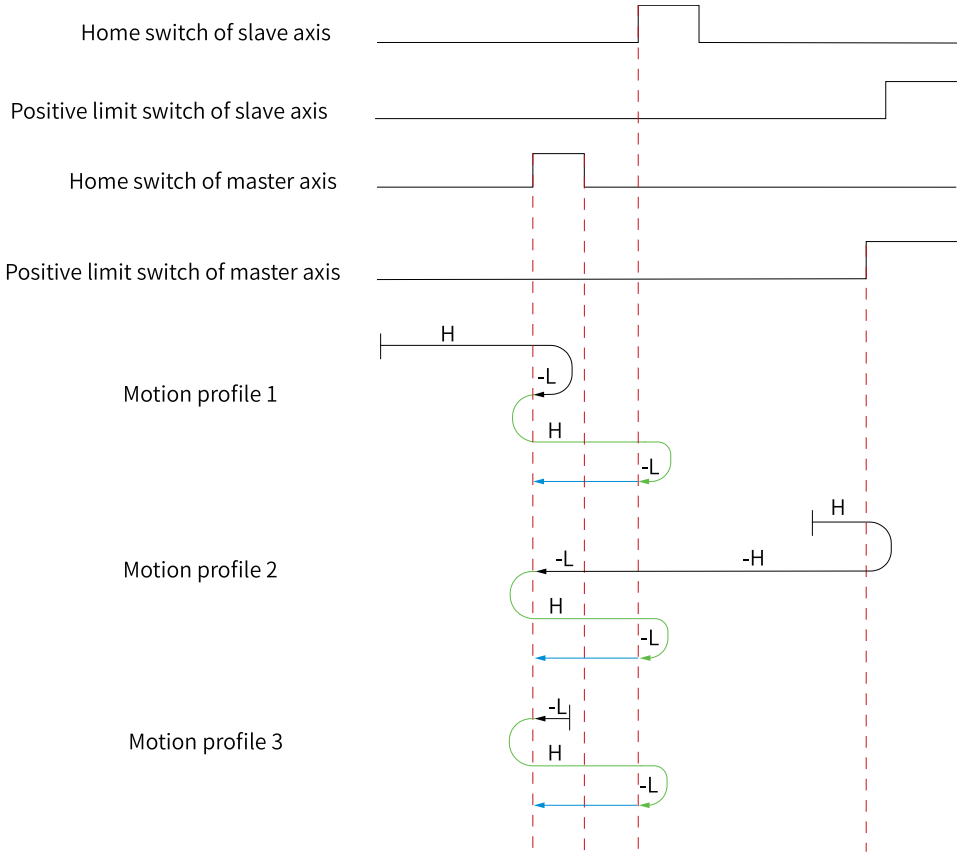
Deceleration point: home switch (HW)



6098 = 23

Home: home switch (HW)

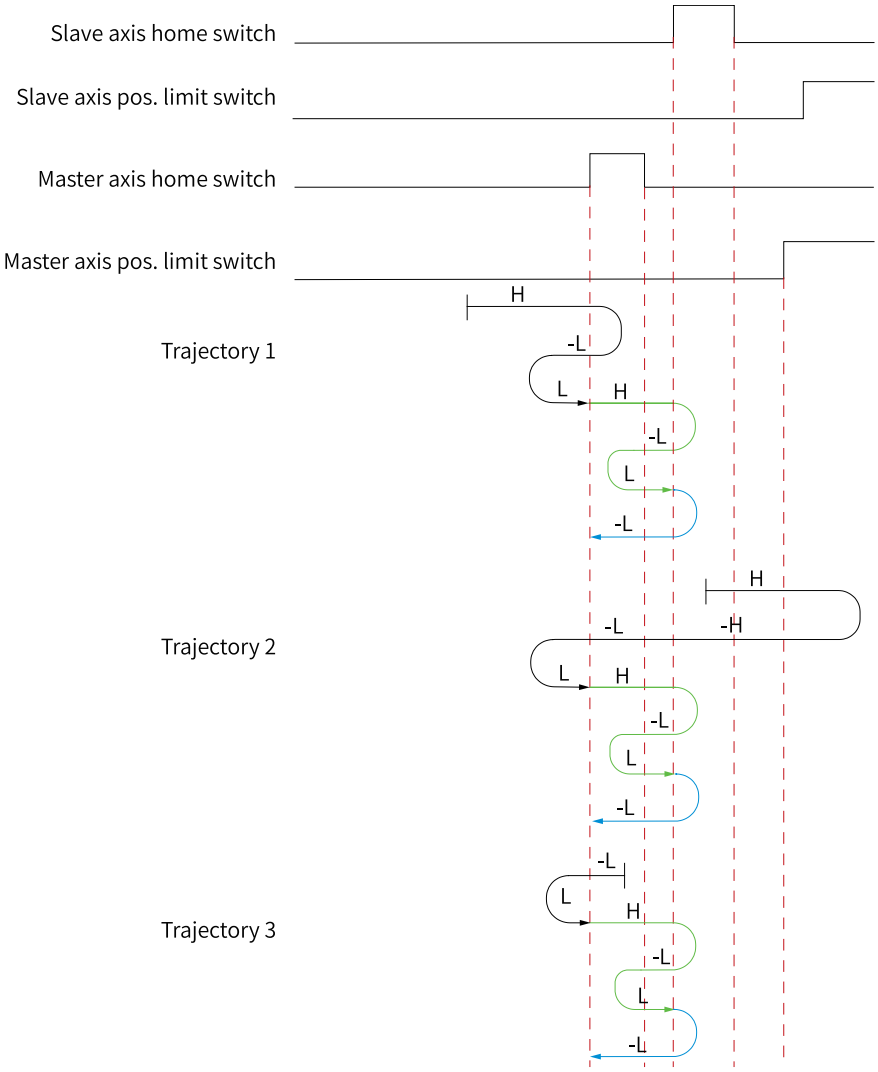
Deceleration point: home switch (HW)



6098 = 24

Home: home switch (HW)

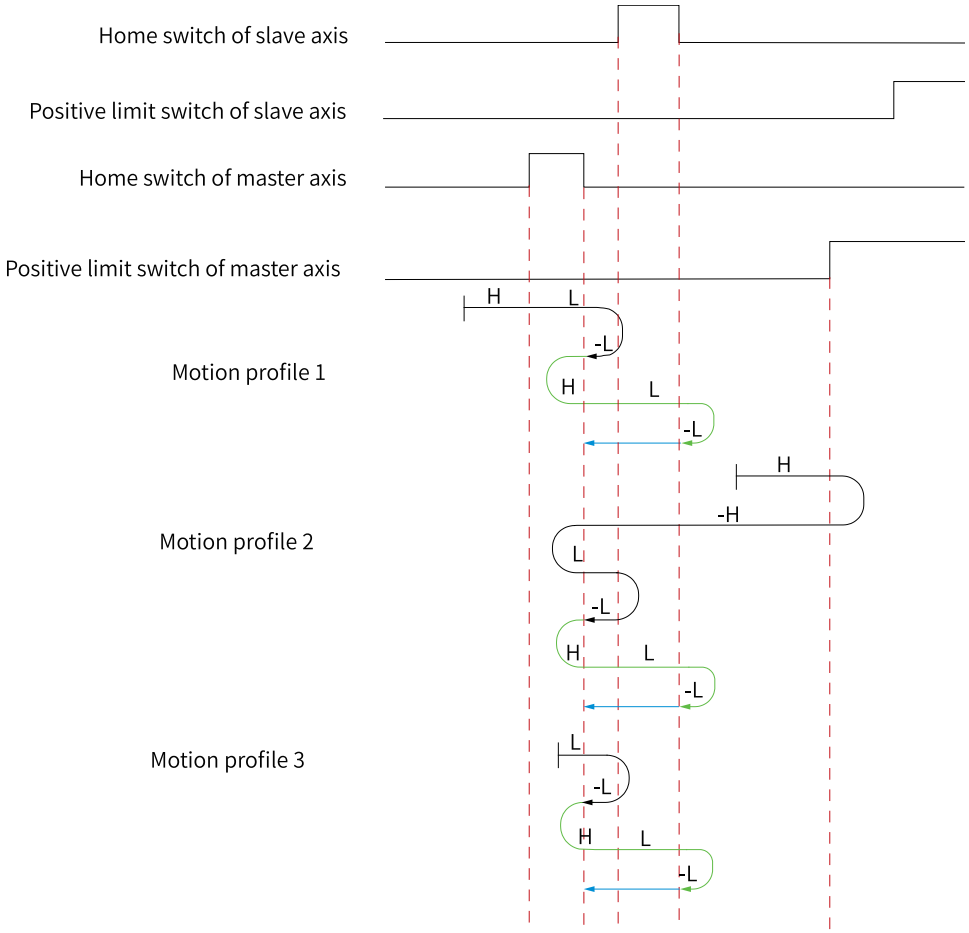
Deceleration point: home switch (HW)



6098 = 25

Home: home switch (HW)

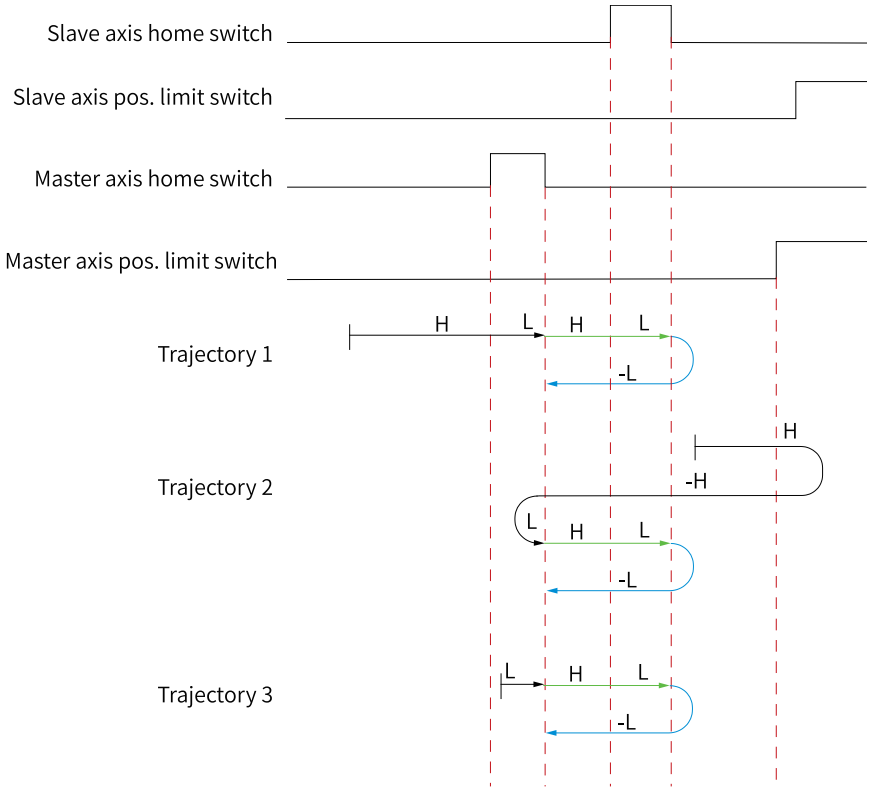
Deceleration point: home switch (HW)



6098 = 26

Home: home switch (HW)

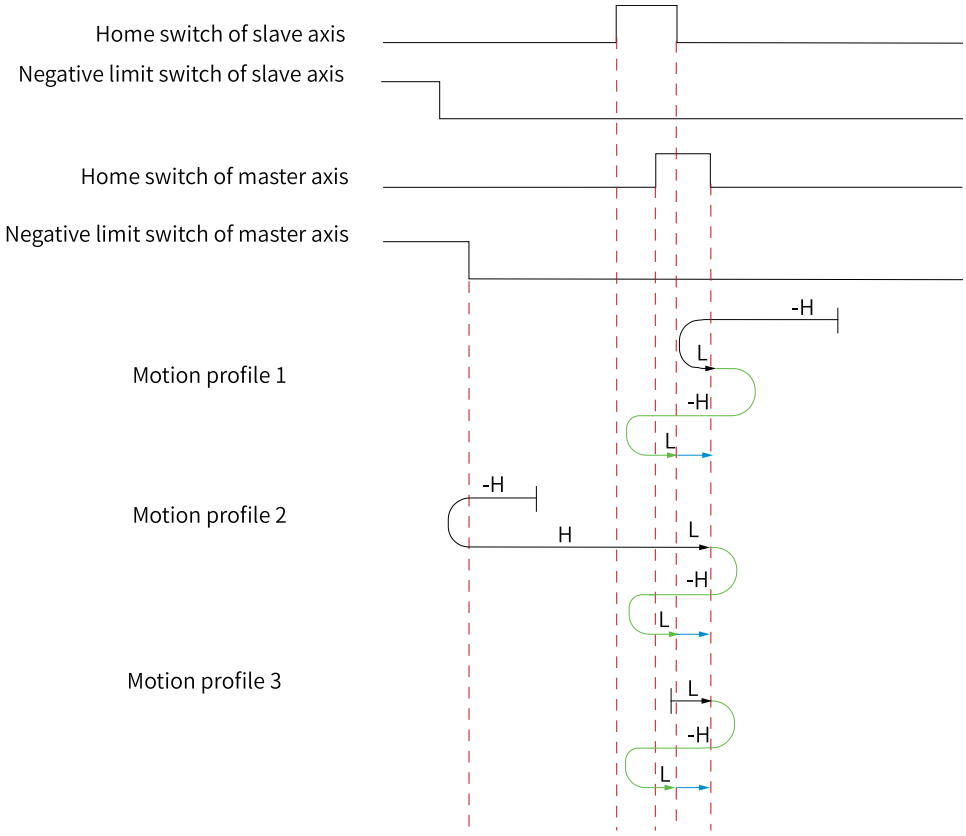
Deceleration point: home switch (HW)



6098 = 27

Home: home switch (HW)

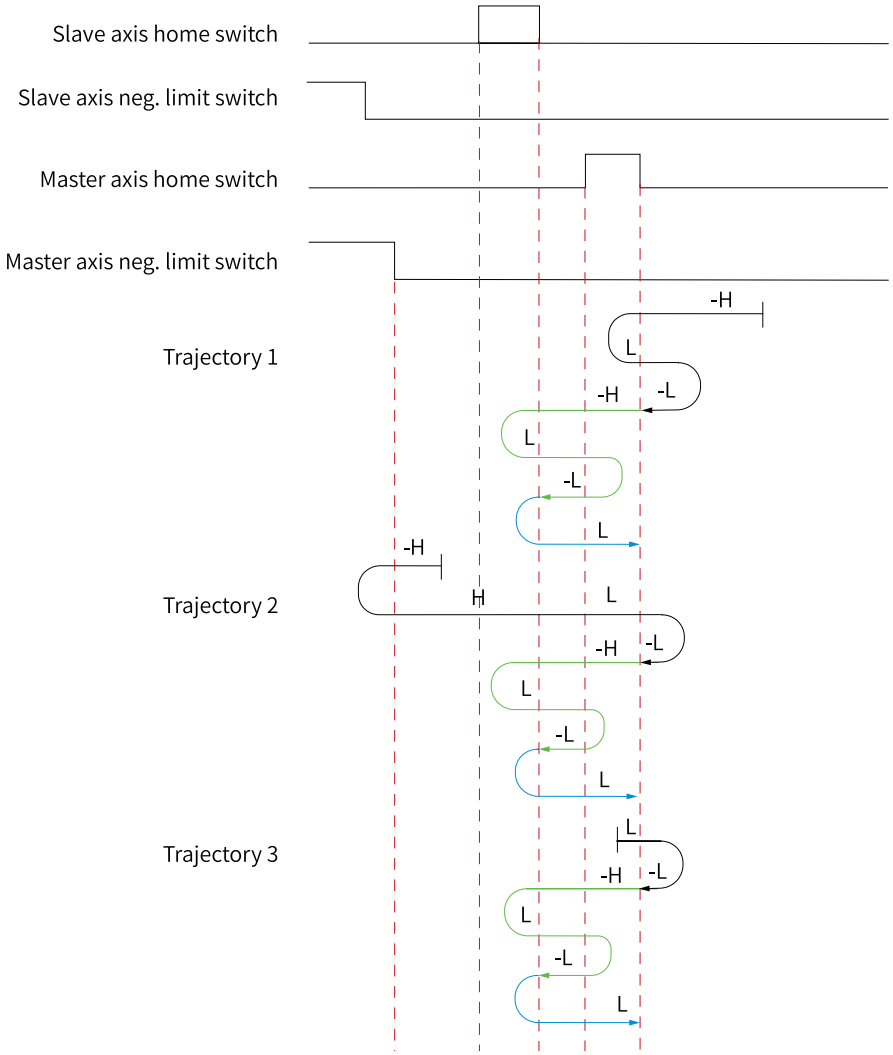
Deceleration point: home switch (HW)



6098 = 28

Home: home switch (HW)

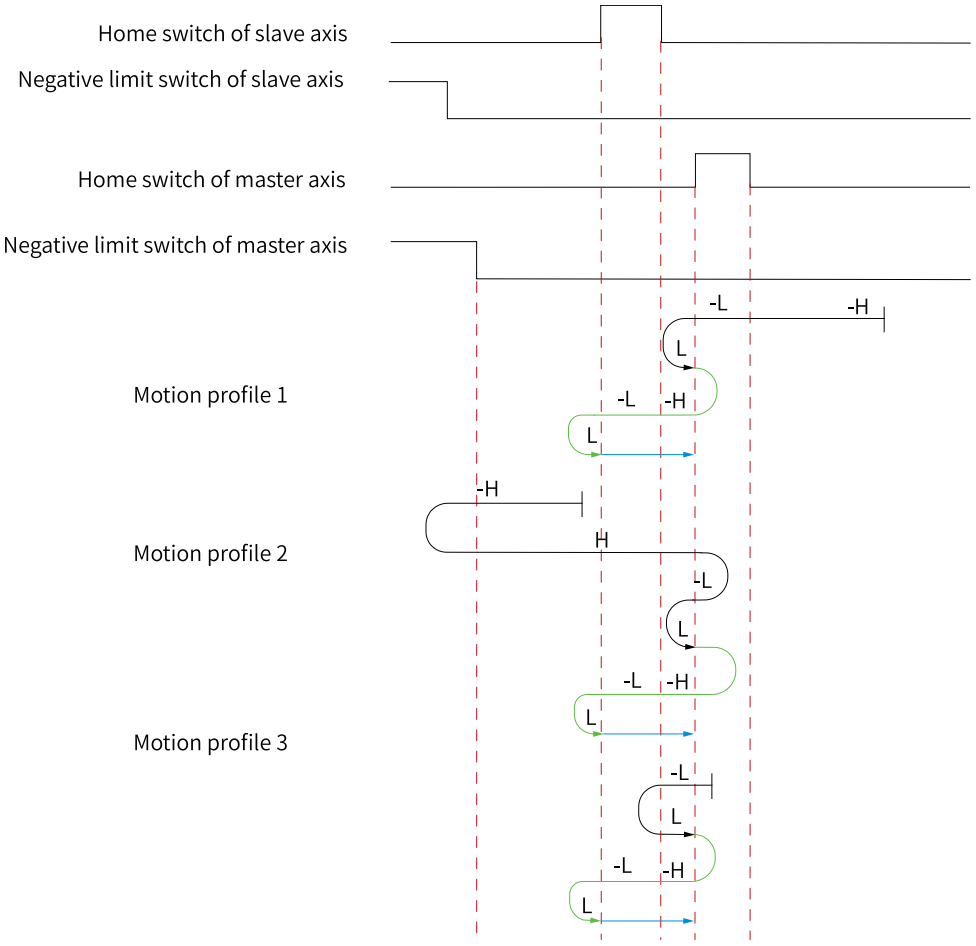
Deceleration point: home switch (HW)



6098 = 29

Home: home switch (HW)

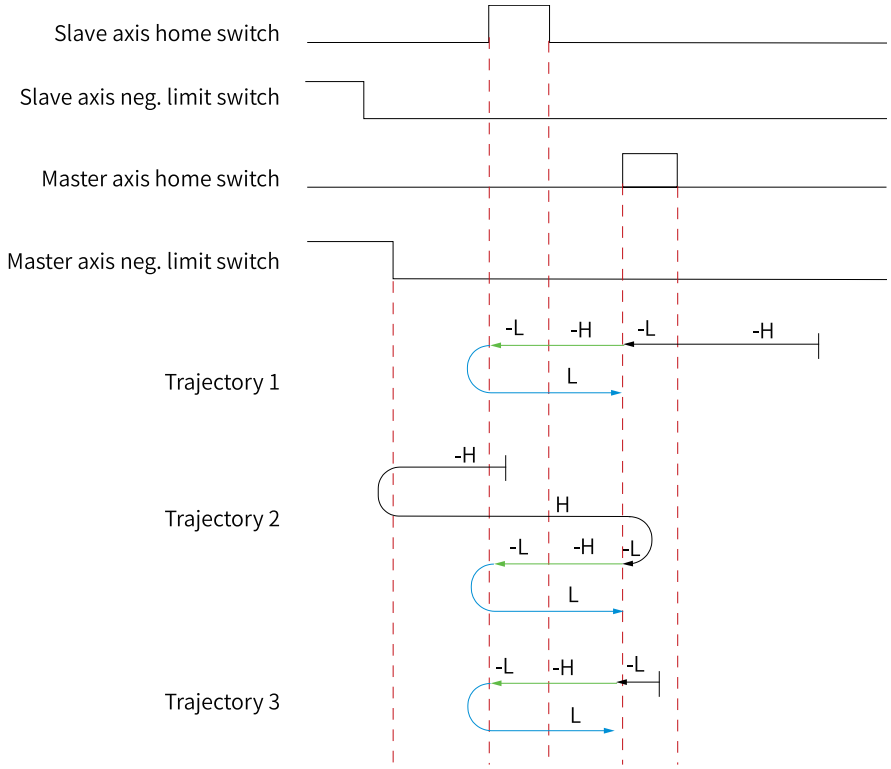
Deceleration point: home switch (HW)



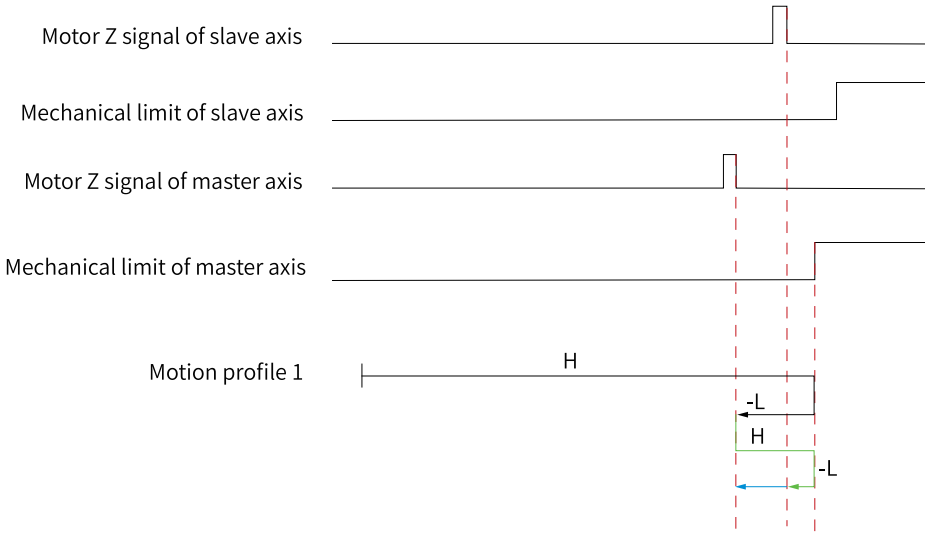
6098 = 30

Home: home switch (HW)

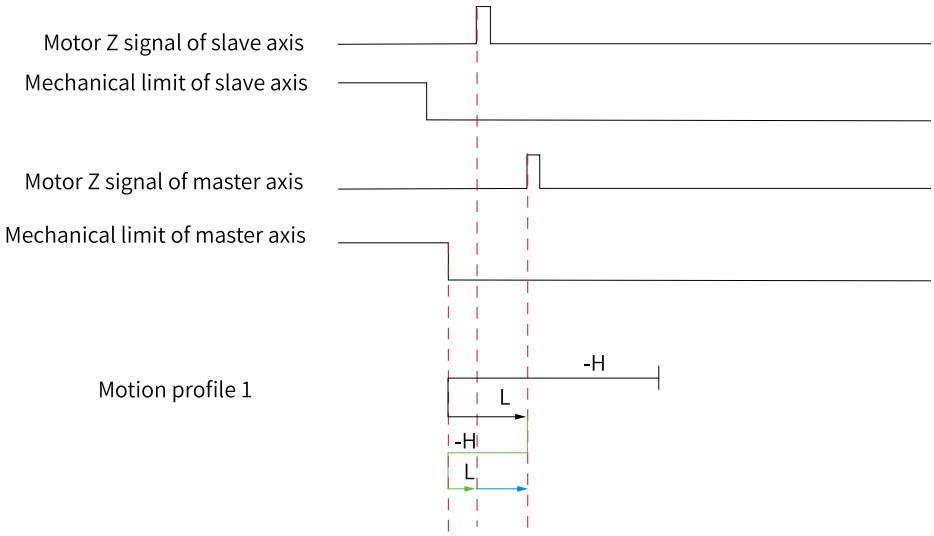
Deceleration point: home switch (HW)


Slave axis home switch
Slave axis neg. limit switch
Master axis home switch
Master axis neg. limit switch
Trajectory 1
Trajectory 2
Trajectory 3
-L
-H
-L
-H
L
-H
H
-L
-H
-L
L
-L
-H
-L
L

6098 = -2

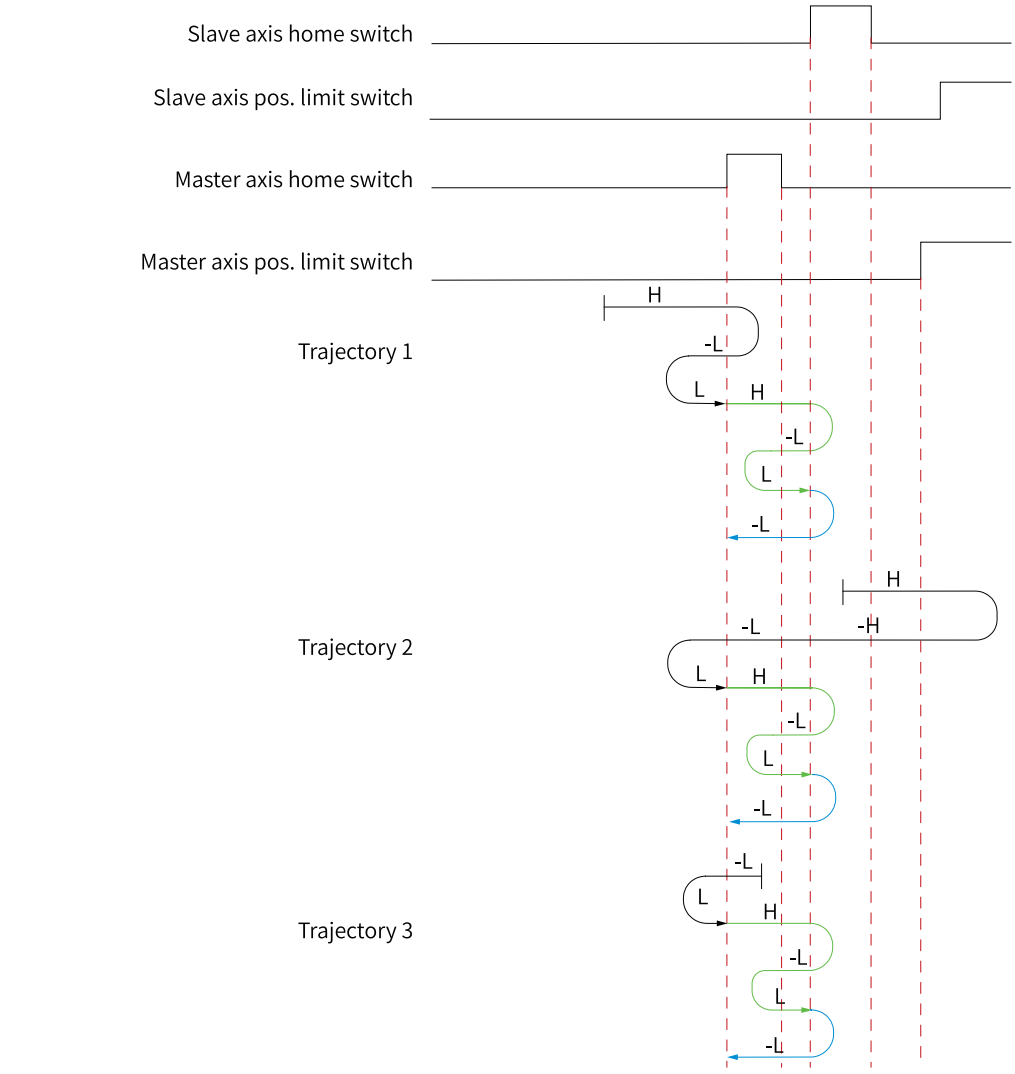

Motor Z signal of slave axis
Mechanical limit of slave axis
Motor Z signal of master axis
Mechanical limit of master axis
Motion profile 1
H
-L
H
-L

6098 = -1



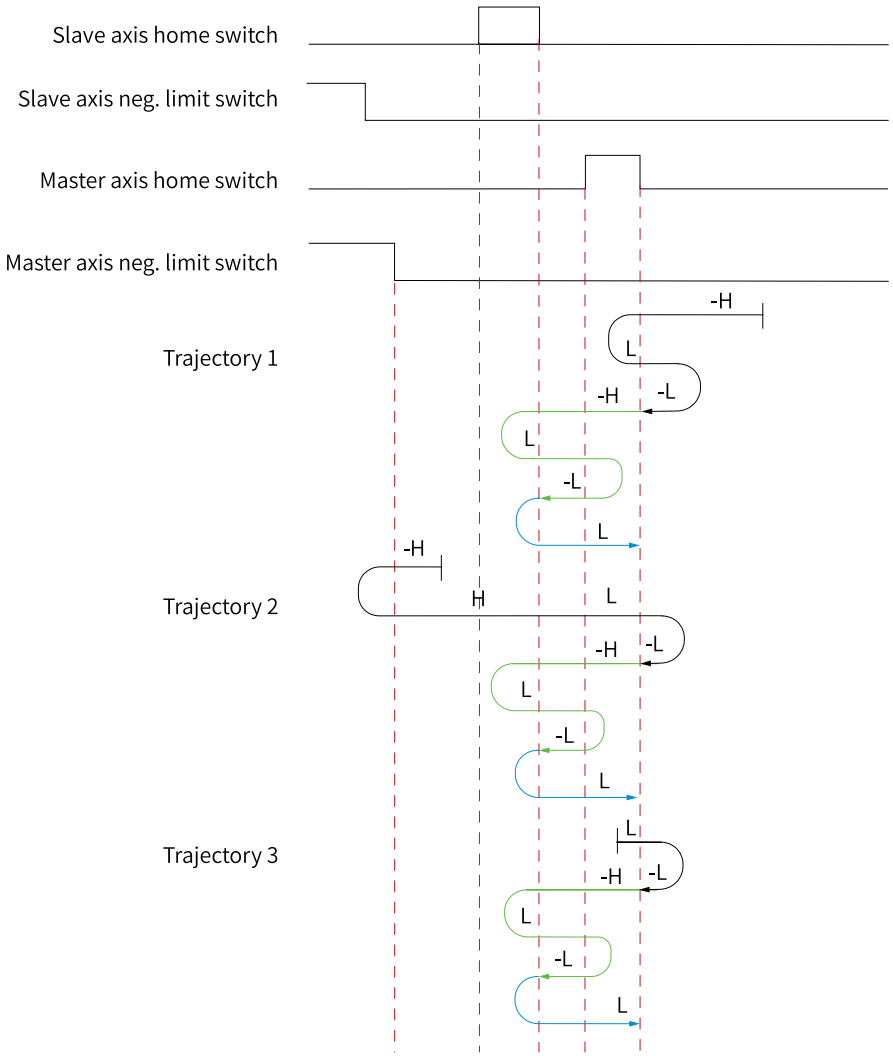
H05.31 = 0

Forward homing, home switch as deceleration point and home



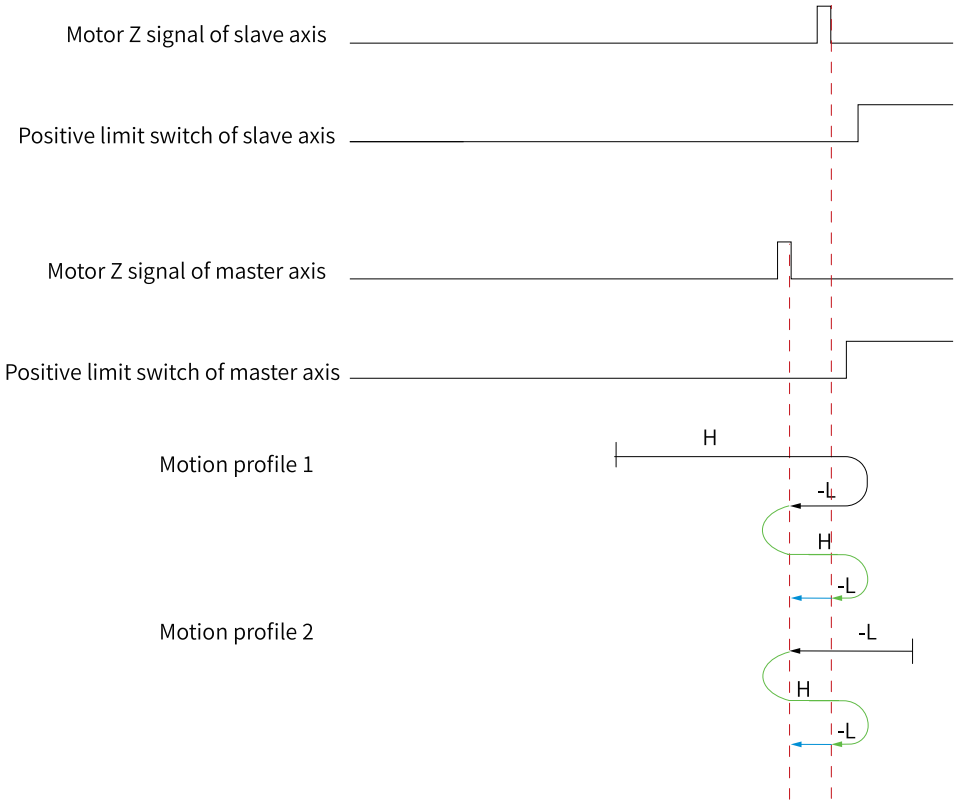
H05.31 = 1

Reverse homing, home switch as deceleration point and home



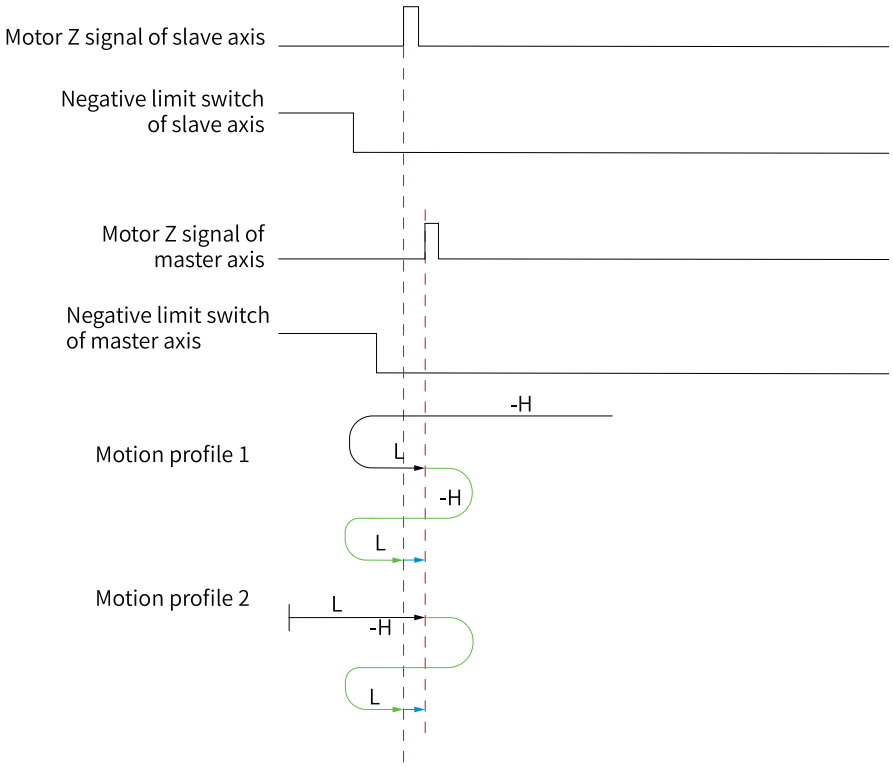
H05.31 = 8

Forward, positive limit switch as deceleration point and Z signal as home



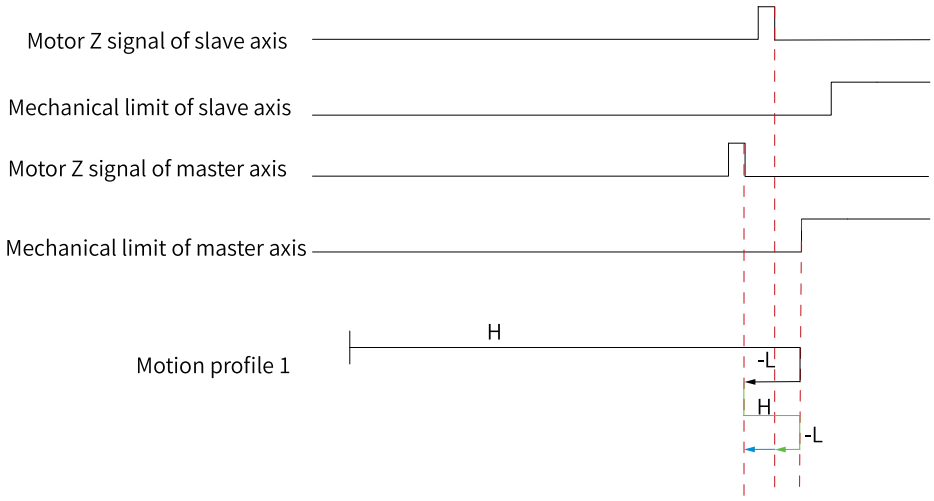
H05.31 = 9

Reverse, negative limit switch as deceleration point signal and Z signal as home



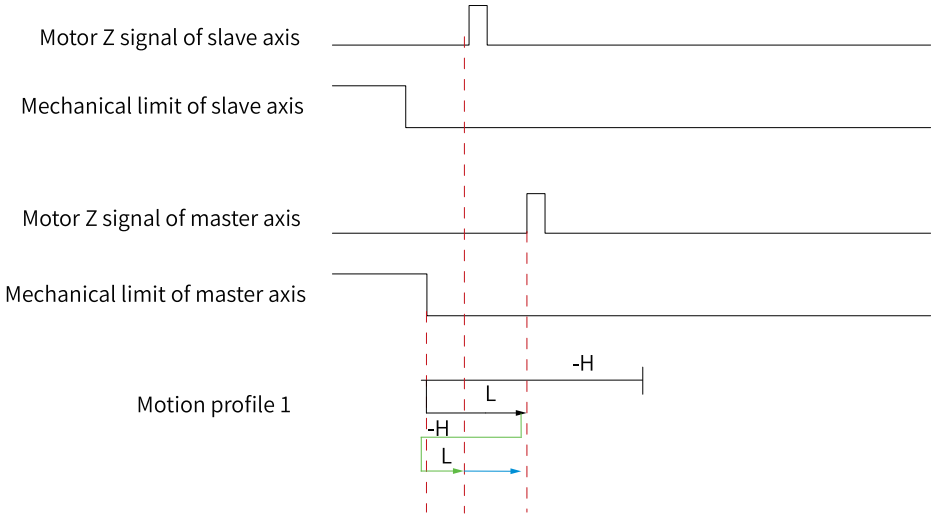
H05.31 = 12

Forward homing: positive mechanical limit as the deceleration point, and motor Z signal as the home



H05.31 = 13

Reverse homing: Negative mechanical limit as the deceleration point, and motor Z signal as the home



6 Safety Functions [Functional Safety Models]

6.1 Safety Overview

6.1.1 List of Safety Functions

Different from a standard drive, a safety-integrated drive can run without additional external components.

The functional safety drive can use the following safety functions

- Safe torque off (STO)
  The STO function immediately shuts off the torque or force output of the motor based on an input signal from an external device. This function corresponds to stop category 0 of IEC/EN 60204-1. If the motor is running when the STO function is activated, it coasts to a stop.
- Safe brake control (SBC)
  The SBC function provides a safe output for controlling external brakes.
- Safe stop 1 (SS1)
  The SS1 function starts deceleration based on an input signal from an external device. After a preset period of time elapses or zero speed is achieved, the STO function will be triggered. This function corresponds to stop category 1 of IEC/EN 60204-1.
  - SS1-t time-monitored SS1
    The motor decelerates to stop according to the input signal of the external device. Then STO is executed after the designated delay time elapsed.
  - SS1-r ramp-monitored SS1
    The motor decelerates to stop according to the input signal of the external device. The deceleration slope is monitored against the specified range. STO is executed when the motor speed is lower than the set limit.
- Safe stop 2 (SS2)
  The SS1 function starts deceleration based on an input signal from an external device. After a preset period of time elapses or zero speed is achieved, the SOS function will be triggered. This function corresponds to stop category 2 of IEC/EN 60204-1.
- Safe operating stop (SOS)
  The SOS function monitors whether the motor stops within the prescribed range for the stop position. The drive is in the closed-loop control mode, and can therefore withstand external forces.
- Safely-limited speed (SLS)
  The SLS function monitors whether the motor speed exceeds a preset speed limit. When the speed is over the limit, torque of the motor will be shut off immediately.
- Safe direction (SDI)
  The SDI function prevents the motor shaft from moving in an unintended direction. If the motor rotates in an impermissible direction, the drive stops the motor as quickly as possible.

- Safe speed monitor (SSM)
  The SSM function provides a safe output signal to indicate whether the motor speed is below a prescribed limit to identify, for example, a standstill. The servo provides a safe output signal for further processing.

Safety function characteristics

- The expansion safety functions are controlled by an external device through DI or a safety bus. The combination of safety module, SV680N-INT series servo drives, and safety motor supports safety functions (SS1-r/SS1-t/SS2/SOS/SLS/SDI/SSM) in compliance with PL e/Cat.3 and SIL3. The SS1-r/SS2/SOS/SLS/SDI/SSM features are not available when the safety motor is not used.
- Integrated STO can be triggered by the CN6 terminal on the panel of the drive.
- Controlling safety functions using a safety bus reduces wiring.



Safety functions SS1-r/SS2/SOS/SLS/SDI/SSM require the use of a safety motor, That does not apply to basic safety functions (STO/SBC/SS1-t).

6.1.2 Terms and Abbreviations

Terms/Abbreviations	Description
Cat.	Safety category, which includes B, 1, 2, 3, and 4
CCF	Common cause failure
DCavg	Average diagnostic coverage
DTI	Diagnostic test interval time
SFF	Safe failure fraction
HFT	Hardware fault tolerance
PFH	Probability of a dangerous Failure per Hour
PL	Performance level
SC	Systematic capability
SIL	Safety integrity level
T_1	Proof test interval
DI	Digital input
DO	Digital output
PCB	Printed circuit board
MCU	Micro computer unit
FPGA	Field programmable gate array
MTTFd	Mean time to dangerous failure
SRA	Safety related application
nSRA	Without SRA parameters (without FSoE safety bus object dictionary parameters)
STO	Safe torque off (The STO function brings the machine safely into a no-torque state and prevents it from unexpected start. When the STO function is activated, the drive stops according to the stop mode upon the level 1 fault (H02.08).)

6.1.3 Safety Standards and Specifications

Compliance

- EU directives and standards
  Low Voltage Directive 2014/35/EU, EN 61800-5-1

  Electromagnetic Compatibility Directive 2014/30/EU, EN 61800-3:2018

  Machinery Directive 2006/42/EC (Safety Functions) 61800-5-2:2007 and EN 61800-5-2:2017

- Safety standards

Safety standards	Reference standards
Functional safety	IEC 61508:2010 ISO 13849-1:2015 ISO 13849-2:2012 IEC 62061:2021 EN 61508:2010 EN ISO 13849-1:2015 EN ISO 13849-1:2023 EN ISO 13849-2:2012 EN IEC 62061:2021 IEC 60204-1:2016, clause 9.2.2 (Stop Category 0, Stop Category 1, Stop Category 2) EN 60204-1 2018, clause 9.2.2 (Stop Category 0, Stop Category 1, Stop Category 2)
EMC	IEC 61800-5-2:2016 IEC 61800-3:2017 IEC 61326-3-1:2017 IEC 61000-6-7:2014 EN 61800-5-2:2017 EN IEC 61800-3:2018 EN 61326-3-1:2017 EN 61000-6-7:2015
LVD	IEC 61800-5-1:2007/AMD1:2016 EN 61800-5-1:2007/AMD1:2017

- Safety parameters
  SV680 is STO-only.

Item	Safety parameters
SIL	SIL3, IEC 61508 Maximum SIL3, EN IEC 62061
PFH	STO safety function: PFH ≤ 0.73 × 10^{-9}[1/h] (0.73% of SIL3)
Cat.	3, EN ISO 13849-1
PL	e, EN ISO 13849-1

Item	Safety parameters
DTI	STO safety function: ≤10ms
MTTFd	645.64 years
DCavg	≥90% (medium)
T_1	20 years
Mission time	20 years
HFT	1
SC	SC3
MTTR	0 hour
MRT	0 hour
Operation Mode	High demand or continuous mode
Device type	Type B

The SV680 series servo drive supports multiple safety functions: safe torque off (STO), safe braking control (SBC), safe stop 1 (SS1), safe operation stop (SOS), safe stop 2 (SS2), safe speed limit (SLS), safety speed monitor (SSM), and safety direction (SDI).

Item	Safety parameters
SIL	SIL3, IEC 61508 Maximum SIL3, EN IEC 62061
PFH	SS1-t/SBC/STO safety function: PFH ≤ 6.55×10^{-9}[1/h] (6.55% of SIL3) SS1-r/SS2/SLS/SSM/SDI safety function: PFH ≤ 19.8×10^{-9}[1/h] (19.8% of SIL3) When all safety functions start at the same time: PFH ≤ 19.8×10^{-9}[1/h] (19.8% of SIL3)
Cat.	3, EN ISO 13849- 1
PL	e, EN ISO 13849-1
DTI	STO/SS1/SS2/SOS/SLS/SDI/SSM safety function: ≤ 20 ms SBC safety function: ≤ 150 ms per channel
MTTFd	SS1-t/SBC/STO: 639.59 years SS1-r/SS2/SLS/SSM/SDI: 324.24 years
T1	20 years
Mission time	20 years
HFT	1
SC	SC3
MTTR	0 hour
MRT	0 hour
Application mode	High demand or continuous mode
Device type	Type B
Safe speed accuracy	2197.98 rpm

Note

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

6.1.4 Precautions

Safety precautions

This chapter contains the warning symbols used in this guide and the safety instructions with which you must comply when you install or maintain safety modules of a drive or an inverter. If you ignore the safety instructions, injury, death or damage can occur. Read this chapter before you start the installation.

Any illustrations, photographs, or examples used in this manual are provided as examples only and may not apply to all products to which this manual is applicable.

The products and specifications described in this guide or the content and presentation of the guide may be changed without notice to improve the product and/or the guide.

Table 6–1 Warnings, cautions, and notes

Label	Indication	Definition	Consequences of negligence
Examples  General hazards  Special hazards Electric shock	DANGER	Danger	Indicates that failure to comply with the notice can result in death or severe personal injury.
	WARNING	Warning	Indicates that failure to comply with the notice may result in death or severe personal injury.
	CAUTION	Caution	Indicates that failure to comply with the notice may result in minor or moderate personal injury or equipment damage.
	STOP	Inhibit	Indicates that failure to comply with the notice can result in equipment or environmental damage.

Caution

- Users must incorporate safety measures in system design and electrical installation for both normal operation and troubleshooting.
- System design, installation, commissioning and maintenance must be carried out by personnel who have the necessary training and experience and read through all the operation instructions and safety information.
- For fully closed-loop functions, the safety speed-related functions (SS1-r, SLS, and SSM) and position-related functions (SS2, SOS, and SDI) only support safety speed and position monitoring on the internal encoder. Safety speed and position monitoring on external encoders is not supported.

It is the responsibility of the machine builder/OEM/system integrator to make sure that the essential health and safety function requirements specified in the Machinery Directive are met. The

manufacturer or its authorized distributor is obliged to conduct a hazard analysis before placing a product on the market, take appropriate measures to reduce/eliminate the related hazards and ensure proper components are selected.

This section describes the information that needs to be noted before you begin. Read the following safety instructions, risk assessment information, and limitations before you begin.

Before using the safety function, properly understand all the related information. Incorrect use of safety functions or use of safety functions that do not meet the safety requirements of the site may result in personal injury.

Safety measures

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

- The safety torque off (STO) function is not a substitute for the emergency stop (E-stop) function. If only the STO function is triggered, with no extra measures taken, and the power supply cannot be cut off in emergency, high-voltage parts of the motor and drive are still energized. This may incur to take actions to prevent accidents when they notice any unexpected situations electric shock or other electricity-related risks. Therefore, maintenance work on electrical parts of the drive or motor can be performed only after the drive system is isolated from the main power supply.
- Depending on standards and requirements for particular applications, STO may be used as part of an E-stop system. However, the main purpose of STO in a dedicated safety control arrangement is to prevent risks without the use of an E-stop.
- An E-stop is often provided in a machine to allow for unexpected situations where an operator sees a hazard and can take actions to prevent accidents.
- The design requirement for an E-stop differs from that of a safety interlock. Generally, E-stop is required to be independent of any complex or intelligent control. It may use purely electromechanical devices to either disconnect the power or initiate a controlled rapid stop by using other measures such as dynamic or regenerative braking.

Note

- The design of safety-related systems requires specialist knowledge. To ensure that a complete control system is safe, it is necessary for the whole system to be designed according to recognized safety principles. The use of individual sub-systems such as drives with STO function, which are intended for safety-related applications, does not in itself ensure that the complete system is safe.
- The STO function can be used to stop the drive in emergency stop situations.
- In processes without personnel protection, it is recommended not to stop the drive by using the STO function. If a drive running is stopped by using STO, the drive performs a coast-to-stop. If this is not acceptable, the system should be stopped using the correct mode instead of the STO function.
- This publication is a guide to the application of safety functions, and also on the design of safety-related systems for machinery control.
- It is the responsibility of the designer of the end product or application to ensure that it is safe and in compliance with the relevant regulations.

Risk assessment

- When using safety functions, perform risk assessment on the servo system in advance. Make sure that the safety integrity level of the standards is met.

- The following residual risks may arise even when safety functions are operating. Therefore, safety must always be given consideration during risk assessment.
- If external force (such as gravitational force of a vertical axis) applies when the safety function is enabled, the motor will rotate. Therefore, you must use a separate mechanical brake to secure the motor.

Note

- In the case of failure of multiple IGBTs, no matter whether the STO function is enabled, the servo drive can generate an alignment torque. This torque can cause the motor shaft to rotate within a range of up to 180 ÷ Number of motor pole pairs (for a synchronous reluctance motor, the range is 180 ÷ 2 × Number of motor pole pairs).
- p indicates the number of pole pairs.

To ensure safety, you should determine all the risk assessments and residual risks in the entire machine equipment. A company and individual who constructed the safety related system must take full responsibility for installation and commissioning of the system. Additionally, when in compliance with a European machinery directive, the system must acquire safety standards certification as a whole.

Perform all risk assessments and safe level certification on the machine or the system as a whole. It is recommended that a Certification Body final safety certification of the system be used.

The following section shows the residual risks concerning the safety observation function of this product.

Common residual risks

- At the shipment to end-users, check the settings of safety-related components by using programming tools and monitored/displayed contents on display and record and save the setting data concerning the safety observation function and the programming tools you used. Perform the checks by using a checklist.
- Safety will not be ensured such as in assembling machines until installation, wiring, and adjustment are completed properly. Install, wire, and adjust your system by referring to the installation guide for each unit.
- Only qualified personnel are authorized to install, perform trial runs, repair, or adjust the equipment in which these components are installed. Only trained engineers should install and operate the equipment.
- Separate the wiring of the safety observation function from other signal wiring.
- Protect the cables with appropriate measures, such as routing them in a cabinet by using a cable guard.
- We recommend that you use a switch, a relay, or a sensor that complies with safety standards. If you need to use a switch, a relay, or a sensor that does not comply with safety standards, perform safety checks.
- Keep a required clearance and creepage distance depending on the voltage that you use.

Residual risks in each function

- **Safe torque off (STO)**

This function only cuts off the torque of the motor, and does not cut off the power supply of the servo or inverter. Before servicing the servo/inverter, cut off the power supply and ensure that the servo/inverter are not energized.

Note

Perform STO function diagnosis at least once every three months. Run the STO function once to check whether the motor stops.

- **Safe brake control (SBC)**
  This function guarantees only that power to the mechanic break is properly supplied, but abrasion of the brake cannot be detected. Check this function regularly to ensure that the mechanic brake can operate. Evaluate whether the holding force of the mechanical brake meets the application requirements. Incorrect use may result in brake abrasion and personal injury.
- **Safely-limited speed (SLS)**
  - The speed monitoring function guarantees the servo motor speed but does not guarantee the actual machine safe speed. Set parameters so that the safe speed of the machine is the same as the safe speed of the specified motor.
  - Check whether the speed of the monitored servo axis is the same as the actual speed by using a tachometer or other tools. If not, evaluate whether the error is caused by the speed reference and encoder resolution.
  - Eliminate the risk of mechanical fractures before operation, such as shaft slippage and belt loss.
  - After the speed exceeds the limit, safety observation errors (OFF signal not triggered) do not occur within the velocity error detection time set by the parameter. Ensure safety during this period.
  - Adjust the speed limit based on the risk of speed ramp-up from an acceptable safe speed to an unacceptable speed due to the system response time.
- **Safe operating stop (SOS)**
  This function is used in scenarios with external loads, such as vertical axes. Servo drive failures can cause axis position hold failures. Evaluate the impact on the system and take hazard reduction or related control measures such as mechanical braking.
- **Safe speed monitor (SSM)**
  - The speed monitoring function guarantees the servo motor speed but does not guarantee the actual machine safe speed. Set parameters so that the safe speed of the machine is the same as the safe speed of the specified motor.
  - Check whether the speed of the monitored servo axis is the same as the actual speed by using a tachometer or other tools. If not, evaluate whether the error is caused by the speed reference and encoder resolution.
  - Eliminate the risk of mechanical fractures before operation, such as shaft slippage and belt loss.
  - After the speed exceeds the limit, safety observation errors (OFF signal not triggered) do not occur within the velocity error detection time set by the parameter. Ensure safety during this period.

- Adjust the speed limit based on the risk of speed ramp-up from an acceptable safe speed to an unacceptable speed due to the system response time.

6.2 General

The combination of the safety module, SV680N-INT drive and safety motor can achieve the following safety functions:

Safety Function	Function
STO	The STO function immediately shuts off the torque or force output of the motor based on an input signal from an external device. This function corresponds to stop category 0 of IEC/EN 60204-1. If the motor is running when the STO function is activated, it coasts to a stop.
SBC	The SBC function provides a safe output for controlling external brakes.
SS1	The SS1 function starts deceleration based on an input signal from an external device. After a preset period of time elapses or zero speed is achieved, the STO function will be triggered. This function corresponds to stop category 1 of IEC/EN 60204-1.
SS2	The SS1 function starts deceleration based on an input signal from an external device. After a preset period of time elapses or zero speed is achieved, the SOS function will be triggered. This function corresponds to stop category 2 of IEC/EN 60204-1.
SOS	The SOS function monitors whether the motor stops within the prescribed range for the stop position. The drive is in the closed-loop control mode, and can therefore withstand external forces.
SLS	The SLS function monitors whether the motor speed exceeds a preset speed limit. When the speed is over the limit, torque of the motor will be shut off immediately.
SDI	The SDI function prevents the motor shaft from moving in an unintended direction. If the motor rotates in an impermissible direction, the drive stops the motor as quickly as possible.
SSM	The SSM function provides a safe output signal to indicate whether the motor speed is below a prescribed limit to identify, for example, a standstill. The servo provides a safe output signal for further processing.

Different from other functions, the SS1-t function in STO, SBC, and SS1 can be used with a non-safety motor.

- When using a safety motor, the SS1-r/SS2/SOS/SLS/SDI/SSM function is allowed after setting H20.80 = 1.
- H20.80 can only be set to 0 when no safety motor is used.

Note

- Software version of H20.00 = 1.10: By reading the safety encoder software version number of H00.04, the safety motor position feedback monitoring is automatically turned on.
- safety module software version of H20.00 = 1.20 and above : Enable safety motor position feedback monitoring by setting safety parameter H20-80 = 1.

To use safety functions of the safety module related to speed and position, you must use an Inovance S6 motor and set H20-80 = 1.

You can choose to trigger the safety functions either locally or through FSoE by setting parameter H20.01. The FSoE mode is only applicable to the SV680N-INT servo drive. For a pulse servo drive, you must choose the local mode.

Related parameters:

Parameter	Name	Value	Default	Unit	Change Mode	Page
H20.01	Safety function trigger selection	0: Locally triggered 1: FSoE triggered-SRA 3: FSoE triggered-nSRA	0	-	At stop	"H20_en.01" on page 1002

When the local mode triggers the safety function, you can configure the safety DI to a safety function (such as STO, SS1 or SS2) and control the function through on and off of the safety DI. You can also configure the DO to a safety function (such as STO, SOS, or SSM). The DO output is active when the corresponding safety function is triggered.

When you choose to trigger the safety functions through FSoE, you need to configure the PDO mapping. The RPDO transfers data from the master to the slave. You can control the triggering of a safety function by setting the bit in RPDO corresponding to the safety function. The TPDO feeds back data from the slave to the master. The safety module feeds back the current safety function state to the host controller through TPDO.

Note

- When the safety functions are configured to be triggered in local mode, the TPDO does not update.
- When the safety functions are triggered in FSoE mode, the DI and DO functions of CN9 and CN10 are not available, but the STO terminal (CN6) can be used normally. STO1 and STO2 need to be short-circuited to the 24 V pin if the STO function of CN6 is not used. This can disable the STO function of CN6.

Priority of safety functions

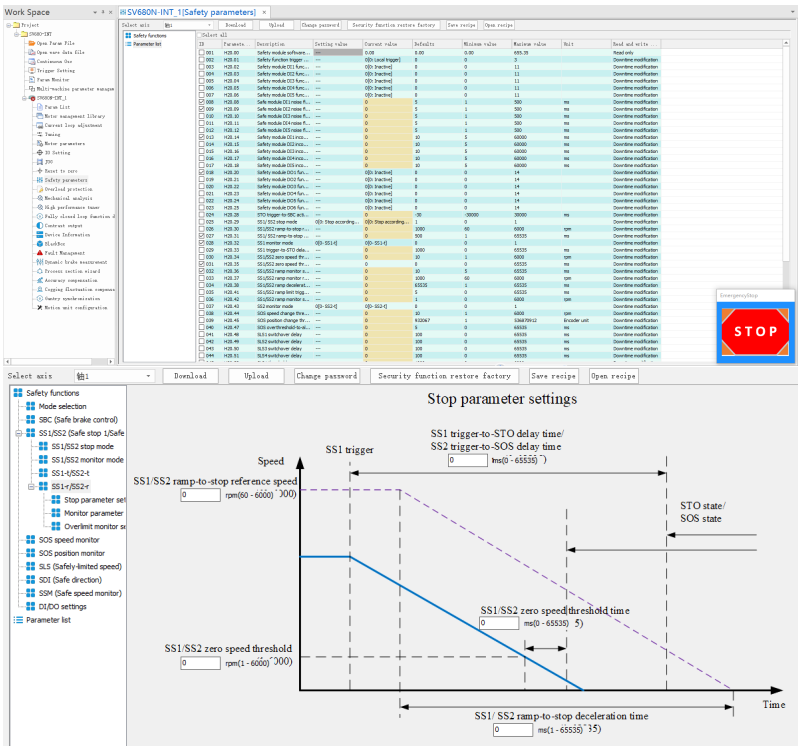
When several safety functions are activated simultaneously, the following priority applies:

- STO has priority over SS1 and SS2.
- SLS/SDI/SSM are independent of each other.

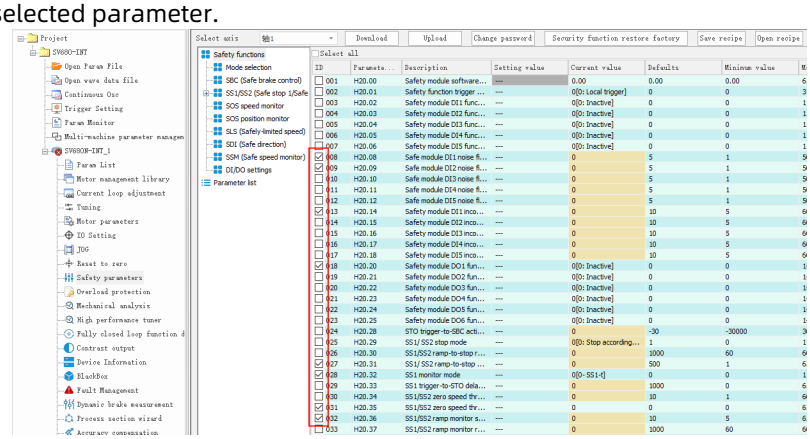
When a safety function overrides another, this does not cancel the request for the overridden safety function. Therefore, the overridden safety function is restarted after other safety functions are completed.

6.3 Software Parameter Configuration

You can configure the safety parameters in "InoDriverShop" tool on the parameter list or on the graphic user interface of corresponding safety function. The object dictionary cannot be configured.

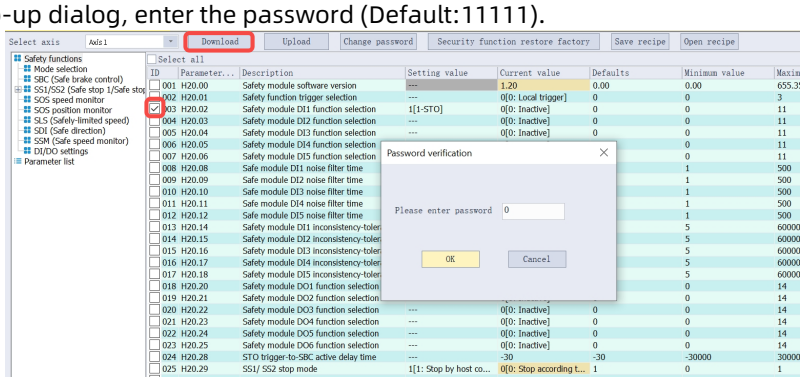


1. On the parameter list, select a parameter you want to configure and then click Upload to read the value of the selected parameter.

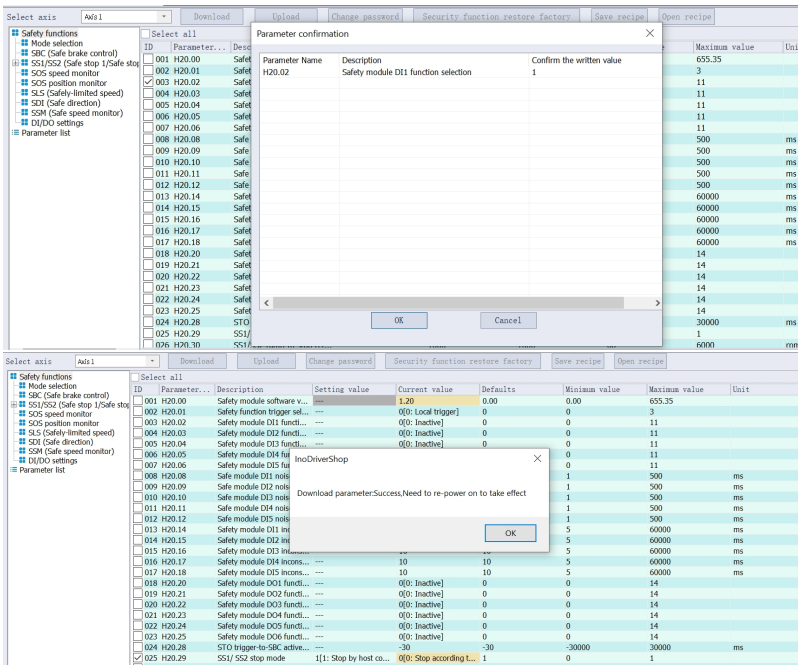


Any changes to any safety parameters take effect only at next power-on.

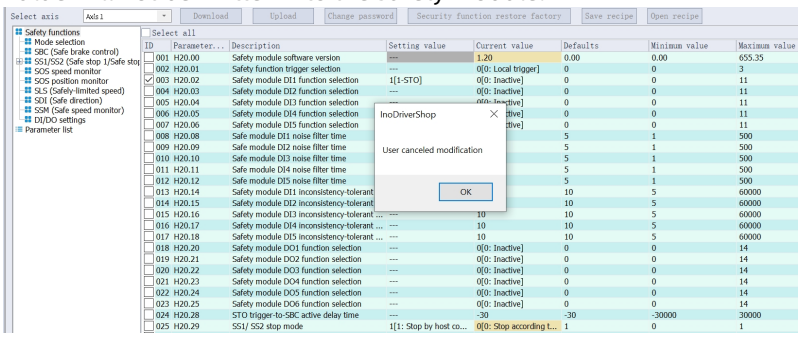
2. Enter a value for the safety parameter and click Download. A password verification dialog pops up. In the pop-up dialog, enter the password (Default:11111).



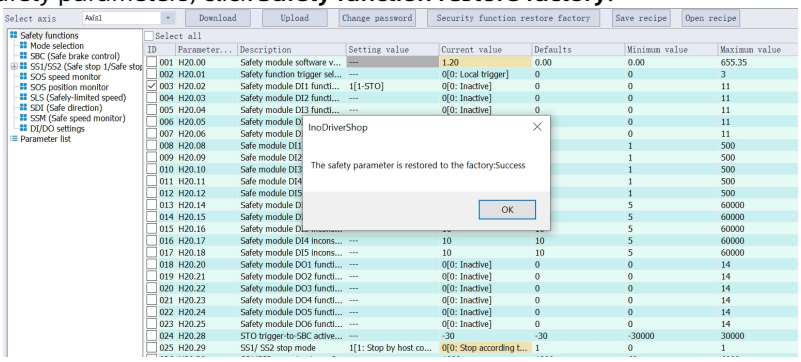
3. A confirmation dialog pops up. Make sure the value entered is correct and click OK. The value is written into the safety module.



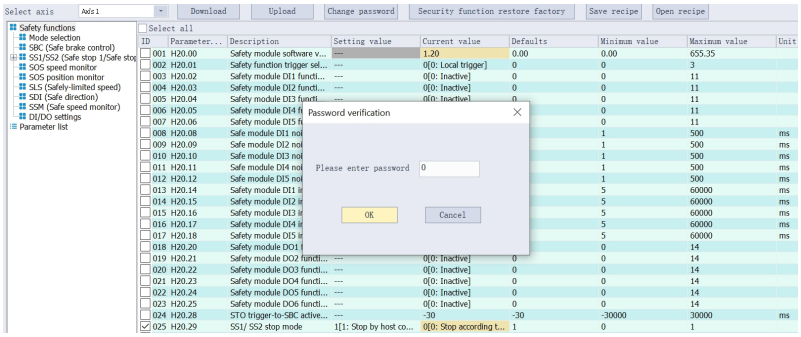
4. If you click Cancel, or fail to click OK within 10 seconds, you are prompted that the modification is canceled. The value will not be written into the safety module.



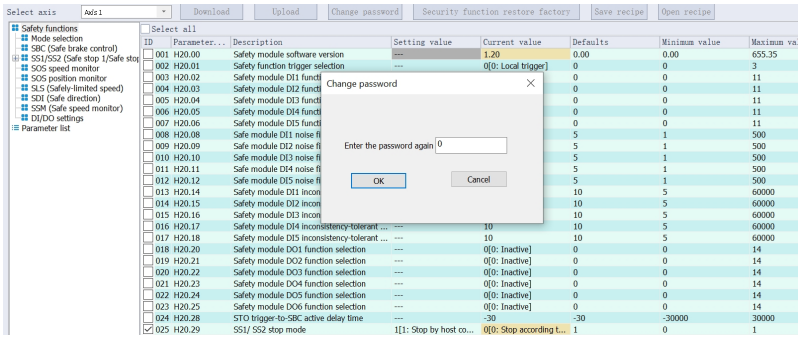
5. To reset the safety parameters, click **Safety function restore factory**.



6. To change the safety password, click **Change password**. In the pop-up password verification dialog, enter the current password. The verification is passed. Then in the pop-up new password dialog, enter the new password (range: 1 to 65535).



7. The confirm password dialog pops up and then enter the new password again. Make sure the new password and the confirm password are the same.
   If they are different, the password change fails.



6.4 Safety DI/DO Function

6.4.1 Safety DI Function

DI Function Selection

The safety module includes five DIs. Each DI is configured to receive two input signals through two channels A and B, and default to 0 (OFF). You can assign each DI with a logic function using the software tool.

Table 6–2 Logic function selection of DI1 to DI5

Pin No.	Name	Pin No.	Name	Configure parameters.
CN9		CN10		
12	DI1A	12	DI1B	You can configure the logic function of DI1 by setting parameter H20.02.
11	DI2A	11	DI2B	You can configure the logic function of DI2 by setting parameter H20.03.
10	DI3A	10	DI3B	You can configure the logic function of DI3 by setting parameter H20.04.
9	DI4A	9	DI4B	You can configure the logic function of DI4 by setting parameter H20.05.
8	DI5A	8	DI5B	You can configure the logic function of DI5 by setting parameter H20.06.

Note

The logical function configuration of each DI must be unique.

DI Input Filtering

To avoid false triggering of safety functions caused by external noise interference, five DI input filter parameters are added to the safety module. Only when the DI input signal is 0 (OFF) and lasts for a period of time exceeding the DI noise rejection filter time, the safety module performs the corresponding safety function.

Table 6–3 Noise Rejection Filter Time of DI1 to DI5

Configure parameters.	Name
H20.08	Safety module DI1 noise rejection filter time, in 1 ms
H20.09	Safety module DI2 noise rejection filter time, in 1 ms
H20.10	Safety module DI3 noise rejection filter time, in 1 ms
H20.11	Safety module DI4 noise rejection filter time, in 1 ms
H20.12	Safety module DI5 noise rejection filter time, in 1 ms

For example, DI1 is assigned with the STO function. The filtering time from when the DI1 receives an input 0 (OFF) to when the STO function is triggered is set by the parameter H20.08.

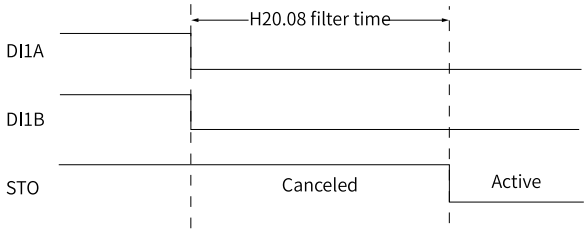


Figure 6-1 Diagram of DI1 noise rejection filter time H20.08

Note

- OFF (0): The 24V voltage of the corresponding DI is off.
- ON (1): The 24V voltage of the corresponding DI is off.

Input Discrepancy Detection

When the function assigned to the DI is active, the safety module monitors whether the signals input to the DI are consistent. If discrepancy exists between the input signals and the discrepancy lasts for a period of time exceeding the allowable discrepancy time, the servo drive issue an alarm E134.x, with x indicating the DI number.

You can configure the following parameters to monitor the discrepancy at input signals of the five DIs.

Table 6–4 Parameter for monitoring discrepancy at input signals of DI1 to DI5

Configure parameters.	Name
H20.14	Safety module DI1 allowable discrepancy time, unit: 1 ms
H20.15	Safety module DI2 allowable discrepancy time, unit: 1 ms

Configure parameters.	Name
H20.16	Safety module DI3 allowable discrepancy time, unit: 1 ms
H20.17	Safety module DI4 allowable discrepancy time, unit: 1 ms
H20.18	Safety module DI5 allowable discrepancy time, unit: 1 ms

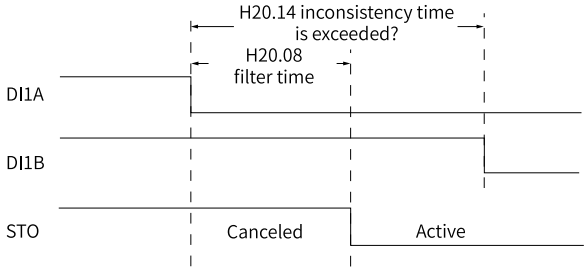


Figure 6-2 Checking for discrepancy at input signals of DI1

Note

The safety DI is mainly used together with the safety DO. For wiring of the safety DI function, see *"13.1 Expansion Safety Function Terminals CN9 and CN10" on page 1170*.

6.4.2 Safety DO Function

DO Function Selection

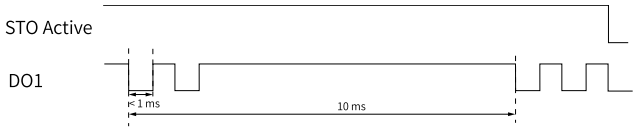
The safety module has six DO terminals, which are all set to 0-Disabled by default. DO3 and DO6 are non-safe DO circuits and cannot be used to configure SSM. You can assign each DI with a logic function using the software tool.

terminals	Pin No.	Name	Configure parameters.
CN9	4	DO1	You can configure the logic function of DO1 by setting parameter H20.20.
	3	DO2	You can configure the logic function of DO2 by setting parameter H20.21.
	1&2	DO3	You can configure the logic function of DO3 by setting parameter H20.22.
CN10	4	DO4	You can configure the logic function of DO4 by setting parameter H20.23.
	3	DO5	You can configure the logic function of DO5 by setting parameter H20.24.
	1&2	DO6	You can configure the logic function of DO6 by setting parameter H20.25.

DO output diagnosis

To ensure that the DO circuit is able to output the signal properly, the safety module will diagnose the DO circuit. To perform DO circuit diagnosis, you need to input 24 V voltage signals to pins 5 and 6 of the CN9 and CN10 terminals.

The following figure shows that when DO1 is configured to STO, the safety module will diagnose the DO1 output circuit when STO is active. The width of the diagnostic pulse is less than 1 ms. When the pulse diagnosis feedback signal is abnormal, the servo drive issues an E125.x alarm, where x is the DO serial number.



Note

- For safety DOs (DO1, DO2, DO4, DO5), the maximum DO output voltage is 2.6 V when the DO does not output, that is, the DO output is in an off state. To prevent malfunction, pay attention to the operation voltage threshold of the external electrical device at the load side of the safety DO.
- The safety DO cannot be used as an EDM signal in the STO function. For details, see *" EDM signal DO output" on page 432*.
- The safety DO is mainly used together with the safety DI. For wiring of the safety DO function, see *"13.1 Expansion Safety Function Terminals CN9 and CN10" on page 1170*.

6.5 FSoE

6.5.1 Overview

The EtherCAT safety technology was developed according to IEC 61508, is approved by TÜV Süd Rail, and is standardized in IEC 61784-3. The protocol is suitable for safety applications with a safety integrity level up to SIL 3. FSoE data communication is performed in a question-and-answer manner. All data exchanges are initiated by the safety master, and additional data are incorporated to ensure integrity. During each safety cycle, the safety connection between the FSoE master and the FSoE slave is fully monitored. The security check, connection ID and watchdog time of every FSoE frame transmission will be checked.

The SV680N-INT servo drive with FSoE functional safety consists of a drive control part (main unit) and an extended part (functional safety module). The FSoE master communicates with the FSoE slave through the EtherCAT bus. The internal safety data of the FSoE slave is exchanged through a black channel. After the FSoE data embedded in the EtherCAT process data reaches the main unit of the servo drive, it is transmitted to the functional safety module through internal communication.

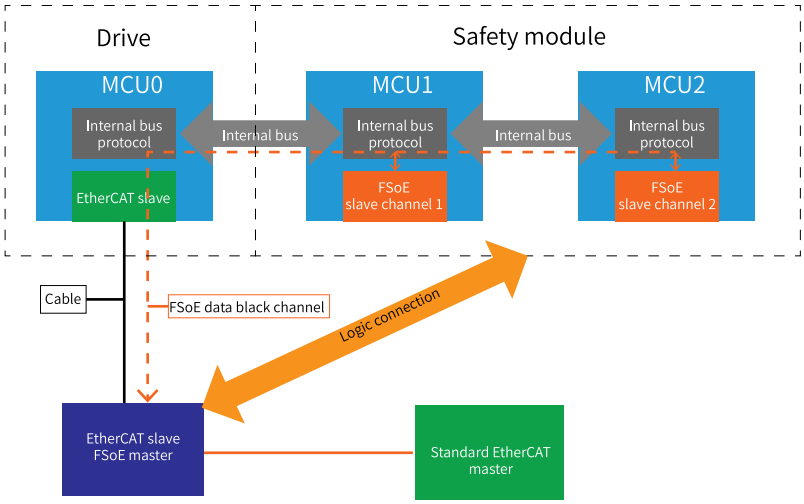


Figure 6-3 FSoE data transmission

6.5.2 Fixed Safety PDO Setting

- **PDO mapping for FSoE reception (170Ah)**

Index	Sub-index	Length (bit)	Name	Data type
E700h	1	8	FSoE master command	USINT
6640h	0	1	STO	BOOL
6650h	0	1	SS1 command	BOOL
6670h	0	1	SS2 command	BOOL
6668h	1	1	SOS1 command	BOOL
0000h	0	1	Reserved	BOOL
66D0h	0	1	SDIp command	BOOL
66D1h	0	1	SDIn command	BOOL
6632h	0	1	Error response	BOOL
6630h	0	1	Reset response	BOOL
6660h	0	1	SBC command	BOOL
6690h	1	1	SLS1 command	BOOL
6690h	2	1	SLS2 command	BOOL
6690h	3	1	SLS3 command	BOOL
6690h	4	1	SLS4 command	BOOL
0000h	0	1	Reserved	BOOL
0000h	0	1	Reserved	BOOL
E700h	3	16	FFSoE master CRC_0	UINT
E700h	2	16	FSoE master connection ID	UINT

- **PDO mapping for FSoE transmission (1B0Ah)**

Index	Sub-index	Length (bit)	Name	Data type
E600h	1	8	FSoE slave command	USINT
6640h	0	1	STO activation	BOOL
66E0h	0	1	SSM state	BOOL
0000h	0	1	Reserved	BOOL
6668h	1	1	STO activation	BOOL
0000h	0	1	Reserved	BOOL
66D0h	0	1	SDIp activation	BOOL
66D1h	0	1	SDIn activation	BOOL
6632h	0	1	Error	BOOL
6630h	0	1	Reset	BOOL
6660h	0	1	SBC activation	BOOL
6690h	1	1	SLS1 command activation	BOOL
6690h	2	1	SLS2 command activation	BOOL
6690h	3	1	SLS3 command activation	BOOL
6690h	4	1	SLS4 command activation	BOOL
0000h	0	1	Reserved	BOOL
E601h	1	1	Safety connection state	BOOL

Index	Sub-index	Length (bit)	Name	Data type
E600h	3	16	FFSoE slave CRC_0	UINT
E600h	2	16	FSoE slave connection ID	UINT

6.6 STO

6.6.1 Overview

For the STO function integrated in the drive, please refer to the corresponding function manual and hardware manual. This chapter only introduces the STO function of the safety module.

The STO function cuts off the input current of the motor to stop it according to an input signal from the safety controller.

When the STO function is triggered, the servo drive turns off the S-RDY signal and enters the safe state.

The safety module can be configured to trigger the STO function in either of the following ways.

Remember to power off and on the drive every three months or trigger the STO through the safety module, so that STO can be reset periodically.

6.6.2 STO Triggered by Local Mode

In order to properly use the input signal function of the safety module, the DI wiring of the safety input must be correct.

Set H20.01 to 0: Local DI triggers the safety function and EtherCAT communication trigger is no longer effective.

Table 6–5 Description of function No.

Code	Name	Function Name	Function
FunIN.1	STO command	STO trigger command	0: STO active 1: STO deselected
FunIN.11	ACK command	ACK trigger command	0: ACK deselected 1: ACK trigger
FunOUT.1	STO Active	STO active	0: Normal state 1: STO state

ACK function not selected for DI: STO status exits automatically when the STO command is canceled.

ACK function is selected for DI: Two DI terminals are used, one configured as STO and one configured as ACK. You can exit the STO state only when the STO command is canceled, and the ACK command is triggered.

See the section on SBC for the sequence of STO and SBC.

Note

- OFF (0): The 24V voltage of the corresponding DI is disconnected.
- ON (1): The 24V voltage of the corresponding DI is connected.

Related parameters:

Parameter	Name	Value	Default	Unit	Change Mode	Page
H20.02	Safety module DI1 function selection	0: Inactive1: STO 2: SBC 3: SS1 4: SS2 5: SLS1 6: SLS2 7: SLS3 8: SLS4 9: SDIp 10: SDIn 11: Ack	0	-	At stop	"H20_en.02" on page 1003
H20.03	Safety module DI2 function selection	0: Inactive 1: STO 2: SBC 3: SS1 4: SS2 5: SLS1 6: SLS2 7: SLS3 8: SLS4 9: SDIp 10: SDIn 11: ACK	0	-	At stop	"H20_en.03" on page 1003
H20.04	Safety module DI3 function selection	0: Inactive 1: STO 2: SBC 3: SS1 4: SS2 5: SLS1 6: SLS2 7: SLS3 8: SLS4 9: SDIp 10: SDIn 11: ACK	0	-	At stop	"H20_en.04" on page 1004

Parameter	Name	Value	Default	Unit	Change Mode	Page
H20.05	Safety module DI4 function selection	0: Inactive 1: STO 2: SBC 3: SS1 4: SS2 5: SLS1 6: SLS2 7: SLS3 8: SLS4 9: SDIp 10: SDIn 11: ACK	0	-	At stop	"H20_en.05" on page 1004
H20.06	Safety module DI5 function selection	0: Inactive 1: STO 2: SBC 3: SS1 4: SS2 5: SLS1 6: SLS2 7: SLS3 8: SLS4 9: SDIp 10: SDIn 11: ACK	0	-	At stop	"H20_en.06" on page 1005
H20.20	Safety module DO1 function selection	0: Inactive 1: STO Active 2: SBC Active 3: SS1 Active 4: SS2 Active 5: SLS1 Active 6: SLS2 Active 7: SLS3 Active 8: SLS4 Active 9: SDIp Active 10: SDIn Active 11: SOS Active 12: SSM Active 13: SS1-r Active 14: SS2-r Active	0	-	At stop	"H20_en.20" on page 1008

Parameter	Name	Value	Default	Unit	Change Mode	Page
H20.21	Safety module DO2 function selection	0: Inactive 1: STO Active 2: SBC Active 3: SS1 Active 4: SS2 Active 5: SLS1 Active 6: SLS2 Active 7: SLS3 Active 8: SLS4 Active 9: SDIp Active 10: SDIn Active 11: SOS Active 12: SSM Active 13: SS1-r Active 14: SS2-r Active	0	-	At stop	"H20_en.21" on page 1008
H20.22	Safety module DO3 function selection	0: Inactive 1: STO Active 2: SBC Active 3: SS1 Active 4: SS2 Active 5: SLS1 Active 6: SLS2 Active 7: SLS3 Active 8: SLS4 Active 9: SDIp Active 10: SDIn Active 11: SOS Active 13: SS1-r Active 14: SS2-r Active	0	-	At stop	"H20_en.22" on page 1009
H20.23	Safety module DO4 function selection	0: Inactive 1: STO Active 2: SBC Active 3: SS1 Active 4: SS2 Active 5: SLS1 Active 6: SLS2 Active 7: SLS3 Active 8: SLS4 Active 9: SDIp Active 10: SDIn Active 11: SOS Active 12: SSM Active 13: SS1-r Active 14: SS2-r Active	0	-	At stop	"H20_en.23" on page 1009

Parameter	Name	Value	Default	Unit	Change Mode	Page
H20.24	Safety module DO5 function selection	0: Inactive 1: STO Active 2: SBC Active 3: SS1 Active 4: SS2 Active 5: SLS1 Active 6: SLS2 Active 7: SLS3 Active 8: SLS4 Active 9: SDIp Active 10: SDIn Active 11: SOS Active 12: SSM Active 13: SS1-r Active 14: SS2-r Active	0	-	At stop	"H20_en.24" on page 1010
H20.25	Safety module DO6 function selection	0: Inactive 1: STO Active 2: SBC Active 3: SS1 Active 4: SS2 Active 5: SLS1 Active 6: SLS2 Active 7: SLS3 Active 8: SLS4 Active 9: SDIp Active 10: SDIn Active 11: SOS Active 13: SS1-r Active 14: SS2-r Active	0	-	At stop	"H20_en.25" on page 1010

6.6.3 Triggering STO in Bus Mode

The safety bus of the safety module supports only EtherCAT communication.

To use the STO function through EtherCAT communication, you need to set the network connection, EtherCAT master, and safety CPU unit.

Set H20.01 to 1 to 3 to trigger FSoE function. In this case, the safety function mode is no longer triggered by safety input signals.

When 6641h is set to 0, the drive automatically exits the STO state when the STO command is deselected.

When 6641h is set to 1, exiting the STO state not only requires the deselection of STO command, but also the triggering of the Ack signal.

Note

6641h is effective when you use a safety PLC with SRA parameters. 6641h is ineffective when you use a safety PLC without SRA parameters . You can set it through bit10 of local parameter H20.61.

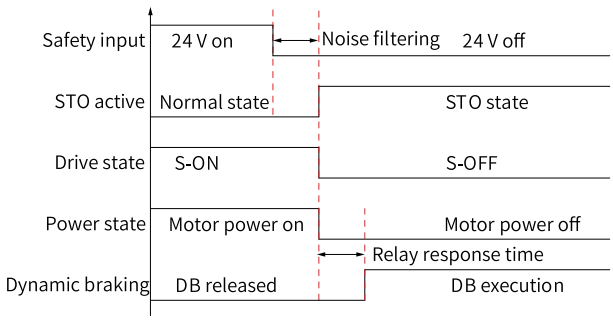
Related parameters:

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H20.61	-	Safety bus function selection (FSoE)	bit0: Enable STO bit1: Enable SS1 Bit 2: Enable SS2 bit3: Enable SOS bit4: Enable SLS bit5: Reserved bit6: Reserved bit7: Enable SDI bit8: Reserved bit9: Enable SBC bit10: Enable ACK (nSRA) bit11: Reserved Bit 12: Reserved bit13: SLS speed limit segment count (lower bits) bit14: SLS speed limit segment count (upper bits) bit15: No STO alarm before establishing FSoE connection	25247	-	At stop	"H20_en.61" on page 1018
6630h	6630h	Restart Ack reset signal	0 to 1	0	-	Real time	"6630h" on page 1024
6640h	6640h	STO signal	0 to 1	0	-	Real time	"6640h" on page 1025
6641h	6641h	STO reset mode selection	0 to 1	0	-	Real time	"6641h" on page 1025

6.6.4 Sequence Diagram

Operation sequence to enter safe state

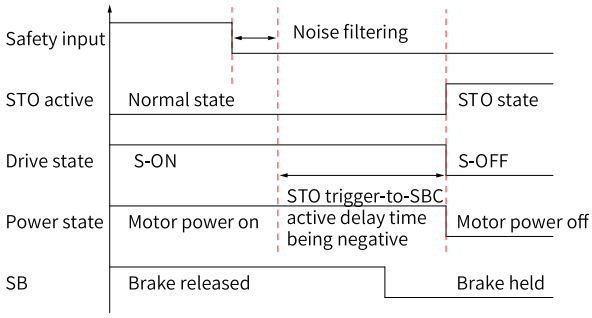
- SBC is not enabled



The safety module starts to shift to STO status when STO input is turned into OFF.

The STO stop mode reuses the stop mode for No. 1 faults. Dynamic braking will operate based on the setting of H02.08.

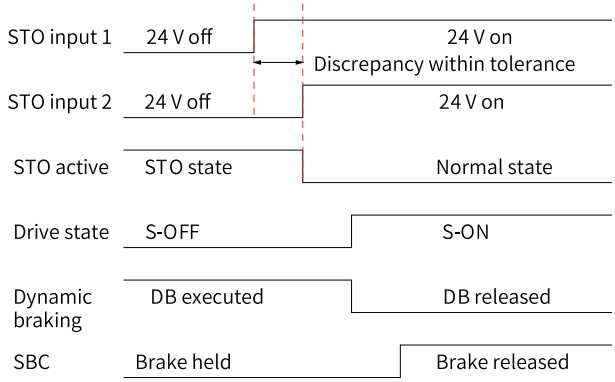
- SBC is enabled
  When you set H20.28 to a negative value, the sequence of STO operations is shown in the following figure.



When SBC is activated before STO and the STO input command is effective, perform S-OFF first as set by H02.05. After the delay of H20.28 elapsed, trigger the No.1 fault stop mode.

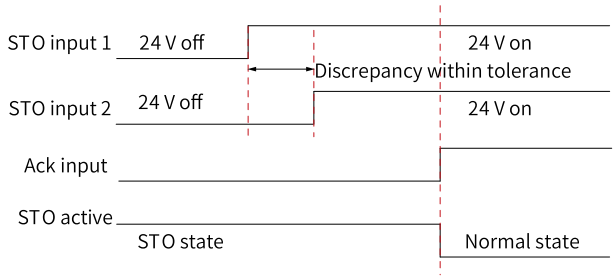
Reset sequence to exit STO safe state

- Ack signal is not required



When the Ack signal is not required, the STO state can exit automatically as long as the 24 V DI input signal of two STOs are restored. After STO status exits, the S-ON operation can be performed normally.

- Ack signal is required



When an Ack signal is required, exiting the STO state not only needs the recovery of the 24V voltage, but also a trigger for an Ack signal. The S-ON operation can only be performed properly after STO state exits normally.

Note

- The STO function is triggered even if the safety module is in faulty state. After the fault cause is eliminated and the fault reset is performed, the safety module automatically exits the STO state without requiring an Ack input signal.
- When H20.01 = 1 or 3, if bit15 of H20.61 = 0, the STO function is triggered by default as a connection status indication before a safe bus connection is established between the servo drive and the host controller. After the FSoE communication is successfully established, the STO state is automatically exited without confirming the Ack input signal.

6.7 Safe Brake Control (SBC)

6.7.1 Overview

For models coming with a safety module, SBC needs not an external relay to control the on and off of the 24 V voltage of the brake motor. The BK+ and BK- pins of the brake motor can be respectively connected to Pin3 and Pin4 of the CN8 terminal on the drive, as shown in the following figure.

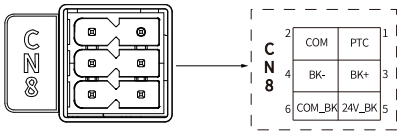


Figure 6-4 Description of CN8 pins

Pin No.	Description	Description	Pin No.	Description	Description
1	PTC	Motor temperature feedback input	2	COM-	Onboard 24 V COM
3	BK+	Brake+	4	BK-	Brake-
5	24V_BK	External power supply for the brake	6	COM_BK	Brake 24 V COM

The safety module can directly control the on and off of the 24 V voltage connected to Pin5 and Pin6 of CN8.

The SBC applies to situations where the servo drive must remain in a safe position even if the motor is not energized. The SBC prevents the droop of suspended or stretched loads (for example, a hoist). No external relay or switch is required, as the feature is integrated in the drive.

Note

- The SBC function cannot detect mechanical wear or damage to the motor brake.
- When the SBC function is enabled or a safety brake motor is installed, Pin5 and Pin6 of CN8 need to be connected to an external 24V±10% voltage; otherwise, the servo drive reports E631.0.

6.7.2 SBC Triggered by Local Mode

When you choose to trigger the safety function locally, DI: FunIN2 is SBC command, DO: FunOUT.2 is SBC active, and DO: FunOUT.2 is SBC active.

Table 6–6 Description of function No.

Code	Name	Function Name	Function
FunIN.2	SBC command	SBC trigger command	0: SBC active 1: SBC deselected
FunOUT.2	SBC Active	SBC active	0: Normal state 1: SBC state

Note

- OFF (0): The 24V voltage of the corresponding DI is disconnected.
- ON (1): The 24V voltage of the corresponding DI is connected.

Related parameters:

Parameter	Communication Address	Name	Value	Default	Unit	Change Mode	Page
H20.02	-	Safety module DI1 function selection	0: Inactive 1: STO 2: SBC 3: SS1 4: SS2 5: SLS1 6: SLS2 7: SLS3 8: SLS4 9: SDIp 10: SDIn 11: Ack	0	-	At stop	"H20_en.02" on page 1003
H20.03	-	Safety module DI2 function selection	0: Inactive 1: STO 2: SBC 3: SS1 4: SS2 5: SLS1 6: SLS2 7: SLS3 8: SLS4 9: SDIp 10: SDIn 11: Ack	0	-	At stop	"H20_en.03" on page 1003

Parameter	Communication Address	Name	Value	Default	Unit	Change Mode	Page
H20.04	-	Safety module DI3 function selection	0: Inactive 1: STO 2: SBC 3: SS1 4: SS2 5: SLS1 6: SLS2 7: SLS3 8: SLS4 9: SDIp 10: SDIn 11: Ack	0	-	At stop	"H20_en.04" on page 1004
H20.05	-	Safety module DI4 function selection	0: Inactive 1: STO 2: SBC 3: SS1 4: SS2 5: SLS1 6: SLS2 7: SLS3 8: SLS4 9: SDIp 10: SDIn 11: Ack	0	-	At stop	"H20_en.05" on page 1004
H20.06	-	Safety module DI5 function selection	0: Inactive 1: STO 2: SBC 3: SS1 4: SS2 5: SLS1 6: SLS2 7: SLS3 8: SLS4 9: SDIp 10: SDIn 11: Ack	0	-	At stop	"H20_en.06" on page 1005

Parameter	Communication Address	Name	Value	Default	Unit	Change Mode	Page
H20.20	-	Safety module DO1 function selection	0: Inactive 1: STO Active 2: SBC Active 3: SS1 Active 4: SS2 Active 5: SLS1 Active 6: SLS2 Active 7: SLS3 Active 8: SLS4 Active 9: SDIp Active 10: SDIn Active 11: SOS Active 12: SSM Active 13: SS1-r Active 14: SS2-r Active	0	-	At stop	"H20_en.20" on page 1008
H20.21	-	Safety module DO2 function selection	0: Inactive 1: STO Active 2: SBC Active 3: SS1 Active 4: SS2 Active 5: SLS1 Active 6: SLS2 Active 7: SLS3 Active 8: SLS4 Active 9: SDIp Active 10: SDIn Active 11: SOS Active 12: SSM Active 13: SS1-r Active 14: SS2-r Active	0	-	At stop	"H20_en.21" on page 1008
H20.22	-	Safety module DO3 function selection	0: Inactive 1: STO Active 2: SBC Active 3: SS1 Active 4: SS2 Active 5: SLS1 Active 6: SLS2 Active 7: SLS3 Active 8: SLS4 Active 9: SDIp Active 10: SDIn Active 11: SOS Active 13: SS1-r Active 14: SS2-r Active	0	-	At stop	"H20_en.22" on page 1009

Parameter	Communication Address	Name	Value	Default	Unit	Change Mode	Page
H20.23	-	Safety module DO4 function selection	0: Inactive 1: STO Active 2: SBC Active 3: SS1 Active 4: SS2 Active 5: SLS1 Active 6: SLS2 Active 7: SLS3 Active 8: SLS4 Active 9: SDIp Active 10: SDIn Active 11: SOS Active 12: SSM Active 13: SS1-r Active 14: SS2-r Active	0	-	At stop	"H20_en.23" on page 1009
H20.24	-	Safety module DO5 function selection	0: Inactive 1: STO Active 2: SBC Active 3: SS1 Active 4: SS2 Active 5: SLS1 Active 6: SLS2 Active 7: SLS3 Active 8: SLS4 Active 9: SDIp Active 10: SDIn Active 11: SOS Active 12: SSM Active 13: SS1-r Active 14: SS2-r Active	0	-	At stop	"H20_en.24" on page 1010
H20.25	-	Safety module DO6 function selection	0: Inactive 1: STO Active 2: SBC Active 3: SS1 Active 4: SS2 Active 5: SLS1 Active 6: SLS2 Active 7: SLS3 Active 8: SLS4 Active 9: SDIp Active 10: SDIn Active 11: SOS Active 13: SS1-r Active 14: SS2-r Active	0	-	At stop	"H20_en.25" on page 1010

Parameter	Communication Address	Name	Value	Default	Unit	Change Mode	Page
H02.11	2002-0Ch	Motor speed threshold at brake output OFF in rotation state	20 rpm to 3000 rpm	30	rpm	Real-time	"H02_en.11" on page 1001
H02.12	2002-0Dh	Delay from S-ON OFF to brake output OFF in rotation state	1 ms–65535 ms	500	ms	Real-time	"H02_en.12" on page 1001

6.7.3 SBC Triggered by Bus Mode

To avoid damage to the motor caused by brake operation during high-speed rotation, the safety module SBC command does not trigger brake action immediately after it is enabled, but executes S-OFF stop first.

When the motor speed is lower than the SBC zero speed threshold or the SBC delay is reached, the safety module will trigger the brake operation.

Related parameters:

Related parameters:

Parameter	Communication Address	Name	Value	Default	Unit	Change Mode	Page
H02.11	2002-0Ch	Motor speed threshold at brake output OFF in rotation state	20 rpm to 3000 rpm	30	rpm	Real-time	"H02_en.11" on page 1001
H02.12	2002-0Dh	Delay from S-ON OFF to brake output OFF in rotation state	1 ms–65535 ms	500	ms	Real-time	"H02_en.12" on page 1001

Parameter	Communication Address	Name	Value	Default	Unit	Change Mode	Page
H20.61	-	Safety bus function enabled (FSoE)	bit0: STO enabled bit1: SS1 enabled bit2: SS2 enabled bit3: SOS enabled bit4: SLS enabled bit5: Reserved bit6: Reserved bit7: SDI enabled bit8: Reserved bit9: SBC enabled bit10: ACK (nSRA) enabled bit11: Reserved bit12: Reserved bit13: SLS speed limit (low bit) bit14: SLS speed limit high bit) 15: No STO prompt before FSoE connection	25247	-	At stop	"H20_en.61" on page 1018
6660h	6660h	SBC signal	0 to 1	0	-	Real-time	"6660h" on page 1027

6.7.4 Sequence Diagram

The response sequence of the SBC function execution is shown below.

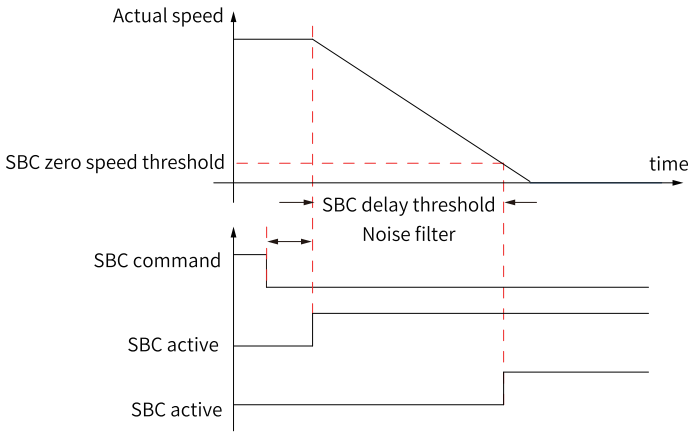


Figure 6-5 Response sequence of SBC function execution

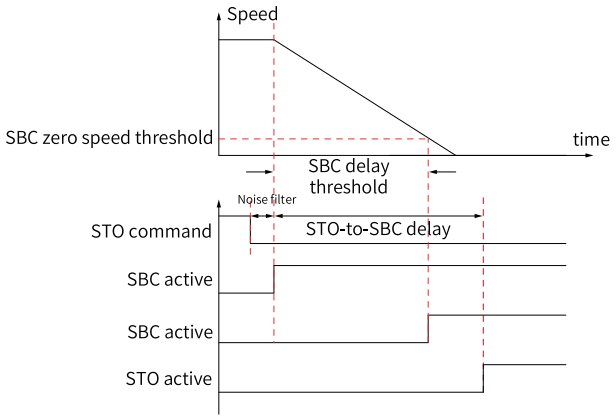
When the SBC command is determined as a valid signal after noise filtering, the S-ON OFF stop is executed. When the SBC zero speed threshold set by H02.11 is reached or the SBC delay threshold set by H02.12 expires, the safety module triggers the motor to brake. The motor rotor is held and the safety module outputs SBC active state.

In addition to being triggered by the SBC command, the SBC function can also be triggered by the STO function.

The sequence of STO and SBC functions can be configured considering the application conditions of STO in different situations.

For example, for the vertical axis application, you may that the load will not drop abnormally when the STO function is triggered. In this case, you can configure the SBC function to take effect before STO is activated.

SBC taking effect before STO



The negative value of H20-28 indicates that the STO takes effect after the SBC. The positive value indicates that the STO takes effect before the SBC. After the safety module receives the STO-triggered command, the servo drive decelerates first.

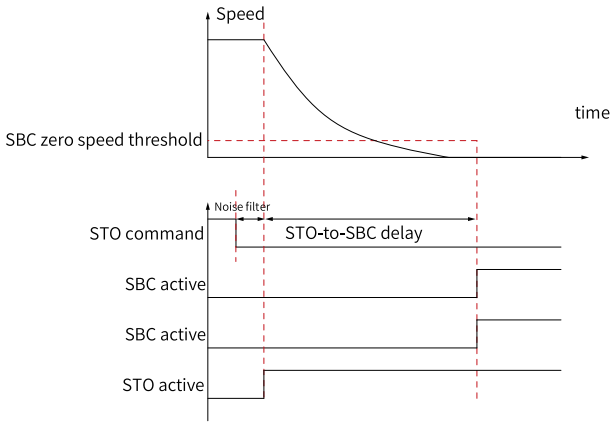
When the delay time or the SBC zero speed threshold is reached, the SBC brake takes effect and the motor rotor is held.

The value of H20.28 needs to consider the time required for the motor to decelerate from the maximum speed to 0 rpm, so as to avoid that the STO takes effect before SBC takes effect.

Note

If STO-to-SBC delay time has not reached, but the delay time after the SBC takes effect reaches the setpoint of H02.10, the servo drive will cut off the motor control power before the STO state takes effect. For vertical axis applications, if you want no falling-off risk on the load side, you also need to consider the value of H02.10.

SBC taking effect after STO



When the delay time H20.28 from STO activation to SBC activation is positive, after the safety module receives the STO trigger command, the drive cuts off the S-ON signal and performs coast-to-stop, and triggers the SBC function when the delay time is reached.

6.8 Safe Stop 1 (SS1)

6.8.1 Overview

SS1 is used to activate motor deceleration stop. It triggers STO after a certain delay or the speed is lower than a certain threshold. The SS1 stop mode includes ramp stop and host controller planned stop, which can be selected through parameter H20.29.

- When you select ramp stop, the servo drive will plan the stop command and stop the motor at the planned speed.
- When you select host controller planned stop, stop command planning does not occur inside the servo drive, but the host controller.

If you choose to trigger safety function locally, you can set parameters H20.02 to H20.03 and set DI function to 3-SS1 to trigger SS1 through DI. When you choose to trigger safety function by FSoE, you can trigger SS1 by controlling the bits in the RPDO corresponding to the SS1 command.

SS1 stop monitoring includes two modes: SS1-t and SS1-r, which can be selected through parameter H20.32.

When SS1-t is selected, the drive is switched to STO status after the delay time between SS1 is triggered and the drive enters STO state elapsed or when the speed feedback is lower than the zero speed threshold and the duration exceeds the zero speed time window.

When SS1-r is selected, since it contains SS1-t, the drive is switched to STO status after the delay time elapsed or when the speed feedback is lower than the zero speed threshold and the duration exceeds the zero speed time window. At the same time, the deceleration process is monitored, and the minimum deceleration speed is set. The actual deceleration must be larger than the monitoring threshold. If the actual deceleration is smaller than the set monitoring ramp range, a fault is reported and the STO status is activated.

The response mode for certain faults can be set to SS1-t. If the fault is triggered, the drive is switched to the SS1 stop state and then enters STO sate if the SS1-t status switchover condition is met.

6.8.2 SS1 Triggered by Local Mode

SS1 trigger-related parameters

When you choose to trigger the safety function locally, DI: FunIN.3 is SS1 command, DO: FunOUT.3 is SS1 active, and DO: FunOUT.13 is SS1-r active.

Table 6–7 Description of function No.

Code	Name	Function Name	Function
FunIN.3	SS1 command	SS1 trigger command	0: SS1 active 1: SS1 deselected
FunOUT.3	SS1 Active	SS1 active	0: SS1 inactive 1: SS1 stop state
FunOUT.13	SS1-r Active	SS1-r active	0: SS1-r inactive 1: SS1-r active state

When any DI in DI1 to DI5 is configured to FunIN.11-Ack and after the DI corresponding to SS1 is triggered and recovered, the drive recovers from STO state to normal operational state only if the DI corresponding to the Ack function is triggered.

When no DI is configured to Ack function, the drive returns to normal operation state after the corresponding DI is triggered and recovered.

Note

- OFF (0): The 24V voltage of the corresponding DI is disconnected.
- ON (1): The 24V voltage of the corresponding DI is connected.

SS1 stop-related parameters

You can select the SS1 stop mode through H20.29.

- When you select ramp stop, the servo drive will plan the stop command and stop the motor at the planned speed.
- When you select host controller planned stop, stop command planning does not occur inside the servo drive, but the host controller.
- When the pulse-type servo drive is used, you can only select ramp stop. When you select the host controller planned stop, the stop mode is forced to ramp stop.

Related parameters:

Parameter	Name	Value	Default	Unit	Change Mode	Page
H20.29	SS1/SS2 stop mode	0: Stop according to ramp 1: Stop by host controller	1	-	At stop	"*H20_en.29*" *on page 1011*

When the stop mode is selected as ramp stop, set the ramp stop reference speed through parameter H20.30 and the ramp stop deceleration time through H20.31. The motor speed decreases from H20.30 to 0 after the time set by H20.31, as shown in the figure.

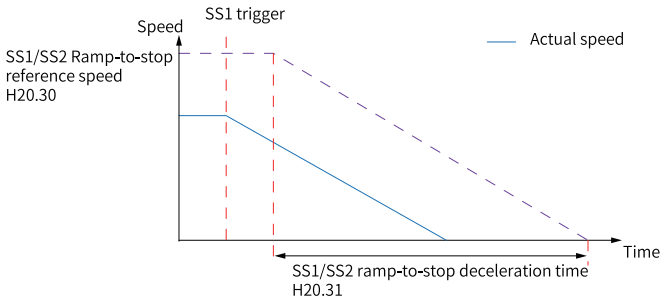


Figure 6-6 Motor speed during ramp stop

Related parameters:

Parameter	Name	Value	Default	Unit	Change Mode	Page
H20.30	SS1/SS2 ramp-to-stop reference speed	60 rpm to 6000 rpm	1000	rpm	At stop	"H20_en.30" on page 1011
H20.31	SS1/ SS2 ramp-to-stop deceleration time	1 ms-65535 ms	500	ms	At stop	"H20_en.31" on page 1012

When the safety function is triggered in the local mode, you can set the delay time between SS1 is triggered and the drive enters STO state through parameter H20.33, set SS1 zero speed threshold by H20.34 and set SS1 zero speed window time by H20.35. When the delay time after SS1 is triggered reaches the setpoint of H20.33, the drive is switched to STO state regardless of the motor speed.

When the safety encoder is used, the drive is switched to the STO state if the delay time does not reach the setpoint of H20.33, but the motor speed is lower than the setpoint of H20.34, and the duration reaches the setpoint of H20.35.

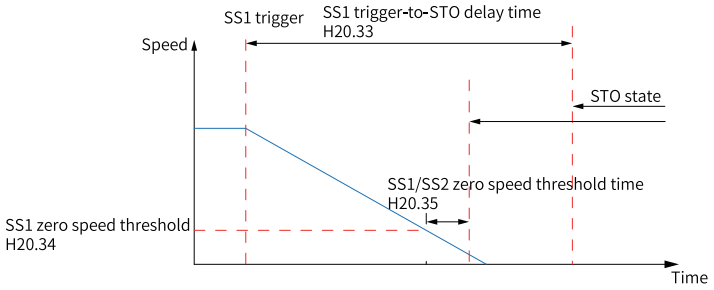


Figure 6-7 Safety function triggered locally, motor speed change

Related parameters:

Parameter	Name	Value	Default	Unit	Change Mode	Page
H20.33	SS1 trigger-to-STO delay time/ SS2 trigger-to-STO delay time	0 ms-65535 ms	1000	ms	At stop	"H20_en.33" on page 1012
H20.34	SS1/ SS1 zero speed threshold	1 rpm to 6000 rpm	10	rpm	At stop	"H20_en.34" on page 1012
H20.35	SS1/SS2 zero speed threshold time	0 ms-65535 ms	0	ms	At stop	"H20_en.35" on page 1013

SS1 monitoring-related parameters

You can select the SS1 monitoring mode through H20.32.

- The speed ramp during deceleration is not monitored when "0-SS1-t" is selected.
- When "1-SS1-r" is selected, the speed ramp during deceleration is monitored. The actual deceleration must be greater than the set minimum deceleration.

Related parameters:

Parameter	Name	Value	Default	Unit	Change Mode	Page
H20.32	SS1 monitor mode	0:SS1-t 1:SS1-r	0	-	At stop	"H20_en.32" on page 1012

In SS1-r monitoring mode, when the safety function is triggered in the local mode:

- You can set the delay time (starting from the time when SS1 is triggered) for ramp monitoring to be activated through parameter H20.36. Speed ramp is monitored after the delay time elapsed.
- You can set the ramp monitoring reference speed through parameter H20.37, set the ramp monitoring time by H20.38, and the ratio between H20.37 and H20.38 corresponds to the motor's minimum deceleration ramp. The actual deceleration must be greater than the minimum deceleration speed, otherwise a deceleration overrun fault is reported.
- You can set the duration from SS1 triggers ramp limit to an alarm is issued through parameter H20.41. A fault is reported when the number of deceleration overruns exceeds the setpoint of H20.41.
- You can set the speed when SS1 ramp monitoring stops through H20.42 and stop ramp monitoring when the motor speed is lower than the setpoint of H20.42.

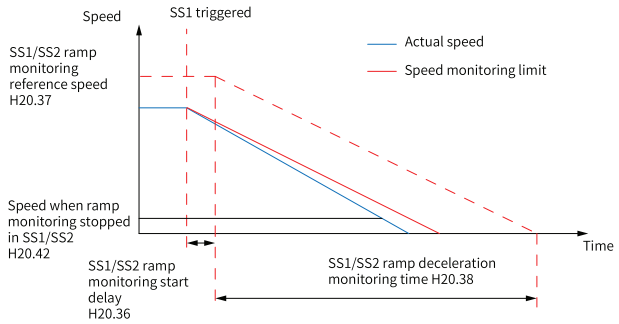


Figure 6-8 Motor speed when safety function is triggered

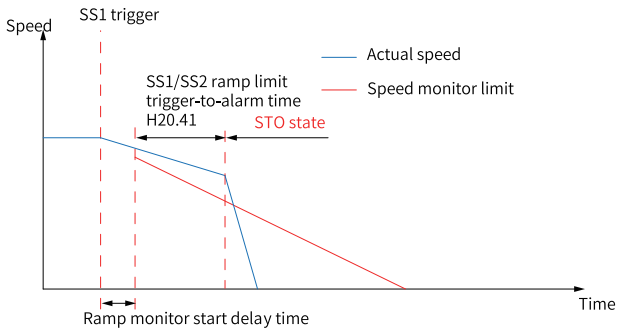


Figure 6-9 Motor speed when ramp limit is triggered

Related parameters:

Parameter	Name	Value	Default	Unit	Change Mode	Page
H20.36	SS1/SS2 ramp monitor start delay time	5 ms-65535 ms	10	ms	At stop	"H20_en.36" on page 1013
H20.37	SS1/SS2 ramp monitor reference speed	60 rpm to 6000 rpm	1000	rpm	At stop	"H20_en.37" on page 1013
H20.38	SS1/SS2 ramp deceleration monitor time	1 ms-65535 ms	65535	ms	At stop	"H20_en.38" on page 1013
H20.41	SS1/SS2 ramp limit trigger-to-alarm time	0 ms-65535 ms	5	ms	At stop	"H20_en.41" on page 1014
H20.42	SS1/SS2 ramp monitor stop speed	0 rpm to 6000 rpm	1	rpm	At stop	"H20_en.42" on page 1014

6.8.3 SS1 Triggered in Bus Mode

SS1 trigger-related parameters

To trigger the safety function in the FSoE mode, 6650h in the RPDO mapping is the SS1 trigger object dictionary, and 6650h in the TPDO mapping is the SS1 trigger object dictionary.

Related parameters:

Parameter	Communication Address	Name	Value	Default	Unit	Change Mode	Page
6650.01h	6650-01h	SS1 signal	0 to 1	0	-	Real-time	"6650_en.01h" on page 1025

Set whether the Restart Ack signal is required when the STO state is restored (the PLC with SRA parameter is set by the object dictionary 6641h, and the PLC without SRA parameter is set by bit10 of H20.61). 6630h in the RPDO mapping is the Restart Ack signal. When 6641h is configured to 1 and SS1 is triggered and then recovered, the drive recovers from STO state to normal operational state only if 1 is written to the Restart Ack signal.

Related parameters:

Parameter	Communication Address	Name	Value	Default	Unit	Change Mode	Page
H20.61	-	Safety bus function enabled (FSoE)	bit0: STO enabled bit1: SS1 enabled bit2: SS2 enabled bit3: SOS enabled bit4: SLS enabled bit5: Reserved bit6: Reserved bit7: SDI enabled bit8: Reserved bit9: SBC enabled bit10: ACK (nSRA) enabled bit11: Reserved bit12: Reserved bit13: SLS speed limit (low bit) bit14: SLS speed limit high bit) 15: No STO prompt before FSoE connection	25247	-	At stop	"H20_en.61" on page 1018
6641h	6641h	STO reset mode selection	0 to 1	0	-	Real-time	"6641h" on page 1025

SS1 stop-related parameters

You can select SS1 stop mode by setting the parameter H20.29.

When you choose "stop according to ramp", you can configure the ramp-to-stop reference speed by setting parameter H20.30 and the ramp-to-stop deceleration time by setting parameter H20.31.

When FSoE mode is selected to trigger safety function (PLC with SRA parameters is set by object dictionary; PLC without SRA parameters is set by the parameter, same as local mode), 6651h (H20.33) sets the SS1-trigger-to-STO delay time, 6653h (H20.34) sets the SS1 zero speed threshold, and 6654h (H20.35) sets SS1 zero speed window time.

Related parameters:

Parameter	Communication Address	Name	Value	Default	Unit	Change Mode	Page
H20.33	-	SS1 trigger-to-STO delay time/SS2 trigger-to-STO delay time	0 ms-65535 ms	1000	ms	At stop	"H20_en.33" on page 1012
H20.34	-	SS1/ SS1 zero speed threshold	1 rpm to 6000 rpm	10	rpm	At stop	"H20_en.34" on page 1012
H20.35	-	SS1/SS2 zero speed threshold time	0 ms-65535 ms	0	ms	At stop	"H20_en.35" on page 1013

Parameter	Communication Address	Name	Value	Default	Unit	Change Mode	Page
6651.01h	6651-01h	SS1 trigger-to-STO delay time	0 ms-65535 ms	1000	ms	Real-time	"6651_en.01h" on page 1026
6653.01h	6653-01h	SS1 zero speed threshold	1 rpm to 6000 rpm	10	rpm	Real-time	"6653_en.01h" on page 1026
6654.01h	6654-01h	SS1 zero speed threshold time	0 ms-65535 ms	0	ms	Real-time	"6654_en.01h" on page 1026

SS1 monitoring-related parameters

You can select SS1 monitoring mode by setting the parameter H20.32.

In the monitoring mode of SS1-r, when the FSoE mode is selected to trigger the safety function (PLC with SRA parameters is set by the object dictionary; PLC without SRA parameter is set by the parameter, which is the same as the local mode): 6657h (H20.36) sets the delay time of enabling ramp monitoring, and 6656h (the ratio of H20.37 to H20.38) sets the SS1 minimum deceleration limit. You can configure the time from triggering of the ramp limit to issuance of the alarm by setting parameter H20.41, and the speed for stopping the ramp monitoring by setting parameter H20.42.

Note

The unit of 6656h is encoder unit/s^2, the ratio of H20.37 to H20.38 in rpm/ms.

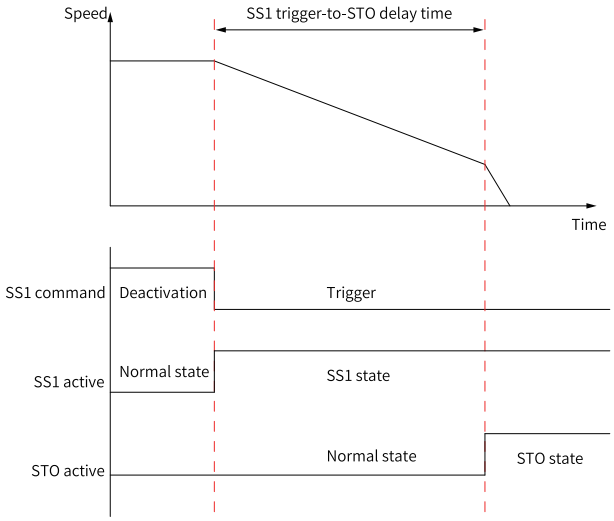
Related parameters:

Parameter	Communication Address	Name	Value	Default	Unit	Change Mode	Page
H20.36	-	SS1/SS2 ramp monitor start delay time	5 ms-65535 ms	10	ms	At stop	"H20_en.36" on page 1013
H20.37	-	SS1/SS2 ramp monitor reference speed	60 rpm to 6000 rpm	1000	rpm	At stop	"H20_en.37" on page 1013
H20.38	-	SS1/SS2 ramp deceleration monitor time	1 ms-65535 ms	65535	ms	At stop	"H20_en.38" on page 1013
H20.41	-	SS1/SS2 ramp limit trigger-to-alarm time	0 ms-65535 ms	5	ms	At stop	"H20_en.41" on page 1014
H20.42	-	SS1/SS2 ramp monitor stop speed	0 rpm to 6000 rpm	1	rpm	At stop	"H20_en.42" on page 1014

Parameter	Communication Address	Name	Value	Default	Unit	Change Mode	Page
6656.01h	6656-01h	SS1 deceleration limit	0 encoder unit/s²-4294967295 encoder unit/s²	15	Encoder unit/s²	Real-time	"6656_en.01h" on page 1027
6657.01h	6657-01h	SS1 ramp monitor start delay time	0 ms-65535 ms	10	ms	Real-time	"6657_en.01h" on page 1027

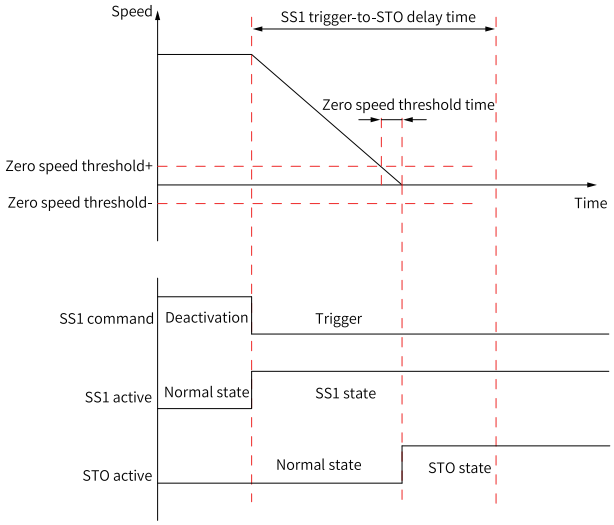
6.8.4 Sequence Diagram

SS1 is triggered and the drive enters STO state after a delay time has elapsed



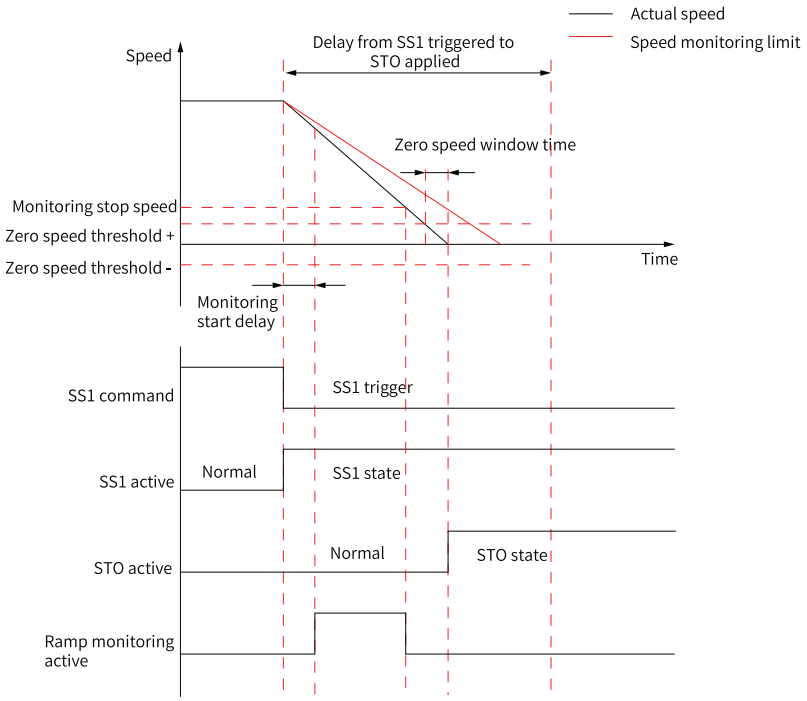
After SS1 is triggered, if you cancel an SS1 command during SS1 stop, the drive will continue to finish the stop process.

SS1 is triggered and the drive enters STO state when the speed meets zero speed conditions

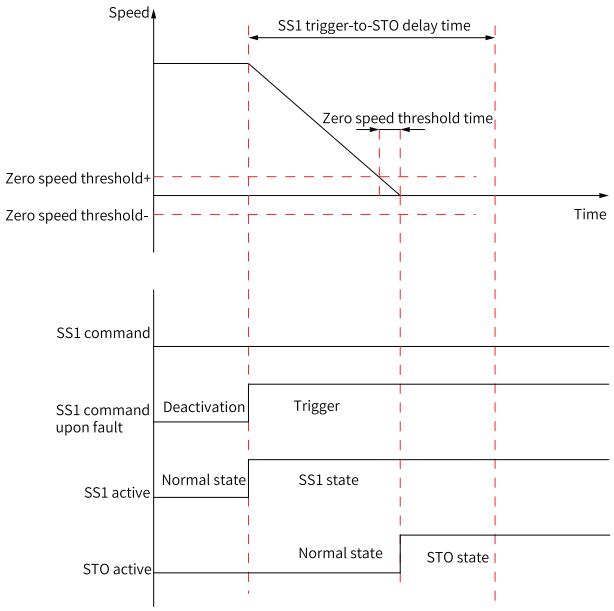


If the SS1 command is canceled after SS1 has been triggered, the drive will retain the SS1 state until the delay time has elapsed or the zero speed conditions are met.

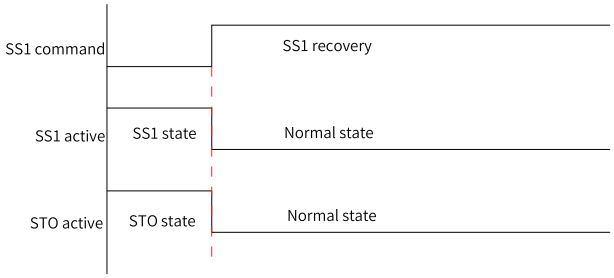
Starting SS1 speed ramp monitoring



SS1-t is triggered by fault and the drive enters STO state when the speed meets zero speed conditions



SS1 reset



6.9 Safe Stop 2 (SS2)

6.9.1 Overview

SS2 is used to activate motor to decelerate to stop. It triggers SOS after a certain delay or the speed is lower than a certain threshold. The SS2 stop mode includes ramp stop and stop as defined by host controller, which can be selected through H20.29. When you select ramp stop, the servo drive will plan the stop command and stop the motor at the planned speed. When you select host controller planned stop, stop command planning does not occur inside the servo drive, but the host controller.

If you choose to trigger safety function locally, you can set parameters H20.02 to H20.03 and set DI function to 4-SS2 to trigger SS2 through DI. When you choose to trigger safety function by FSoE, you can trigger SS2 by controlling the bits in the RPDO corresponding to the SS2 command.

SS2 stop monitoring includes two modes: SS2-t and SS2-r, which can be selected through H20.43.

When SS2-t is selected, the drive is switched to SOS status after the delay time between SS2 is triggered and the drive enters SOS state elapsed or when the speed feedback is lower than the zero speed threshold and the duration exceeds the zero speed time window.

When SS2-r is selected, since it contains SS2-t, the drive is switched to SOS status after the delay time elapsed or when the speed feedback is lower than the zero speed threshold and the duration exceeds the zero speed time window. At the same time, the deceleration process is monitored, and the minimum deceleration speed is set. The actual deceleration must be larger than the monitoring threshold. If the actual deceleration is smaller than the set monitoring ramp range, a fault is reported and the STO status is activated.

6.9.2 SS2 Triggered by Local Mode

SS2 trigger-related parameters

When you choose to trigger the safety function locally, DI: FunIN.4 is SS2 command, DO: FunOUT.4 is SS2 active, and DO: FunOUT.14 is SS2-r active.

Table 6–8 Description of function No.

Code	Name	Function Name	Function
FunIN.4	SS2 command	SS2 trigger command	0: SS2 active 1: SS2 deselected
FunOUT.4	SS2 Active	SS2 active	0: SS2 inactive 1: SS2 stop state
FunOUT.14	SS2-r Active	SS2-r active	0: SS2-r inactive 1: SS2-r active

When any DI in DI1 to DI5 is configured to FunIN.11-Ack and after the DI corresponding to SS2 is triggered and recovered, the drive recovers from SOS state to normal operational state only if the DI corresponding to the Ack function is triggered. When no DI is configured to Ack function, the drive returns to normal operation state after the corresponding DI is triggered and recovered.

Note

- OFF (0): The 24V voltage of the corresponding DI is disconnected.
- ON (1): The 24V voltage of the corresponding DI is connected.

SS2 stop-related parameters

When you select ramp stop, the servo drive will plan the stop command and stop the motor at the planned speed. When you select host controller planned stop, stop command planning does not occur inside the servo drive, but the host controller. When the pulse-type servo drive is used, you can only select ramp stop. When you select the host controller planned stop, the stop mode is forced to ramp stop.

Related parameters:

Parameter	Name	Value	Default	Unit	Change Mode	Page
H20.29	SS1/SS2 stop mode	0: Stop according to ramp 1: Stop by host controller	1	-	At stop	"*H20_en.29*" *on page 1011*

When the stop mode is selected as ramp stop, set the ramp stop reference speed through parameter H20.30 and the ramp stop deceleration time through H20.31. The motor speed decreases from H20.30 to 0 after the time set by H20.31, as shown in the figure.

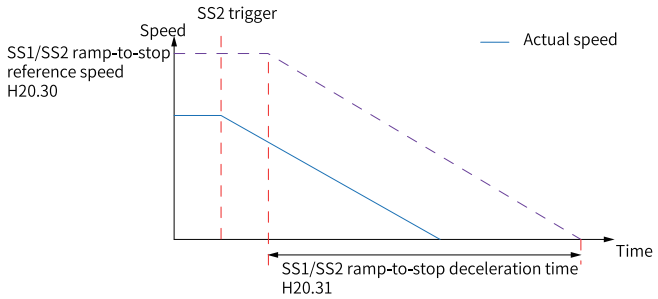


Figure 6-10 Motor speed during ramp stop

Caution

In the CSP mode, the SS2 stop mode H20.29 is set to ramp-to-stop, and SS2 state is canceled during or after stop. Note that 607A of the host controller is aligned to 6064. Otherwise, alignment to 607A can cause a high speed or even alarm B01.2 upon exiting.

Related parameters:

Parameter	Name	Value	Default	Unit	Change Mode	Page
H20.30	SS1/SS2 ramp-to-stop reference speed	60 rpm to 6000 rpm	1000	rpm	At stop	"H20_en.30" on page 1011
H20.31	SS1/ SS2 ramp-to-stop deceleration time	1 ms-65535 ms	500	ms	At stop	"H20_en.31" on page 1012

When the safety function is triggered in the local mode, you can set the delay time between SS2 is triggered and the drive enters SOS state through parameter H20.33, set SS2 zero speed threshold by H20.34 and set SS2 zero speed window time by H20.35. If the delay time after the SS2 function is triggered reaches the value of H20.33, the drive switches to the SOS state regardless of the motor speed. If the delay time after the SS2 function is triggered does not reach the value of H20.33 but the motor speed falls below the value of H20.34 for a period of time exceeding the value of H20.35, the drive switches to the SOS state in advance.

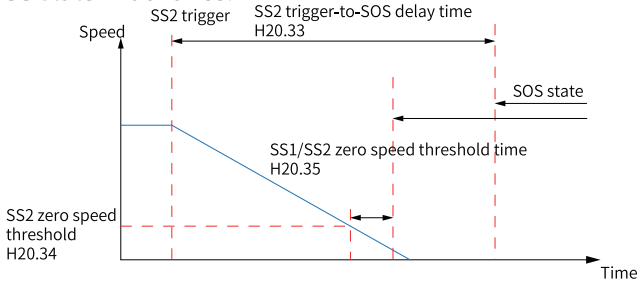


Figure 6-11 Safety function triggered locally, motor speed change

Related parameters:

Parameter	Name	Value	Default	Unit	Change Mode	Page
H20.33	SS1 trigger-to-STO delay time/ SS2 trigger-to-STO delay time	0 ms-65535 ms	1000	ms	At stop	"H20_en.33" on page 1012
H20.34	SS1/ SS1 zero speed threshold	1 rpm to 6000 rpm	10	rpm	At stop	"H20_en.34" on page 1012
H20.35	SS1/SS2 zero speed threshold time	0 ms-65535 ms	0	ms	At stop	"H20_en.35" on page 1013

SS2 monitoring-related parameters

You can configure the SS2 monitoring mode by setting parameter H20.43. If you choose “0: SS2-t”, the speed ramp will not be monitored during the deceleration process; if you choose “1: SS2-r”, the speed ramp will be monitored during the deceleration process and the actual deceleration of the motor must be larger than the preset minimum deceleration.

Related parameters:

Parameter	Name	Value	Default	Unit	Change Mode	Page
H20.43	SS2 monitor mode	0:SS2-t 1:SS2-r	0	-	At stop	“H20_en.43” on page 1014

In Ss2-r monitoring mode, after you choose to trigger the safety function locally, you can set the delay time (starting from the time when SS2 is triggered) for ramp monitoring to be activated through parameter H20.36. Speed ramp is monitored after the delay time elapsed.

You can set the ramp monitoring reference speed through parameter H20.37, set the ramp monitoring time by H20.38, and the ratio between H20.37 and H20.38 corresponds to the motor's minimum deceleration ramp. The actual deceleration must be greater than the minimum deceleration speed, otherwise a deceleration overrun fault is reported.

You can set the duration from SS2 triggers ramp limit to an alarm is issued through parameter H20.41. A fault is reported when the number of deceleration overruns exceeds the setpoint of H20.41. You can set the speed when SS2 ramp monitoring stops through H20.42 and stop ramp monitoring when the motor speed is lower than the setpoint of H20.42.

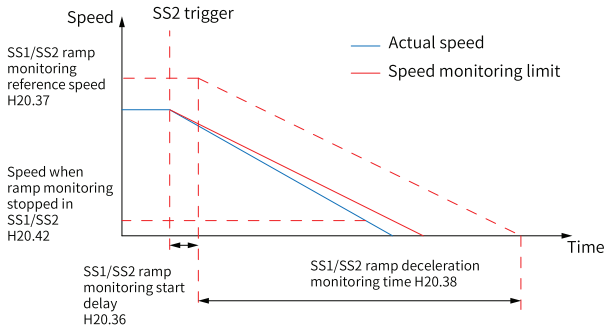


Figure 6-12 Motor speed when safety function is triggered

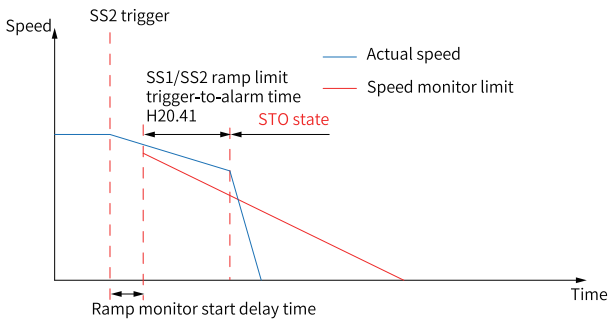


Figure 6-13 Motor speed when ramp limit is triggered

Related parameters:

Parameter	Name	Value	Default	Unit	Change Mode	Page
H20.36	SS1/SS2 ramp monitor start delay time	5 ms-65535 ms	10	ms	At stop	"H20_en.36" on page 1013
H20.37	SS1/SS2 ramp monitor reference speed	60 rpm to 6000 rpm	1000	rpm	At stop	"H20_en.37" on page 1013
H20.38	SS1/SS2 ramp deceleration monitor time	1 ms-65535 ms	65535	ms	At stop	"H20_en.38" on page 1013
H20.41	SS1/SS2 ramp limit trigger-to-alarm time	0 ms-65535 ms	5	ms	At stop	"H20_en.41" on page 1014
H20.42	SS1/SS2 ramp monitor stop speed	0 rpm to 6000 rpm	1	rpm	At stop	"H20_en.42" on page 1014

6.9.3 SS2 Triggered in Bus Mode

SS2 trigger-related parameters

To trigger the safety function in the FSoE mode, 6670h in the RPDO mapping is the SS2 trigger object dictionary, and 6670h in the TPDO mapping is the SS2 trigger object dictionary.

Related parameters:

Parameter	Communication Address	Name	Value	Default	Unit	Change Mode	Page
6670.01h	6670-01h	SS2 signal	0 to 1	0	-	Real-time	"6670_en.01h" on page 1028

Set whether the Restart Ack signal is required when SOS state is restored (PLC with SRA parameters is set by 6641h, PLC without SRA parameters is set by bit10 of H20.61), and 6630h in RPDO mapping is the Restart Ack signal. When 6676h is configured to 1 and SS2 is triggered and then recovered, the drive recovers from SOS state to normal operational state only if 1 is written to the Restart Ack signal.

Related parameters:

Parameter	Communication Address	Name	Value	Default	Unit	Change Mode	Page
H20.61	-	Safety bus function enabled (FSoE)	bit0: STO enabled bit1: SS1 enabled bit2: SS2 enabled bit3: SOS enabled bit4: SLS enabled bit5: Reserved bit6: Reserved bit7: SDI enabled bit8: Reserved bit9: SBC enabled bit10: ACK (nSRA) enabled bit11: Reserved bit12: Reserved bit13: SLS speed limit (low bit) bit14: SLS speed limit high bit) 15: No STO prompt before FSoE connection	25247	-	At stop	"H20_en.61" on page 1018
6676.01h	6676-01h	SS2 reset mode selection	0 to 1	0	-	Real-time	"6676_en.01h" on page 1029

SS2 stop-related parameters

You can select SS2 stop mode by setting the parameter H20.29.

When you choose "stop according to ramp", you can configure the ramp-to-stop reference speed by setting parameter H20.30 and the ramp-to-stop deceleration time by setting parameter H20.31.

When FSoE mode is selected to trigger safety function, set SS2-trigger-to-SOS delay time (PLC with SRA parameters is set by 6671h, PLC without SRA parameters is set by local parameter H20.33), 666Ch (H20.34) sets SS2 zero speed threshold, and 6672h (H20.35) sets SS2 zero speed window time.



In the CSP mode, the SS2 stop mode H20.29 is set to ramp-to-stop, and SS2 state is canceled during or after stop. Note that 607A of the host controller is aligned to 6064. Otherwise, alignment to 607A can cause a high speed or even alarm B01.2 upon exiting.

Related parameters:

Parameter	Communication Address	Name	Value	Default	Unit	Change Mode	Page
H20.33	-	SS1 trigger-to-STO delay time/SS2 trigger-to-STO delay time	0 ms-65535 ms	1000	ms	At stop	"H20_en.33" on page 1012
H20.34	-	SS1/ SS1 zero speed threshold	1 rpm to 6000 rpm	10	rpm	At stop	"H20_en.34" on page 1012
H20.35	-	SS1/SS2 zero speed threshold time	0 ms-65535 ms	0	ms	At stop	"H20_en.35" on page 1013
666C.01h	666C-01h	SOS zero speed threshold	0 rpm to 6000 rpm	10	rpm	Real-time	"666C_en.01h" on page 1028
6671.01h	6671-01h	SS2 trigger-to-STO delay time	0 ms-65535 ms	10	ms	Real-time	"6671_en.01h" on page 1029
6672.01h	6672-01h	SS2 zero speed threshold time	0 ms-65535 ms	0	ms	Real-time	"6672_en.01h" on page 1029

SS2 monitoring-related parameters

You can select SS2 monitoring mode by setting the parameter H20.43.

In the monitoring mode of SS2-r, when FSoE mode is selected to trigger the safety function (PLC with SRA parameter, set by object dictionary; PLC without SRA parameter, set by function code, same as local mode), the delay time for enabling ramp monitoring is set by 6675h (H20.36), and the minimum deceleration limit of SS2 is set by 6674h (ratio of H20.37 and H20.38). You can configure the time from triggering of the ramp limit to issuance of the alarm by setting parameter H20.41, and the speed for stopping the ramp monitoring by setting parameter H20.42.

Note

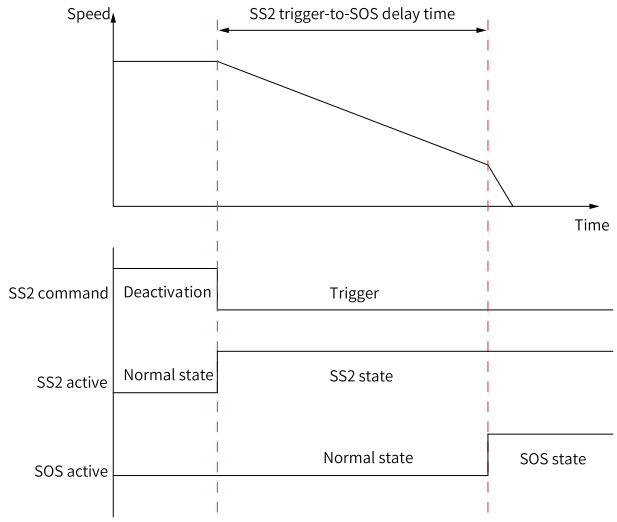
The unit of 6674h is encoder unit/s^2, the ratio of H20.37 to H20.38 in rpm/ms.

Related parameters:

Parameter	Communication Address	Name	Value	Default	Unit	Change Mode	Page
H20.36	-	SS1/SS2 ramp monitor start delay time	5 ms-65535 ms	10	ms	At stop	"H20_en.36" on page 1013
H20.37	-	SS1/SS2 ramp monitor reference speed	60 rpm to 6000 rpm	1000	rpm	At stop	"H20_en.37" on page 1013
H20.38	-	SS1/SS2 ramp deceleration monitor time	1 ms-65535 ms	65535	ms	At stop	"H20_en.38" on page 1013
6674.01h	6674-01h	SS2 deceleration limit	0 encoder unit/s²-4294967295 encoder unit/s²	15	Encoder unit/s²	Real-time	"6674_en.01h" on page 1029
6675.01h	6675-01h	SS2 ramp monitor start delay time	0 ms-65535 ms	10	ms	Real-time	"6675_en.01h" on page 1029

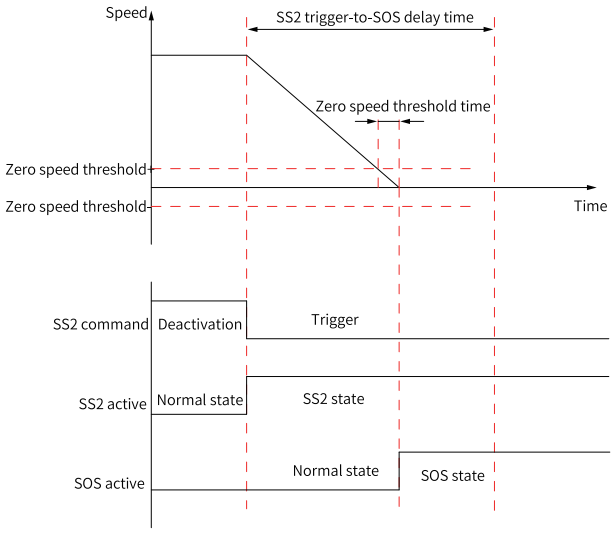
6.9.4 Sequence Diagram

SS2 is triggered and the drive enters SOS state after a delay time has elapsed



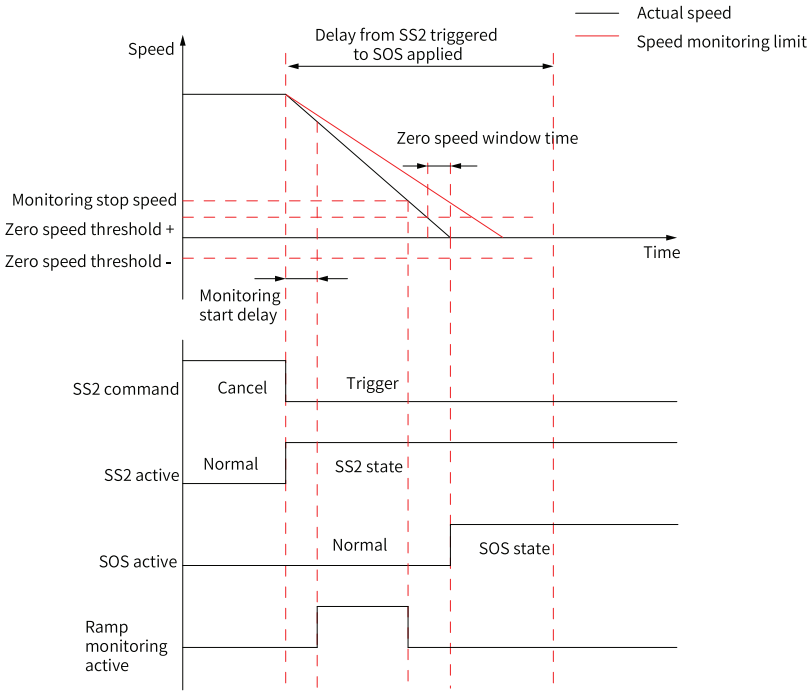
If the SS2 command is canceled after SS2 has been triggered, the drive will retain the SS2 state until the delay time has elapsed.

SS2 is triggered and the drive enters SOS state when the speed meets zero speed conditions

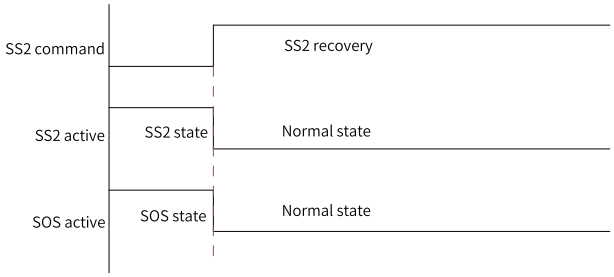


If the SS2 command is canceled after SS2 has been triggered, the drive will retain the SS2 state until the delay time has elapsed or the zero speed conditions are met.

Starting SS2 speed ramp monitoring



SS2 reset



6.10 Safe Operating Stop (SOS)

6.10.1 Overview

The SOS function monitors whether the speed and position of the motor in a stationary state are within thresholds, ensuring that the motor is in a safe stop state while providing the power needed to maintain the external load. After SS2 is triggered, the drive switches from the SS2 state to the SOS state when the switching conditions are met. The SOS function requires a safety encoder.

In the SOS state, the position and speed of the motor will be monitored. When the position or speed of the motor exceeds the threshold, a fault will be reported and the drive will enter the STO state.

Note

During SOS monitoring, no action commands can be sent to the drive to prevent the drive from responding to the cumulative commands sent during SOS monitoring after the SOS monitoring state is released.

6.10.2 SOS Triggered by Local Mode

SOS trigger-related parameters

The parameter DO: FunOUT.11 (SOS Active) enables the DO to output that SOS function is active.

Table 6–9 Description of function No.

Code	Name	Function Name	Function
FunOUT.11	SOS Active	SOS active	0: SOS inactive 1: SOS active

When any DI in DI1 to DI5 is configured to FunIN.11-Ack and after the DI corresponding to SS2 is triggered and recovered, the drive recovers from SOS state to normal operational state only if the DI corresponding to the Ack function is triggered.

When no DI is configured to Ack function, the drive returns to normal operation state after the corresponding DI is triggered and recovered.

Note

- OFF (0): The 24V voltage of the corresponding DI is disconnected.
- ON (1): The 24V voltage of the corresponding DI is connected.

SOS-related parameters

You can configure the SOS speed change threshold by setting parameter H20.44, the SOS position change threshold by H20.45, and the SOS overthreshold-to-alarm time by H20.47.

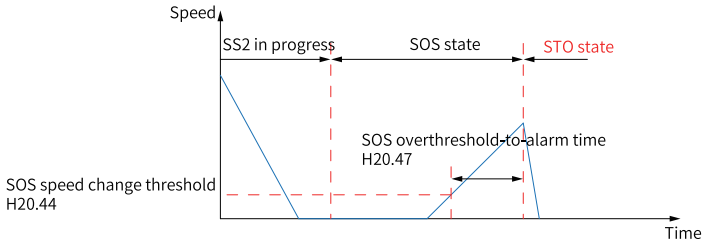


Figure 6-14 SOS speed change threshold

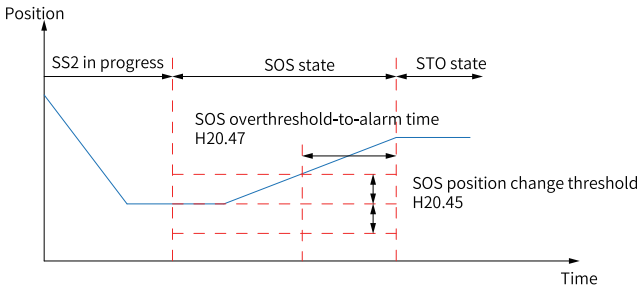


Figure 6-15 SOS position change threshold

Related parameters:

Parameter	Name	Value	Default	Unit	Change Mode	Page
H20.44	SOS speed change threshold	1 rpm to 6000 rpm	10	rpm	At stop	"H20_en.44" on page 1014
H20.45	SOS position change threshold	1 to 536870912	932067	encoder unit	At stop	"H20_en.45" on page 1015
H20.47	SOS overthreshold-to-alarm time	0 ms-65535 ms	5	ms	At stop	"H20_en.47" on page 1015

6.10.3 SOS Triggered by Bus Mode

SOS trigger-related parameters

To trigger the safety function in the FSoE mode, 6668h in the TPDO mapping is the SOS trigger object dictionary.

Related parameters:

Parameter	Communication Address	Name	Value	Default	Unit	Change Mode	Page
6668.01h	6668-01h	SOS signal	0 to 1	0	-	Real-time	"6668_en.01h" on page 1027

Set whether the Restart Ack signal is required when SOS state is restored (PLC with SRA parameters is set by 6630h, PLC without SRA parameters is set by bit10 of H20.61), and 6630h in RPDO mapping is the Restart Ack signal. When 6676h is configured to 1 and SS2 is triggered and then recovered, the drive recovers from SOS state to normal operational state only if 1 is written to the Restart Ack signal.

Related parameters:

Parameter	Communication Address	Name	Value	Default	Unit	Change Mode	Page
H20.61	-	Safety bus function enabled (FSoE)	bit0: STO enabled bit1: SS1 enabled bit2: SS2 enabled bit3: SOS enabled bit4: SLS enabled bit5: Reserved bit6: Reserved bit7: SDI enabled bit8: Reserved bit9: SBC enabled bit10: ACK (nSRA) enabled bit11: Reserved bit12: Reserved bit13: SLS speed limit (low bit) bit14: SLS speed limit high bit) 15: No STO prompt before FSoE connection	25247	-	At stop	"H20_en.61" on page 1018
6676.01h	6676-01h	SS2 reset mode selection	0 to 1	0	-	Real-time	"6676_en.01h" on page 1029

SOS-related parameters

When the FSoE mode is selected to trigger the safety function (PLC with SRA parameters is set by object dictionary, PLC without SRA parameters is set by local parameter). The SOS zero threshold is set by object dictionary 666Ah (H20.45), and the SOS zero speed threshold is set by 666Ch (H20.44). You can set the SOS overthreshold-to-alarm time through H20.47.

Related parameters:

Parameter	Communication Address	Name	Value	Default	Unit	Change Mode	Page
H20.44	-	SOS speed change threshold	1 rpm to 6000 rpm	10	rpm	At stop	"H20_en.44" on page 1014
H20.45	-	SOS position change threshold	1 to 536870912	932067	encoder unit	At stop	"H20_en.45" on page 1015
666A.01h	666A-01h	SOS zero position threshold	0 to 536870912	932067	encoder unit	Real-time	"666A_en.01h" on page 1028
666C.01h	666C-01h	SOS zero speed threshold	0 rpm to 6000 rpm	10	rpm	Real-time	"666C_en.01h" on page 1028

6.10.4 Sequence Diagram

SOS speed monitoring overrun

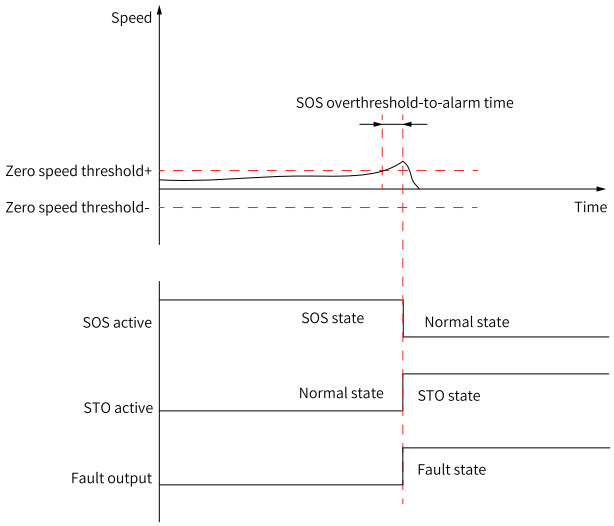


Figure 6-16 SOS speed monitoring timing diagram

SOS position monitoring overrun

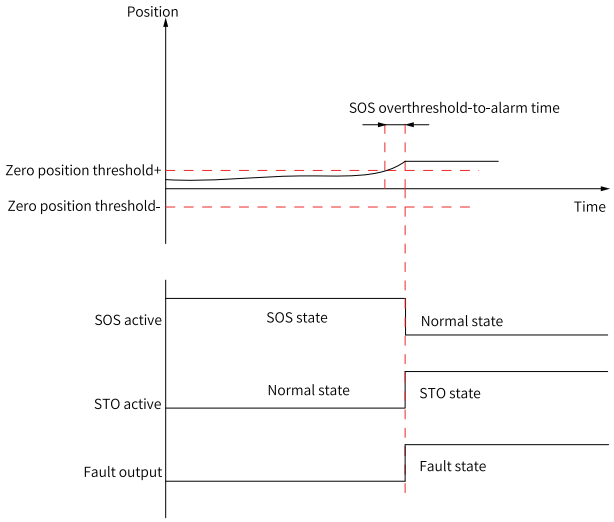


Figure 6-17 SOS position monitoring timing diagram

6.11 Safety-limited Speed (SLS)

6.11.1 Overview

When the SLS function is active, the safety module monitors whether the motor speed exceeds the SLS threshold. Once the allowable speed is exceeded, the servo drive responds in a preset way. You can configure the way for the servo drive to handle the SLS fault by setting the parameter H20.60.

There are four SLS thresholds and you can switch monitoring of these these thresholds during operation.

The SLS function is suitable for motors that can be dangerous due to overspeed.

6.11.2 SLS Triggered by Local Mode

The parameter DI: FunIN5 (SLS1) enables the DI to trigger the SLS1 function, DI: FunIN6 (SLS2) enables the DI to trigger the SLS2 function, DI: FunIN7 (SLS3) enables the DI to trigger the SLS3 function, DI: FunIN8 (SLS4) enables the DI to trigger the SLS4 function, DO: FunOUT.5 (SLS1 Active) enables the DO to output that SLS1 is active, DO: FunOUT.6 (SLS2 Active) enables the DO to output that SLS6 is active, DO: FunOUT.7 (SLS3 Active) enables the DO to output that SLS3 is active, and DO: FunOUT.8 (SLS4 Active) enables the DO to output that SLS4 is active.

Table 6–10 Description of function No.

Code	Name	Function Name	Function
FunIN.5	SLS1 command	SLS1 trigger command	0: SS1 active 1: SS1 deselected
FunIN.6	SLS2 command	SLS2 trigger command	0: SS2 active 1: SS2 deselected

Code	Name	Function Name	Function
FunIN.7	SLS3 command	SLS3 trigger command	0: SS3 active 1: SS3 deselected
FunIN.8	SLS4 command	SLS4 trigger command	0: SS4 active 1: SS4 deselected
FunOUT.5	SLS1 Active	SLS1 active	0: Normal state 1: SLS1 monitoring state
FunOUT.6	SLS2 Active	SLS2 active	0: Normal state 1: SLS2 monitoring state
FunOUT.7	SLS3 Active	SLS3 active	0: Normal state 1: SLS3 monitoring state
FunOUT.8	SLS4 Active	SLS4 active	0: Normal state 1: SLS4 monitoring state

Note

- OFF (0): The 24V voltage of the corresponding DI is disconnected.
- ON (1): The 24V voltage of the corresponding DI is connected.

Related parameters:

Parameter	Name	Value	Default	Unit	Change Mode	Page
H20.02	Safety module DI1 function selection	0: Inactive 1: STO 2: SBC 3: SS1 4: SS2 5: SLS1 6: SLS2 7: SLS3 8: SLS4 9: SDIp 10: SDIn 11: Ack	0	-	At stop	"H20_en.02" on page 1003
H20.03	Safety module DI2 function selection	0: Inactive 1: STO 2: SBC 3: SS1 4: SS2 5: SLS1 6: SLS2 7: SLS3 8: SLS4 9: SDIp 10: SDIn 11: Ack	0	-	At stop	"H20_en.03" on page 1003

Parameter	Name	Value	Default	Unit	Change Mode	Page
H20.04	Safety module DI3 function selection	0: Inactive 1: STO 2: SBC 3: SS1 4: SS2 5: SLS1 6: SLS2 7: SLS3 8: SLS4 9: SDIp 10: SDIn 11: Ack	0	-	At stop	"H20_en.04" on page 1004
H20.05	Safety module DI4 function selection	0: Inactive 1: STO 2: SBC 3: SS1 4: SS2 5: SLS1 6: SLS2 7: SLS3 8: SLS4 9: SDIp 10: SDIn 11: Ack	0	-	At stop	"H20_en.05" on page 1004
H20.06	Safety module DI5 function selection	0: Inactive 1: STO 2: SBC 3: SS1 4: SS2 5: SLS1 6: SLS2 7: SLS3 8: SLS4 9: SDIp 10: SDIn 11: Ack	0	-	At stop	"H20_en.06" on page 1005

Parameter	Name	Value	Default	Unit	Change Mode	Page
H20.20	Safety module DO1 function selection	0: Inactive 1: STO Active 2: SBC Active 3: SS1 Active 4: SS2 Active 5: SLS1 Active 6: SLS2 Active 7: SLS3 Active 8: SLS4 Active 9: SDIp Active 10: SDIn Active 11: SOS Active 12: SSM Active 13: SS1-r Active 14: SS2-r Active	0	-	At stop	"H20_en.20" on page 1008
H20.21	Safety module DO2 function selection	0: Inactive 1: STO Active 2: SBC Active 3: SS1 Active 4: SS2 Active 5: SLS1 Active 6: SLS2 Active 7: SLS3 Active 8: SLS4 Active 9: SDIp Active 10: SDIn Active 11: SOS Active 12: SSM Active 13: SS1-r Active 14: SS2-r Active	0	-	At stop	"H20_en.21" on page 1008
H20.22	Safety module DO3 function selection	0: Inactive 1: STO Active 2: SBC Active 3: SS1 Active 4: SS2 Active 5: SLS1 Active 6: SLS2 Active 7: SLS3 Active 8: SLS4 Active 9: SDIp Active 10: SDIn Active 11: SOS Active 13: SS1-r Active 14: SS2-r Active	0	-	At stop	"H20_en.22" on page 1009

Parameter	Name	Value	Default	Unit	Change Mode	Page
H20.23	Safety module DO4 function selection	0: Inactive 1: STO Active 2: SBC Active 3: SS1 Active 4: SS2 Active 5: SLS1 Active 6: SLS2 Active 7: SLS3 Active 8: SLS4 Active 9: SDIp Active 10: SDIn Active 11: SOS Active 12: SSM Active 13: SS1-r Active 14: SS2-r Active	0	-	At stop	"H20_en.23" on page 1009
H20.24	Safety module DO5 function selection	0: Inactive 1: STO Active 2: SBC Active 3: SS1 Active 4: SS2 Active 5: SLS1 Active 6: SLS2 Active 7: SLS3 Active 8: SLS4 Active 9: SDIp Active 10: SDIn Active 11: SOS Active 12: SSM Active 13: SS1-r Active 14: SS2-r Active	0	-	At stop	"H20_en.24" on page 1010
H20.25	Safety module DO6 function selection	0: Inactive 1: STO Active 2: SBC Active 3: SS1 Active 4: SS2 Active 5: SLS1 Active 6: SLS2 Active 7: SLS3 Active 8: SLS4 Active 9: SDIp Active 10: SDIn Active 11: SOS Active 13: SS1-r Active 14: SS2-r Active	0	-	At stop	"H20_en.25" on page 1010
H20.48	SLS1 switchover delay	0 ms-65535 ms	100	ms	At stop	"H20_en.48" on page 1015
H20.49	SLS2 switchover delay	0 ms-65535 ms	100	ms	At stop	"H20_en.49" on page 1015

Parameter	Name	Value	Default	Unit	Change Mode	Page
H20.50	SLS3 switchover delay	0 ms-65535 ms	100	ms	At stop	"H20_en.50" on page 1016
H20.51	SLS4 switchover delay	0 ms-65535 ms	100	ms	At stop	"H20_en.51" on page 1016
H20.52	SLS1 threshold	0 rpm to 6000 rpm	1000	rpm	At stop	"H20_en.52" on page 1016
H20.53	SLS2 threshold	0 rpm to 6000 rpm	1000	rpm	At stop	"H20_en.53" on page 1016
H20.54	SLS3 threshold	0 rpm to 6000 rpm	1000	rpm	At stop	"H20_en.54" on page 1016
H20.55	SLS4 threshold	0 rpm to 6000 rpm	1000	rpm	At stop	"H20_en.55" on page 1017
H20.56	SLS1 filter time	0 ms-65535 ms	100	ms	At stop	"H20_en.56" on page 1017
H20.57	SLS2 filter time	0 ms-65535 ms	100	ms	At stop	"H20_en.57" on page 1017
H20.58	SLS3 filter time	0 ms-65535 ms	100	ms	At stop	"H20_en.58" on page 1017
H20.59	SLS4 filter time	0 ms-65535 ms	100	ms	At stop	"H20_en.59" on page 1017
H20.61	Safety bus function enabled (FSoE)	bit0: STO enabled bit1: SS1 enabled bit2: SS2 enabled bit3: SOS enabled bit4: SLS enabled bit5: Reserved bit6: Reserved bit7: SDI enabled bit8: Reserved bit9: SBC enabled bit10: ACK (nSRA) enabled bit11: Reserved bit12: Reserved bit13: SLS speed limit (low bit) bit14: SLS speed limit high bit) 15: No STO prompt before FSoE connection	25247	-	At stop	"H20_en.61" on page 1018
H20.80	Speed/Position monitoring setting	0: No speed and position monitoring 1: Use safety motor and speed and position monitoring	0	-	At stop	"H20_en.80" on page 1020

6.11.3 SLS Triggered by Bus Mode

When the bus mode triggers the SLS function and H20.01 = 1 or 3, you need to set bit4, bit14, and bit13 of H20.61 to select the number of allowed SLS commands.

Example:

SLS function configuration parameters			Available SLS commands
bit14	bit13	bit4	
Any value	Any value	0	0
0	0	1	SLS1
0	1	1	SLS1, SLS2
1	0	1	SLS1, SLS2, SLS3
1	1	1	SLS1, SLS2, SLS3, SLS4

There are two ways to enter the SLS speed limit monitoring function. You need to set 6691h and 6694h only for matching a PLC with SRA parameters:

1. You can set the delay time from activation of the SLS command to starting of the SLS speed monitoring. When the delay time has elapsed, the safety module will turn on the speed monitoring regardless of whether the current speed of the servo motor is within the speed range.
2. You can also set the SLS filter time. It defines the filtering time for determining that the motor speed is within the SLS limit. When the SLS filter time is reached, the SLS speed monitoring will be activated regardless of whether the delay time is reached.

The object dictionary parameters involved in this mode are as follows.

Note:

- Object dictionaries 6690.01h and 6690.04h must be configured regardless of SRA parameters. Other object dictionaries need to be configured only for matching PLCs with SRA parameters.
- When using a PLC without SRA parameters, there is no need to configure the safe DIDO of H20 group parameters. You need to configure the SLS signal input through the object dictionary 6690h. Other parameter configurations are the same as those of the local mode.

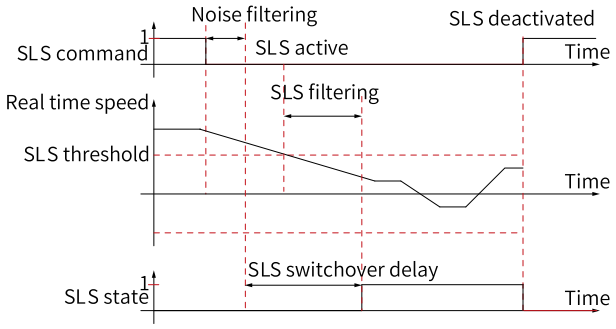
Related parameters:

Parameter	Communication Address	Name	Value	Default	Unit	Change Mode	Page
6690.01h	6690-01h	SLS1 signal	0 to 1	0	-	Real-time	"6690_en.01h" on page 1030
6690.02h	6690-02h	SLS2 signal	0 to 1	0	-	Real-time	"6690_en.02h" on page 1030
6690.03h	6690-03h	SLS3 signal	0 to 1	0	-	Real-time	"6690_en.03h" on page 1031
6690.04h	6690-04h	SLS4 signal	0 to 1	0	-	Real-time	"6690_en.04h" on page 1031
6691.01h	6691-01h	SLS1 switchover delay	0 ms-65535 ms	100	ms	Real-time	"6691_en.01h" on page 1031
6691.02h	6691-02h	SLS2 switchover delay	0 ms-65535 ms	100	ms	Real-time	"6691_en.02h" on page 1032

Parameter	Communication Address	Name	Value	Default	Unit	Change Mode	Page
6691.03h	6691-03h	SLS3 switchover delay	0 ms-65535 ms	100	ms	Real-time	"6691_en.03h" on page 1032
6691.04h	6691-04h	SLS4 switchover delay	0 ms-65535 ms	100	ms	Real-time	"6691_en.04h" on page 1032
6693.01h	6693-01h	SLS1 threshold	0 rpm to 6000 rpm	1000	rpm	Real-time	"6693_en.01h" on page 1032
6693.02h	6693-02h	SLS2 threshold	0 rpm to 6000 rpm	1000	rpm	Real-time	"6693_en.02h" on page 1032
6693.03h	6693-03h	SLS3 threshold	0 rpm to 6000 rpm	1000	rpm	Real-time	"6693_en.03h" on page 1033
6693.04h	6693-04h	SLS4 threshold	0 rpm to 6000 rpm	1000	rpm	Real-time	"6693_en.04h" on page 1033
6694.01h	6694-01h	SLS1 filter time	0 ms-65535 ms	10	ms	Real-time	"6694_en.01h" on page 1033
6694.02h	6694-02h	SLS2 filter time	0 ms-65535 ms	10	ms	Real-time	"6694_en.02h" on page 1033
6694.03h	6694-03h	SLS3 filter time	0 ms-65535 ms	10	ms	Real-time	"6694_en.03h" on page 1033
6694.04h	6694-04h	SLS4 filter time	0 ms-65535 ms	10	ms	Real-time	"6694_en.04h" on page 1034

6.11.4 Sequence Diagram

Sequence of SLS triggering



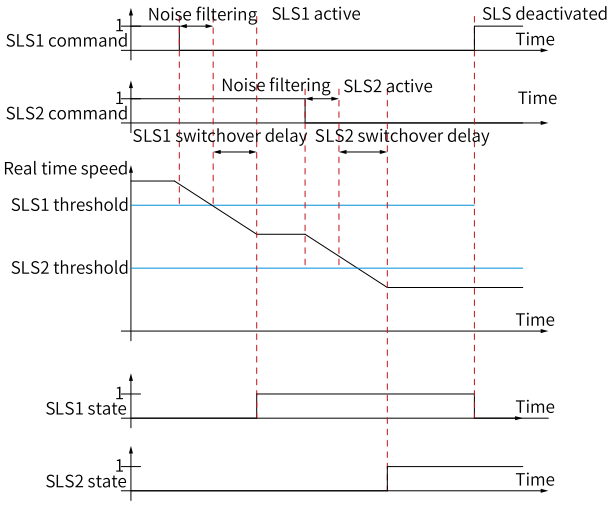
- When the SLS command is active, the speed of the servo motor must be below the SLS threshold before the SLS switchover delay expires; otherwise, the safety module will issue an SLS alarm.
- The safety module only monitors whether the motor speed and SLS switchover delay reach the thresholds. It will not actively send deceleration commands to the servo drive. To make the motor speed fall below the SLS threshold within the SLS switchover delay, the servo drive must be controlled externally for deceleration.

- When the SLS command is canceled, the SLS monitoring function is turned off, and the servo drive can immediately continue to run at a larger preset speed.
- Conditions for SLS to enter the monitoring state:

  1. The SLS switchover delay expires.
  2. SLS speed limit filter time expires.

Sequence of multiple SLS triggering

The safety module enables monitoring for four different SLS thresholds. When multiple SLS commands are all active, the motor speed must be kept below the smallest SLS threshold; otherwise, the safety module will issue an SLS alarm.



During normal operation of the servo drive, the SLS1 monitoring is triggered. Before the SLS1 switchover delay expires, the motor speed needs to be kept below the SLS1 threshold. After the SLS1 switchover delay expires, the SLS1 monitoring is turned on. During the SLS1 monitoring, the SLS2 monitoring is triggered. Before the SLS2 switchover delay expires, the motor speed needs to be kept below the SLS2 threshold. After the SLS2 switchover delay expires, the SLS2 monitoring is turned on.

In this case, both SLS1 and SLS2 monitoring are executed at the same time. The smaller one of the SLS1 and SLS2 thresholds is used. When the SLS1 command is canceled, the SLS1 monitoring is turned off.

6.12 Safe Direction (SDI)

6.12.1 Overview

The SDI function prevents the motor shaft from moving in an unintended direction.

When the SDIp input command is active, the safety module monitors whether the motor shaft moves in the prohibited forward direction; when the SDIn input command is active, the safety module monitors whether the motor shaft moves in the prohibited reverse direction.

When the motor shaft moves in an unexpected direction and exceeds the allowable threshold, the safety module triggers the corresponding stop alarm. You can configure the stop mode at SDI faults in H20.78.

The SDI function must be used with a safety motor.

6.12.2 Triggering SDI in Local Mode

Parameters for the safety digital input (SDI) function:

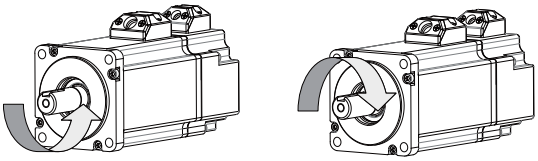
Table 6–11 Parameter description

Param.	Name	Function	Description
FunIN.9	SDIp command	Command for triggering SDI positive (SDIp)	0: SDIp active, forward rotation prohibited 1: SDIp canceled, forward rotation allowed
FunIN.10	Command for triggering SDI negative (SDIn)	SDIn trigger command	0: SDIn active, reverse rotation prohibited 1: SDIn canceled, reverse rotation allowed
FunOUT.9	SDIp Status	SDIp status	0: SDIp inactive, motor not rotating forwardly 1: SDIp active, motor rotating forwardly
FunOUT.10	SDIn Status	SDIn status	0: SDIn inactive, motor not rotating reversely 1: SDIn active, motor rotating reversely

Note

- OFF (0): The 24 V voltage of the corresponding DI is disconnected.
- ON (1): The 24 V voltage of the corresponding DI is connected.

From the perspective of the motor load side, clockwise rotation of the motor is abbreviated as CW, and counterclockwise rotation is abbreviated as CCW, as shown below.



The logical relationship between SDI command and state is as follows.

SDI command		SDI state		Description
SDIp	SDIn	SDIp	SDIn	
1	1	-	-	The motor can rotate both forwardly and reversely.
1	0	1	0	The motor can only rotate forwardly.
0	1	0	1	The motor can rotate only reversely.
0	0	0	0	The motor cannot rotate forwardly or reversely.

Note

0: Inactive, meaning that the 24V voltage of the corresponding DI is off;

1: Active, meaning that the 24V voltage of the corresponding DI is on.

Related parameters:

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H20.00	-	Functional safety module software version	0.00 to 655.35	0.00	-	Read-only	"H20_en.00" on page 1002
H20.02	-	Safety module DI1 function selection	0: Disabled 1: STO 2: SBC 3: SS1 4: SS2 5: SLS1 6: SLS2 7: SLS3 8: SLS4 9: SDIp 10: SDIn 11: Ack	0	-	At stop	"H20_en.02" on page 1003
H20.03	-	Safety module DI2 function selection	0: Disabled 1: STO 2: SBC 3: SS1 4: SS2 5: SLS1 6: SLS2 7: SLS3 8: SLS4 9: SDIp 10: SDIn 11: Ack	0	-	At stop	"H20_en.03" on page 1003
H20.04	-	Safety module DI3 function selection	0: Disabled 1: STO 2: SBC 3: SS1 4: SS2 5: SLS1 6: SLS2 7: SLS3 8: SLS4 9: SDIp 10: SDIn 11: Ack	0	-	At stop	"H20_en.04" on page 1004

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H20.05	-	Safety module DI4 function selection	0: Disabled 1: STO 2: SBC 3: SS1 4: SS2 5: SLS1 6: SLS2 7: SLS3 8: SLS4 9: SDIp 10: SDIn 11: Ack	0	-	At stop	"H20_en.05" on page 1004
H20.06	-	Safety module DI5 function selection	0: Disabled 1: STO 2: SBC 3: SS1 4: SS2 5: SLS1 6: SLS2 7: SLS3 8: SLS4 9: SDIp 10: SDIn 11: Ack	0	-	At stop	"H20_en.06" on page 1005
H20.20	-	Safety module DO1 function selection	0: Disabled 1: STO active 2: SBC active 3: SLS1 active 4: SS2 active 5: SLS1 active 6: SLS2 active 7: SLS3 active 8: SLS4 active 9: SDIp active 10: SDIn active 11: SOS active 12: SSM active 13: SS1-r active 14: SS2-r active	0	-	At stop	"H20_en.20" on page 1008

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H20.21	-	Safety module DO2 function selection	0: Disabled 1: STO active 2: SBC active 3: SLS1 active 4: SS2 active 5: SLS1 active 6: SLS2 active 7: SLS3 active 8: SLS4 active 9: SDIp active 10: SDIn active 11: SOS active 12: SSM active 13: SS1-r active 14: SS2-r active	0	-	At stop	"H20_en.21" on page 1008
H20.22	-	Safety module DO3 function selection	0: Disabled 1: STO active 2: SBC active 3: SLS1 active 4: SS2 active 5: SLS1 active 6: SLS2 active 7: SLS3 active 8: SLS4 active 9: SDIp active 10: SDIn active 11: SOS active 13: SS1-r active 14: SS2-r active	0	-	At stop	"H20_en.22" on page 1009
H20.23	-	Safety module DO4 function selection	0: Disabled 1: STO active 2: SBC active 3: SLS1 active 4: SS2 active 5: SLS1 active 6: SLS2 active 7: SLS3 active 8: SLS4 active 9: SDIp active 10: SDIn active 11: SOS active 12: SSM active 13: SS1-r active 14: SS2-r active	0	-	At stop	"H20_en.23" on page 1009

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H20.24	-	Safety module DO5 function selection	0: Disabled 1: STO active 2: SBC active 3: SLS1 active 4: SS2 active 5: SLS1 active 6: SLS2 active 7: SLS3 active 8: SLS4 active 9: SDIp active 10: SDIn active 11: SOS active 12: SSM active 13: SS1-r active 14: SS2-r active	0	-	At stop	"H20_en.24" on page 1010
H20.25	-	Safety module DO6 function selection	0: Disabled 1: STO active 2: SBC active 3: SLS1 active 4: SS2 active 5: SLS1 active 6: SLS2 active 7: SLS3 active 8: SLS4 active 9: SDIp active 10: SDIn active 11: SOS active 13: SS1-r active 14: SS2-r active	0	-	At stop	"H20_en.25" on page 1010
H20.61	-	Safety bus function selection (FSoE)	bit0: Enable STO bit1: Enable SS1 Bit 2: Enable SS2 bit3: Enable SOS bit4: Enable SLS bit5: Reserved bit6: Reserved bit7: Enable SDI bit8: Reserved bit9: Enable SBC bit10: Enable ACK (nSRA) bit11: Reserved Bit 12: Reserved bit13: SLS speed limit segment count (lower bits) bit14: SLS speed limit segment count (upper bits) bit15: No STO alarm before establishing FSoE connection	25247	-	At stop	"H20_en.61" on page 1018

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H20.74	-	SDI zero position threshold	1 to 536870912	932067	Encoder unit	At stop	"H20_en.74" on page 1019
H20.76	-	SDI zero speed threshold	0 to 3000	10	rpm	At stop	"H20_en.76" on page 1019
H20.77	-	SDI delay time	0 to 65535	0	ms	At stop	"H20_en.77" on page 1020
H20.78	-	SDI fault response mode	0: STO 1: SS1-t	0	-	At stop	"H20_en.78" on page 1020
H20.80	-	Speed/ Position monitoring setting	0: Speed/position monitoring is not performed 1: Use safety motor and perform speed and position monitoring	0	-	At stop	"H20_en.80" on page 1020
H02.02	2002-03h	Rotation direction	0: CCW direction as the forward direction 1: CW direction as the forward direction	0	-	At stop	"H02_en.02" on page 1001

6.12.3 SDI Function Triggered Through Safety Bus

The external functional characteristics of the SDI function triggered through FSoE are the same as those of the SDI function triggered through the local mode. The SDI function controlled through FSoE involves the following object dictionary configuration.

Note:

1. The object dictionaries 66D0h to 66D1h must be configured for a PLC with or without SRA parameters. The other object dictionaries only need be configured for PLCs with SRA parameters.
2. If a safety PLC without SRA parameters is used, the SDI zero speed window and SDI zero position window are set in the same way as the local mode.

Related parameters:

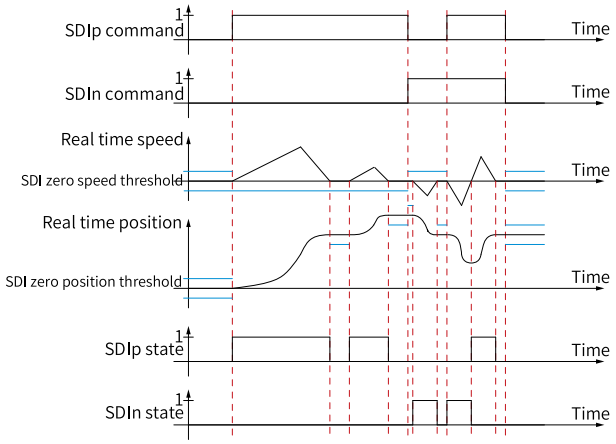
Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H02.02	2002-03h	Rotation direction	0: CCW direction as the forward direction 1: CW direction as the forward direction	0	-	At stop	"H02_en.02" on page 1001
66D0h	66D0h	SDIp signal	0 to 1	0	-	Real time	"66D0h" on page 1034
66D1h	66D1h	SDIn signal	0 to 1	0	-	Real time	"66D1h" on page 1034

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
66D3h	66D3h	SDI zero position threshold	0 to 536870912	932067	Encoder unit	Real time	"66D3h" on page 1035
66D5h	66D5h	SDI zero speed threshold	0 to 3000	10	rpm	Real time	"66D5h" on page 1035

6.12.4 Sequence Diagram

SDI control bit setting

You can control rotation direction of the motor by setting the SDI control bit. The permissible rotation direction is given by SDI positive (SDIp) and SDI negative (SDIn) control bits.



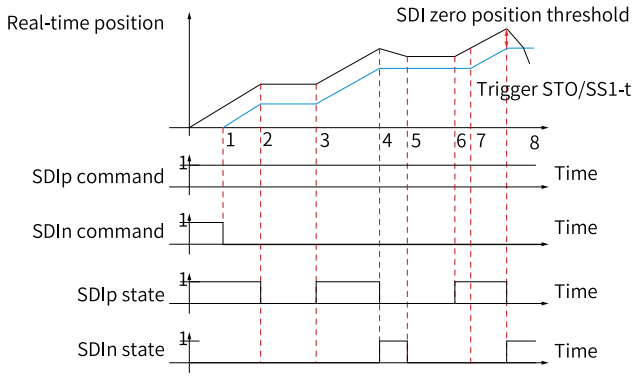
- The SDIp and SDIn states displayed by the safety module indicate the current rotational state of the servo motor, independent of whether the input SDI command is active or not. When both SDIp and SDIn states are 0, it means the servo motor is stopped.
- When the SDIp command is deactivated, the motor can rotate in forward direction, and when it is activated, the motor can only rotate in reverse direction.
- When the SDIn command is deactivated, the motor can rotate in reverse direction, and when it is activated, the motor can only rotate in forward direction.

SDI monitoring

When the SDI zero position threshold or SDI zero speed threshold is exceeded, the stop mode defined by H02.78 is triggered.

The SDI monitoring diagram is shown below.

Stop according to H20.78 when the SDI zero position threshold is exceeded



The sequence is described as follows:

1. The safety module receives an active SDIn command and starts monitoring whether the motor shaft rotates into the reverse direction. The motor rotates into the allowable forward direction.

2. The motor stops rotating and the position feedback remains unchanged.

3. The motor continues to rotate into the allowable forward direction.

4. The motor rotates into the reverse direction, the safety module locks the maximum allowed reverse position threshold and checks whether the current position exceeds the maximum allowed value.

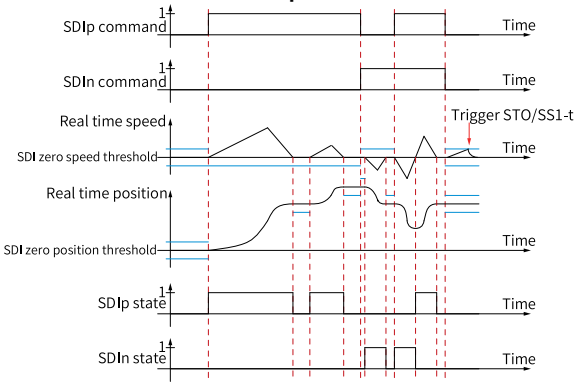
5. The motor stops before the maximum reverse position threshold is reached.

6. The motor continues to rotate into the allowable forward direction.

7. The motor returns to the position it was in when the reverse position threshold was locked.

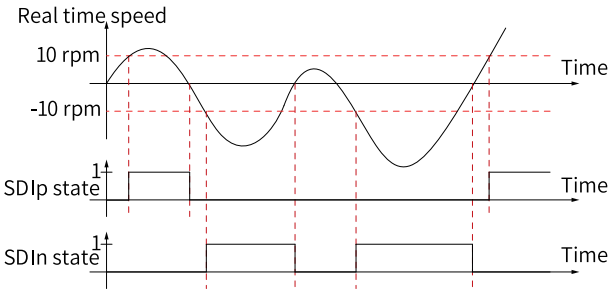
8. The zero position threshold is exceeded and the safety stop set by H20.78 is triggered.

Stop according to H20.78 when the SDI zero speed threshold is exceeded



Hysteresis speed

To avoid the SDIp and SDIn states jumping back and forth near zero speed, the safety module is configured with a hysteresis speed of 10 rpm. Only when the speed exceeds ±10rpm, the corresponding SDI state value changes to 1.



6.13 Safe Speed Monitor (SSM)

6.13.1 Overview

The SSM function provides a safe output signal to indicate whether the motor speed is below a prescribed limit to identify, for example, a standstill. The safety module provides a safe output signal for further processing.

The SSM monitors whether the motor speed is within the limit threshold. The safety module does not trigger any stop response when the motor speed exceeds the SSM limit threshold.

The SSM applies to enabling through feedback in the local mode, such as unlocking the protective door at a speed lower than the critical speed.

The SSM state can be output through the local mode or through the TPDO status word of the EtherCAT safety bus.

6.13.2 SSM Triggered Locally

The parameter DO: FunOUT.12 (SSM Active) enables the DO to output that SSM function is active.

Table 6–12 Description of function No.

Code	Name	Function Name	Function
FunOUT.12	SSM Active	SSM active	0: Out of SSM limit 1: Within SSM limit

Note

- OFF (0): The 24V voltage of the corresponding DI is disconnected.
- ON (1): The 24V voltage of the corresponding DI is connected.

The parameters for safety DO controlling SSM are as follows:

Related parameters:

Parameter	Name	Value	Default	Unit	Change Mode	Page
H20.20	Safety module DO1 function selection	0: Inactive 1: STO Active 2: SBC Active 3: SS1 Active 4: SS2 Active 5: SLS1 Active 6: SLS2 Active 7: SLS3 Active 8: SLS4 Active 9: SDIp Active 10: SDIn Active 11: SOS Active 12: SSM Active 13: SS1-r Active 14: SS2-r Active	0	-	At stop	"H20_en.20" on page 1008
H20.21	Safety module DO2 function selection	0: Inactive 1: STO Active 2: SBC Active 3: SS1 Active 4: SS2 Active 5: SLS1 Active 6: SLS2 Active 7: SLS3 Active 8: SLS4 Active 9: SDIp Active 10: SDIn Active 11: SOS Active 12: SSM Active 13: SS1-r Active 14: SS2-r Active	0	-	At stop	"H20_en.21" on page 1008
H20.23	Safety module DO4 function selection	0: Inactive 1: STO Active 2: SBC Active 3: SS1 Active 4: SS2 Active 5: SLS1 Active 6: SLS2 Active 7: SLS3 Active 8: SLS4 Active 9: SDIp Active 10: SDIn Active 11: SOS Active 12: SSM Active 13: SS1-r Active 14: SS2-r Active	0	-	At stop	"H20_en.23" on page 1009

Parameter	Name	Value	Default	Unit	Change Mode	Page
H20.24	Safety module DO5 function selection	0: Inactive 1: STO Active 2: SBC Active 3: SS1 Active 4: SS2 Active 5: SLS1 Active 6: SLS2 Active 7: SLS3 Active 8: SLS4 Active 9: SDIp Active 10: SDIn Active 11: SOS Active 12: SSM Active 13: SS1-r Active 14: SS2-r Active	0	-	At stop	"H20_en.24" on page 1010
H20.70	SSM upper limit	-6000 rpm to 6000 rpm	200	rpm	At stop	"H20_en.70" on page 1018
H20.71	SSM lower limit	-6000 rpm to 6000 rpm	-200	rpm	At stop	"H20_en.71" on page 1019
H20.72	SSM hysteresis threshold	0 rpm to 6000 rpm	10	rpm	At stop	"H20_en.72" on page 1019

Note

- When the upper and lower limits of SSM are set to 0 at the same time, the SSM function can be disabled, and the SSM status is always inactive.
- The upper limit of the SSM must be greater than the lower limit, and the hysteresis threshold of the SSM must be less than the upper limit minus the lower limit.
- The SSM hysteresis threshold is set by parameter H20.72, and is valid for both local DO and FSoE output status words.

6.13.3 SSM Output in Bus Mode

The SSM hysteresis threshold is not planned in the object dictionary. To prevent the motor speed from fluctuating near the upper or lower SSM threshold, the SSM hysteresis threshold configured for the SSM function triggered locally adopts the value set by the parameter 20.72.

That is, the SSM hysteresis threshold set by H20.72 will take effect for both the local mode and the bus mode.

The object dictionaries involved are as follows:

Note:

- Object dictionaries 66E2.01h and 66E4.01h are involved only for PLCs with SRA parameters.
- When a PLC without SRA parameters is used, the SSM upper limit threshold and lower limit threshold are set through H20.70 and H20.71 respectively.

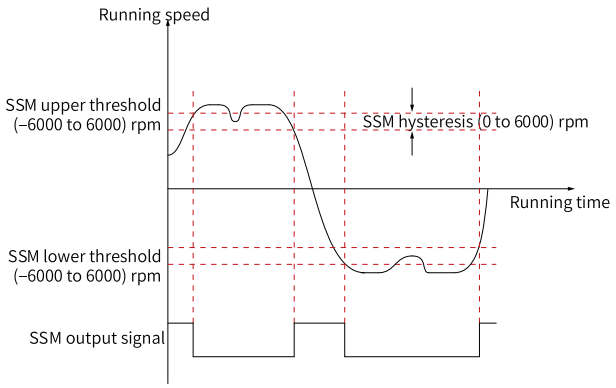
Related parameters:

Param.	Comm. address	Name	Value	Default	Unit	Change mode	Page
H20.70	-	SSM upper limit	-6000 to 6000	200	rpm	At stop	"H20_en.70" on page 1018
H20.71	-	SSM lower limit	-6000 to 6000	-200	rpm	At stop	"H20_en.71" on page 1019
H20.72	-	SSM hysteresis threshold	0 to 6000	10	rpm	At stop	"H20_en.72" on page 1019
66E0.01h	66E0-01h	SSM status	0 to 1	0	-	Read-only	"66E0_en.01h" on page 1035
66E2.01h	66E2-01h	SSM upper limit	-6000 to 6000	200	rpm	Real time	"66E2_en.01h" on page 1036
66E4.01h	66E4-01h	SSM lower limit	-6000 to 6000	-200	rpm	Real time	"66E4_en.01h" on page 1036

Note

- When the upper and lower limits of SSM are set to 0 at the same time, the SSM function is turned off and the SSM state is always inactive.
- The upper limit of the SSM must be greater than the lower limit, and the hysteresis threshold of the SSM must be less than the upper limit minus the lower limit.
- The SSM hysteresis threshold is set by parameter H20.72, and is valid for both local DO and FSoE output status words.

6.13.4 Sequence Diagram



The purpose of the SSM hysteresis setting is to achieve a more stable signal output when the motor speed is near the upper or lower SSM threshold. The SSM function prevents the SSM output signal from jumping back and forth between 0 and 1 several times around the threshold due to the real-time fluctuation of the motor speed.

- When the motor speed is within the upper and lower SSM thresholds, the SSM output is 1.
- When the motor speed exceeds the upper SSM threshold, the SSM output is 0.
- When the motor speed drops below upper SSM threshold minus hysteresis threshold, the SSM output is 1 again.
- When the motor speed drops below the lower SSM threshold, the SSM output is 0.

- When the motor speed increases to lower SSM threshold + hysteresis threshold, the SSM output is 1 again.

6.14 STO Response Time

Caution

Set the parameters correctly to achieve the desired response time and ensure the accumulation of diagnostic test interval (DTI) and safety function response time can meet the safety requirements of the system.

6.14.1 Response Time for Triggering Safety Functions in Local Mode

When the local mode triggers the safety function, configure the safety DI to a safety function and trigger the corresponding safety function by controlling the safety DI. The response time from DI operation to the time when the safety function take effect is shown in the following table.

Table 6–13 Response time during terminal control

Function	Max. response time[5]
STO/SBC/SS1/SS2	t_DI[1]+2.5ms
SLS	t_DI[1]+t_SLS[3] + 6.5ms
SDI	t_DI[1]+t_SDI[4] + 6.5ms
SOS	t_SOS[2] + 6.5ms
SSM	4 ms

Note

[1]: t_DI is the noise removal filter time of the safety module DI, which is configured by parameters H20.08 to H20.12, with setpoints ranging from 1 ms to 500 ms.

[2]: t_SOS is the filter time set by H20.47, which ranges from 0 ms to 65535 ms.

[3]: t_SLS is the delay time set by parameters H20.48 to H20.51, which ranges from 0 ms to 65535 ms.

[4]: t_SDI is the delay time set by H20.77, which ranges from 0 ms to 65535 ms.

[5]: Indicates the time interval between the safety function demand state and the safety function completion state (such as entering the safety state).

6.14.2 Response Time in Bus Mode

When the FSoE mode triggers safety function, the corresponding safety function is triggered by the control word of a certain safety function in the RPDO. The following table shows the time between function trigger and start.

Table 6–14 Response time during FSoE control

Function	Max. response time[7]
STO/SBC/SS1/SS2	2*t_ET[1]+ 2ms
SLS	2*t_ET[1]+ t_SLS[3] + 6.5ms

Function	Max. response time[7]
SDI	2*t_ET[1]+ t_SDI[4] + 6.5ms
SOS	t_SOS[2] + 6.5ms
SSM	4*t_EFS[5] +4*t_EFM[6]

Note

- [1]: t_ET is the EtherCAT communication synchronization cycle. The setpoint is determined by the parameter configurations of the customer controller.
- [2]: t_SOS is the filter time set by H20.47, which ranges from 0 ms to 65535 ms.
- [3]: t_SLS is the delay set by H20.48 to H20.51, which ranges from 0 ms to 65535 ms.
- [3]: t_SDI is the delay set by H20.77, which ranges from 0 ms to 65535 ms.
- [5] t_EPS is the communication cycle between the EtherCAT master and the FSoE slave. The setpoint is determined by the parameter configurations of the customer controller.
- [6]: t_EFM is the communication cycle between the EtherCAT master and the FSoE master. The setpoint is determined by the parameter configurations of the customer controller.
- [7]: Indicates the time interval between the safety function demand state and the safety function completion state (such as entering the safety state).

6.15 Safety Module Working with Beckhoff Safety CPU

The following is an example of the simple configuration for FSoE-triggered safety function, with a Beckhoff safety CPU and TwinCAT3 master.

Hardware

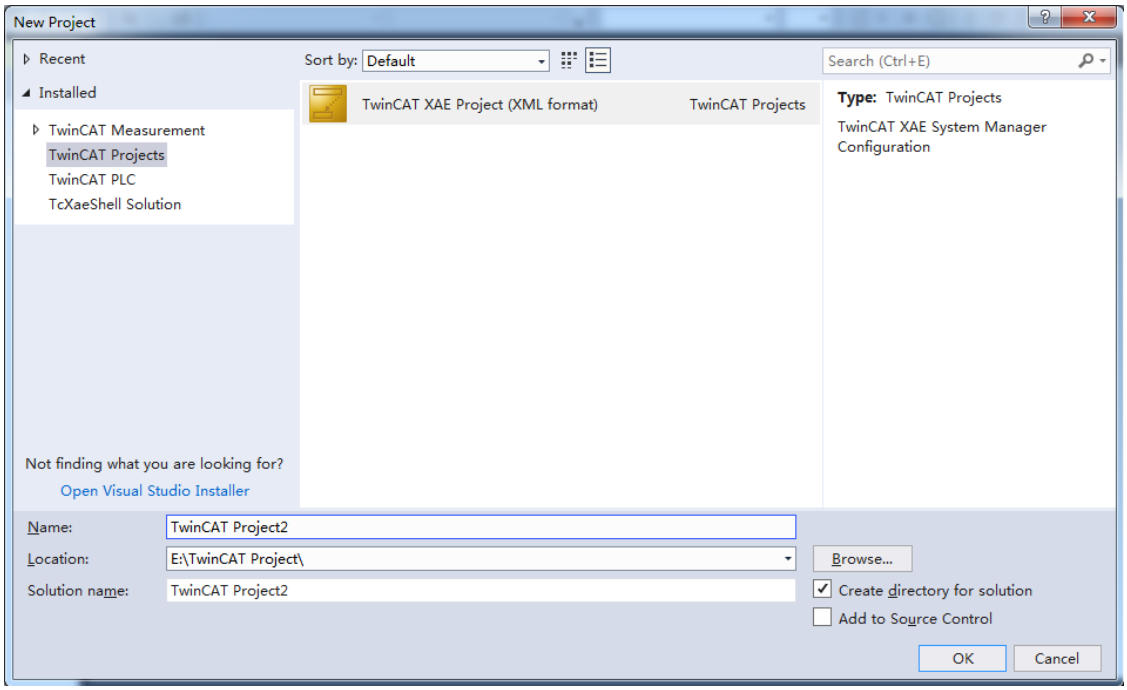
The Beckhoff safety CPU unit includes a logic sub-module EL6900, 4-channel DI sub-module EL1904, and 4-channel DO sub-module EL2904 which are connected to EtherCAT network through EtherCAT coupler EK1100. For FSoE network hardware wiring, see *"13.2 FSoE Connection and Setting" on page 1178*.

The safety address must be set to the safety module and every module of the safety CPU unit. The safety address cannot be 0, and the safety address must be unique for every module of the system. You can set the safety address for the safety module through the knob.

Software

You can obtain TwinCAT3 at the official website of Beckhoff. The software version of TwinCAT must be 3.1.4024.1 or above when FSoE is used.

1. Copy the SV680N-INT EtherCAT configuration file (SV680_1Axis_04001_FSoE.xml) to the TwinCAT installation directory: TwinCAT\3.1\Config\Io\EtherCAT.
2. Start TwinCAT3 and Create a TwinCAT project.

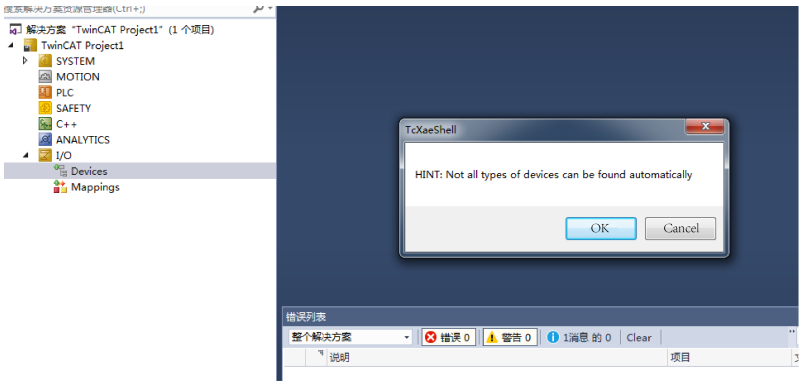


Search for devices.

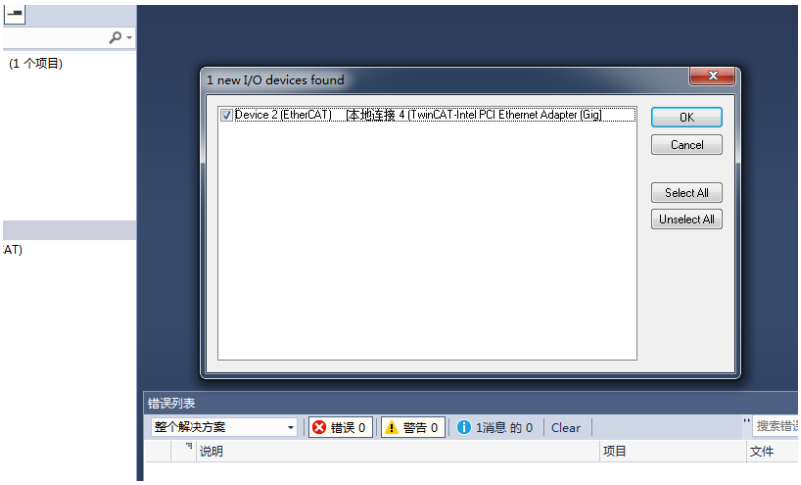
1. Select Devices , and click as shown below.



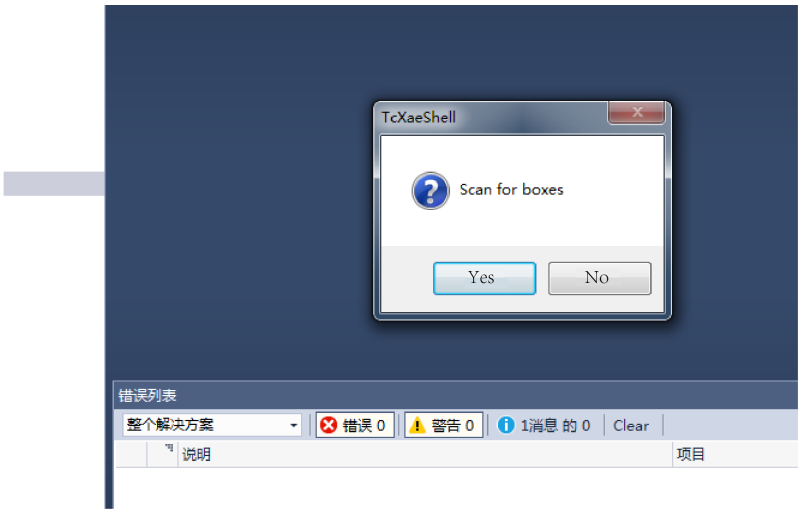
2. Click **OK**.



3. Click **OK**.



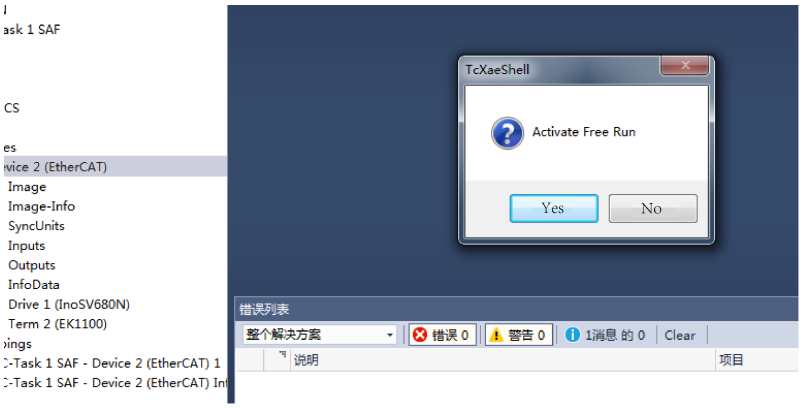
4. Click **OK**.



5. Click **OK**.



6. Click **Cancel**.



7. If the search is successful, the following devices should show: the SV680N-INT servo drive, safety module, Beckhoff EK1100, EL6900, EL1904 and EL2904.
8. Safety parameter mode selection:

   a. Select the drive that you need to configure and click Enter.

   b. Click "Slots".

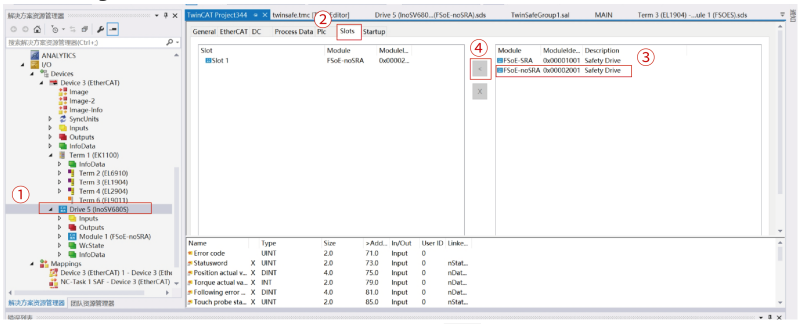
   c. Set the FSoE safety parameter mode to SRA or nSRA as required.

   Note:

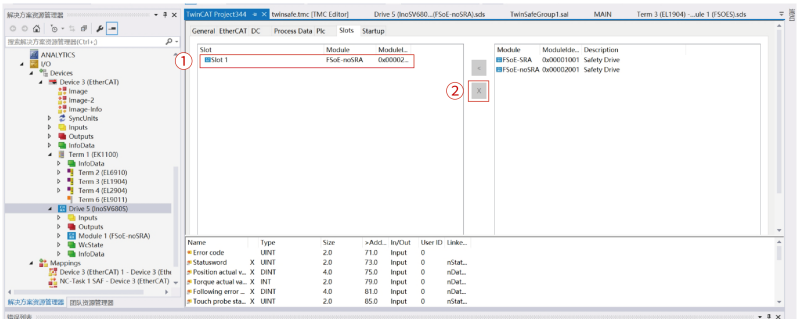
   SRA: refers to the FSoE safety bus that supports SRA parameters, adapted to the safety PLC that supports SRA parameters, such as Beckhoff EL6900/EL6910.

   nSRA: refers to the FSoE safety bus without SRA parameters, adapted to safety PLCs that do not support SRA parameters, such as Pilz's safety PLCs.

   d. Click "". The setting was successful.



   e. If the setting is incorrect, select the mode and click "" to delete.



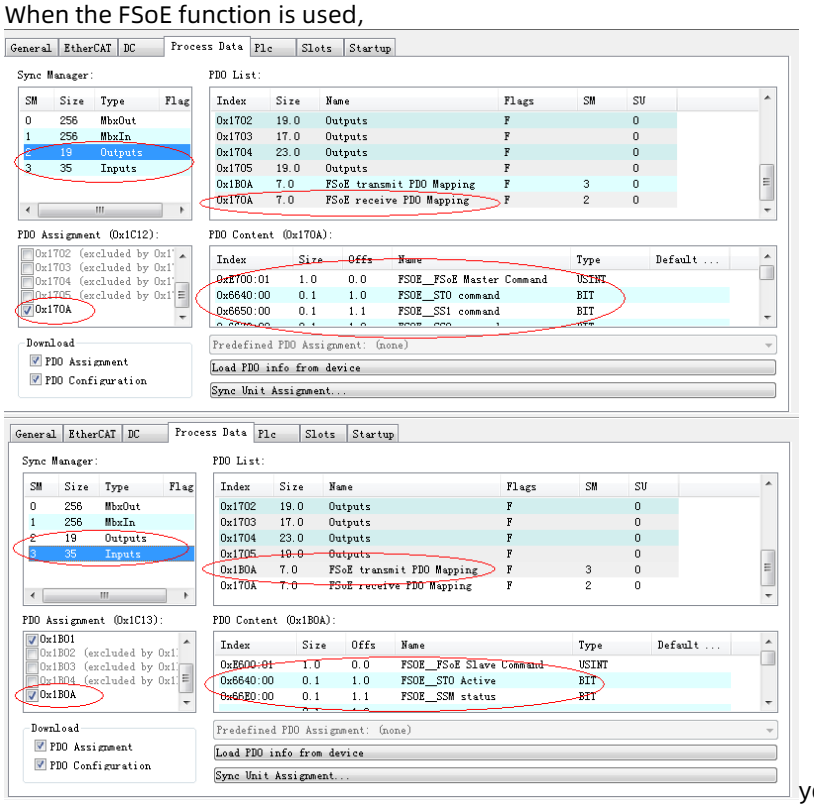
9. Set parameter H20.01 (safety function mode selection):

   If the safe mode is set to SRA, set H20.01 = 1.

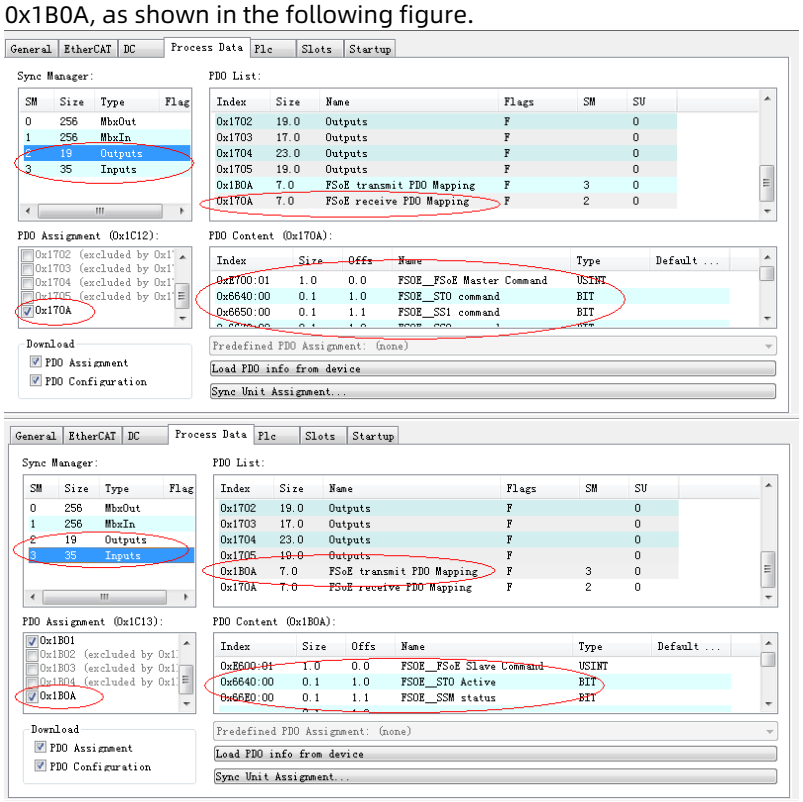
   If the safe mode is set to nSRA, set H20.01 = 3.

Configuring PDO

When the FSoE function is used,



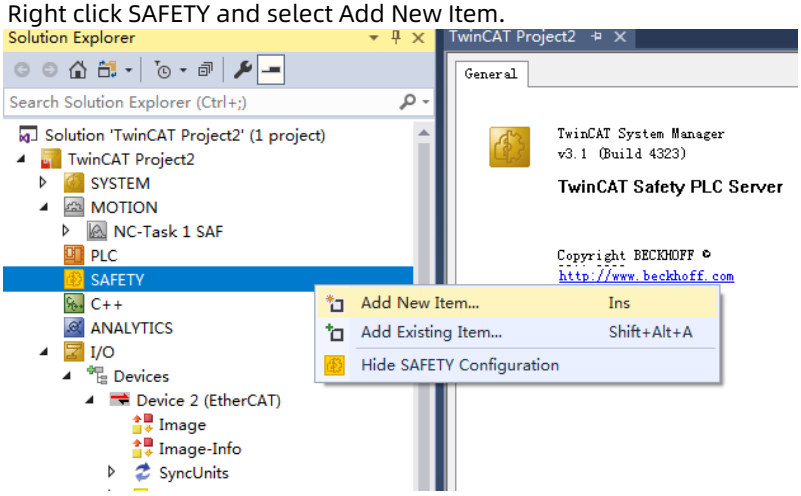
you must select 0x170A and 0x1B0A, as shown in the following figure.



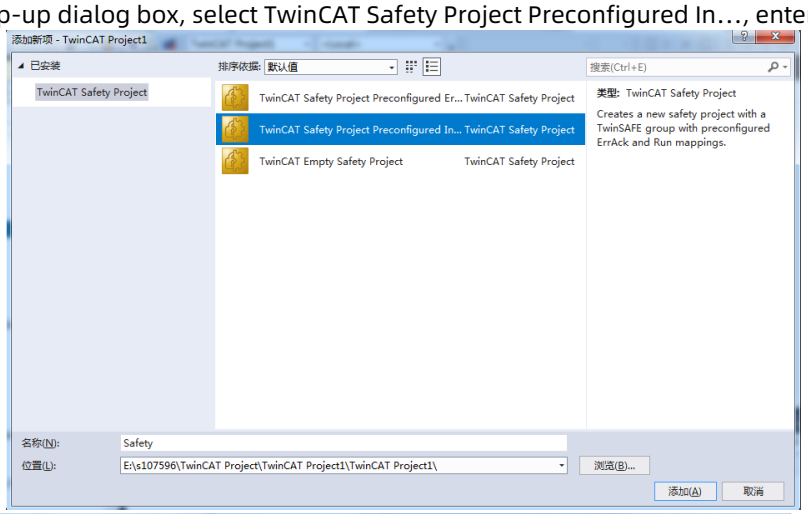
Safety hardware configuration

1. Create a safety project.

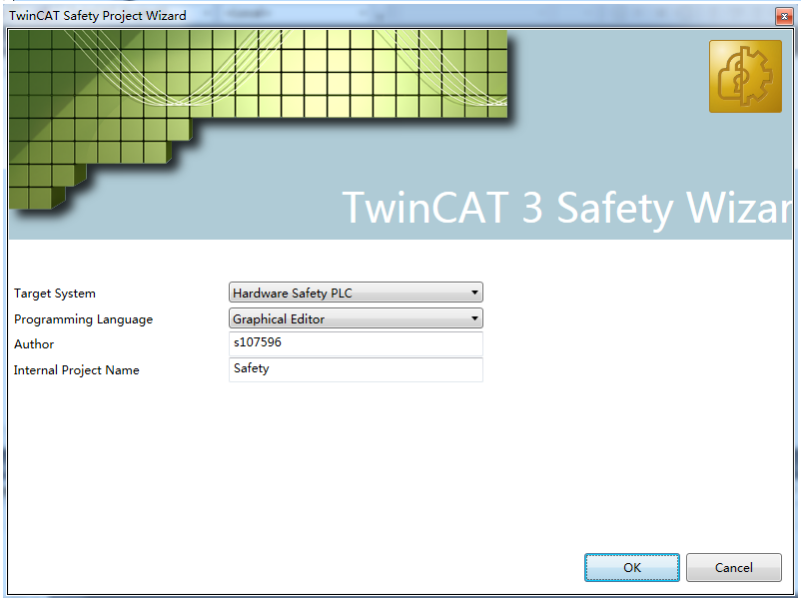
a. Right click SAFETY and select Add New Item.



b. In the pop-up dialog box, select TwinCAT Safety Project Preconfigured In…, enter the name and click Add.

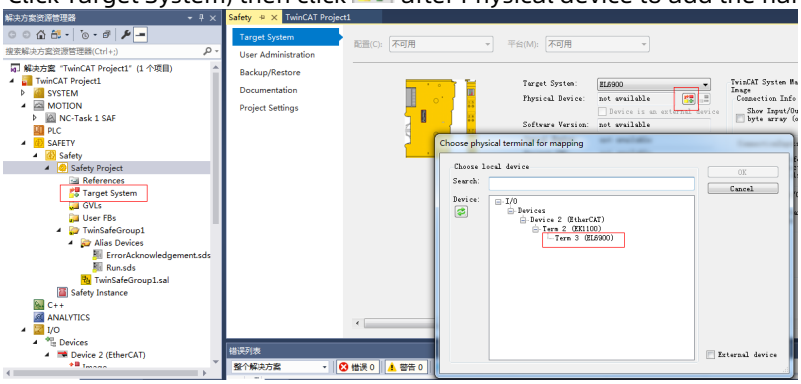


c. Click OK.



2. Set EL6900 as the safety logic module, do as follows.

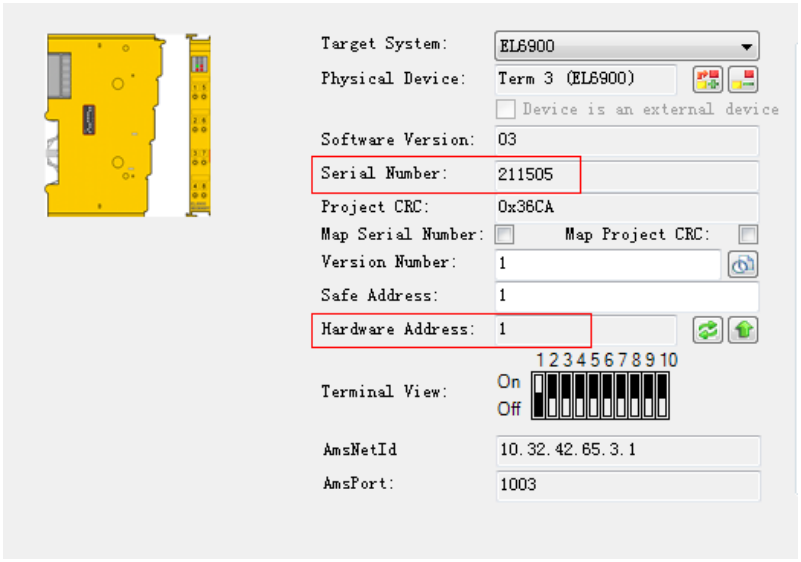
a. Click Target System, then click  after Physical device to add the hardware device.



b. Check the serial number and hardware address of the EL69XX module.

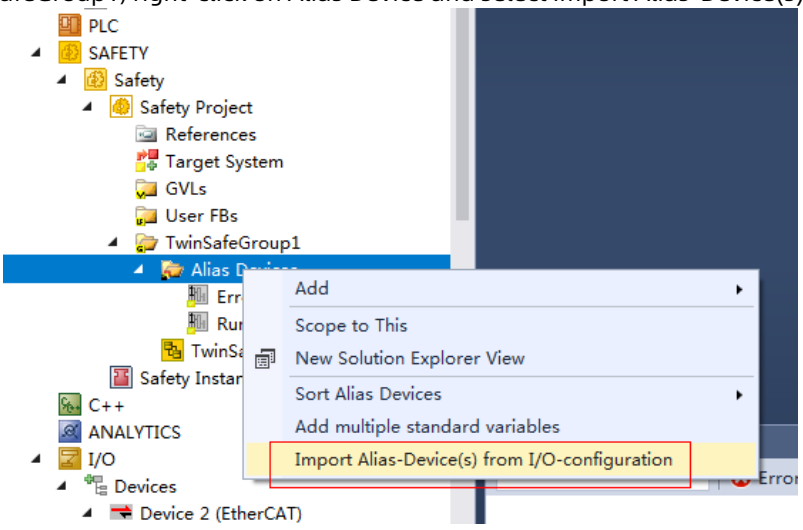
Note

You need to select a matching model for Target System. The EL6900 model is used in this example.

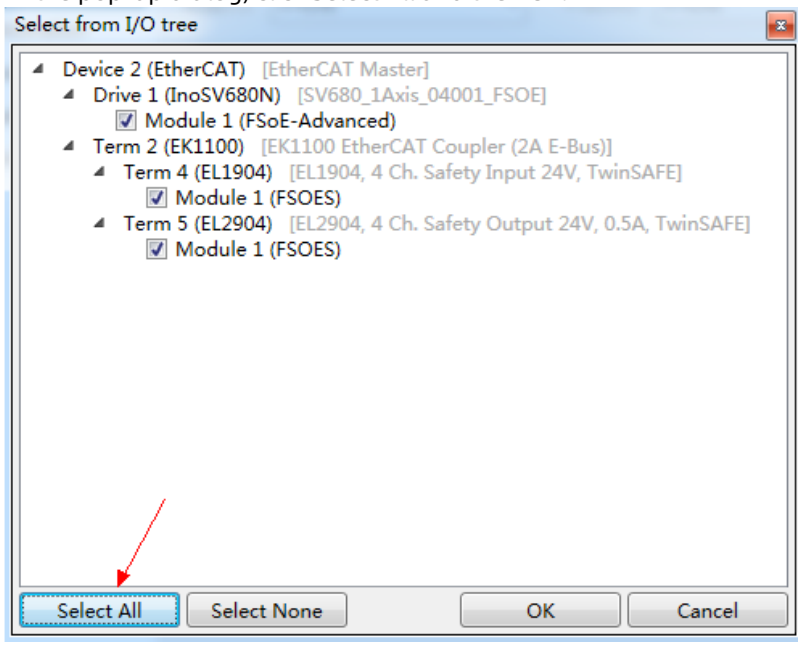


3.

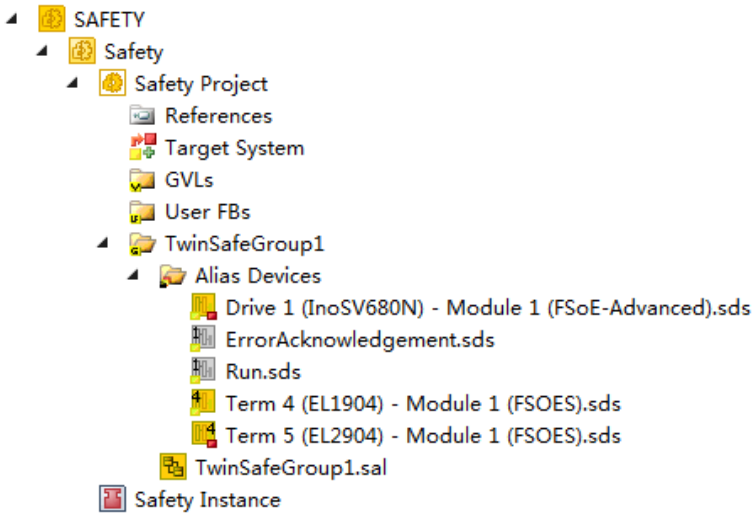
a. Expand TwinSafeGroup1, right-click on Alias Device and select Import Alias-Device(s) from I/O-configuration.



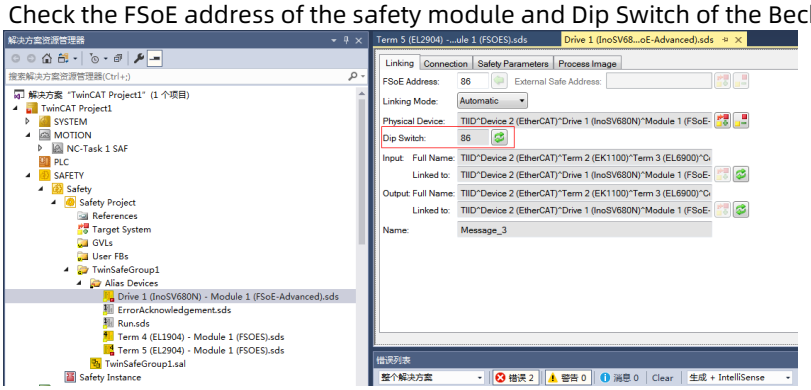
b. In the pop-up dialog, click Select All and then OK.

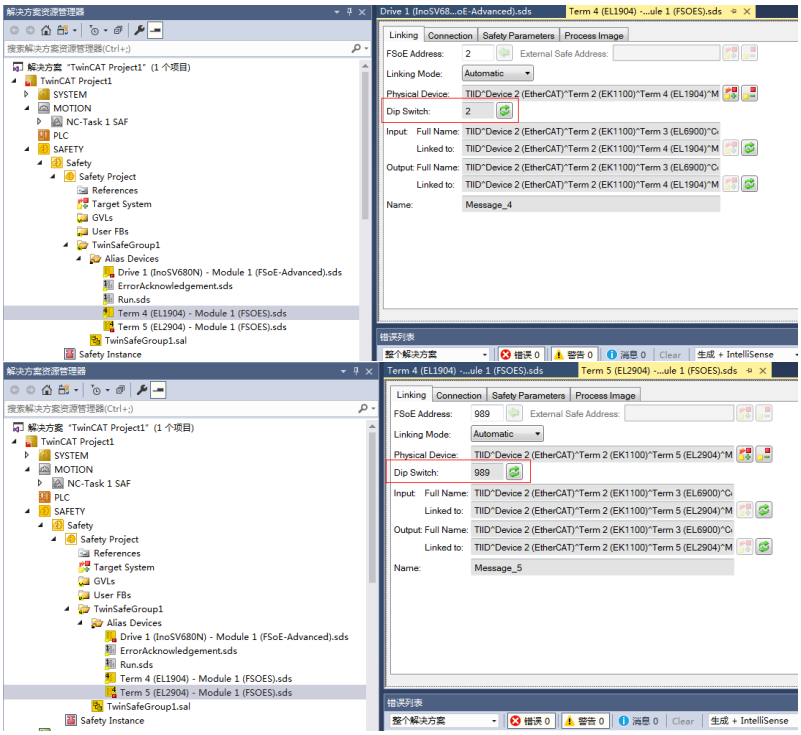


c. Add safety I/O module and safety module under Alias Devices.



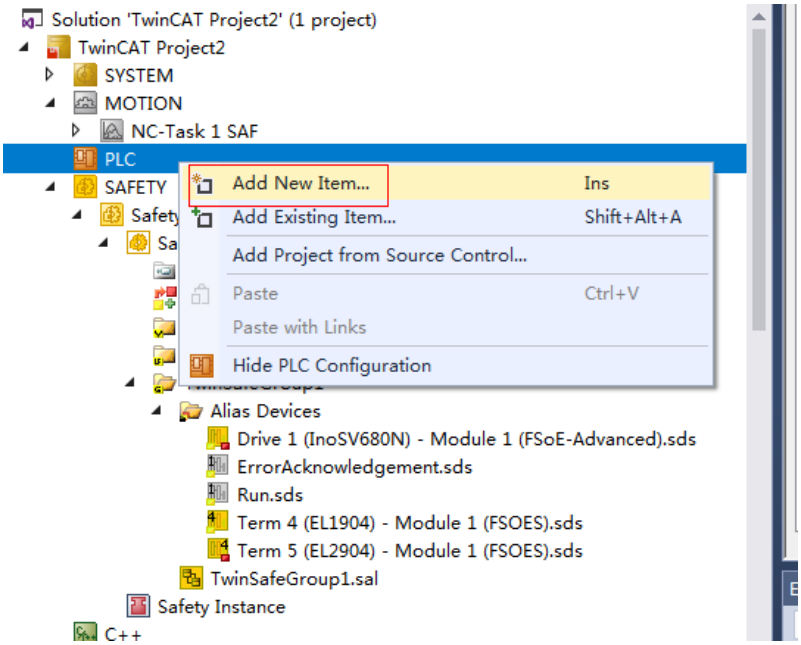
d. Check the FSoE address of the safety module and Dip Switch of the Beckhoff module.





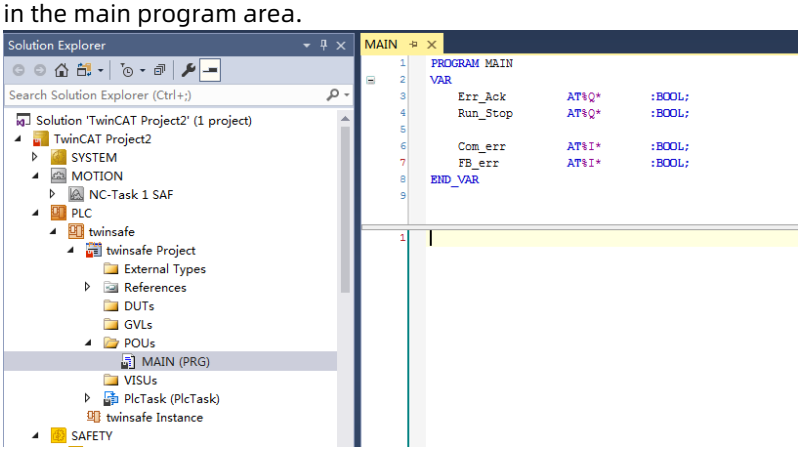
Safety program configuration

1. Add a PLC project.

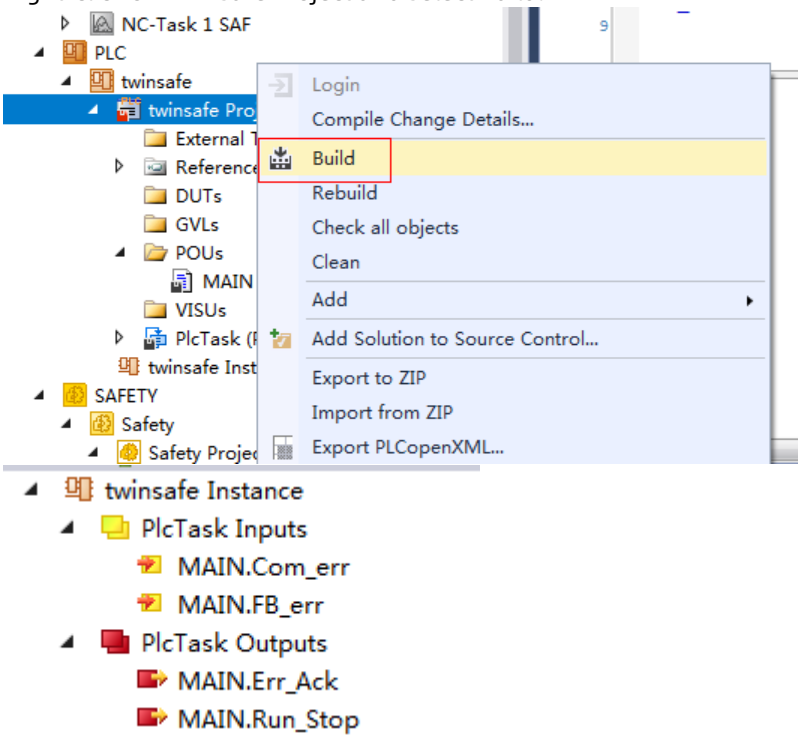


a. Click Add New Item….

b. Select Standard PLC Project, name the project as "twinsafe" and make the following statement in the main program area.

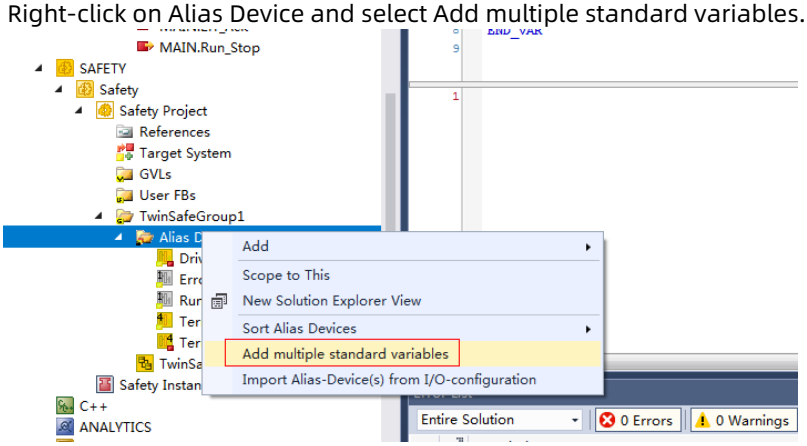


c. Right-click on Twinsafe Project and select Build.

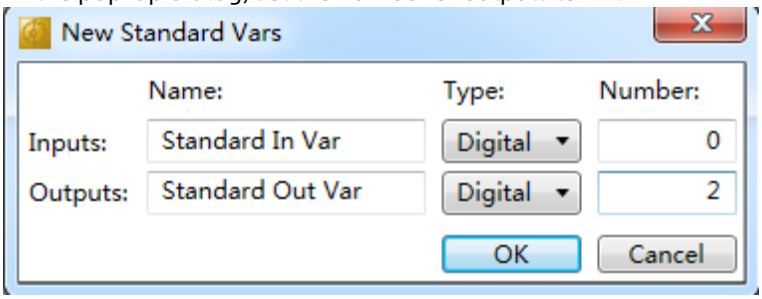


2. Add non-safety standard variables.

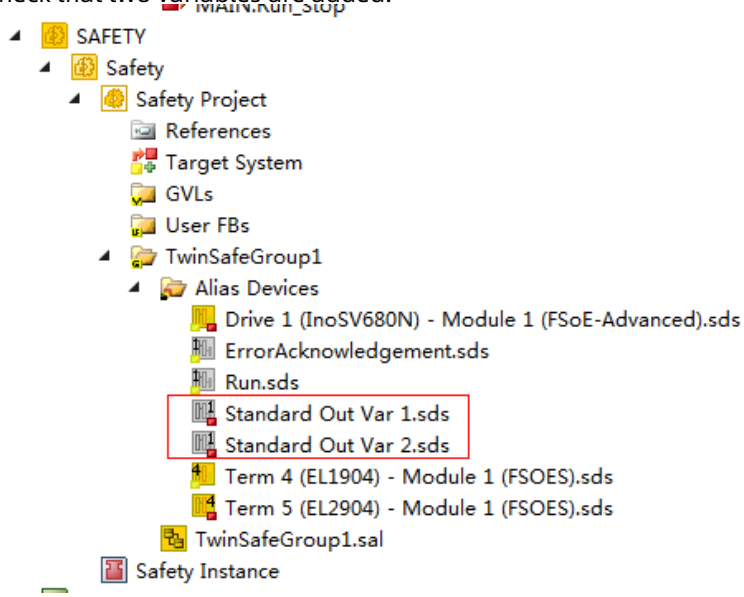
a. Right-click on Alias Device and select Add multiple standard variables.



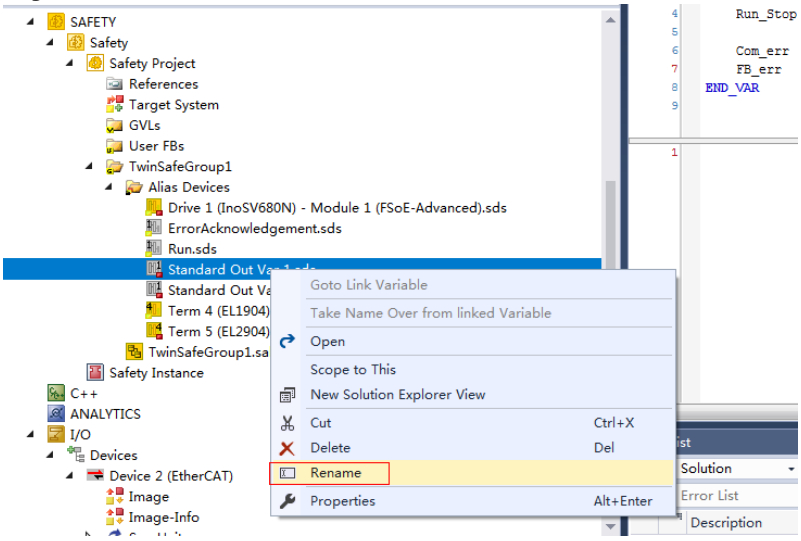
b. In the pop-up dialog, set the number of outputs to "2".



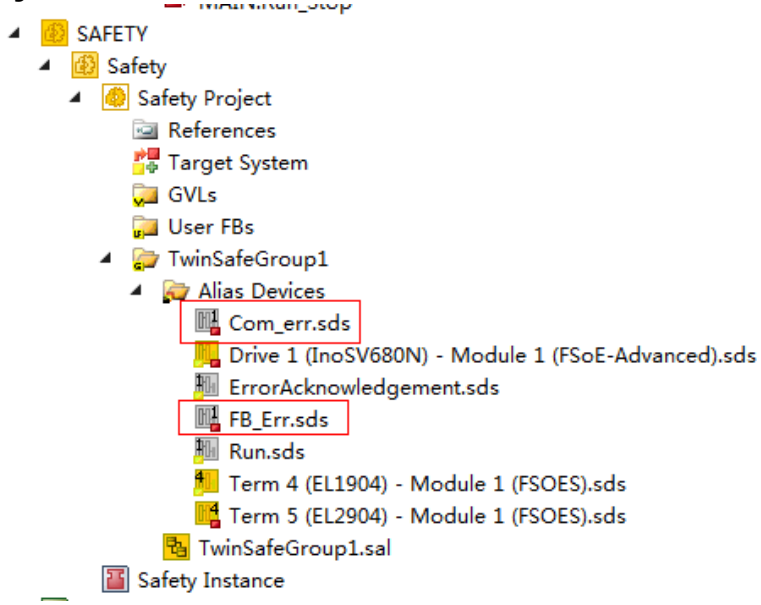
c. Check that two variables are added.



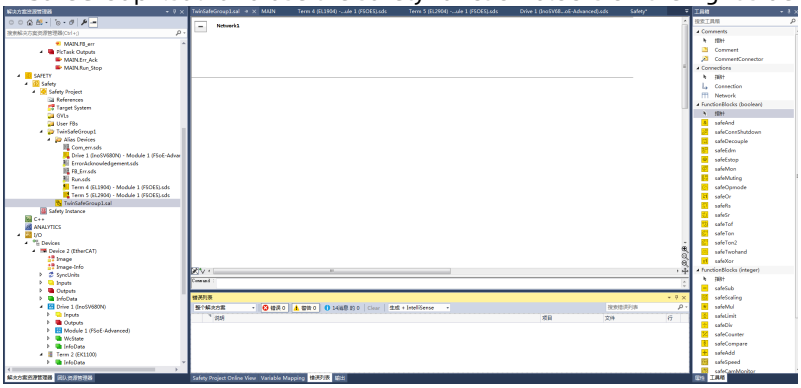
d. Right-click on Standard Out Var 1.sds and select Rename to rename it to Com_err.sds.



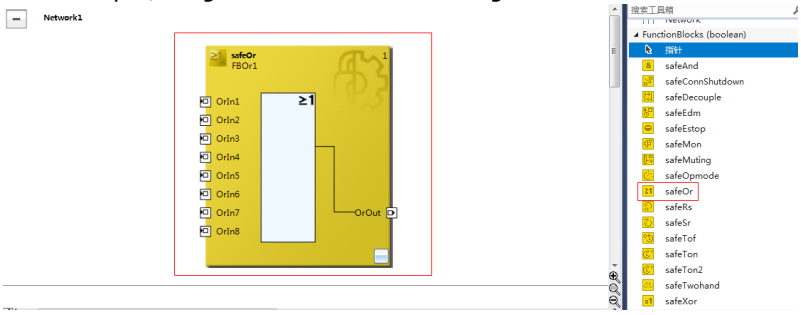
e. Right-click on Standard Out Var 2.sds and select Rename to rename it to "FB_Err.sds".



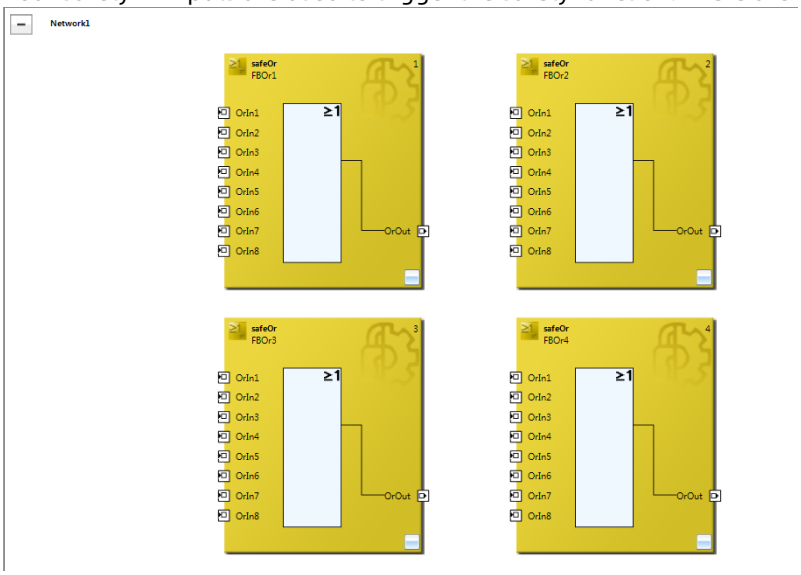
3. Write the safety program.

a. Double click "TwinSafeGroup1.sal" and use the safety function blocks on the right side to write the safety logic. 

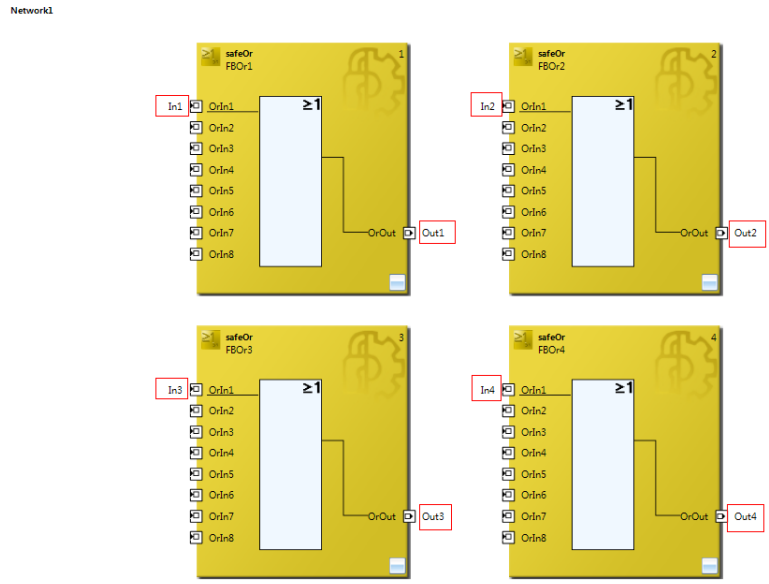
b. For example, drag safeOr block from the right side to Network1.



c. Four safety DI inputs are used to trigger the safety function. There are four safeOr blocks in total.

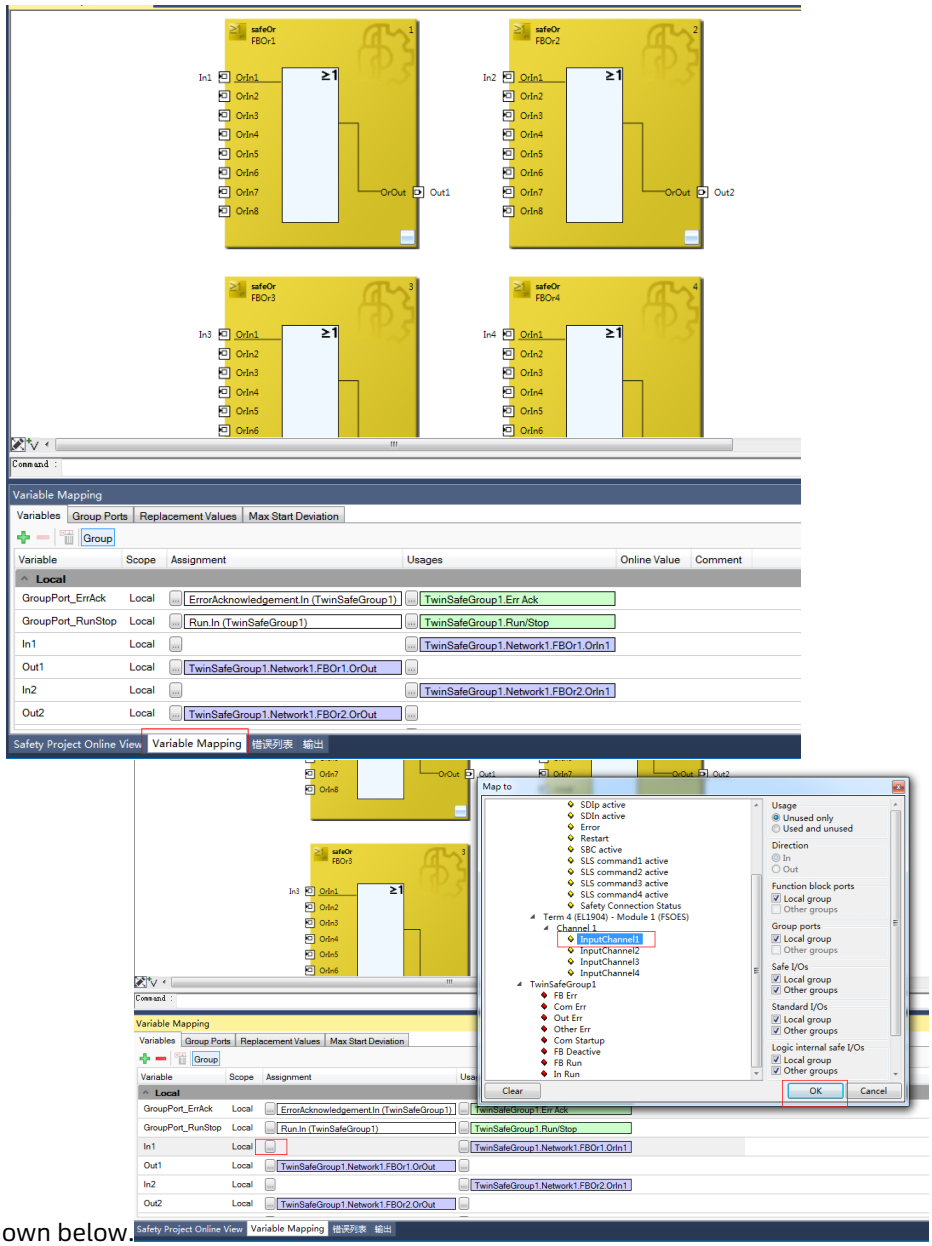


d. Define the pins as needed.



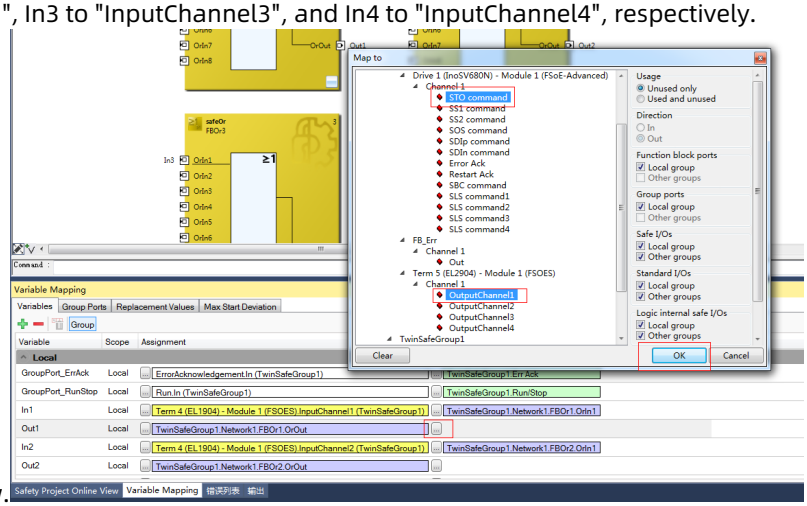
4. Link the safety program to the safety hardware.

a. Find Variable Mapping.



b. Set In1 as shown below.

c. Set In2 to "InputChannel2", In3 to "InputChannel3", and In4 to "InputChannel4", respectively.



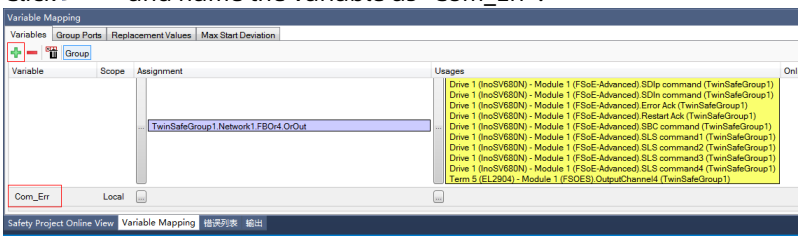
d. Set Out1 as shown below.

Use In1 to control the control word corresponding to STO and Out1 to indicate the state of In1.

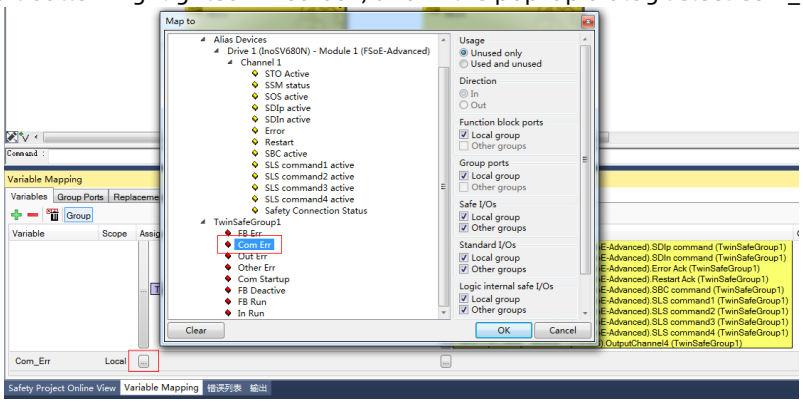
e. Set Out2 to "SS1 command" and "OutputChannel2", Out3 to "SS2 command" and "OutputChannel3", and Out4 to command corresponding to remaining bits of RPDO and "OutputChannel4", respectively.

f. Add two more variables. Follow the steps below to add the first variable.

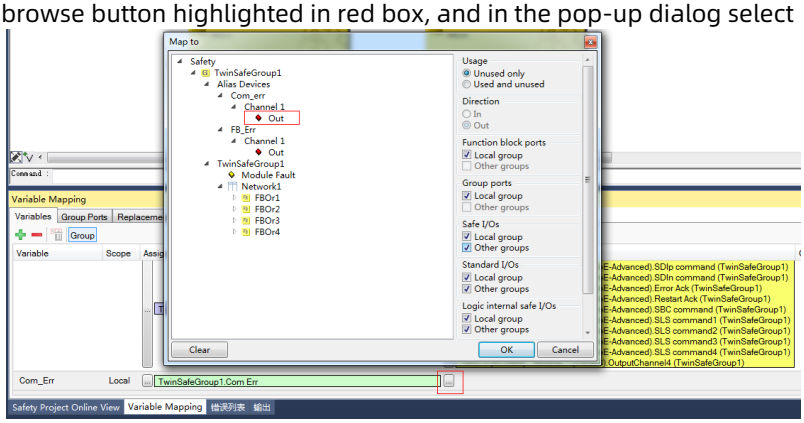
1). Click  and name the variable as "Com_Err".



2). Click the bottom left button highlighted in red box, and in the pop-up dialog select Com_Err and then click OK.

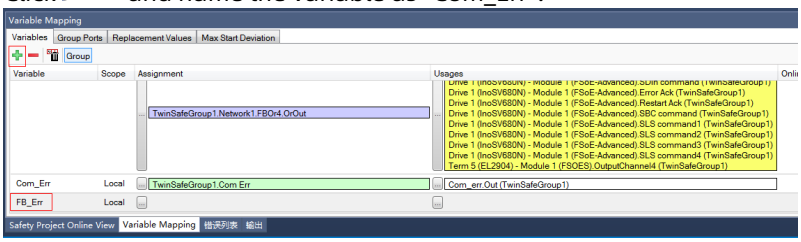


3). Click the bottom right browse button highlighted in red box, and in the pop-up dialog select Out and then click OK.

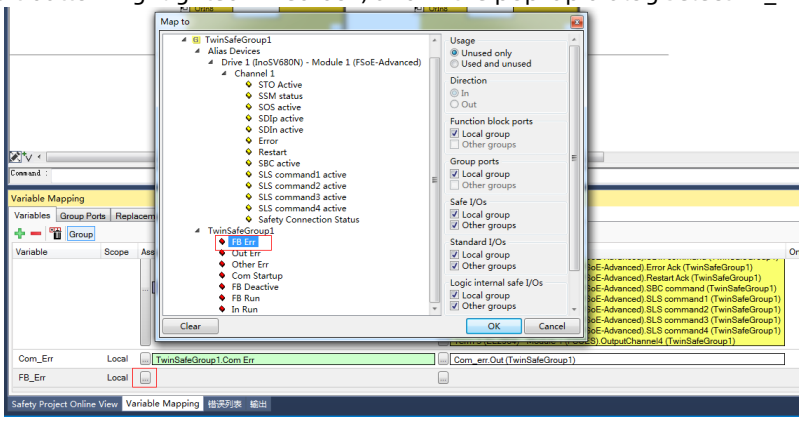


g. Follow the steps below to add the second variable.

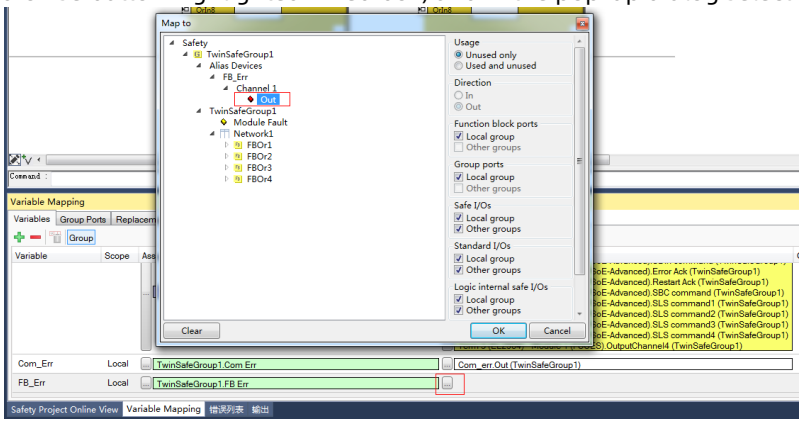
1). Click  and name the variable as "Com_Err".



2). Click the bottom left button highlighted in red box, and in the pop-up dialog select FB_Err and then click OK.

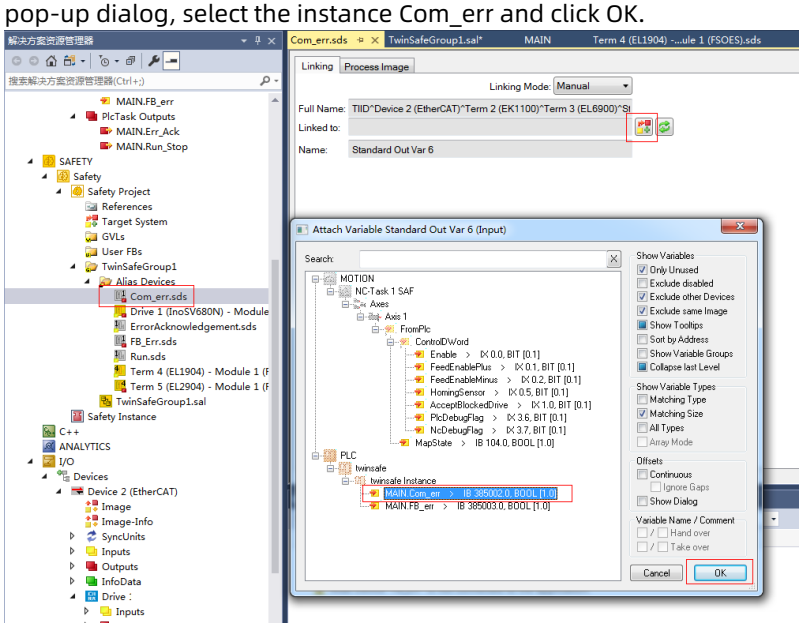


3). Click the bottom right browse button highlighted in red box, and in the pop-up dialog select Out and then click OK.

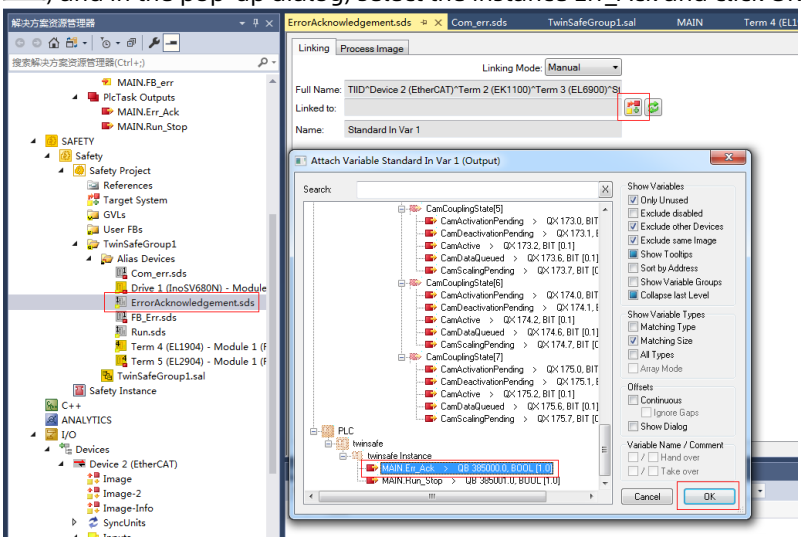


5. Link the non-safety variables added in step 2 to to the variables in the PLC program.

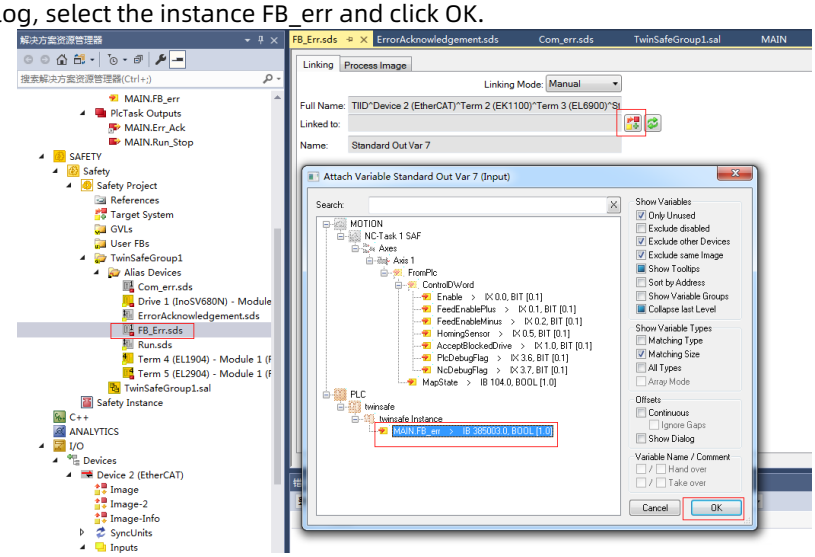
a. On the left side, double-click the variable Com_err.sds. On the right side, click , and in the pop-up dialog, select the instance Com_err and click OK.



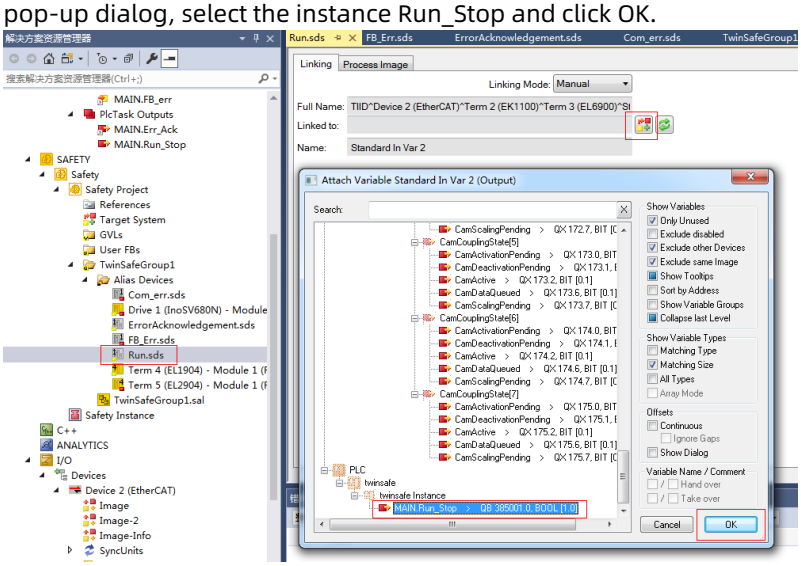
b. On the left side, double-click the variable ErrorAcknowledgement.sds. On the right side, click , and in the pop-up dialog, select the instance Err_Ack and click OK.



c. On the left side, double-click the variable FB_Err.sds. On the right side, click , and in the pop-up dialog, select the instance FB_err and click OK.

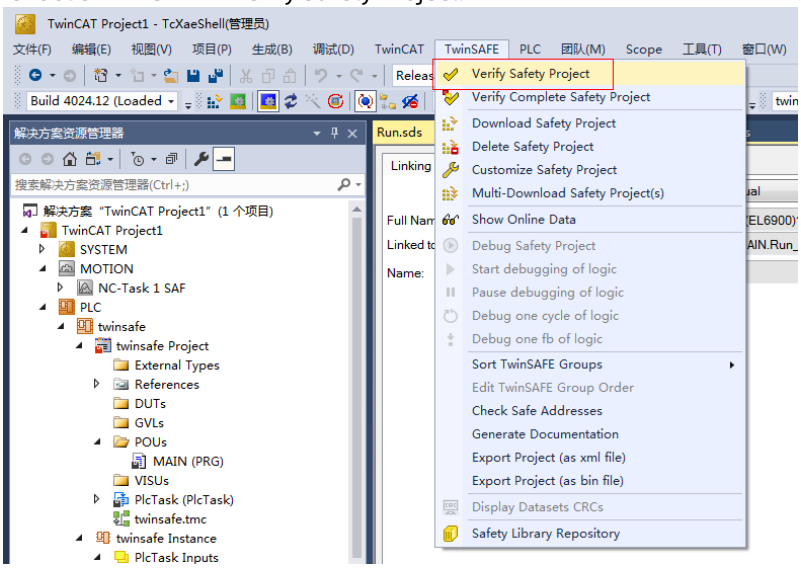


d. On the left side, double-click the variable Run.sds. On the right side, click , and in the pop-up dialog, select the instance Run_Stop and click OK.



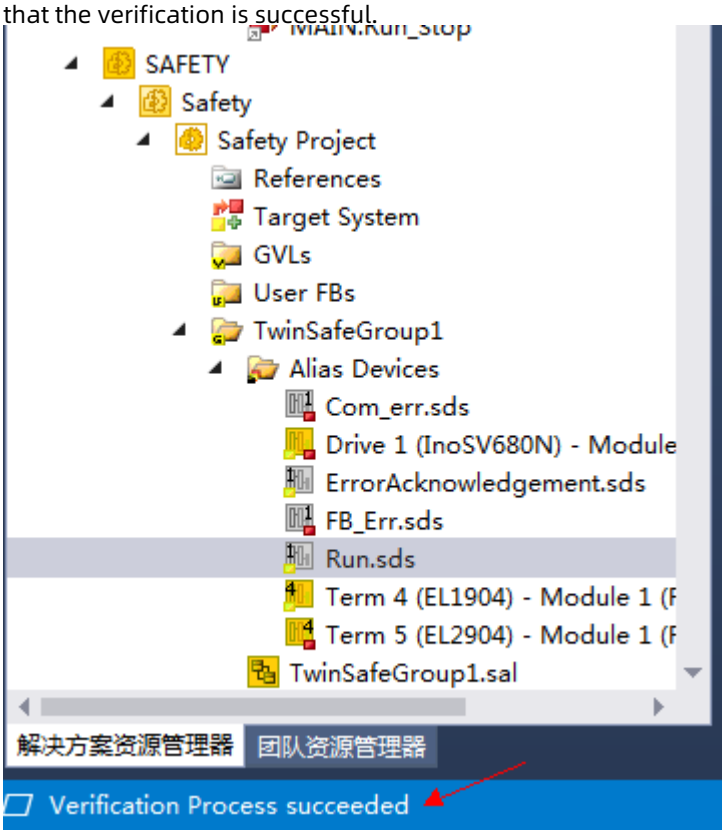
6. Verify the safety logic program.

a. Choose TwinSAFE > Verify Safety Project.



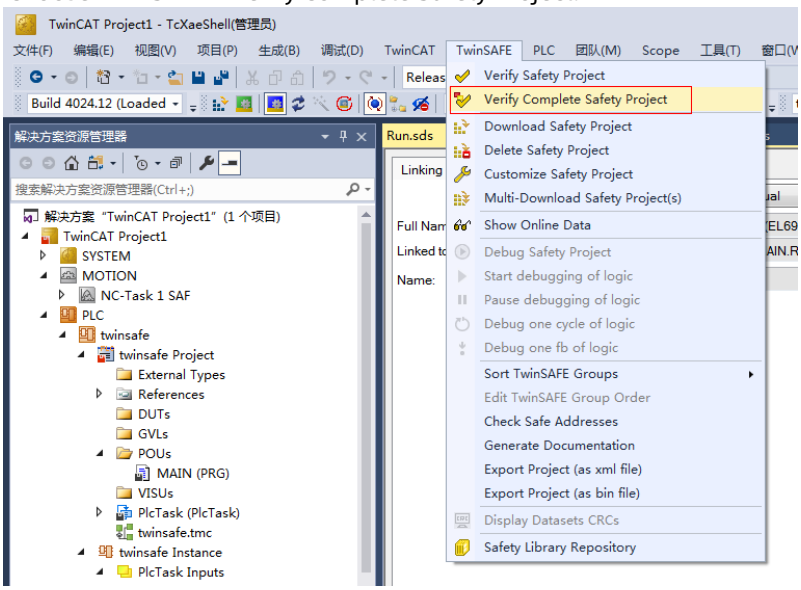
b. After verification is complete, check whether there is an error and whether the message "Verification Process succeeded" appears in the lower left corner. The following figure shows

that the verification is successful.

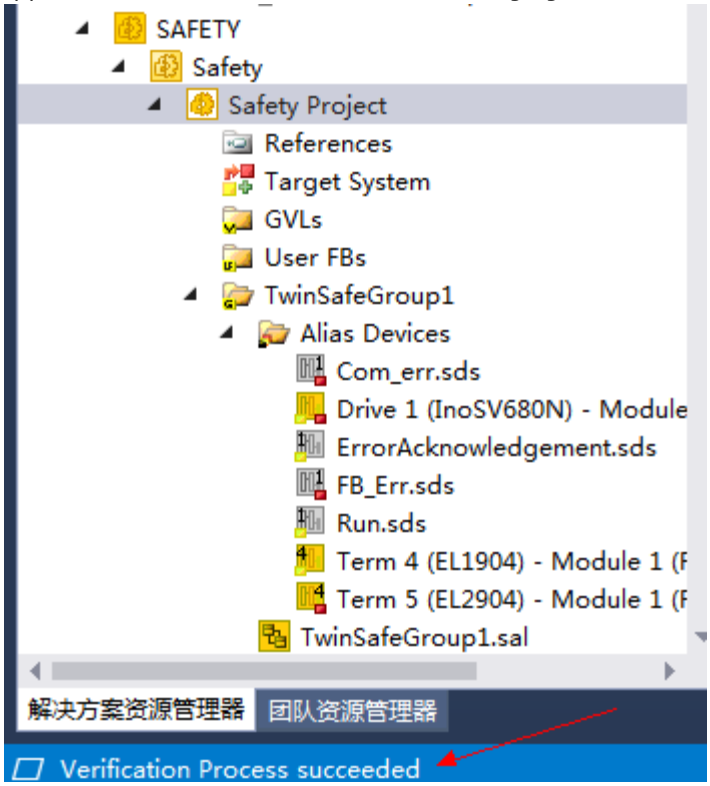


7. Verify the safety logic program and hardware modules.

a. Choose TwinSAFE > Verify Complete Safety Project.

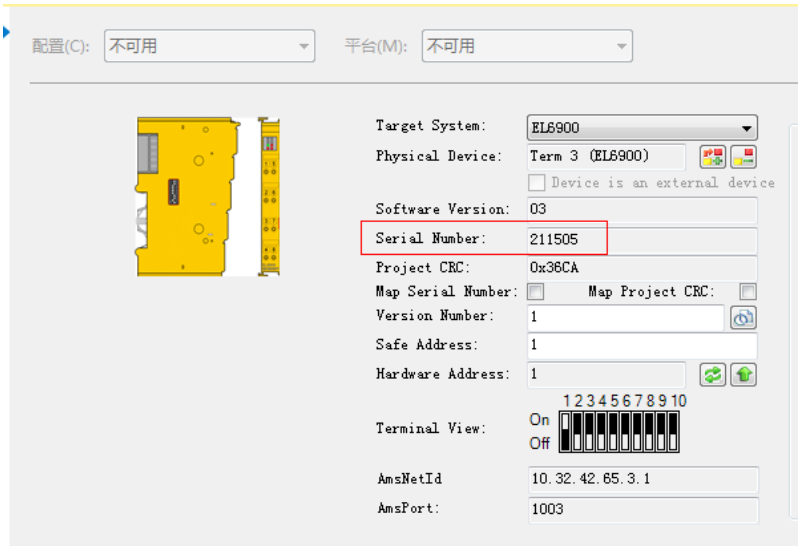


b. After verification is complete, check whether there is an error and whether the message "Verification Process succeeded" appears in the lower left corner. The following figure shows that the verification is successful.

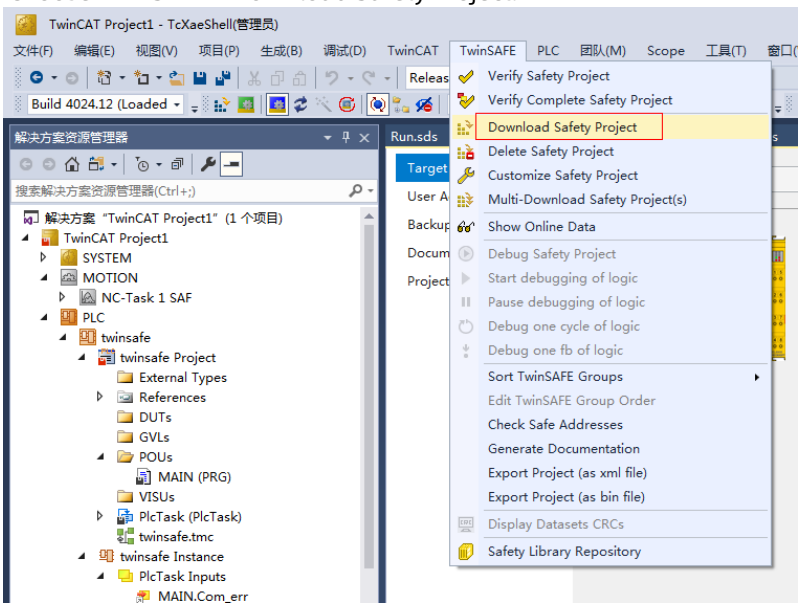


8. Download the safety program.

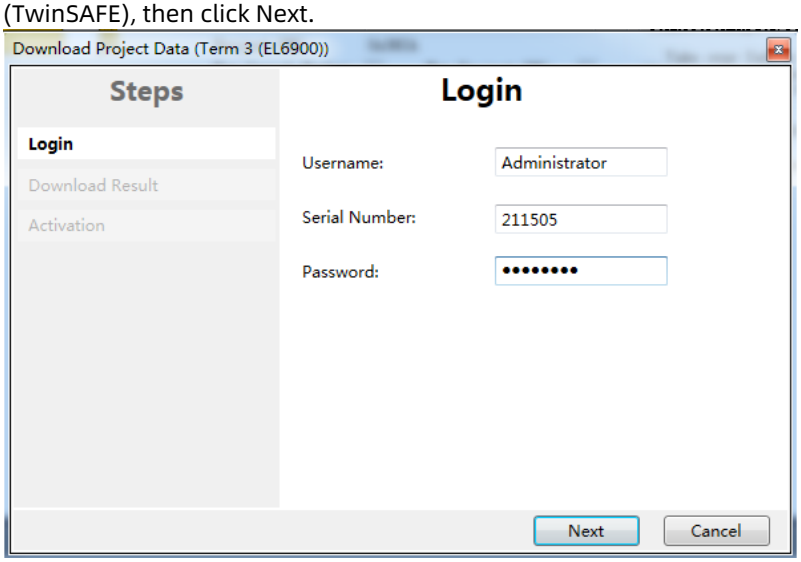
a. Copy the Serial Number "211505".



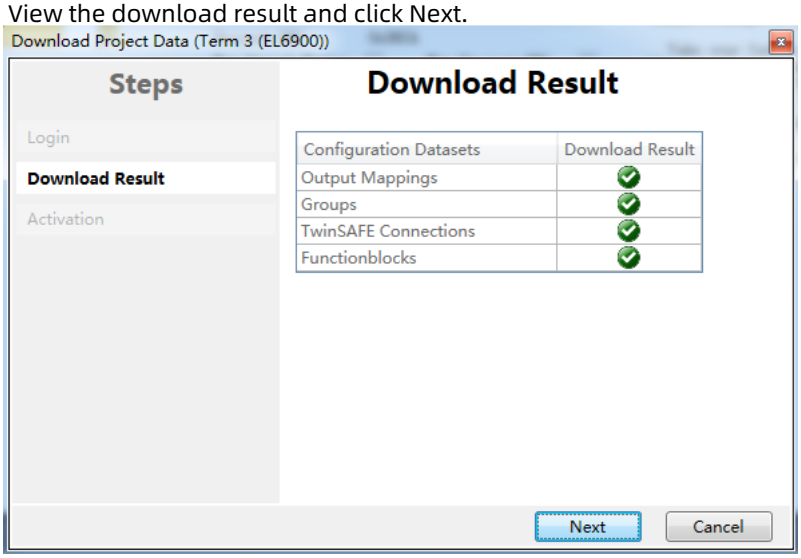
b. Choose TwinSAFE > Download Safety Project.



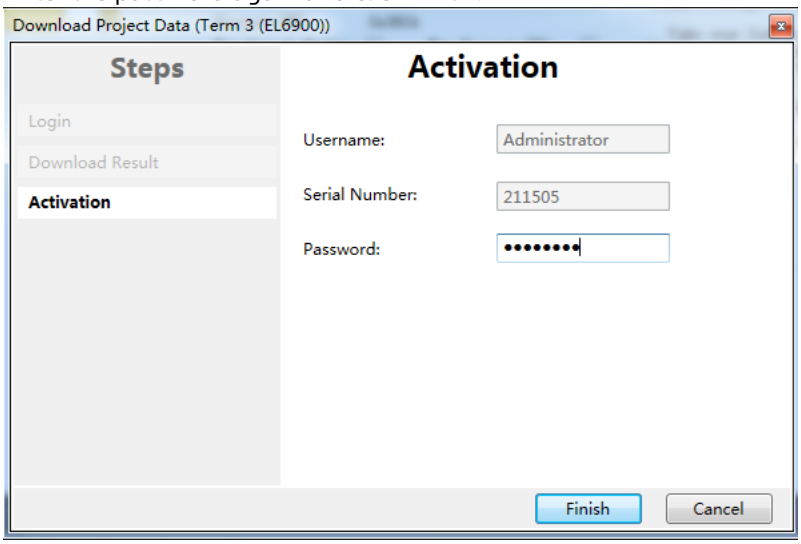
c. In the pop-up dialog, enter the Username (Administrator), Serial Number, and Password (TwinSAFE), then click Next.



d. View the download result and click Next.



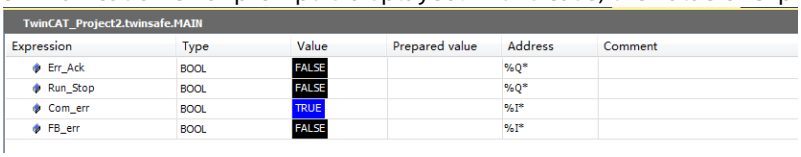
e. Enter the password again and click Finish.



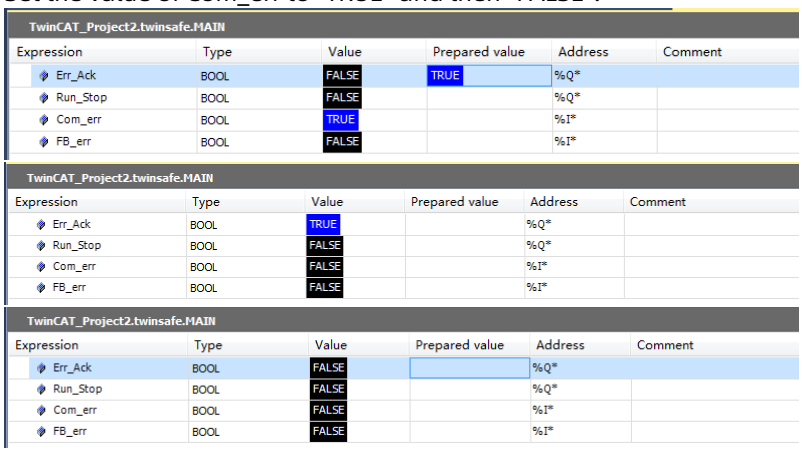
f. After completing all the above configurations, you can activate the hardware configuration and carry out safety function test.

Safety Function Test

1.  Click  to activate the configuration and the controller turns to the running mode.
2. Click  and then  to execute the PLC program.
3. As the safety program is downloaded and run for the first time, the communication is re-established. A communication error prompt is displayed. In this case, the value of expression Com_err is "TRUE".

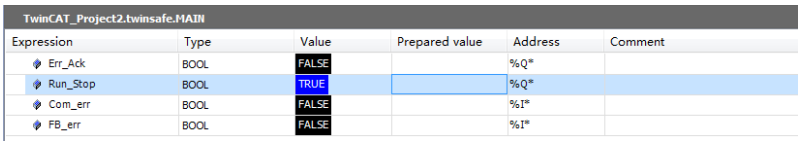


Set the value of Com_err to "TRUE" and then "FALSE".

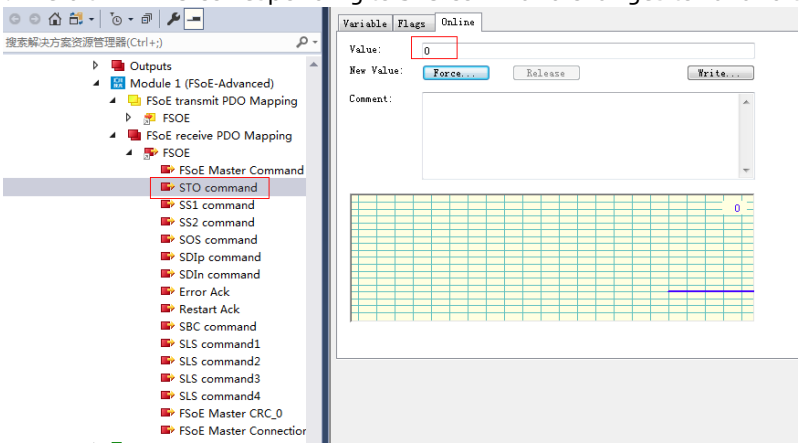


The communication error is cleared.

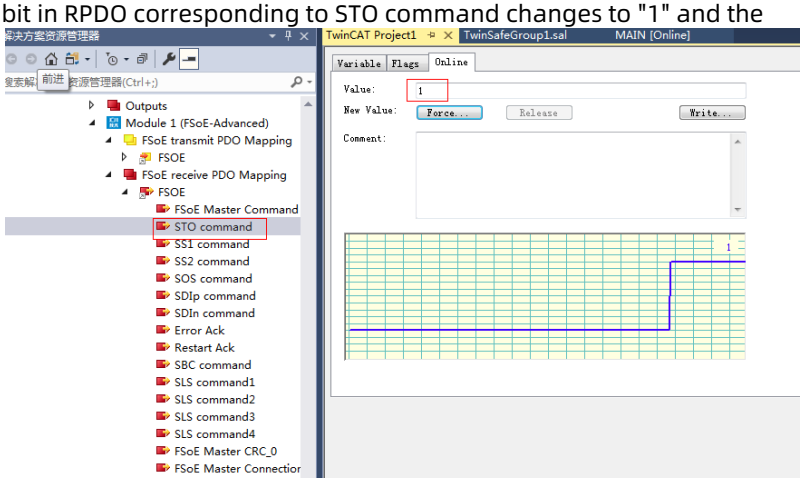
4. Run the safety program and set Run_Stop to "True".



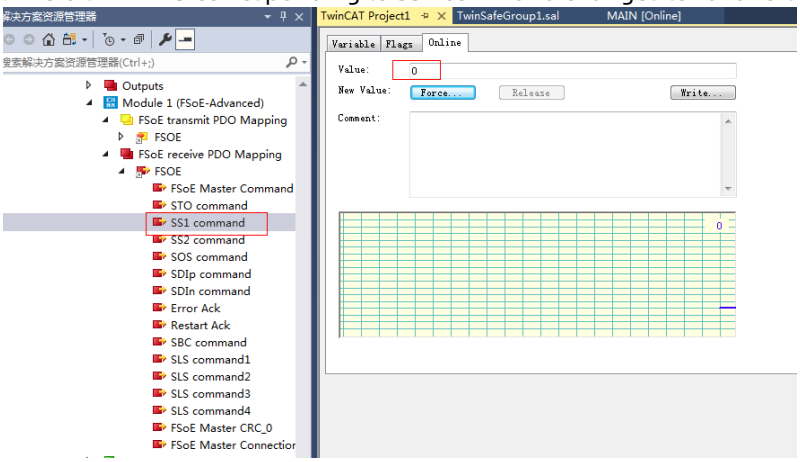
5. Disconnect the safety DI1. The bit in RPDO corresponding to STO command changes to "0" and the STO function is triggered.



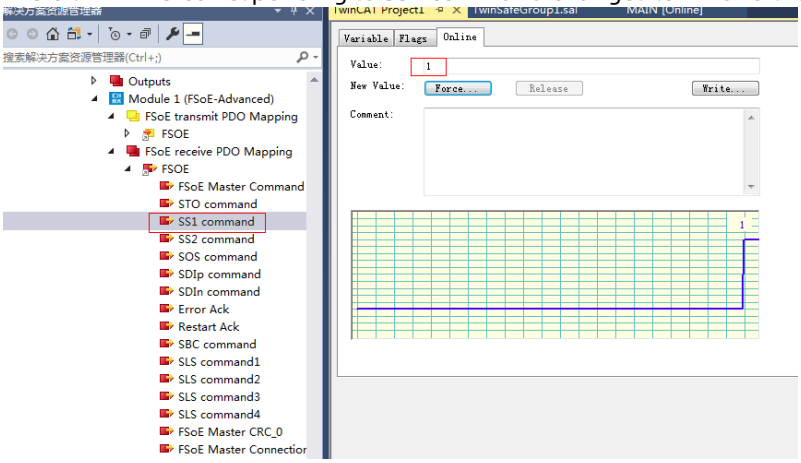
Restore the safety DI1. The bit in RPDO corresponding to STO command changes to "1" and the STO function is deselected.



6. Disconnect the safety DI2. The bit in RPDO corresponding to SS1 command changes to "0" and the SS1 function is triggered.

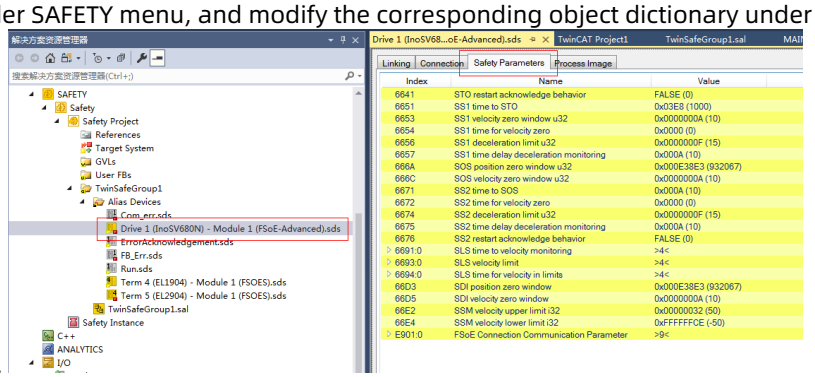


Restore the safety DI2. The bit in RPDO corresponding to SS1 command changes to "1" and the SS1 function is deselected.

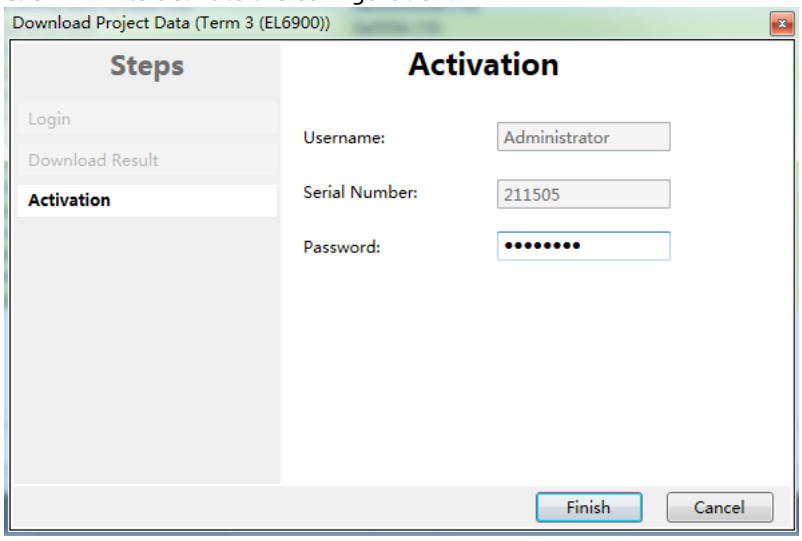


Modifying the Safety Object Dictionary

1. When modifying the safety object dictionary, you need to find the corresponding safety module under SAFETY menu, and modify the corresponding object dictionary under the Safety Parameters tab.



2. After the modification is completed, you need to download the safety program again, and then click  to activate the configuration.



6.16 Safety Module Working with Pilz Safety PLC Unit

The following takes a Pilz safety PLC (PNOZmulti 2) and an AC810 master station as an example to describe how the safety module uses the FSoE mode to trigger safety functions.

Hardware Configuration

Recommended specifications for a Pilz safety PLC include the basic module PNOZ m B1 (772101), the safety bus communication module PNOZ m EF EtherCAT FSoE (772123), and the safety input/output module PNOZ m EF 4DI4DOR (772143), or PNOZ m EF 8DI4DOR (772142). Combine the safety bus communication module, the basic module and the safety digital input/output module from left to right, as shown in *"Figure 6-18 Pilz safety PLC module combination" on page 367*. The FSoE module and the basic module need to be connected to a 24V power supply.

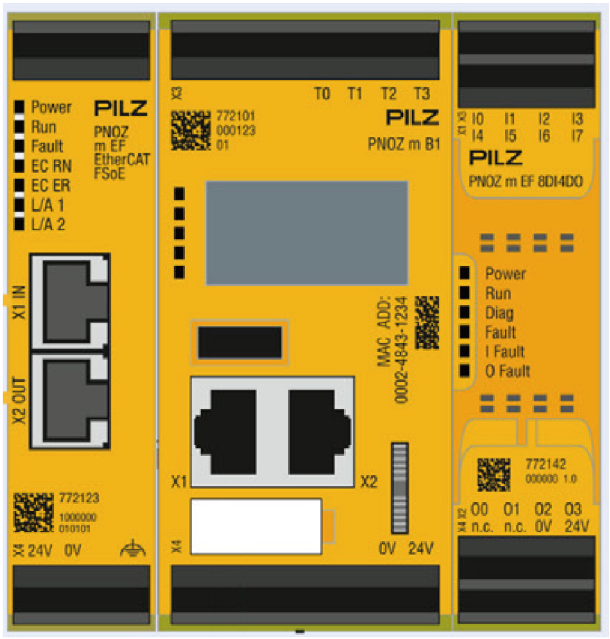


Figure 6-18 Pilz safety PLC module combination

Programming and downloading

Before using the Pilz Safety PLC to connect the host computer to the servo drive, you need to use PNOZmulti Configurator to write the user program in the PLC. The PNOZmulti Configurator software can be obtained on the PILZ official website. When configuring PNOZmulti 2, ensure the software version is 11.0 or above.

The following takes the combination of PNOZ m EF EtherCAT FSoE + PNOZ m B1 + PNOZ m EF 4DI4DOR as an example to detail how the user program is downloaded into the Pilz safety PLC.

1. Create a project

   a. Use a network cable to connect the X1 interface of the basic module (PNOZ m B1) to the computer network port.

   b. Open PNOZmulti Configurator. The New Project window displays by default, as shown in *"Figure 6-19 Default interface of PNOZmulti Configurator" on page 368*.

c. Under the Hardware Configuration window, you can select the basic unit to be used in the "Module" column on the left. After you select the basic unit, the software displays other compatible expansion modules (for example, the connection module and relay output module). Double-click the PNOZ m B1 basic unit, and the configured hardware will be displayed on the right side of the "Modules" column.

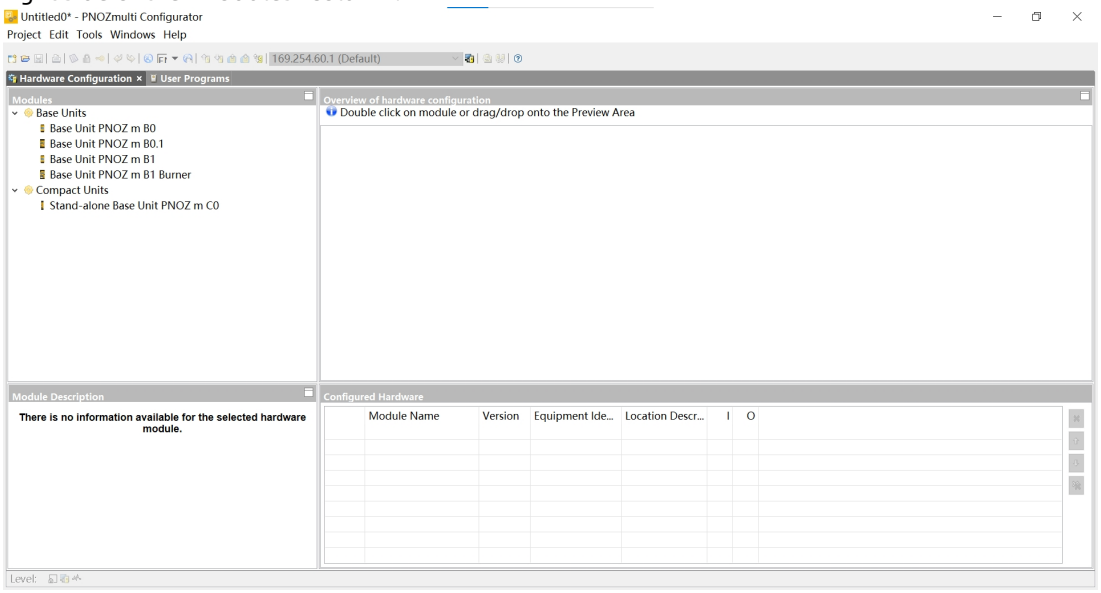


Figure 6-19 Default interface of PNOZmulti Configurator

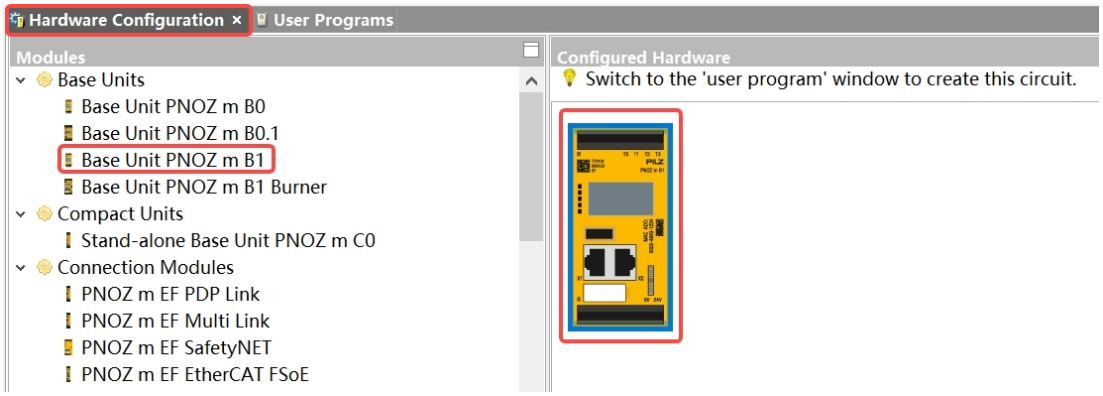


Figure 6-20 Selecting basic unit

d. Find the relay output module in the "Modules" column and double-click PNOZ m EF 4DIDOR

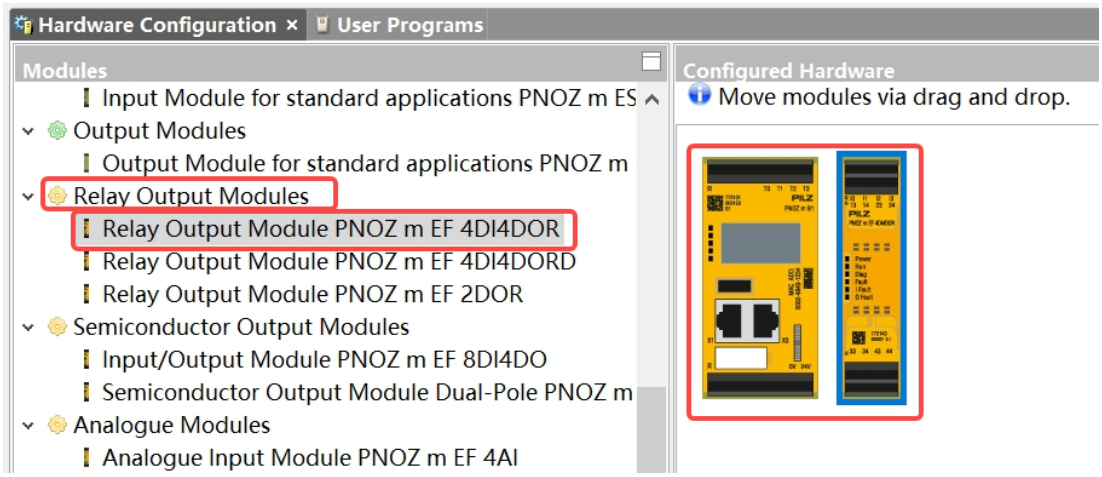


Figure 6-21 Selecting the safety input/output module

e. Find the connection module in the "Modules" column, and double-click PNOZ m EF EtherCAT FSoE. When the module is selected, the EtherCAT/FSoE window is displayed above the interface.

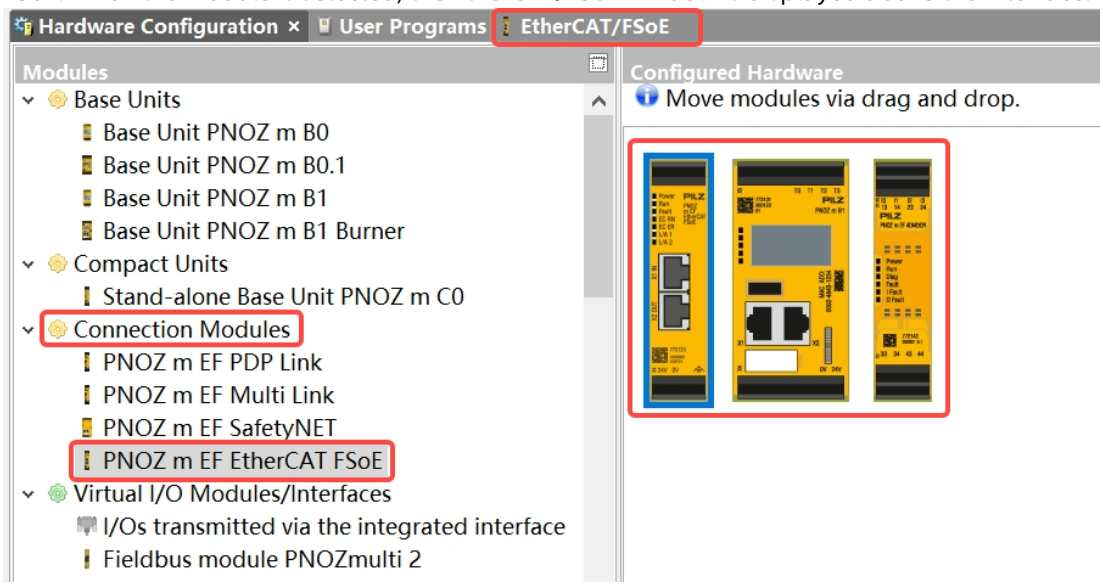


Figure 6-22 Selecting the safety bus communication module

f. To facilitate user program writing, it is recommended to modify the device ID in the configured hardware list at the bottom of the interface, as shown in *"Figure 6-23 Default device ID" on page 370* and *"Figure 6-24 Modify device ID" on page 370*.

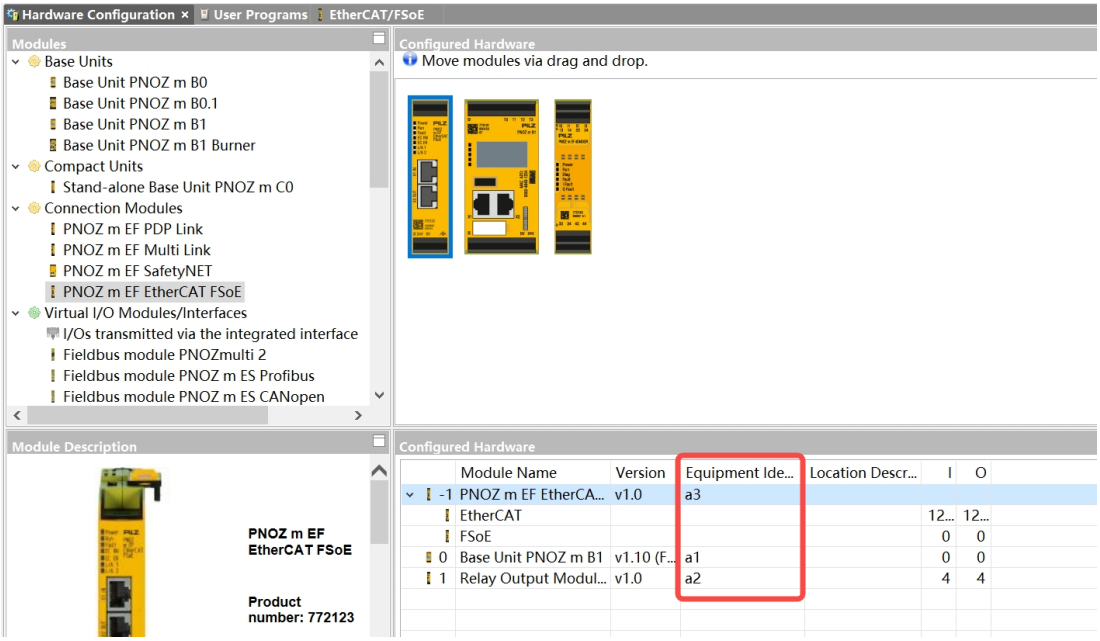


Figure 6-23 Default device ID

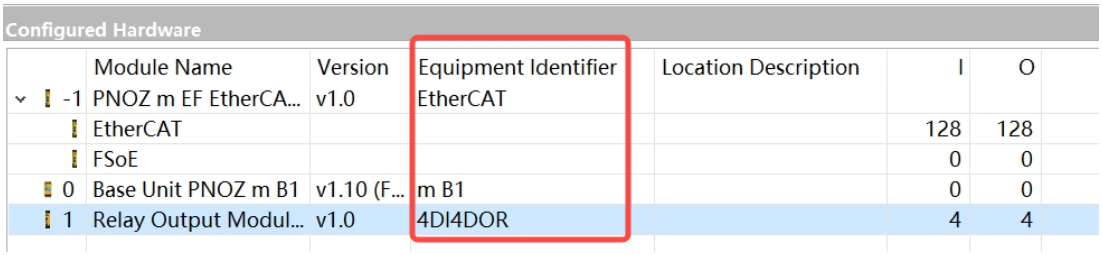


Figure 6-24 Modify device ID

g. After modifying the device ID, click the button at the top left of the interface to save the project.

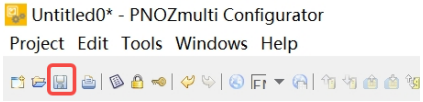


Figure 6-25 Saving the project

h. After clicking the Save Project button, the system will pop up the Set Password window. The level 1 password has the highest permissions, which can read and write projects. The level 2 password has the lowest permissions, which can only read projects. The level 3 password can read projects and make limited modifications. Set the three passwords and press the OK button to save them. You must set a different password for each level before you can save the project. Keep the passwords carefully. If you forget your password, it cannot be retrieved, and the software does not provide an option to restore factory settings or any super password/ administrator password. You can only reproduce a brand-new project according to the original project.

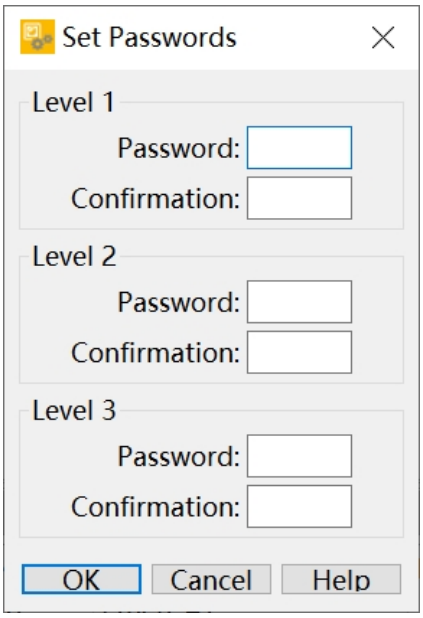


Figure 6-26 Setting the password

i. Set the project name and select the save path, and click the OK button to save.

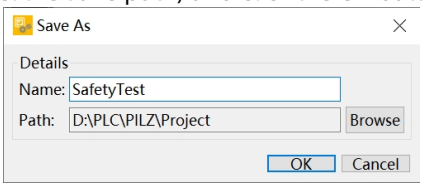


Figure 6-27 Setting the project name

2. Configure slave information

a. Tools-> EtherCAT/FSoE-> Import ESI file(s) to import the corresponding xml file.

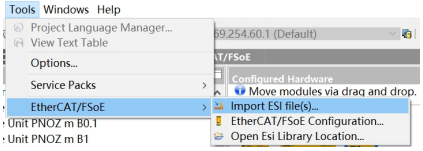


Figure 6-28 Importing the ESI file

b. Click the EtherCAT/FSoE window directly from the main interface, or click **Tools** -> **EtherCAT/FSoE** -> **EtherCAT/FSoE Configuration**, expand **Inovance** in the **EtherCAT/FSoE** column on the right, and double-click SV680S1Axis_02002.

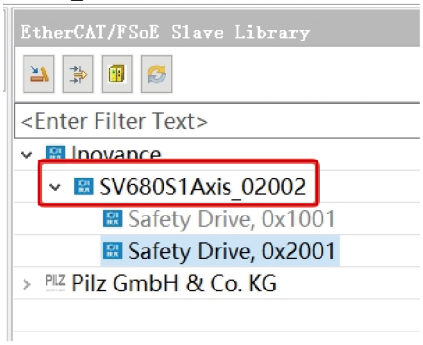


Figure 6-29 Establish master-slave module connection

c. Double click SV680S1Axis_02002, and the interface will automatically generate a Slot 1, and the system will automatically load the module of type FSoE-noSRA. Modify the FSoE slave address of Slot 1 to match the FSoE slave address configured by the two knobs on the safety module.

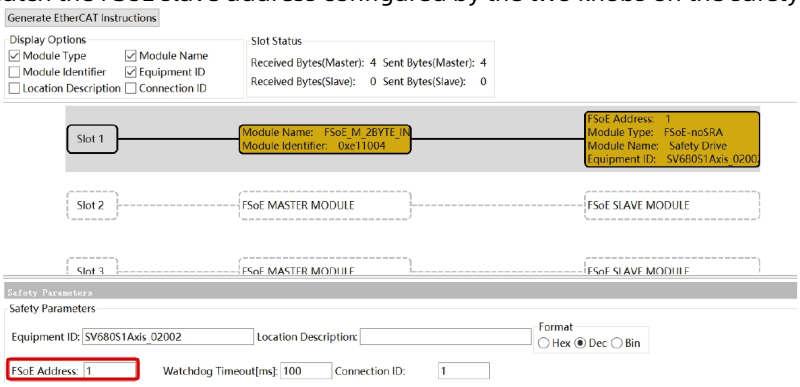


Figure 6-30 Modify FSoE slave address

3. Write a program

Note: Only the STO function is configured in the example. If you need to use other safety functions, you can configure them in the same way. The maximum number of functions that can be configured depends on the number of DIs/DOs in the safety input/output module.

a. Switch to the user program interface and double-click the page under **User Program**

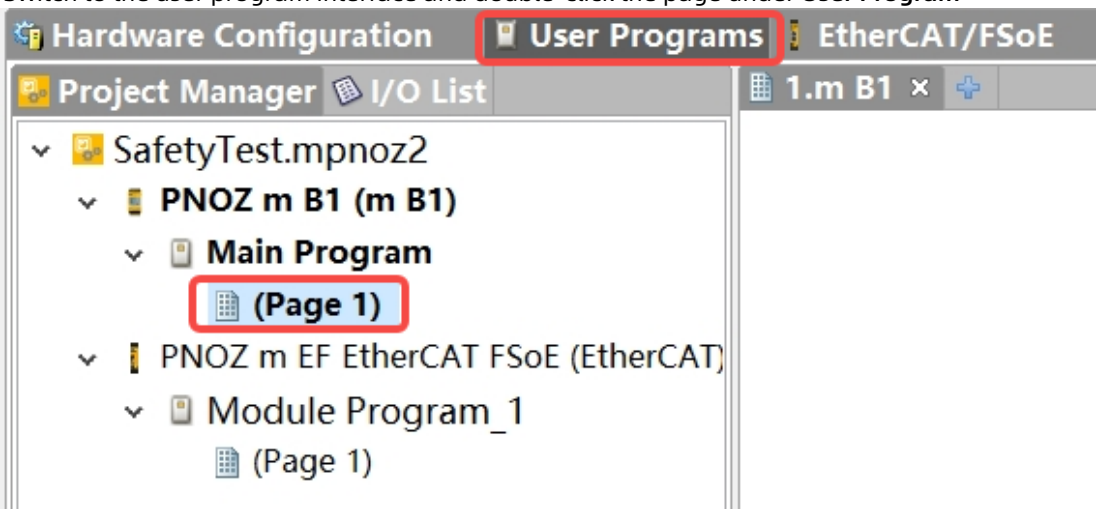


Figure 6-31 Selecting the user program

b. Drag the emergency stop button function block into the leftmost blank rectangular slot, and select the switch type, device ID, and input/output ports, as shown in *"Figure 6-32 Configuring the input switch" on page 373*. Click the OK button at the bottom of the window to complete the setup.

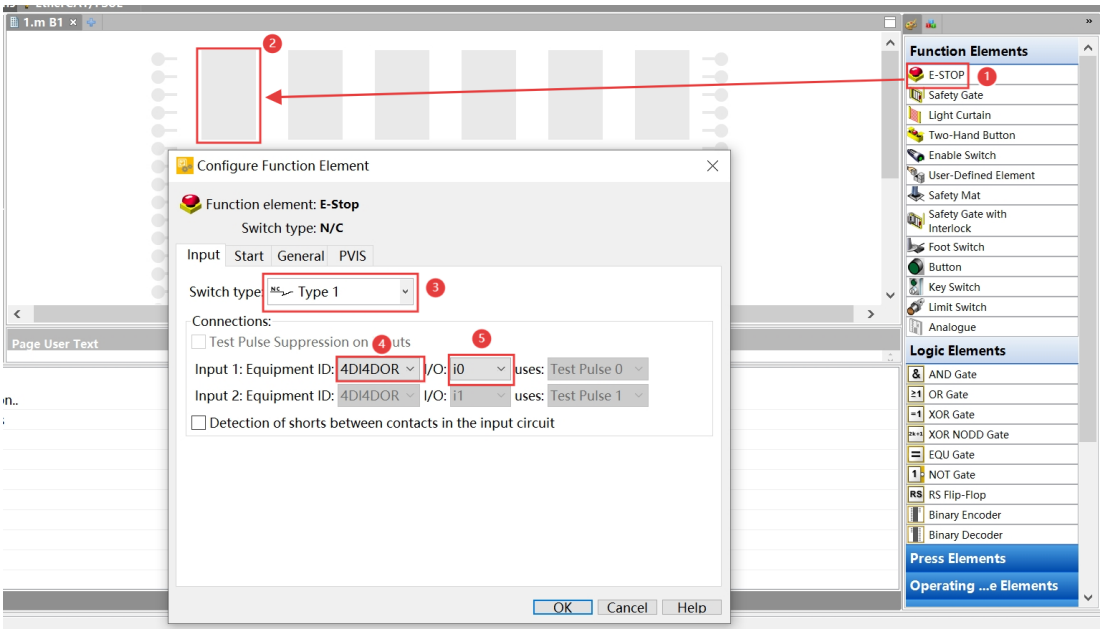


Figure 6-32 Configuring the input switch

c. Double-click the module program page in the project manager, drag the semiconductor output block into the rightmost blank rectangular slot, and select the output quantity and output connection, as shown in *"Figure 6-33 Configuring semiconductor output" on page 373*. The output device ID is 1_SV680S1Axis_02002, then select the safety function command to be configured, and click the OK button at the bottom of the window to complete the setting.

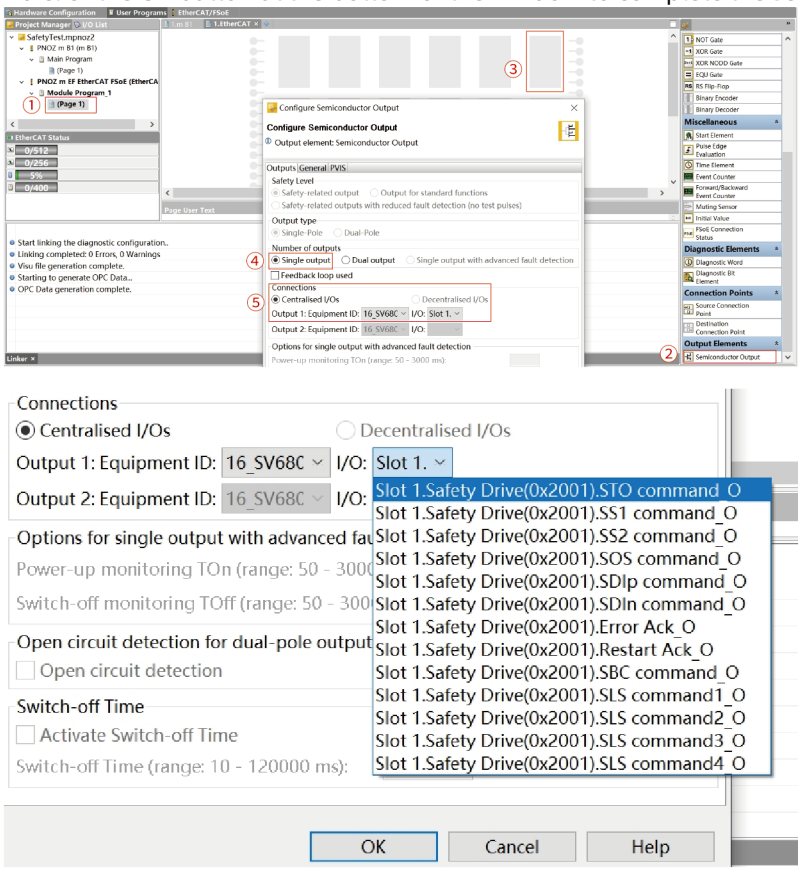


Figure 6-33 Configuring semiconductor output

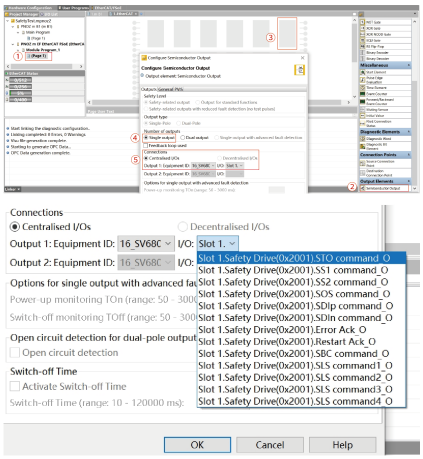


Figure 6-34 Safety function command selection

d. Click the rightmost blank circular slot, select **Program Connector-I/O** in the pop-up Activate Input/Output window, and configure the input/output port to i0. Click the **OK** button at the bottom of the window to complete the setting.

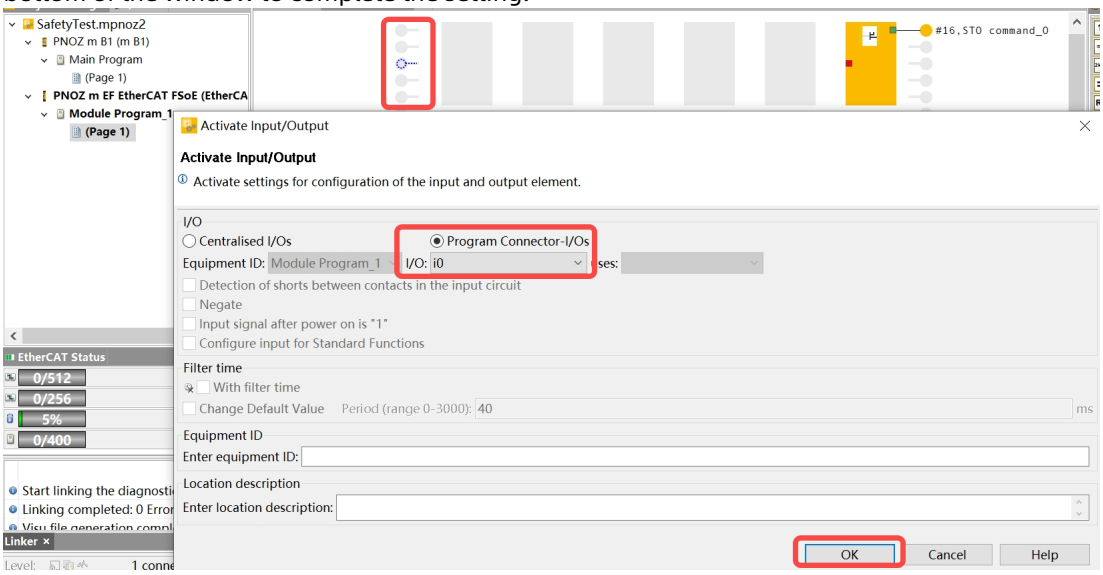


Figure 6-35 Configuring FSoE input

e. Connect i0 to semiconductor output



Figure 6-36 Connecting FSoE input and output

f. Switch to the user program page, double-click the rightmost blank circular slot, and select **Program connector-I/O** in the pop-up Activate Input/output window, select module program_1 for the device ID, and configure the input/output port to i0. Click the **OK** button at the bottom of the window to complete the setting.

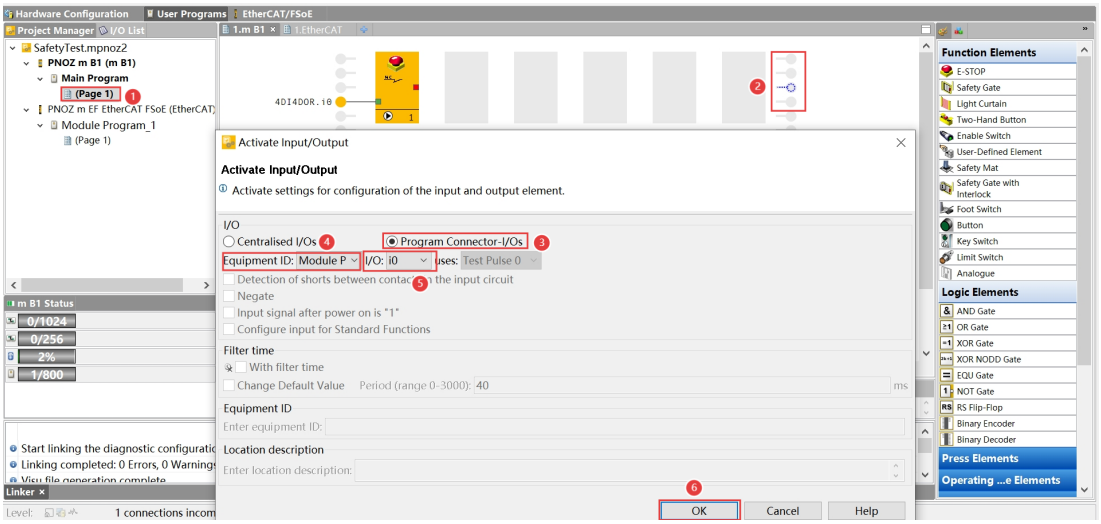


Figure 6-37 Configuring emergency stop button connection point

g. Connect the emergency stop button with i0



Figure 6-38 Connecting the emergency stop button with i0

h. Under the user program page, continue to drag the relay output block into the rightmost blank rectangular slot, and select **Unipolar output** for output quantity, **4DI4DOR** for the output device ID, and **o0** for the input/output.

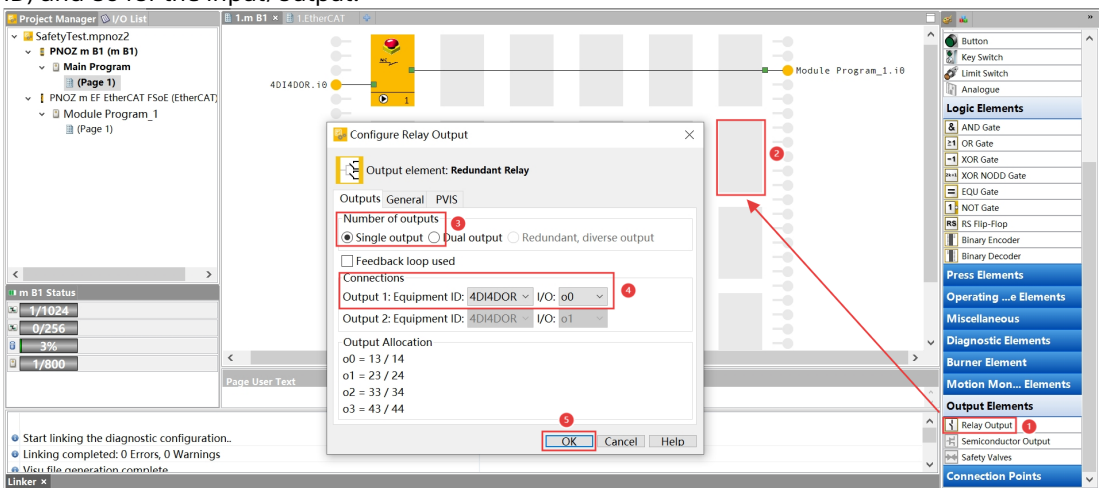


Figure 6-39 Configuring the relay output switch

i. Switch to the module program page, drag the emergency stop button function block into the leftmost rectangular blank slot, select the switch type as Type 1, and Device ID as 1_SV680S1Axis_02002, as shown in *"Figure 6-40 Configuring FSoE output" on page 376*. Select the safety function output status corresponding to step c for the "Input/output", and click the **OK** button at the bottom of the window to complete the setting. See *"Figure 6-41 Selecting the safety function status" on page 376*.

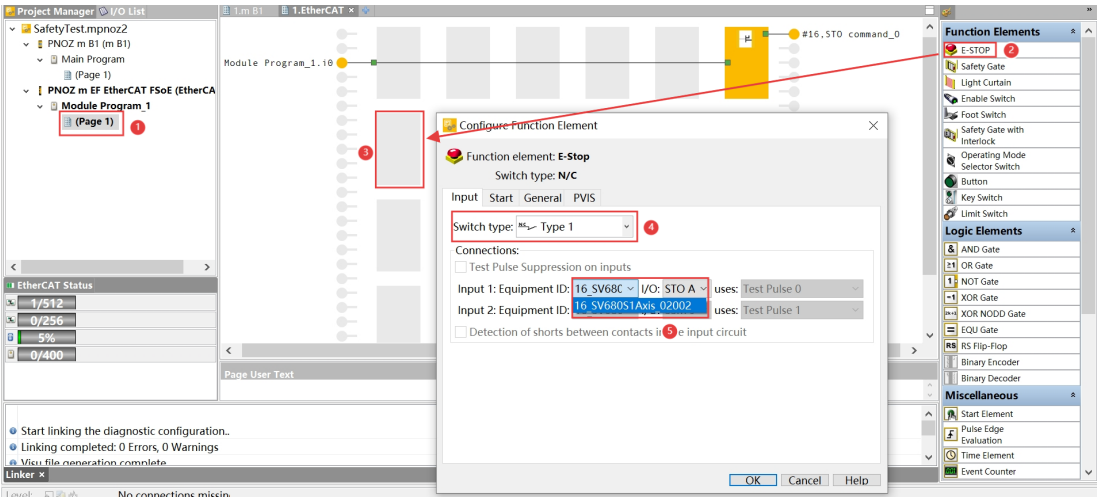


Figure 6-40 Configuring FSoE output

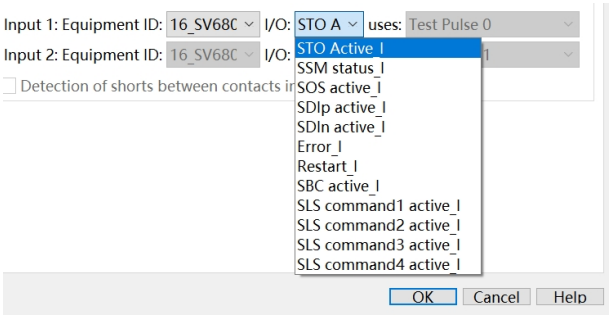


Figure 6-41 Selecting the safety function status

j. Double-click the rightmost blank circular slot, select **Program Connector-I/O** in the pop-up Activate Input/Output window, and configure the input/output port to o0. Click the **OK** button at the bottom of the window to complete the setting.

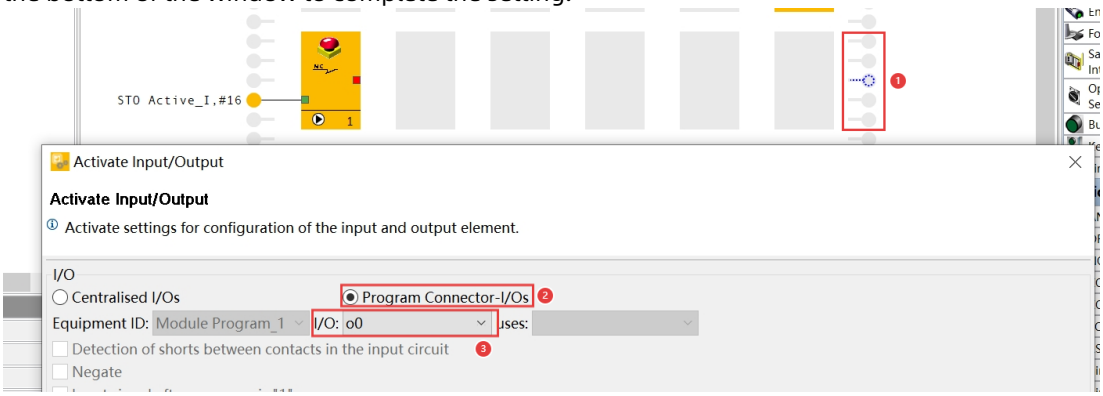


Figure 6-42 Configuring FSoE output connection point

k. Connecting the emergency stop button with o0

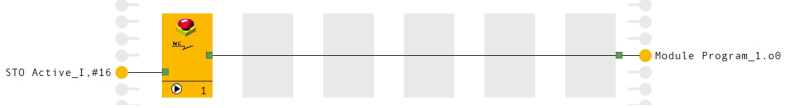


Figure 6-43 Connecting the emergency stop button with o0

l. Switch to the user program page, double-click the leftmost blank circular slot, and select **Program connector-I/O** in the pop-up Activate Input/output window, select module program_1

for the device ID, and configure the input/output port to o0. Click the **OK** button at the bottom of the window to complete the setting.

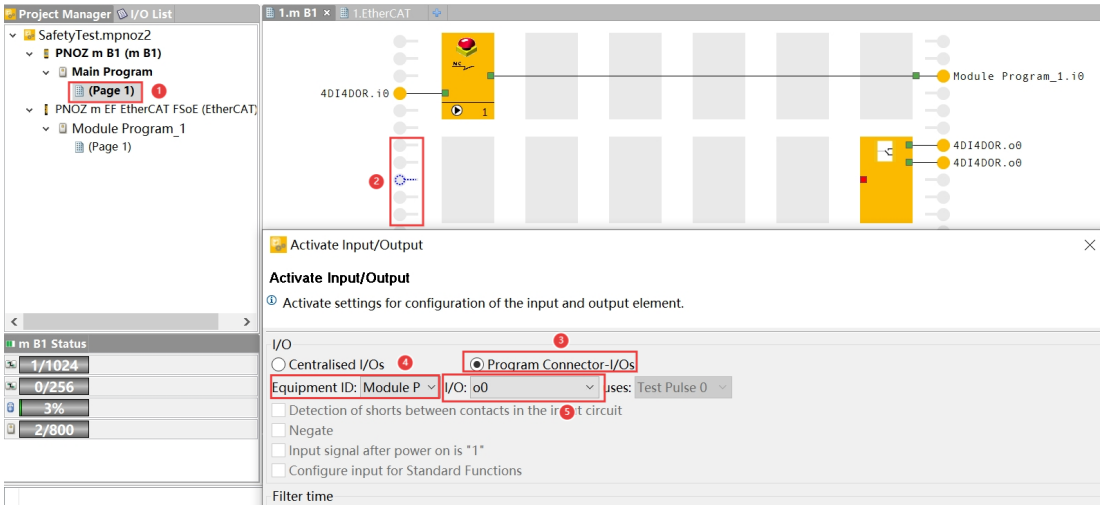


Figure 6-44 Configuring relay output connection point

m. Connect o0 to relay output switch



Figure 6-45 Connecting o0 to relay output switch

n. Click  on the top left of the interface to save the program. After connection is successful, the relevant information will be displayed at the bottom of the interface.

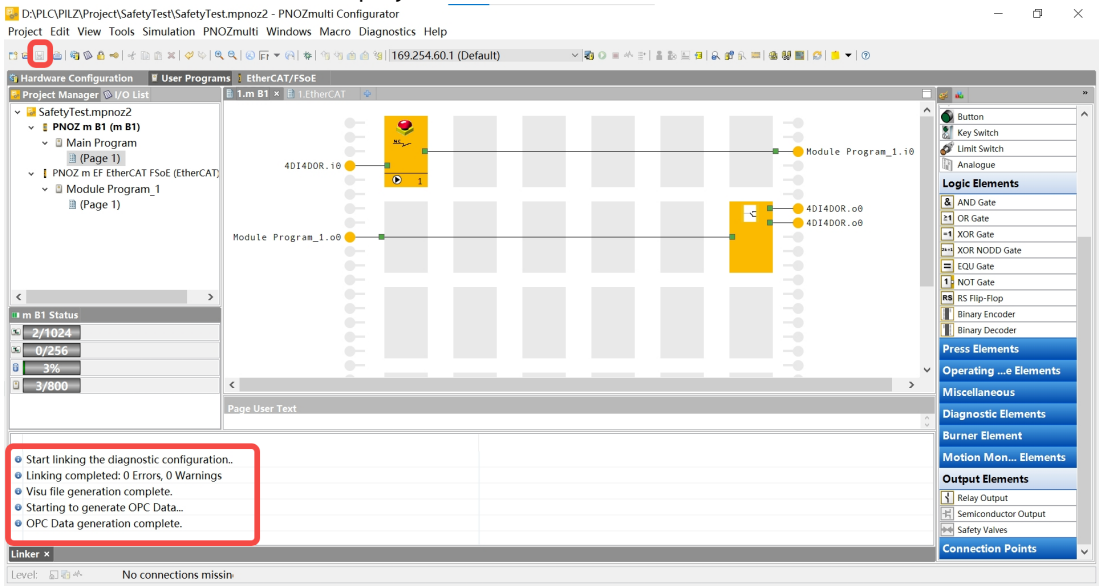


Figure 6-46 Saving the program

4. Program download

a. In the PNOZ m B1 module, there is a scroll wheel at the bottom right of the display for switching the menu items. Slide the wheel up and down to select Ethernet in the menu, and finally press the wheel to confirm the selection.



Figure 6-47 Selecting menu items

b. Select **Info** in the Ethernet interface to view the IP address and subnet mask of the PLC, as shown in *"Figure 6-48 Ethernet -> Info" on page 378* and *"Figure 6-49 IP address and subnet mask" on page 378*.



Figure 6-48 Ethernet -> Info



Figure 6-49 IP address and subnet mask

c. Click **Add Ethernet Connection** in the toolbar of PNOZmulti Configurator, set the IP address to the PLC internal IP address obtained in step b, and click the **OK** button at the bottom of the window to complete the setting.

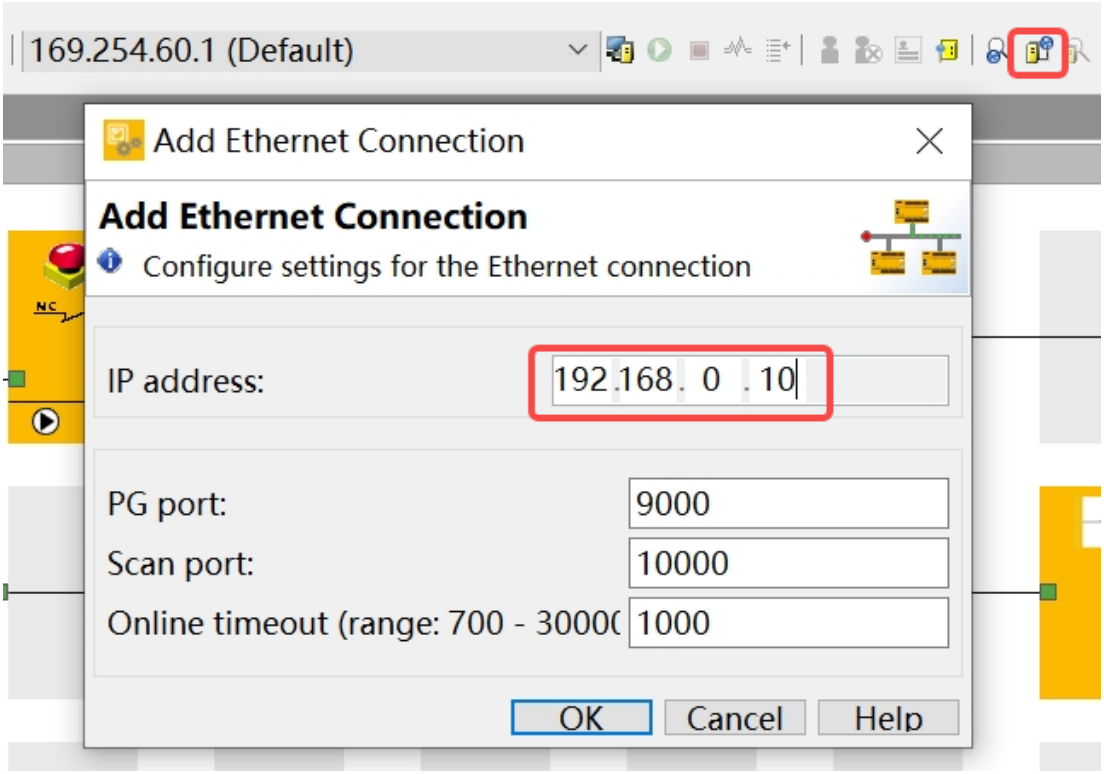


Figure 6-50 Adding an Ethernet connection

d. Set the IPv4 address of the computer to be on the same network segment as the Pilz safety PLC.

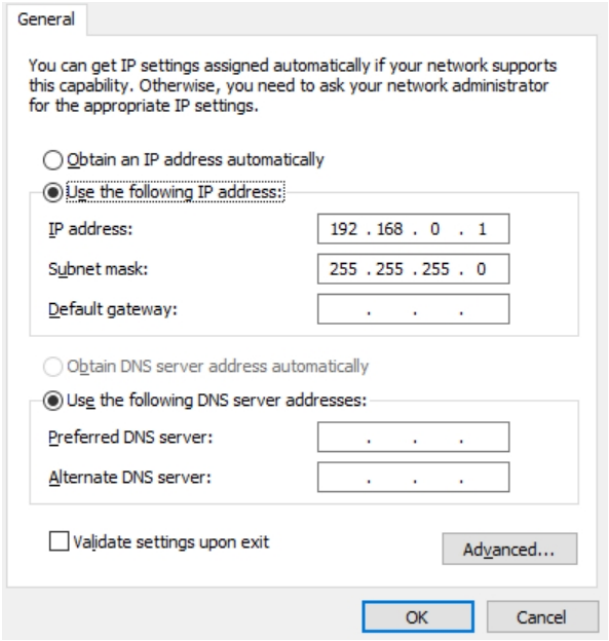


Figure 6-51 Configuring computer network segment

e. In the toolbar, click the  button to establish an online connection. If the network cable is connected correctly (X1 and computer network port), but the PLC still cannot be connected after

the IP address is configured, restart the computer and try the steps in "4. Program Download" again.

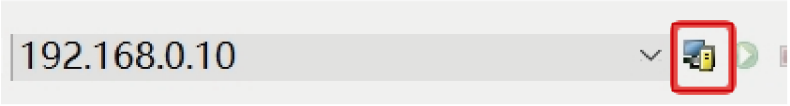


Figure 6-52 Establishing an online connection

f. In the menu of the safety PLC, select **Device Info** (*"Figure 6-53 Selecting "Device info"" on page 380*) and press the scroll wheel to confirm, and then press it again when the interface as shown in *"Figure 6-53 Selecting "Device info"" on page 380* appears. The order number and serial number of the base unit device ID will show (*"Figure 6-55 Displaying the information of the base unit" on page 381*)



Figure 6-53 Selecting "Device info"

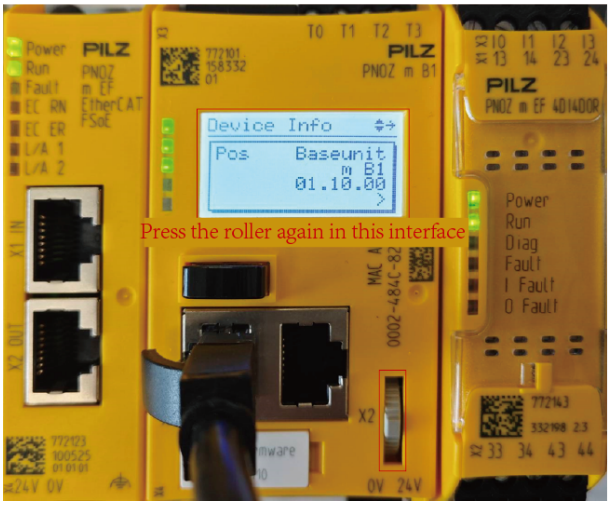


Figure 6-54 Enter the Device Info interface

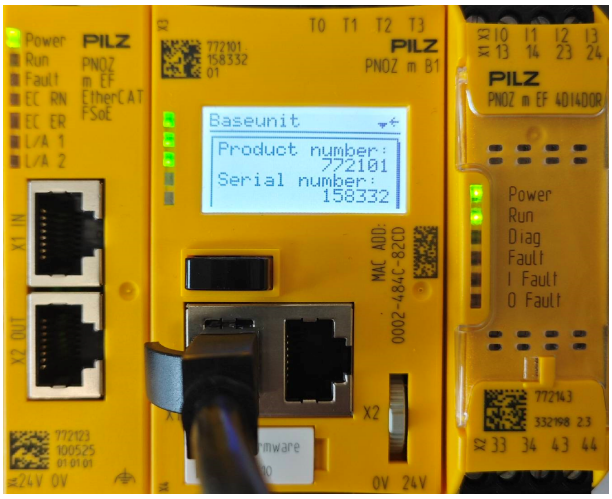


Figure 6-55 Displaying the information of the base unit

g. Click  button to open the project manager, enter the order number and serial number obtained in step f in the safety window interface, and click **OK** to enter the next page.

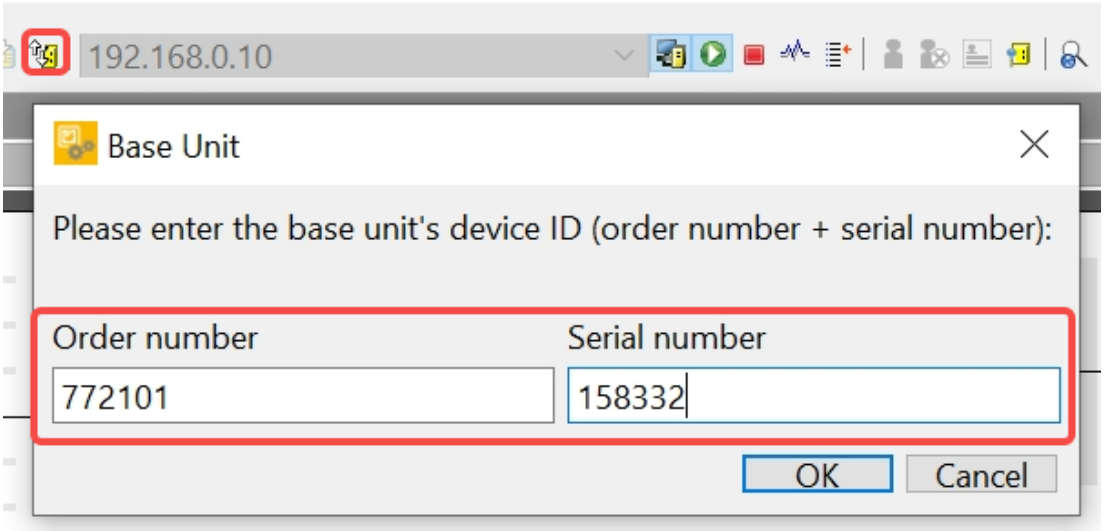


Figure 6-56 Entering basic unit information

h. Download the program in the pop-up Project Manager window.

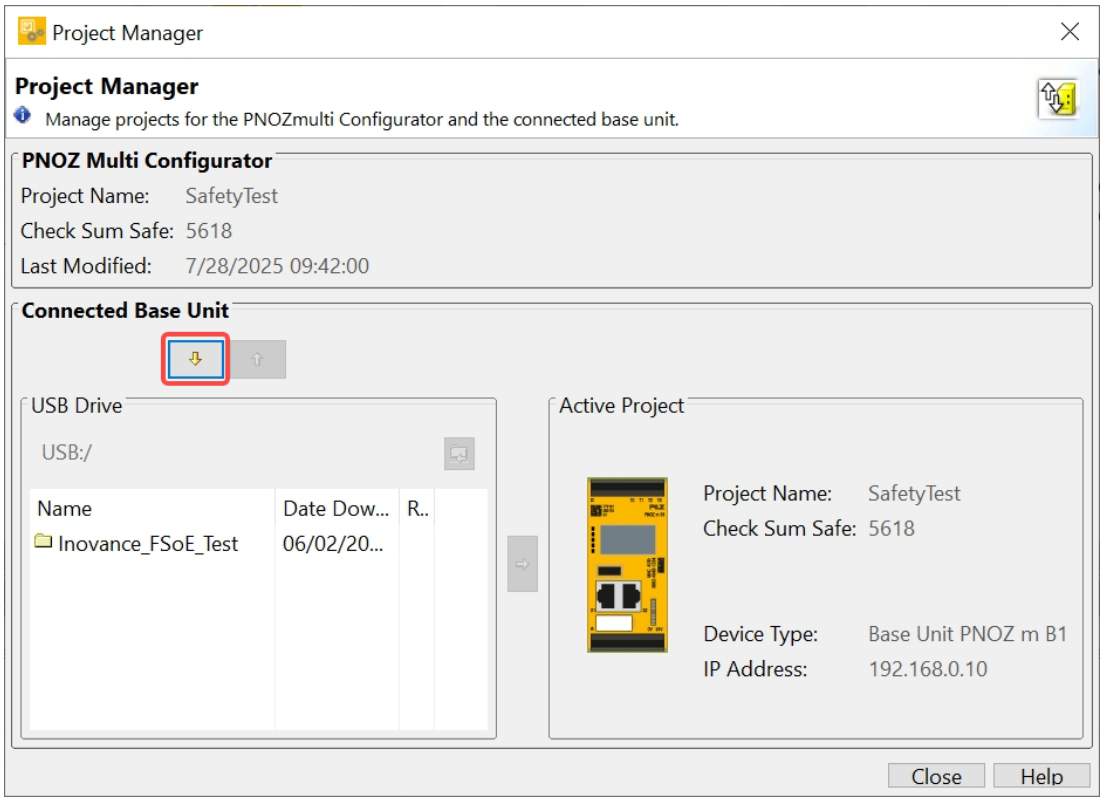


Figure 6-57 Project manager

i. Select "Select device Ethernet connection" and click **OK** to complete the download.

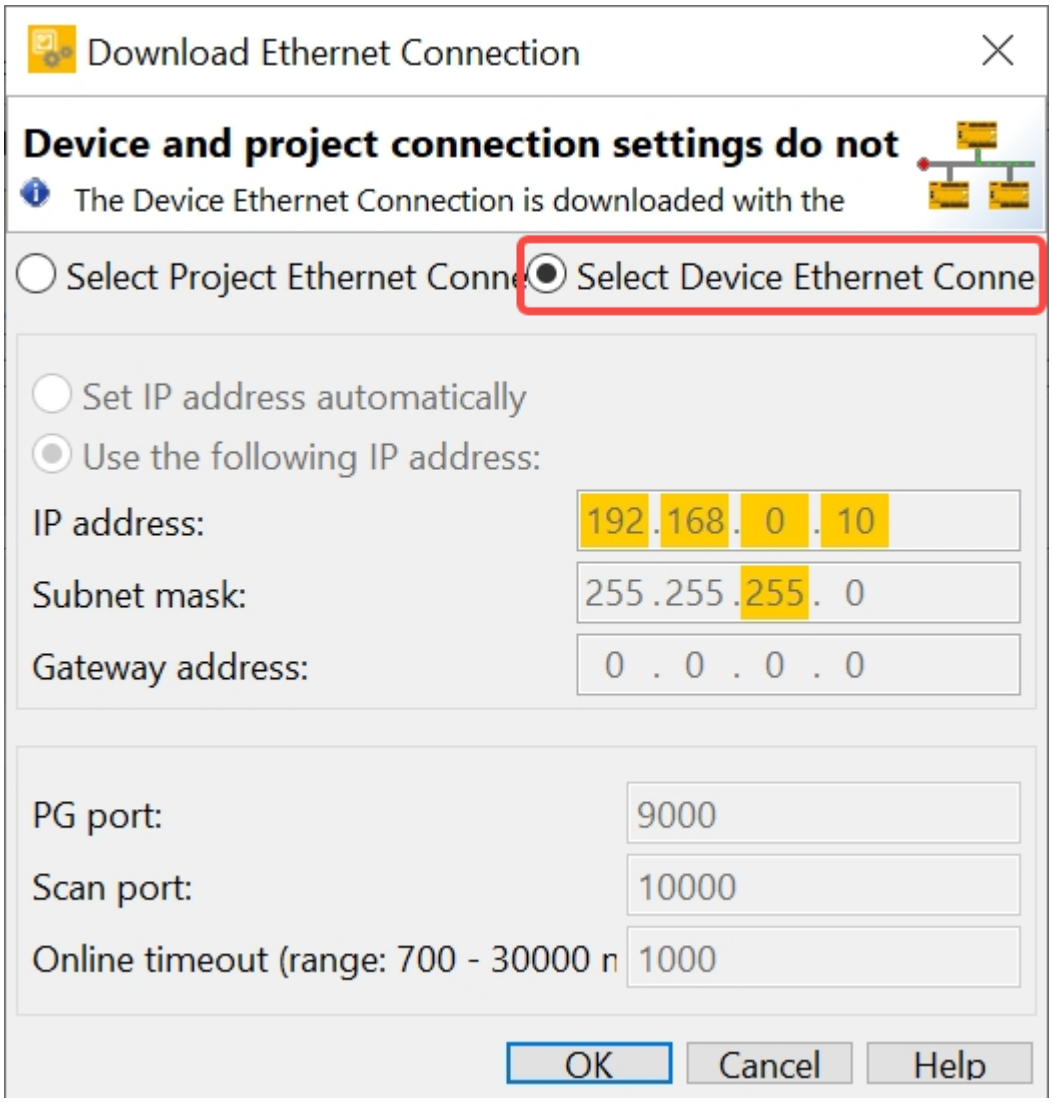


Figure 6-58 Downloading Ethernet connection

j. In the pop-up warning window, select "Save project on USB device and activate".

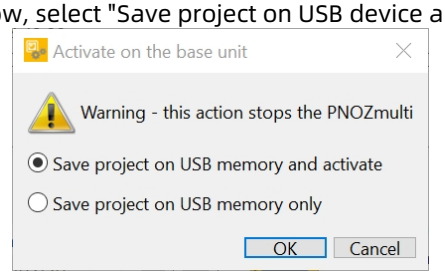


Figure 6-59 Activating on the basic module

k. Select "Accept changes to safety configuration".

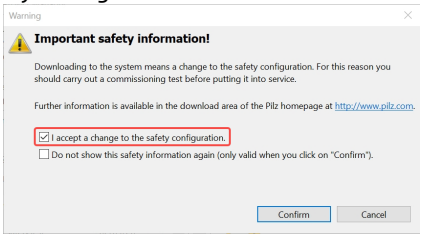


Figure 6-60 Accepting changes to safety configuration

l. After the download is completed, the project manager will show that the download is successful. Click **Yes** to restart PNOZmulti. After the restart, the project manager will show that the device restarted successfully. You can view the project you just downloaded in the USB driver column.

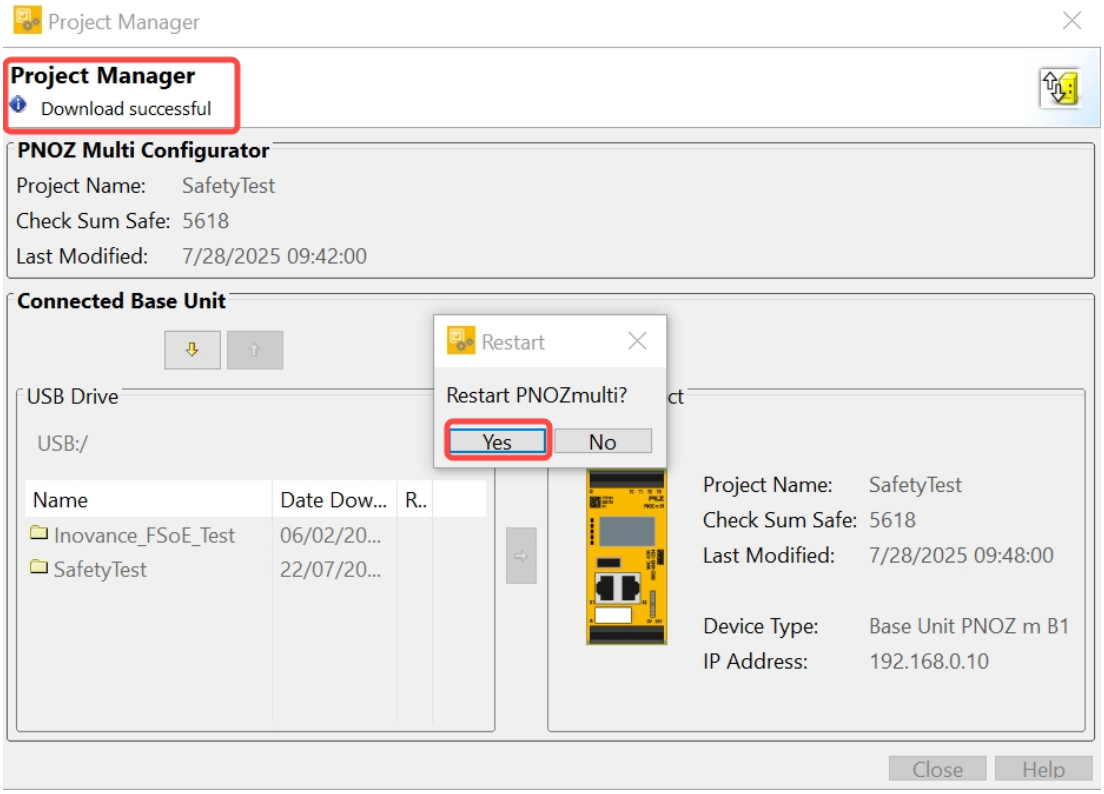


Figure 6-61 Interface after download is completed

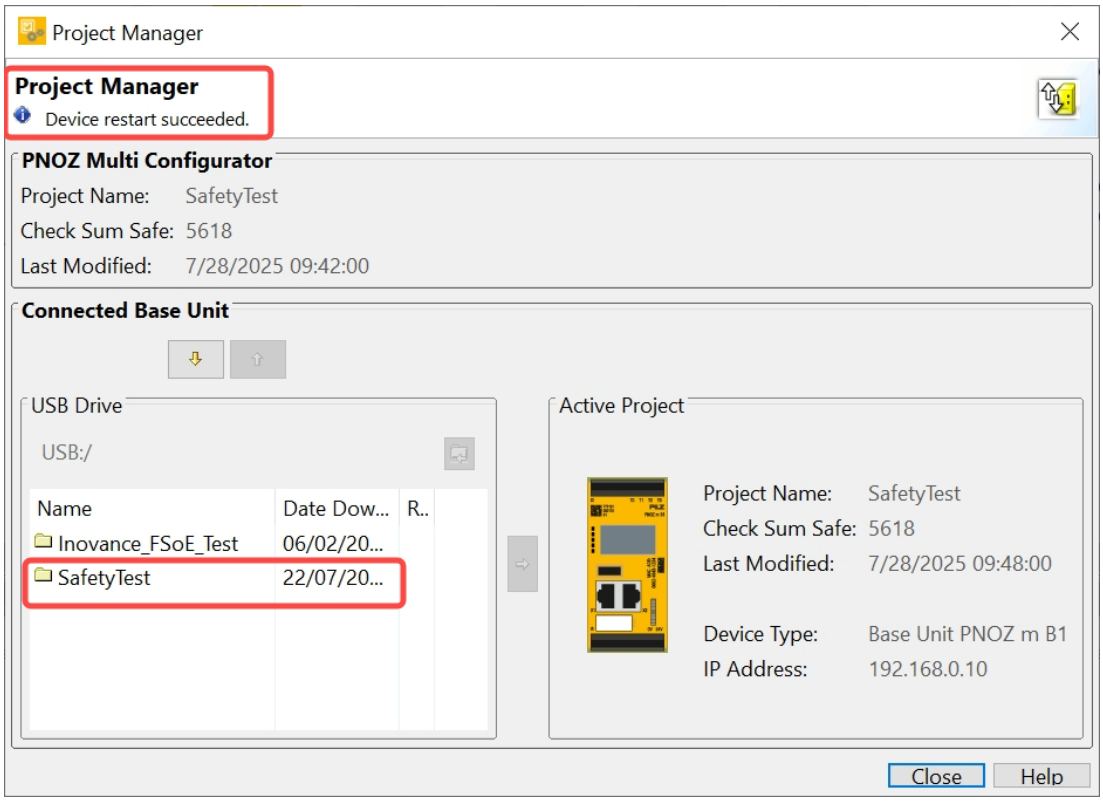


Figure 6-62 Restarting PLC

Adapting the master station

For unconfigured safety functions, the Command issued by the Pilz safety PLC is 0 by default. When Command is equal to 0, the corresponding safety function will be triggered. Therefore, before establishing the FSoE network, you must use H20-61 to mask the safety function commands that you do not need. When H20-80 = 1, all safety functions can be used. When H20-80 = 0, SS1-r/SS2/SDI/SLS/SSM is not available.

The following example shows how to adapt a Pilz PLC a Beckhoff master station and AC810 master station. You can also use an AC802 instead of an AC810. They are the same in terms of the configuration steps.

1. TwinCAT

   In the FSoE network, the EtherCAT master station is simulated by TwinCAT3, the safety CPU unit and safety IO module is a Pilz safety PLC + safety IO module, and the servo drive is SV680N-INT (functional safety).

   a. Connect TwinCAT + Pilz safety PLC + SV680N-INT with network cables

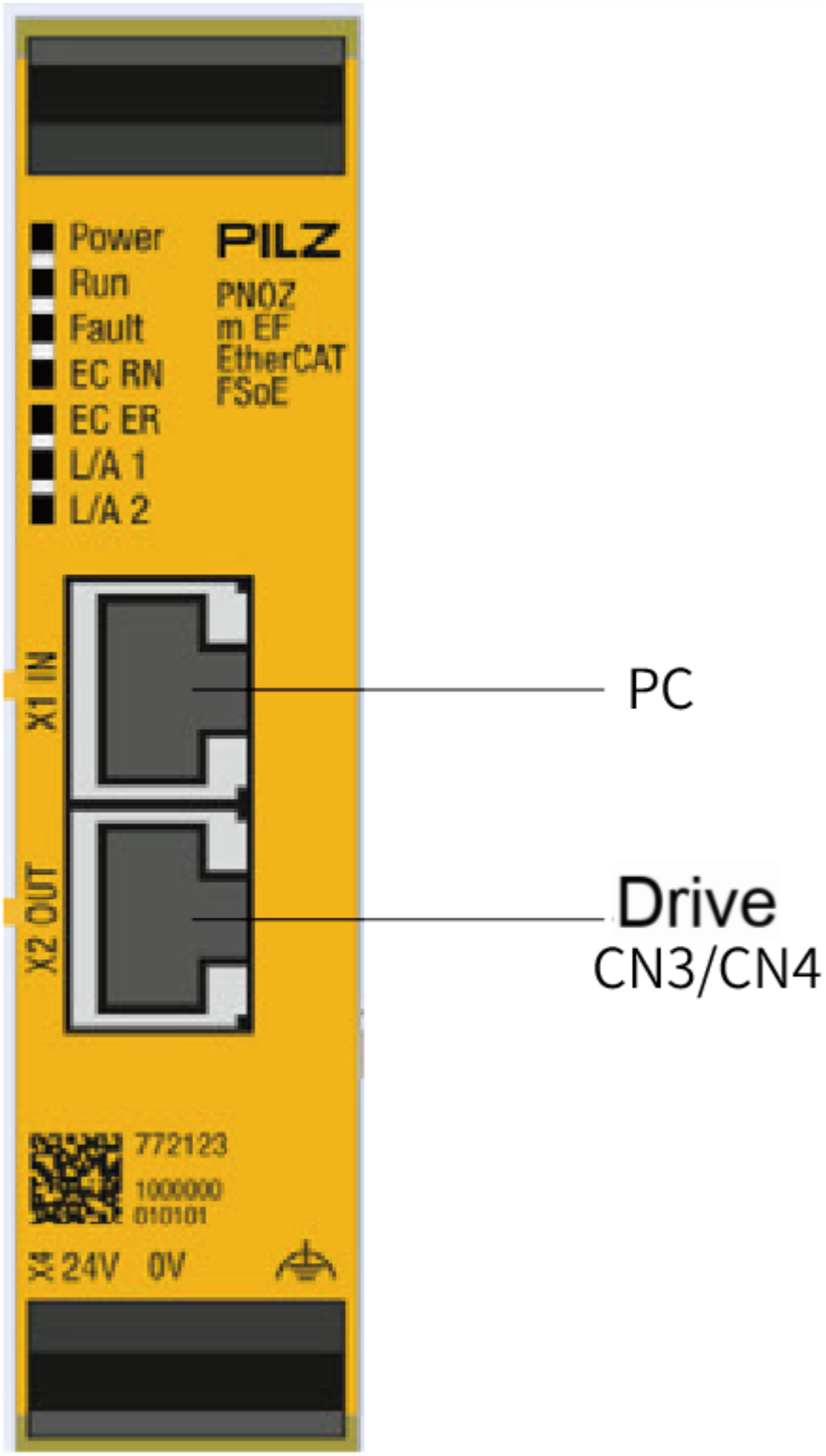


Figure 6-63 TwinCAT + Pilz safety PLC + SV680N-INT network wiring

b. Copy the xml file for the Pilz safety PLC (PNOZ_m_EF_EtherCAT_FSOE.xml) and the xml file for the SV680N-INT (FSOE) to the TwinCAT installation directory: TwinCAT\3.1\Config\Io\EtherCAT, and ensure that there is only one xml file for the SV680N-INT under this path.

c. Start TwinCAT3 and create a TwinCAT project.

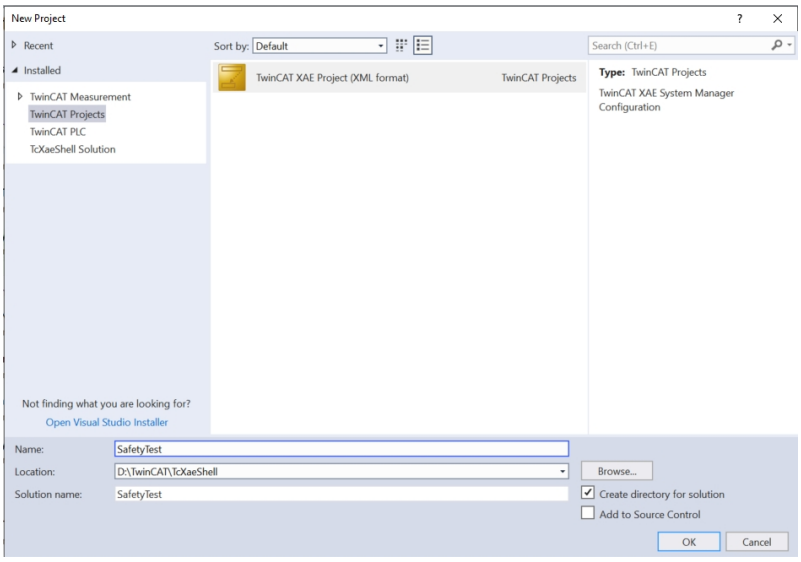


Figure 6-64 Creating a TwinCAT project

d. Right-click Device under the I/O column of Solution Manager and select **Scan** to search for devices.

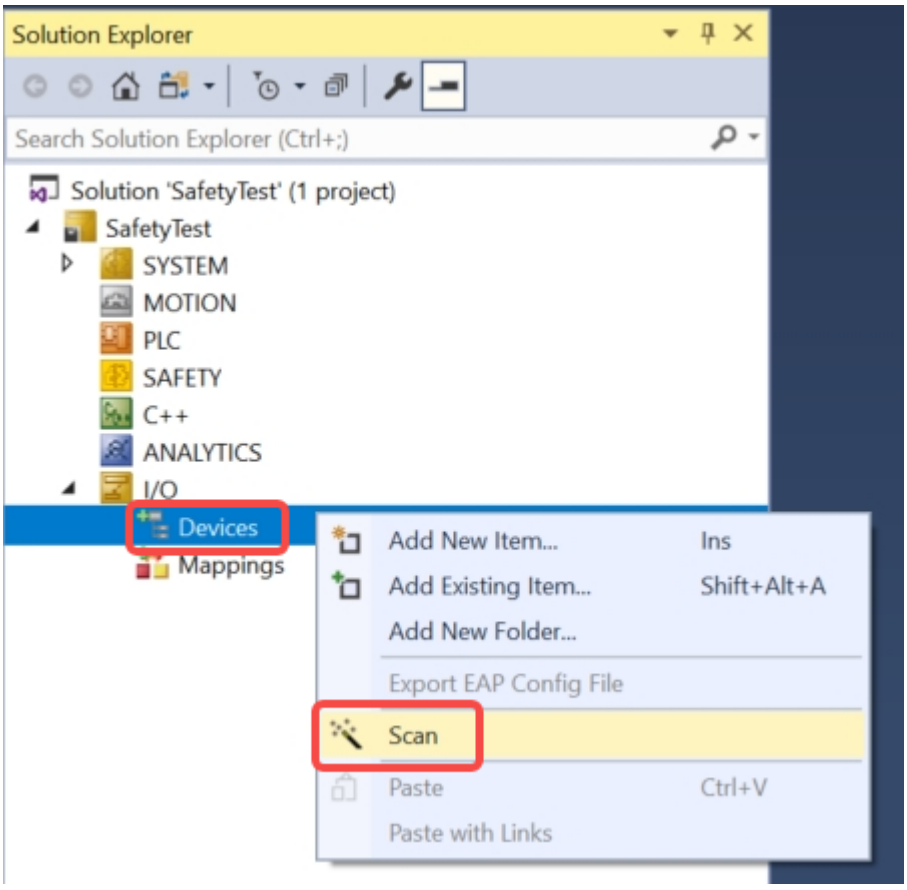


Figure 6-65 Searching for devices

e. Click "OK" in the pop-up window.

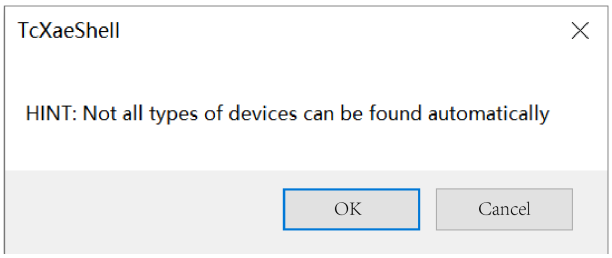


Figure 6-66 Clicking OK

f. Select the corresponding network port in the New I/O Devices Found window and click the **OK** button.

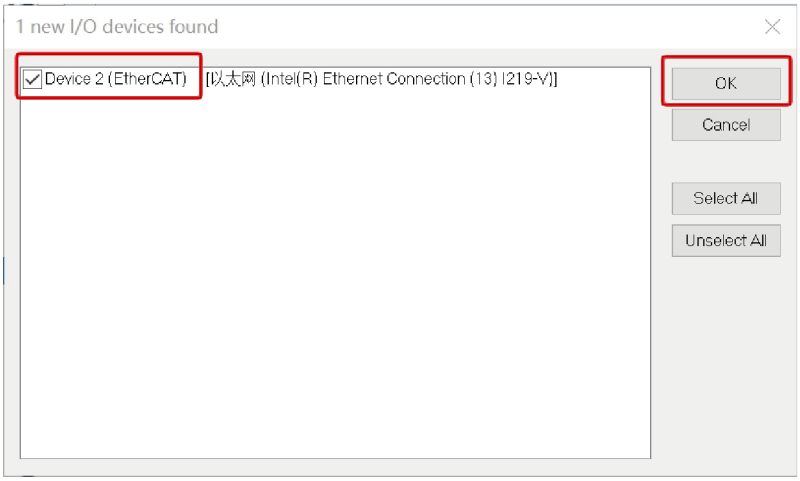


Figure 6-67 Select the found device

g. Select **Yes** in the pop-up window.

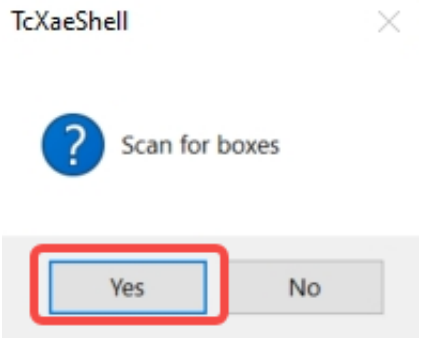


Figure 6-68 Clicking Yes

h. Click the **OK** button after selecting NC-Configuration.

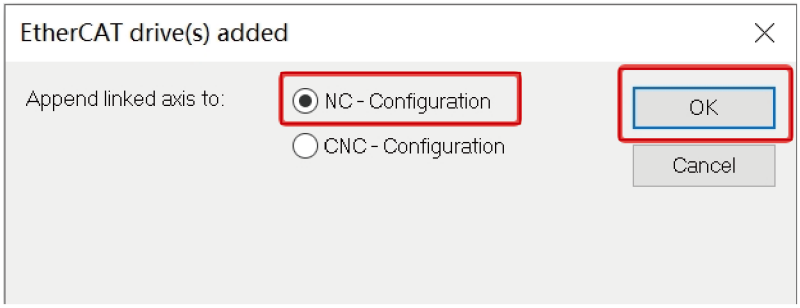


Figure 6-69 Selecting the axis type

i. Select **No** in the pop-up window.

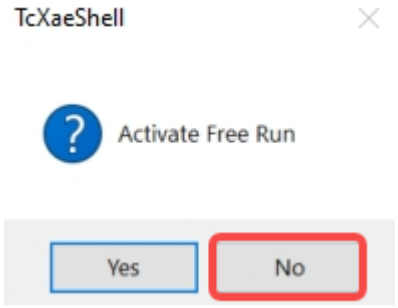


Figure 6-70 Clicking No

Note: The FSoE-SRA module and the FSoE-nSRA module are integrated in the latest xml file. If the xml file is loaded, manually double-click the SV680S device after completing step i, and select "FSoE-noSRA" in Slots. The FSoE-noSRA module in the new xml file is the same as the FSoE-Advanced module in the legacy xml file without SRA parameters in terms of configuration.

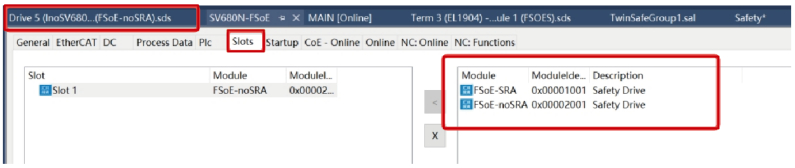


Figure 6-71 Safety module slot selection

j. Find the FSoE of TPDO in Module 1 under the PNOZ m EF EtherCAT FSoE module, right-click it and select **Change Link.**

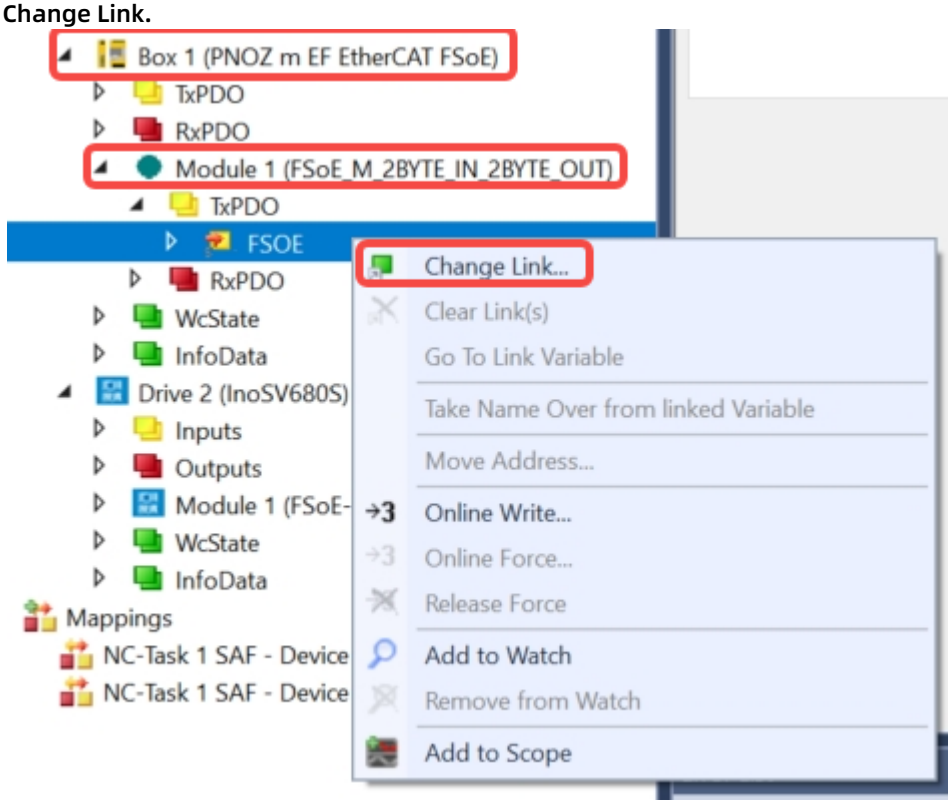


Figure 6-72 POD mapping 1

k. After unselecting "Exclude same Image", select RPDO of InoSV680S, and click OK to complete the selection.

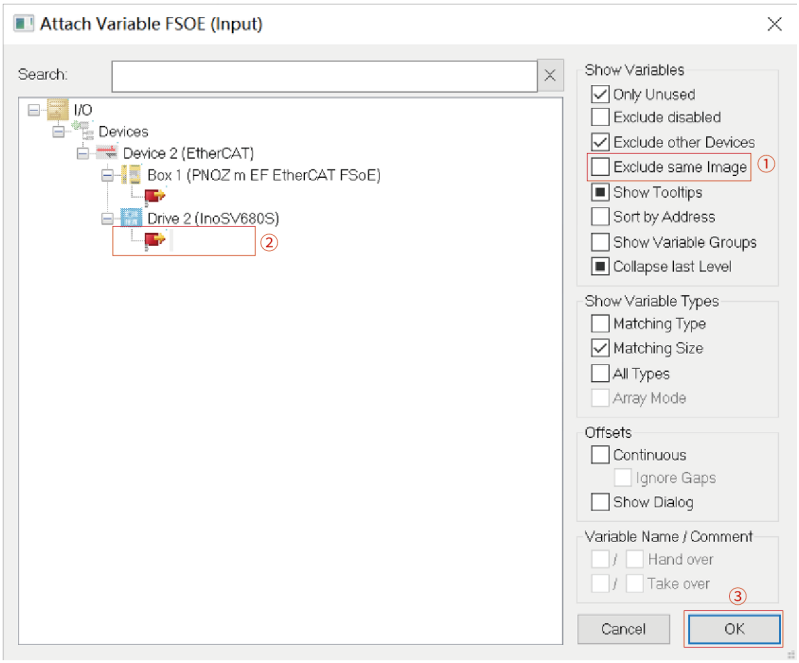


Figure 6-73 Connecting PLC TPDO to RPDO of SV680N

l. Find the FSoE of RPDO in Module 1 under the PNOZ m EF EtherCAT FSoE module, right-click it and select **Change Link.**

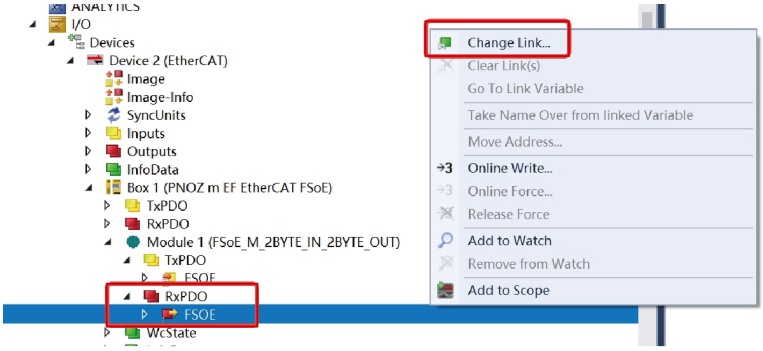


Figure 6-74 PDO mapping 2

m. Select the TPDO of InoSV680S and click OK to complete the selection.

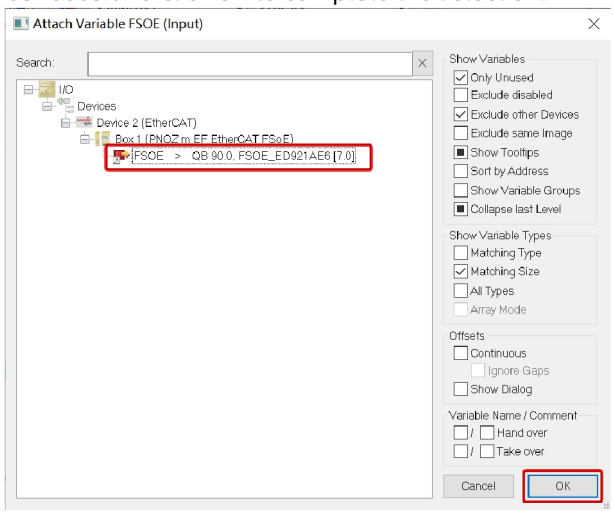


Figure 6-75 Connecting PLC RPDO with TPDO of SV680N

n. Find the FSoE of TPDO in Module 1 under the Drive2 (InoSV680S) module, right-click it and select **Change Link**, (**Note: Do not skip steps n-q, otherwise safe communication cannot be established).**

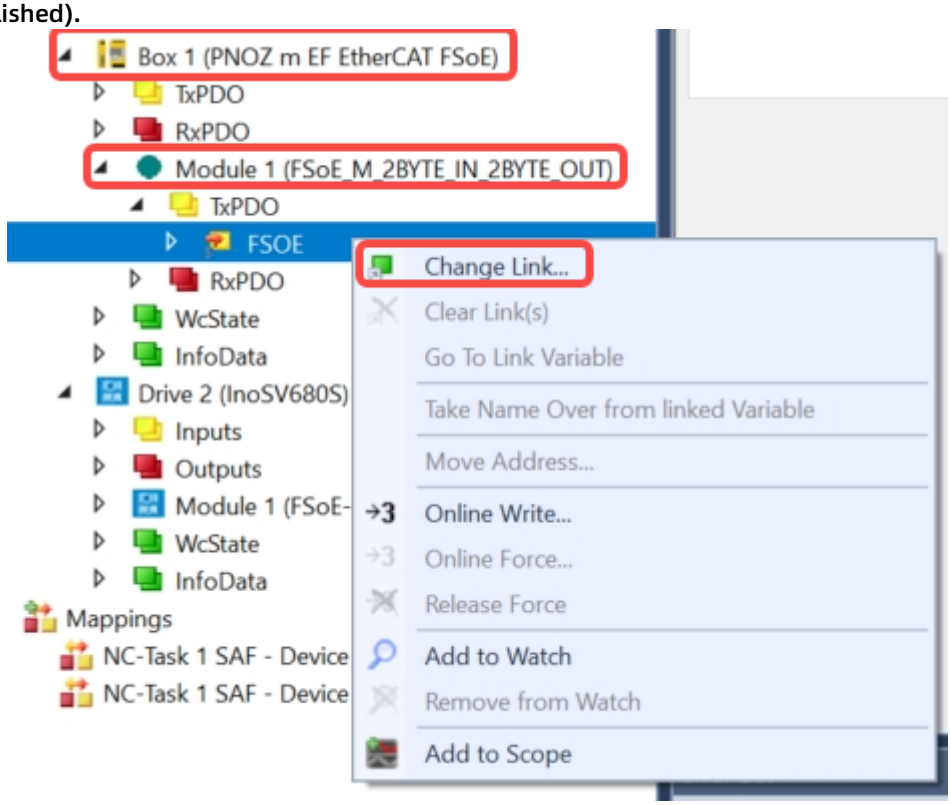


Figure 6-76 PDO mapping 3

o. Select the RPDO of the PNOZ m EF EtherCAT module and click the **OK** button to complete the selection.

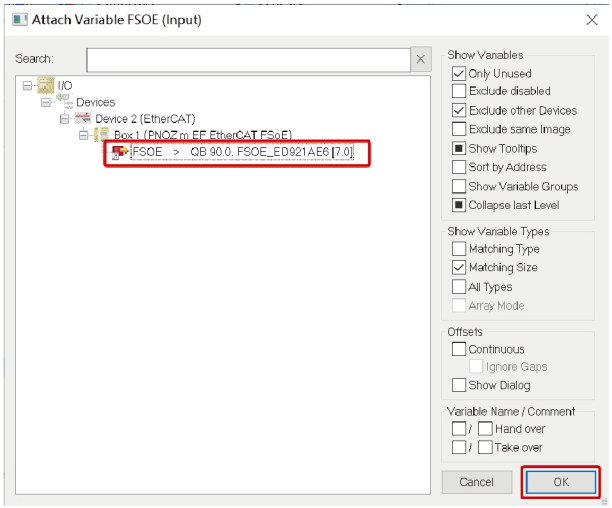


Figure 6-77 Connecting PLC RPDO with TPDO of SV680N

p. Find the FSoE of RPDO in Module 1 under Drive2 (InoSV680S) module, right-click it and select **Change Link**.

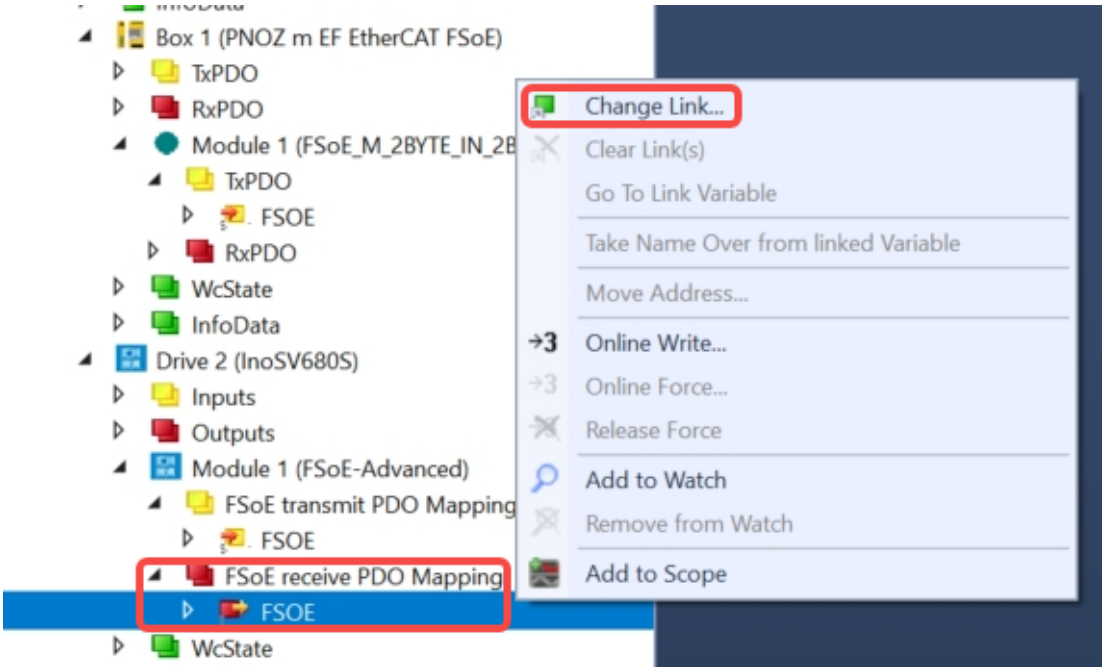


Figure 6-78 PDO mapping 4

q. Select the TPDO of the PNOZ m EF EtherCAT module and click the **OK** button to complete the selection.

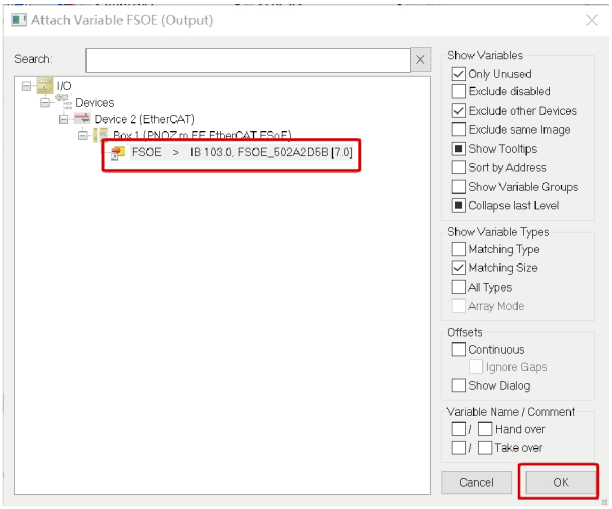


Figure 6-79 Connecting PLC TPDO to RPDO of SV680N

r. Click **Reload Devices** to let the above PDO mapping relationship take effect. The SV680N can enter FSoE normal safety bus communication mode.

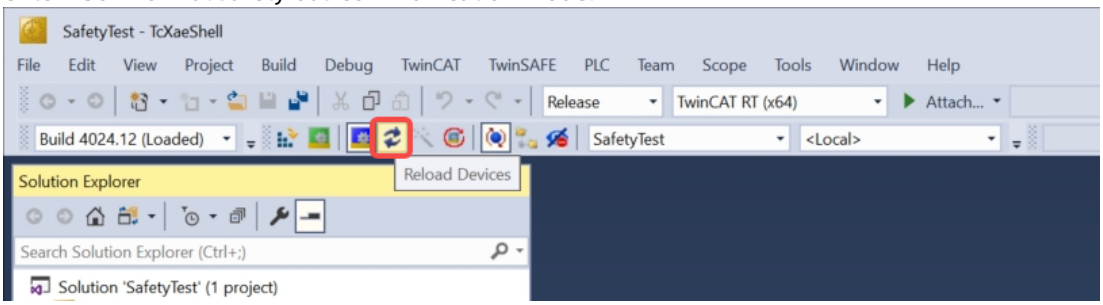


Figure 6-80 Reload Device

s. Select **Yes** in the pop-up window.

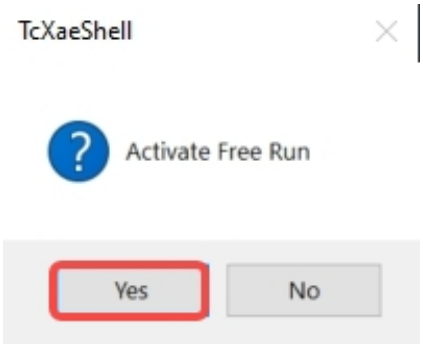


Figure 6-81 Selecting Yes

t. After successfully establishing communication, you can find that the CRC check of each module PDO is constantly changing, and the CMD of the master station and slave stations are 0x36. If the Online data remains 0, the communication establishment must have failed.



Figure 6-82 PDO data status

u. After successfully establishing communication, change the safety function input. You can select the status (such as STO Active) or command (such as STO command) you want to view in TPDO and RPDO under the InoSV680S device. Select the Online page on the right side of the interface, where you can observe the online changes of input commands and output status.

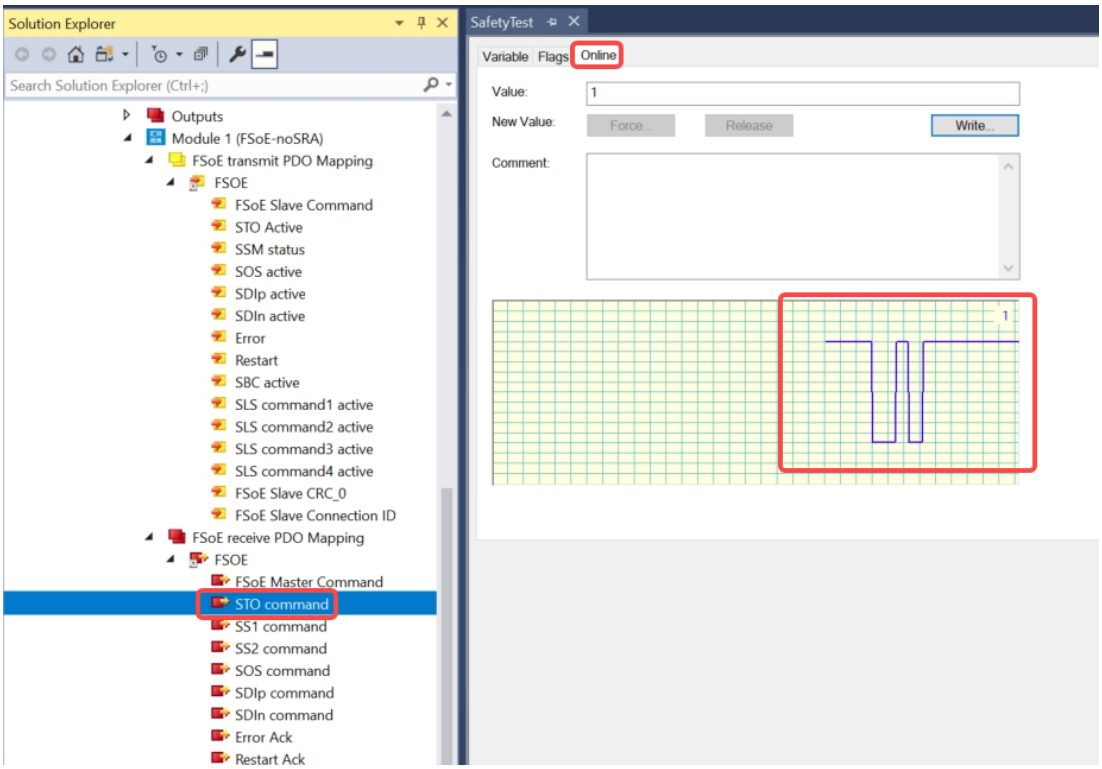


Figure 6-83 PDO Online

v. Compared to Beckhoff, the Pilz safety process data is generated by means of slots. If you do not want to use the safety function in the Free Run synchronization mode, you need to manually configure the invalid slot in the Pilz safety PLC as an empty module, and activate the configuration after setting all slots. The specific operations are as follows:

1). Click Box 1 (PNOZ m EF EtherCAT FSoE)

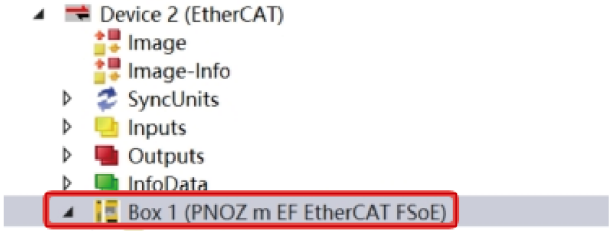


Figure 6-84 Selecting Box 1 (PNOZ m EF EtherCAT FSoE)

2). Click **Slots** in the Properties interface on the right.

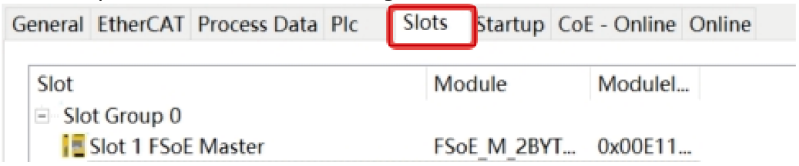


Figure 6-85 Selecting the Slots page

3). Click "Slot 2 FSoE Master", select "Empty Module" in the right pane and add an empty module.

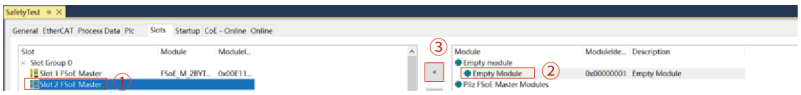


Figure 6-86 Adding an empty module

4). After adding the empty module, the corresponding configuration will be displayed in the Module column of Slot.

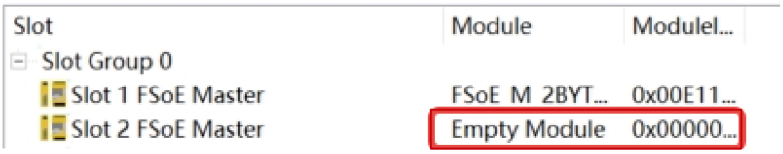


Figure 6-87 Displaying the configuration

5). Configure all the remaining invalid slots as Empty Module according to step 3. This operation only needs to be performed once for the project. The configuration will be saved.

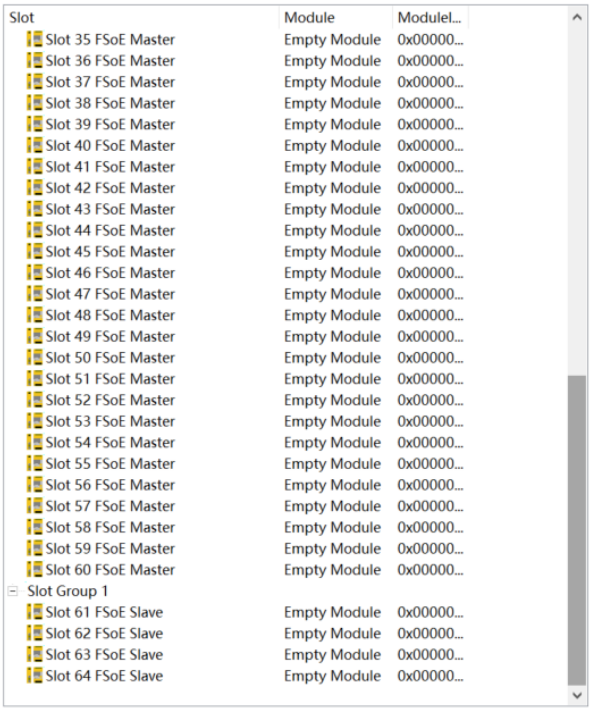


Figure 6-88 Configuring remaining available slots

6). Click the  button activate the configuration, and select **OK** for all pop-up dialog boxes.

The upper left corner of the software shows the activated status .

7). After successful connection, the servo drive exits the STO status and the panel displays 8xry.

2. AC810

a. The PLC model in the example is AC810-0122-U0R0, with firmware version 2.0.10.8.

b. Establish the topology connection as shown in the figure below.

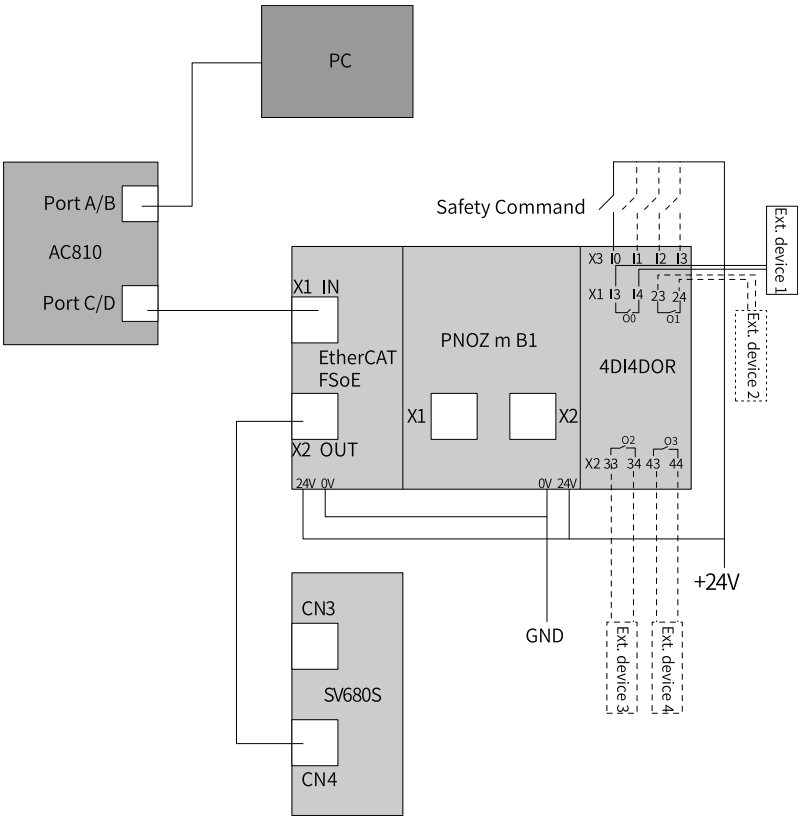


Figure 6-89 AC810+Pilz+SV680S topology configuration

c. Open the InoProShop software. Note that its version must be at least V1.9.0.1. Select **New Project** on the start page of the software.



Figure 6-90 Creating a new project in InoProShop

d. Select the PLC model in the software, select structured text as the programming language, set the project name and directory at the bottom of the window, and then click the **OK** button to create the project.

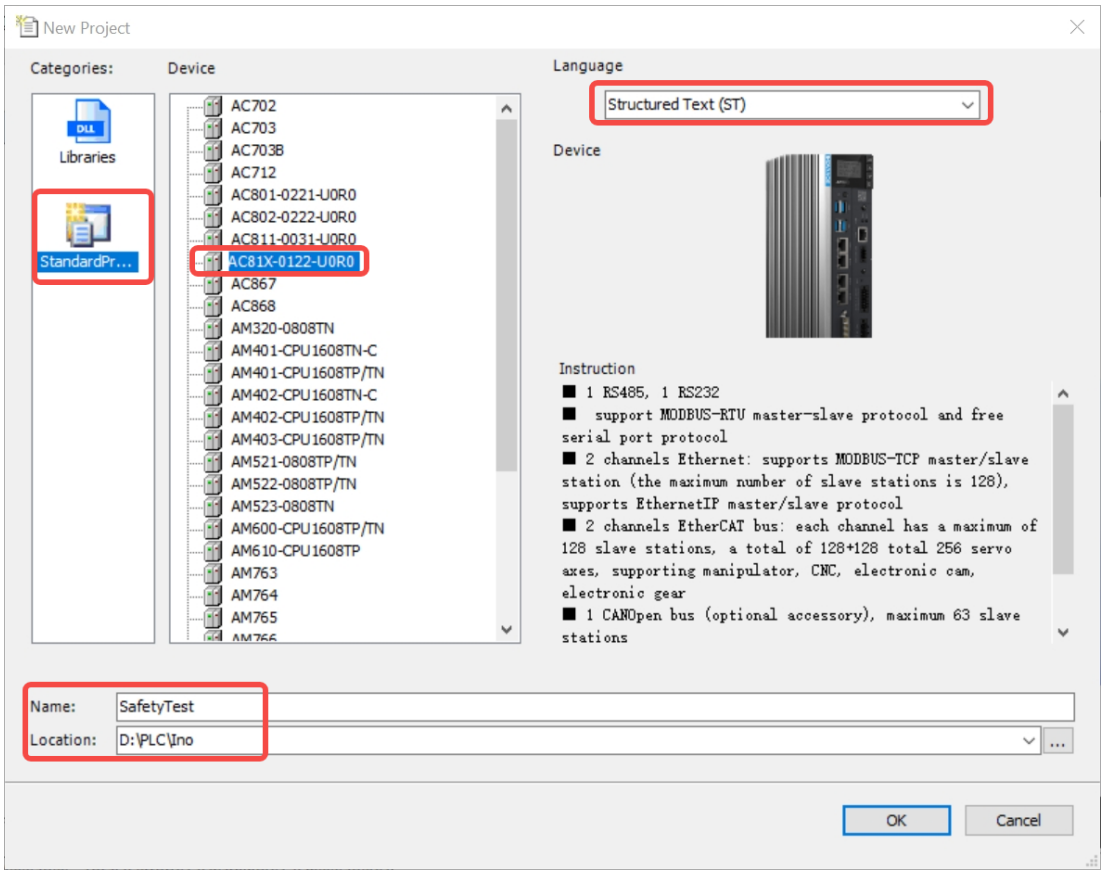


Figure 6-91 Selecting PLC model and programming language

e. Select **Device Library** on the toolbar.

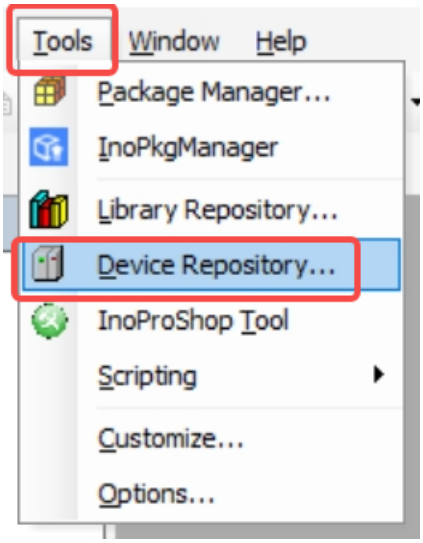


Figure 6-92 Entering the device library

f. Once you open the Device Library window, click the Install button to select the device description file.

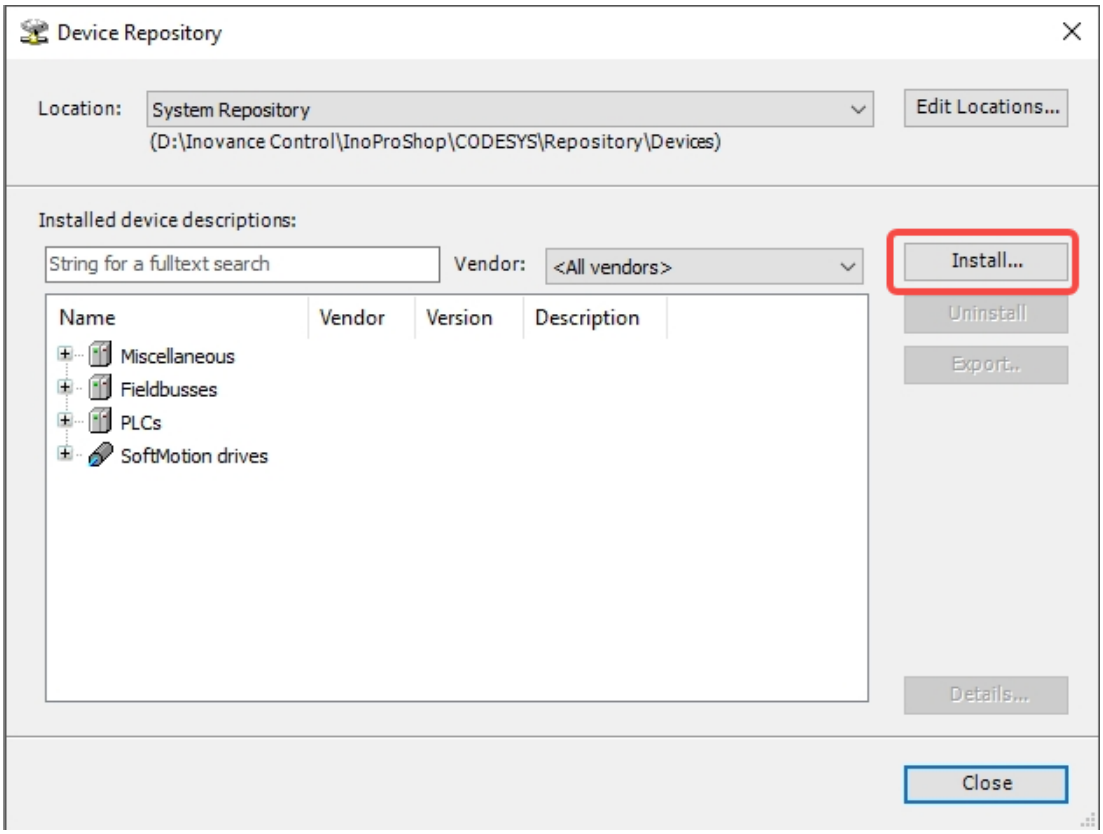


Figure 6-93 Installing device description file

g. When selecting a file, switch the file type at the lower right corner to "EtherCAT XML device description file", so that it can be installed correctly into the PLC project. Select the XML files for Pilz and SV680N-INT (FSoE) and click the **Open** button.

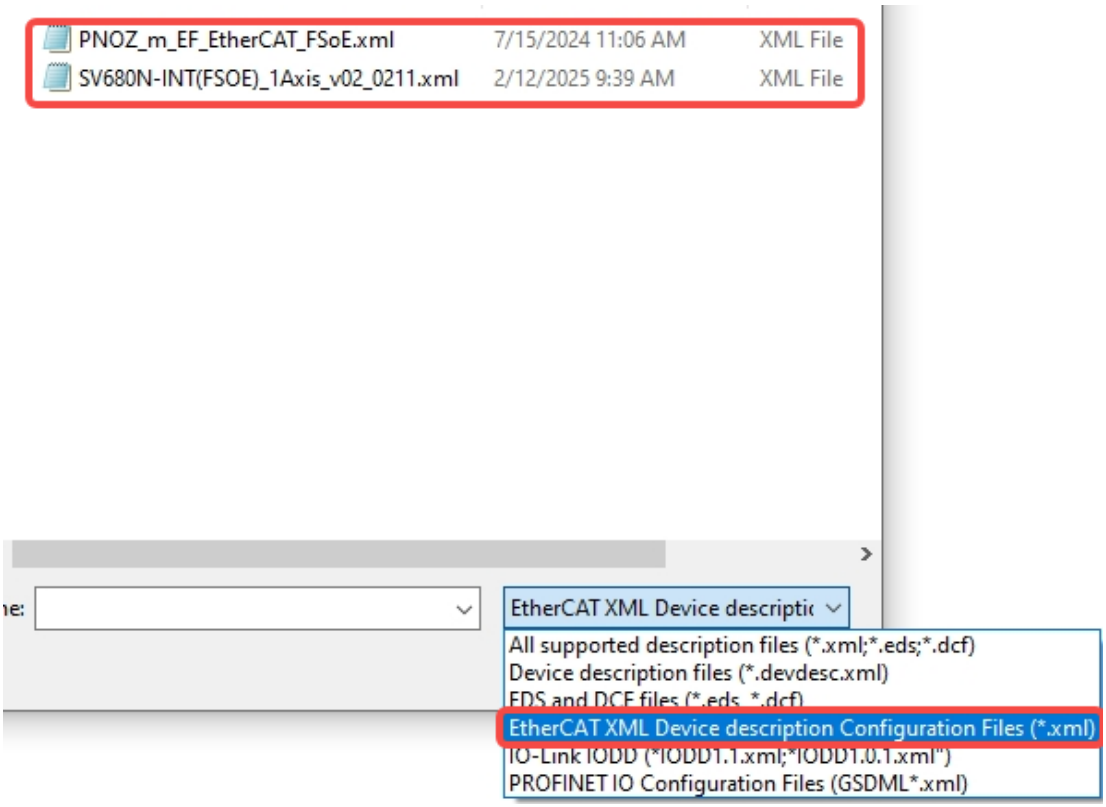


Figure 6-94 Selecting the EtherCAT XML

h. The following messages will appear in the Device Library window during installation. After confirming that there are no error warnings, click the **Close** button to exit the Device Library window.

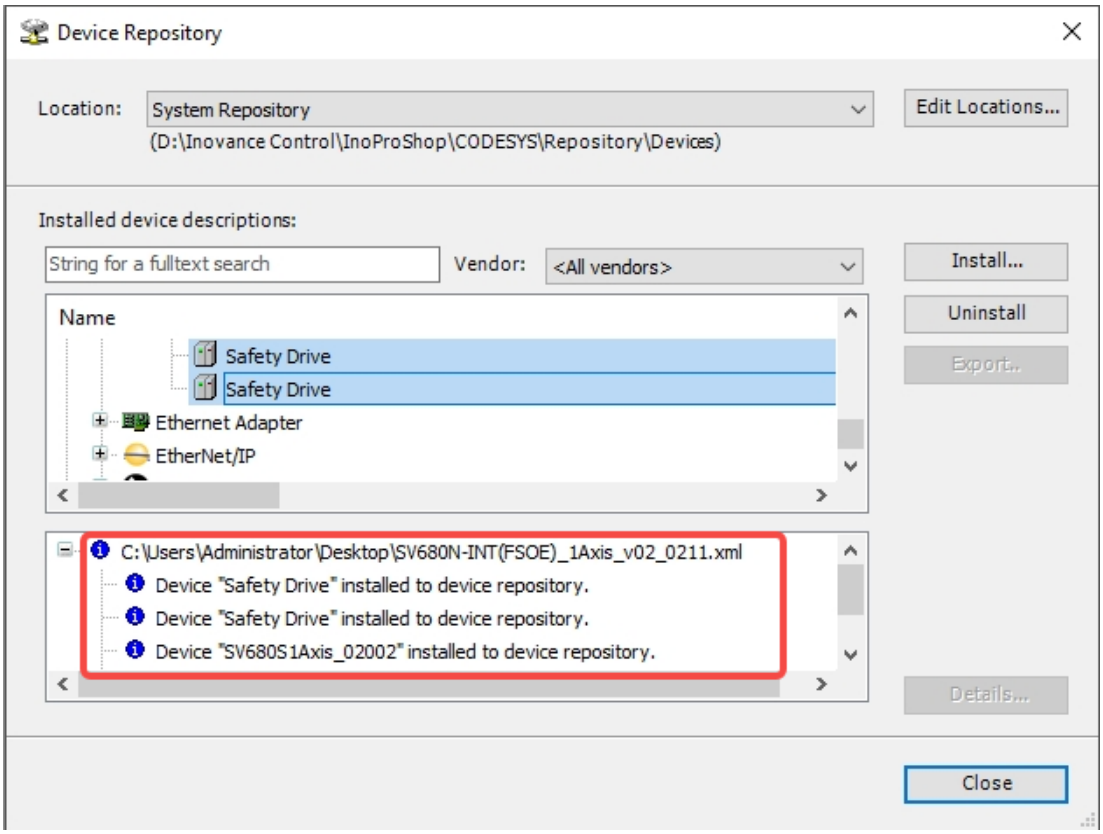


Figure 6-95 Messages

i. Read the IP port address of network port A in AC810 panel.

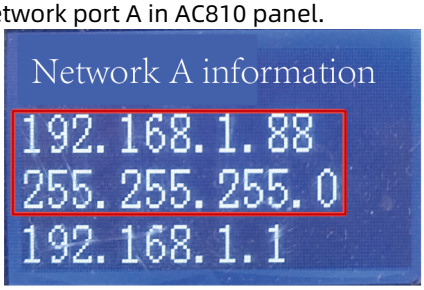


Figure 6-96 Network port A information

j. Set the IPv4 address of the computer to be on the same network segment as port A.

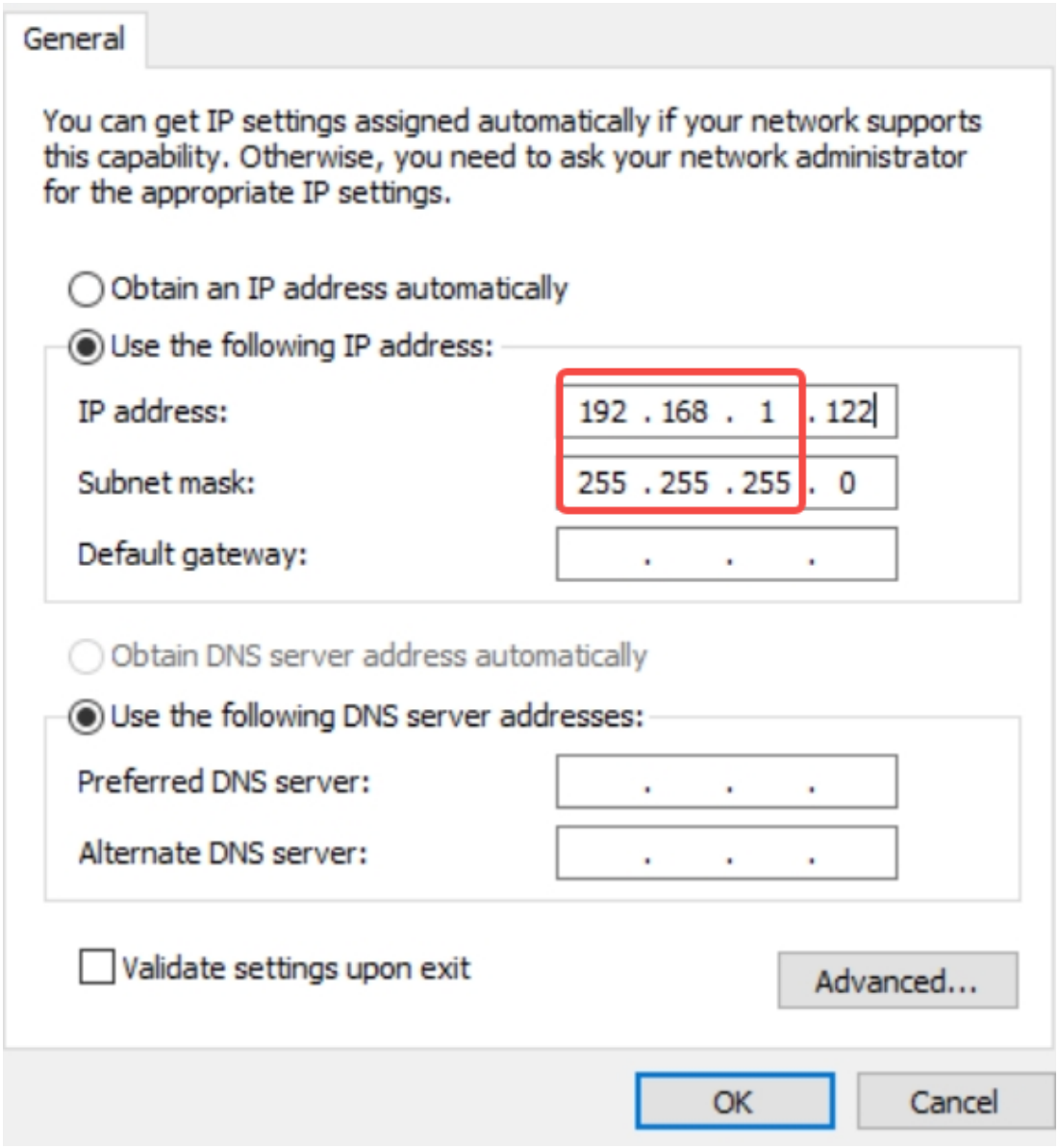


Figure 6-97 Setting the computer network segment

k. Check that the GateWay software icon on your computer's taskbar is in the started state . Double-click **Device**, and click **Scan Network** in the right interface.

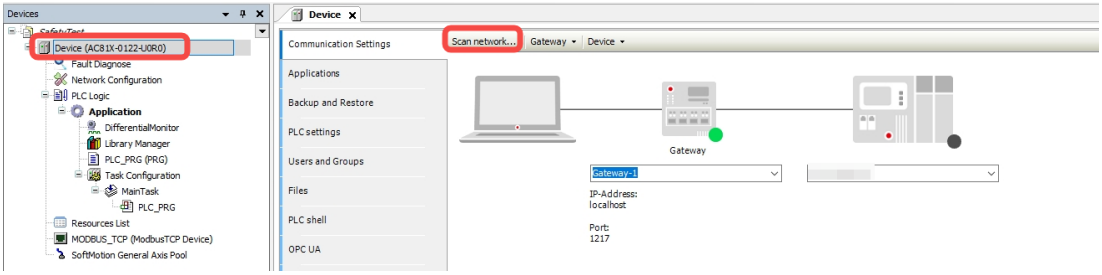


Figure 6-98 Scanning the network

l. Double-click the AC810 device to complete the selection.

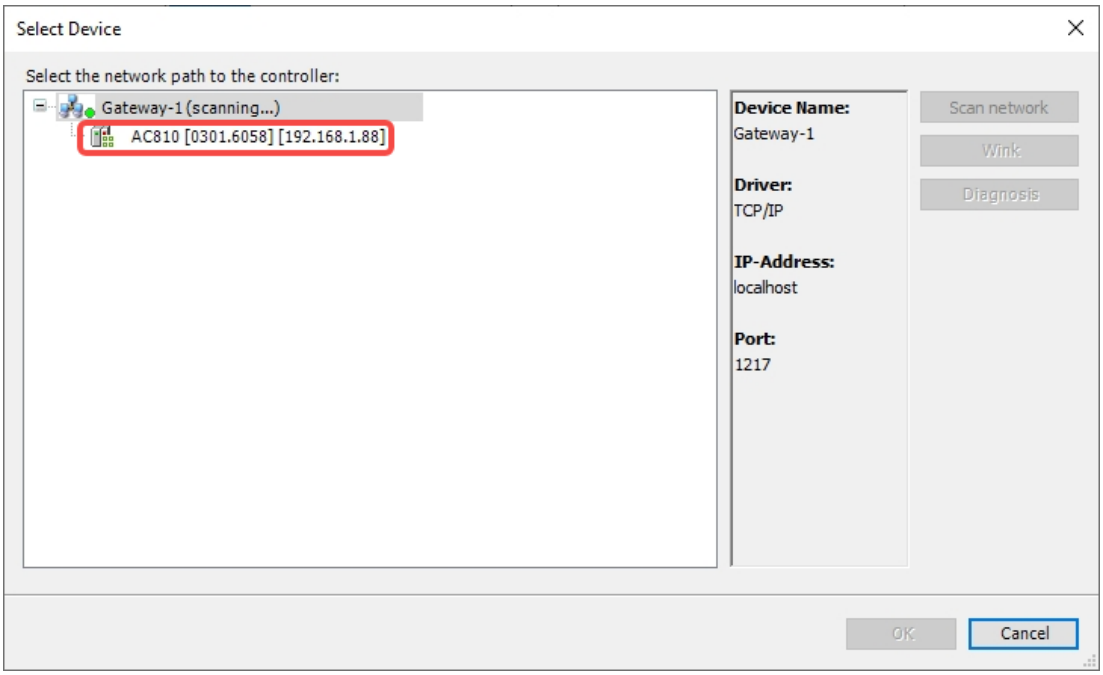


Figure 6-99 Selecting the AC810 device

m. After AC810 is connected, the Device interface is shown.

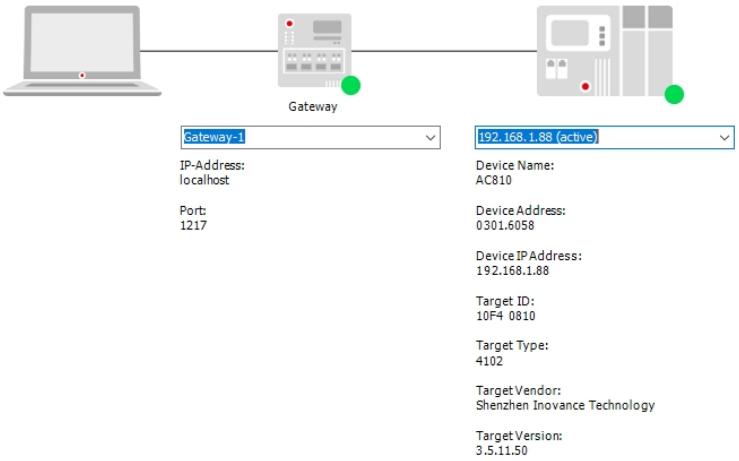


Figure 6-100 Connection between PC and AC810

n. It is recommended to scan devices in the FSoE network in the order of [Hot Reset]-> [Logout]-> [Scan Device]. The specific steps are as follows:

1). Double-click **Network Configuration**, select "EtherCAT master" for port C, and unselect "ModbusTCP slave" for port A/port B.

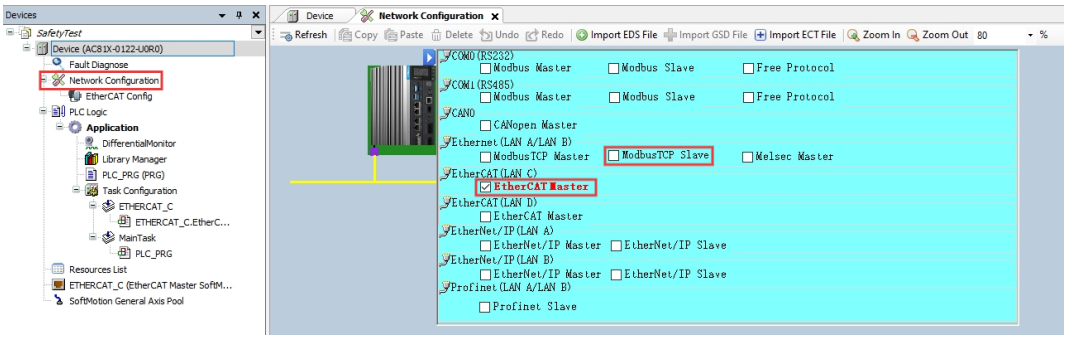


Figure 6-101 Selecting AC810 as EtherCAT master

2). In the toolbar at the top of the interface, select **Online** -> **Login.**

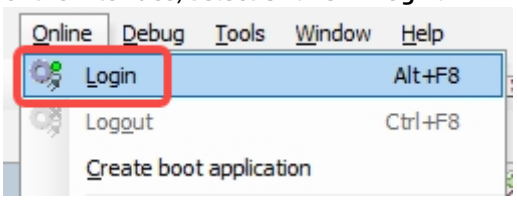


Figure 6-102 Logging in

3). Select **Yes** for program download.

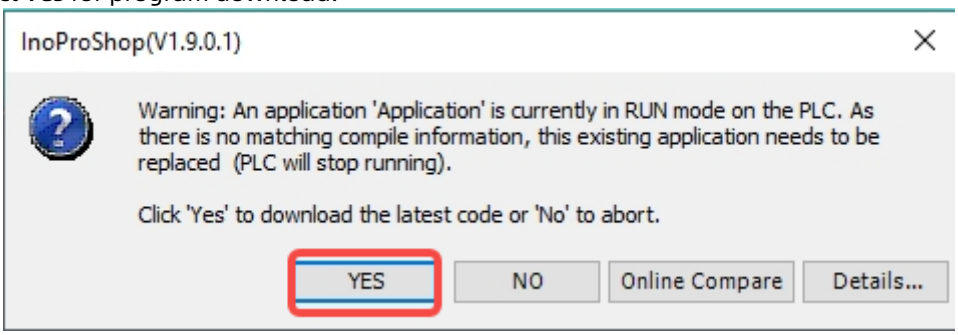


Figure 6-103 Downloading the program

4). In the toolbar at the top of the interface, select **Online** -> **Hot Reset.**

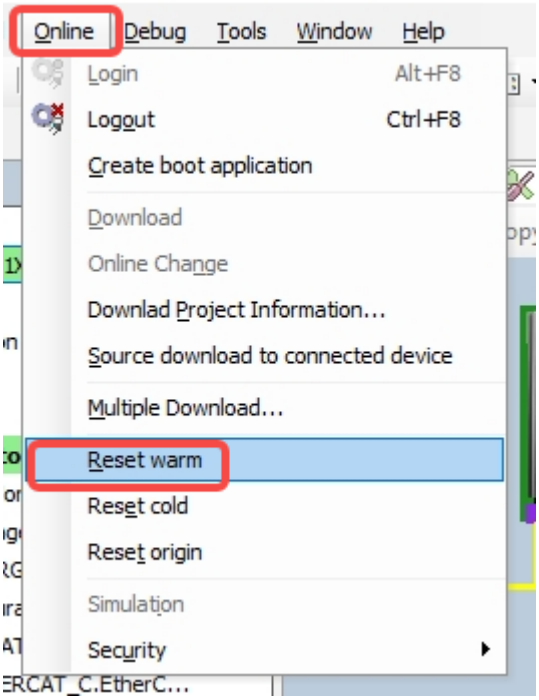


Figure 6-104 Hot reset

5). Select **Yes** to perform hot reset.

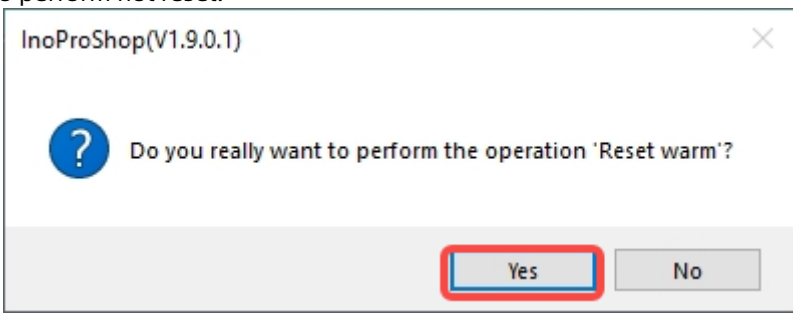


Figure 6-105 Performing a hot reset operation

6). In the toolbar at the top of the interface, select **Online** -> **Logout.**

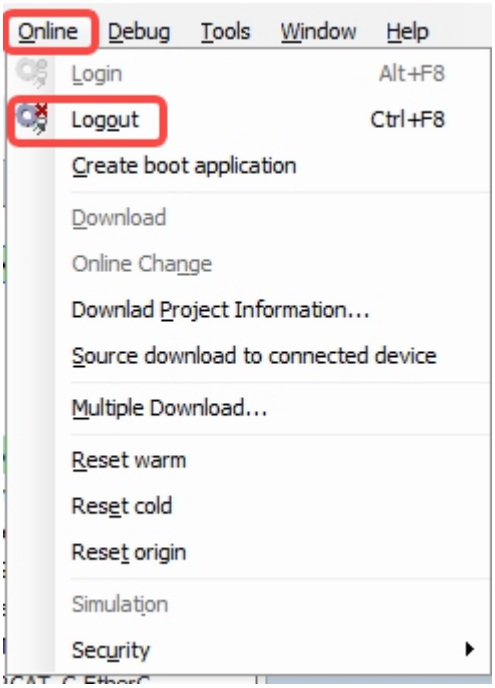


Figure 6-106 Logging out

7). Right-click ETHERCAT_C and select **Scan Device**.

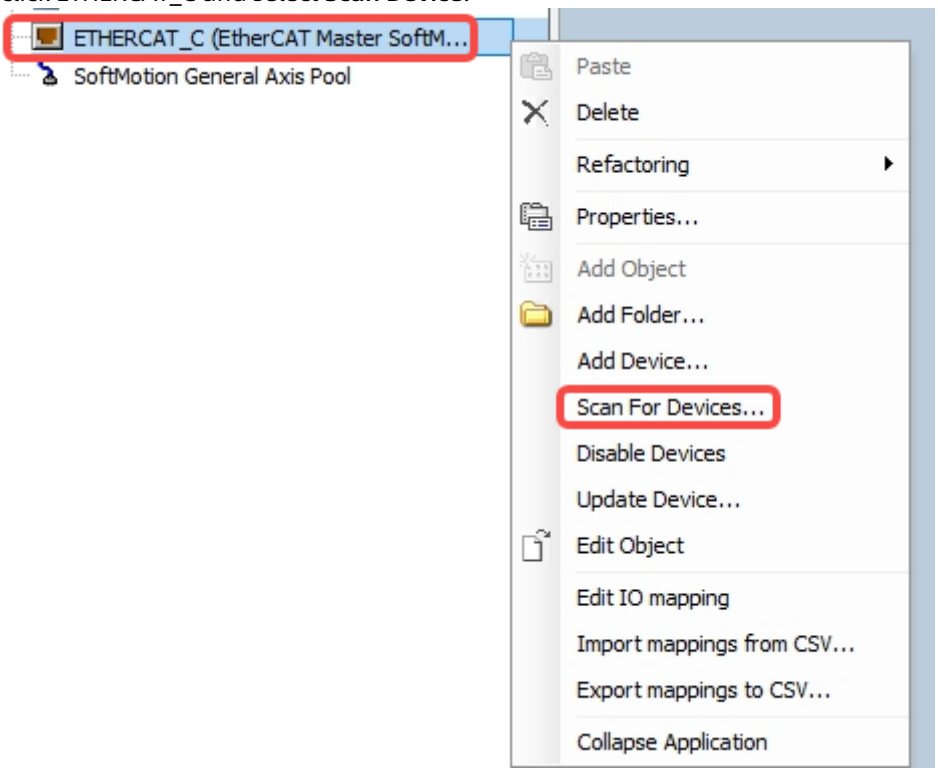


Figure 6-107 Scanning for devices under port C

8). Click the **Scan Device** button in the lower left corner to scan for FSoE network devices. After the Pilz safety PLC and SV680S are found, click **Copy Device** in the lower right corner.

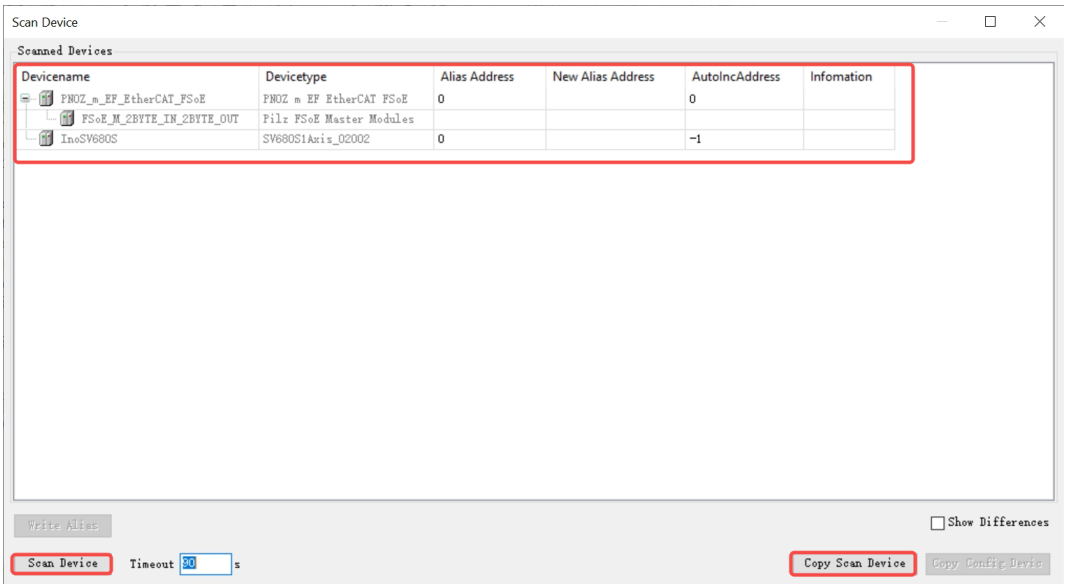
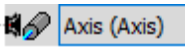


Figure 6-108 Scanning for devices and copy them to project

9). If you need to configure axis control, double-click **Axis** 

under the InoSV680S device. After configuring the axis, click the  button to save the settings. Skip this step when using the object dictionary for control.

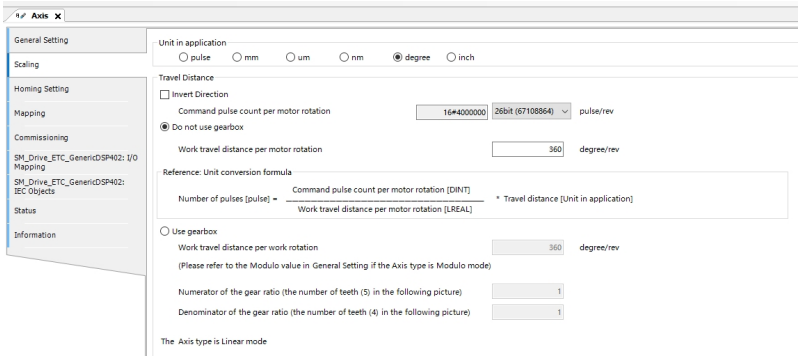


Figure 6-109 Setting axis parameters

10). Right-click InoSV680S and select **Add Device**.

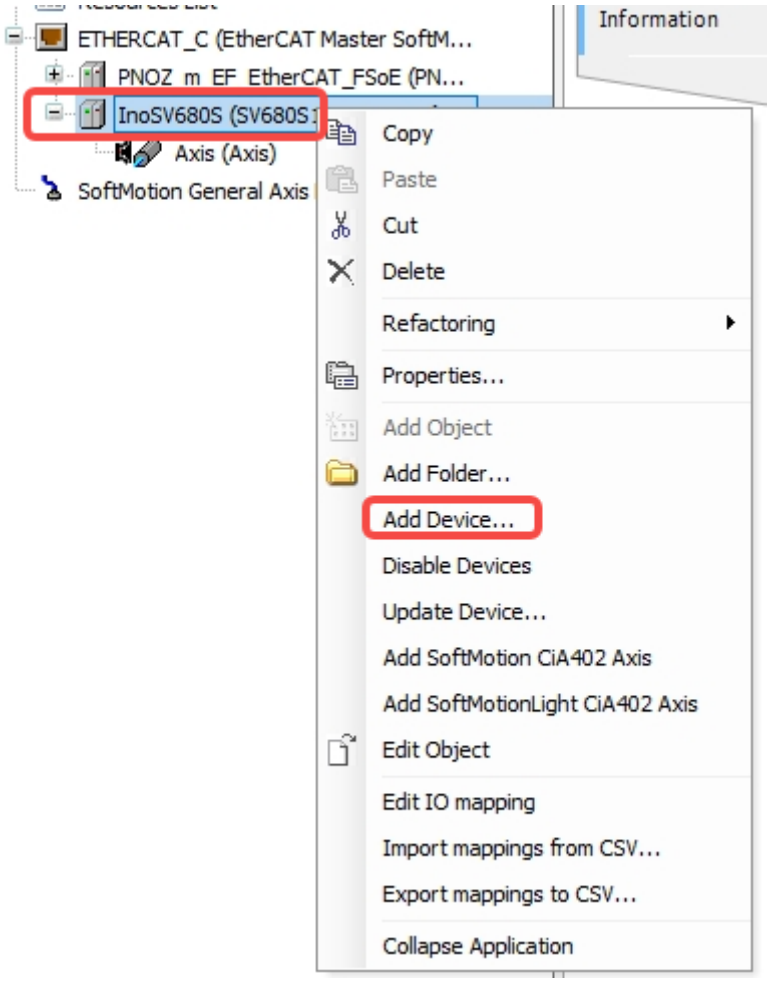


Figure 6-110 Adding a safety drive device

11). Double-click the device named FSoE_noSR to complete the selection. After successfully adding the safety drive device, click the **Close** button to exit the current window to complete the FSoE network establishment.

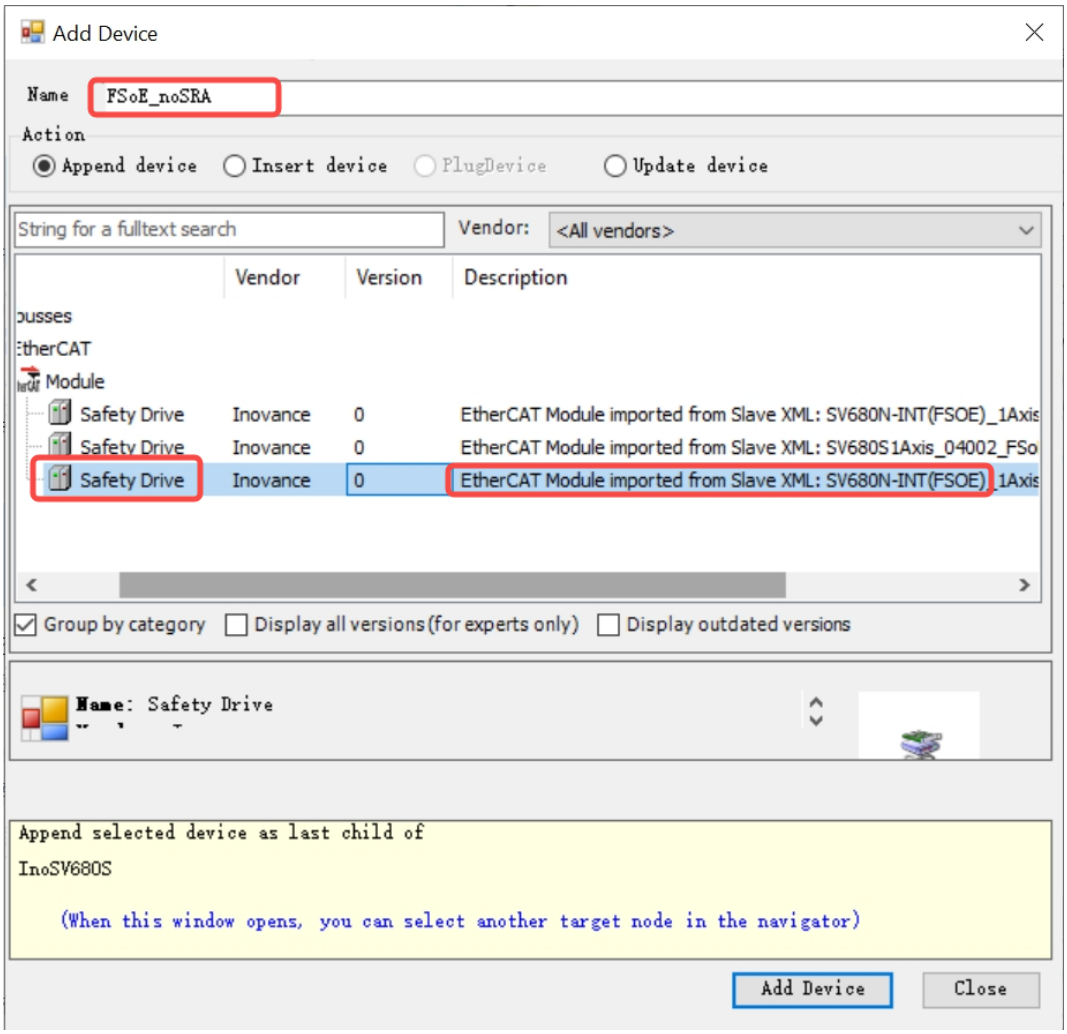


Figure 6-111 Selecting an XML file without SRA parameters

12). Double-click the PNOZ_m_EF_EtherCAT_FSoE device to view the PDO data structure of pilz in the Process Data (PDO Settings) interface.

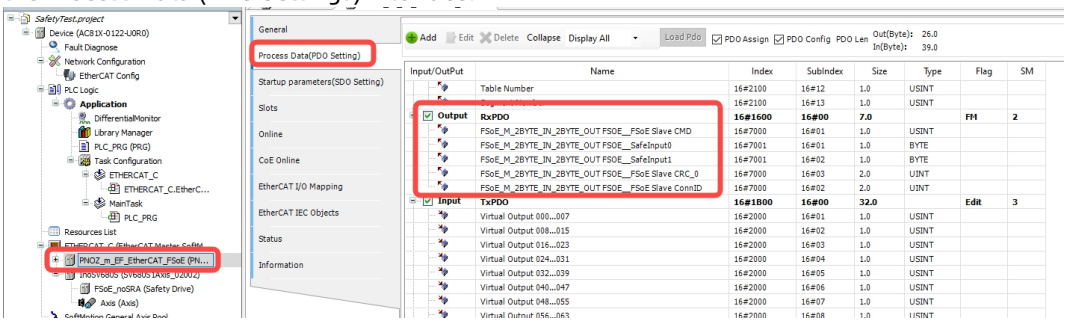


Figure 6-112 Pilz safety PDO Data structure

13). Right-click **Application** and select **Add Object** -> DUT...

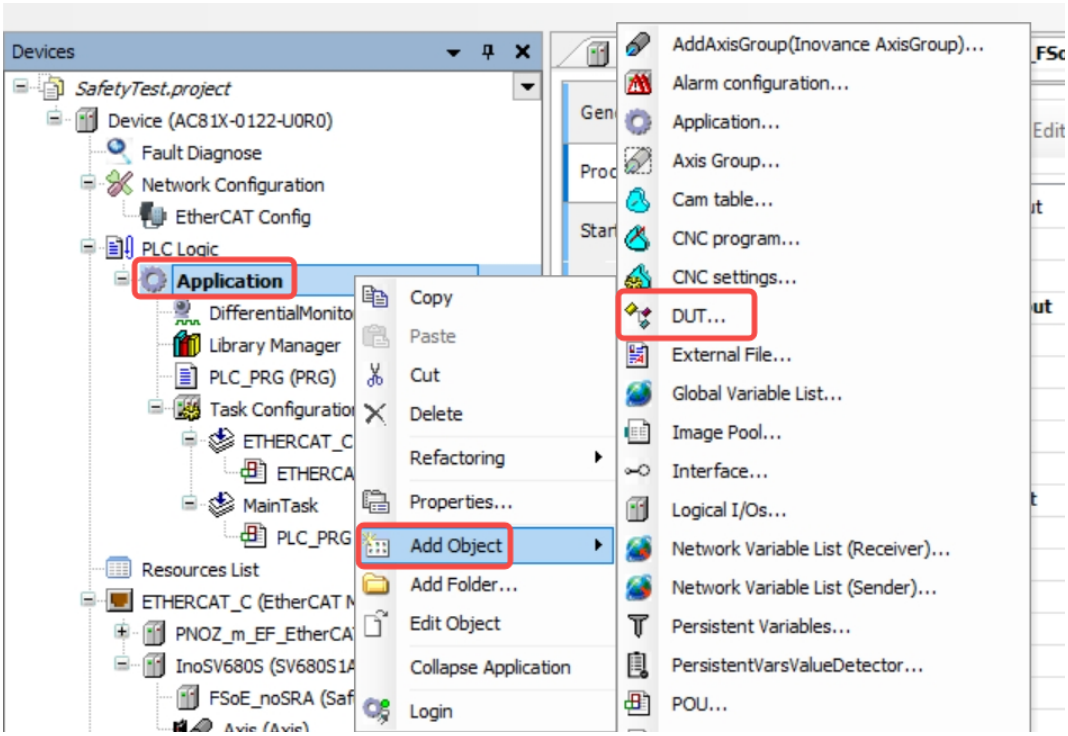


Figure 6-113 Create a data unit

14). Name the new structure FSOE_TYPE.

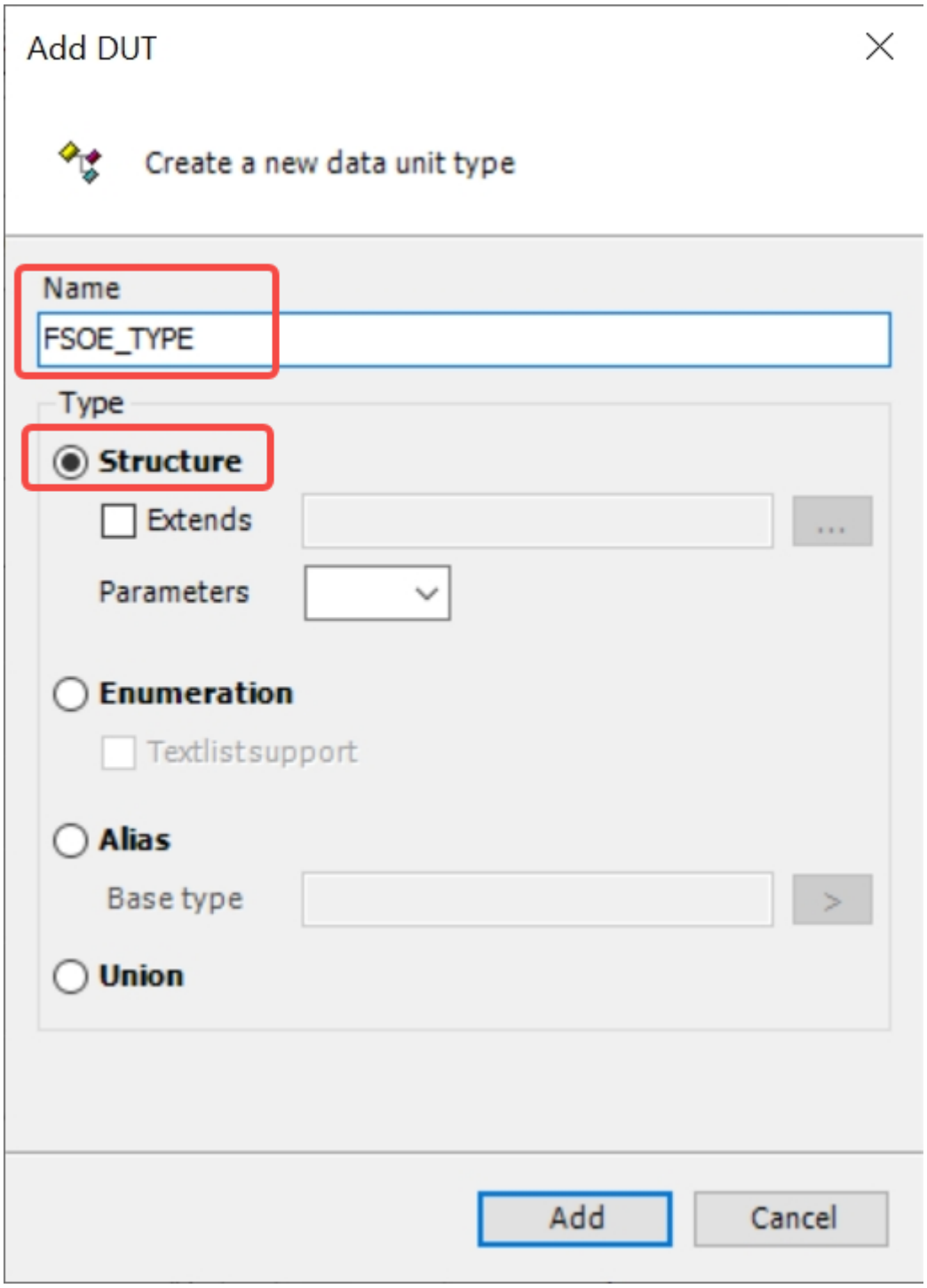


Figure 6-114 Setting data unit name and type

15). Define the structure according to Pilz's PDO data format.

```
FSOE_TYPE
1  TYPE FSOE_TYPE :
2  STRUCT
3      byCmd          : USINT;
4      bySafeData_L   : BYTE;
5      bySafeData_H   : BYTE;
6      uiCRC          : UINT;
7      uiConnID       : UINT;
8  END_STRUCT
9  END_TYPE
10
```

Figure 6-115 Defining structure variables

16). Double-click **Device** and select "Assign IO addresses in sequence" in PLC settings.

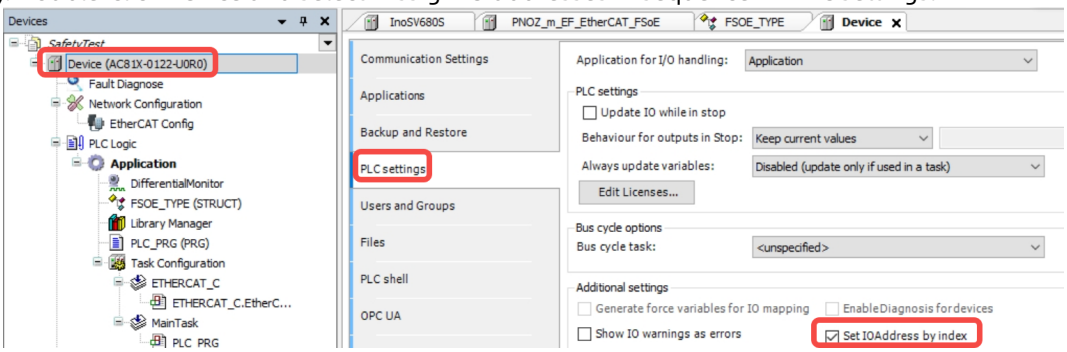


Figure 6-116 Sequential allocation of IO addresses

17). Double-click the PNOZ_m_EF_EtherCAT_FSoE device, locate the RPDO head address of the safety PLC in the EtherCAT I/O mapping interface, and change it to %QB20.

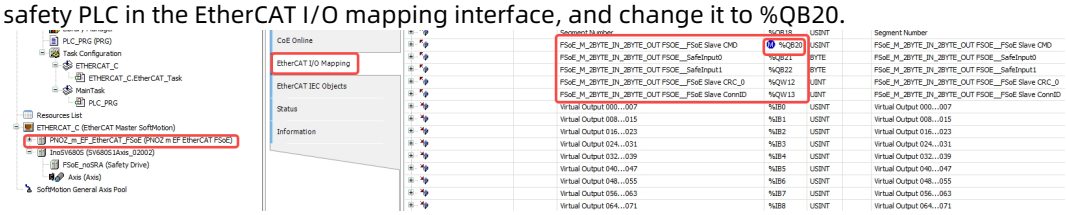


Figure 6-117 Safety PLC slave RPDO mapping address

18). View the TPDO head address of the safety PLC in the EtherCAT I/O mapping interface.

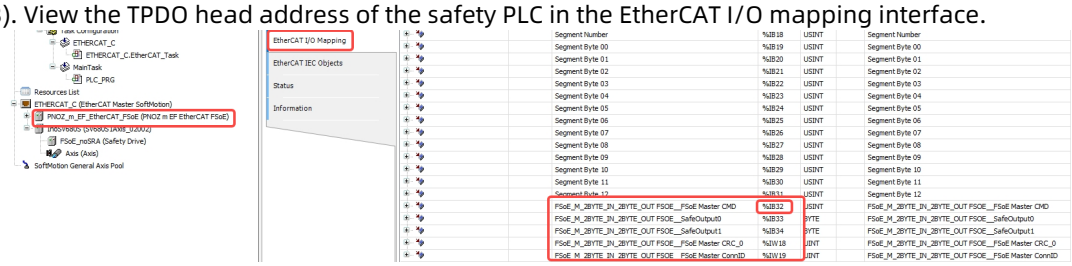


Figure 6-118 Safety PLC slave TPDO mapping address

19). Double-click the InoSV680S device to view the head address of slave PDO mapping FSoE in the EtherCAT I/O mapping interface.

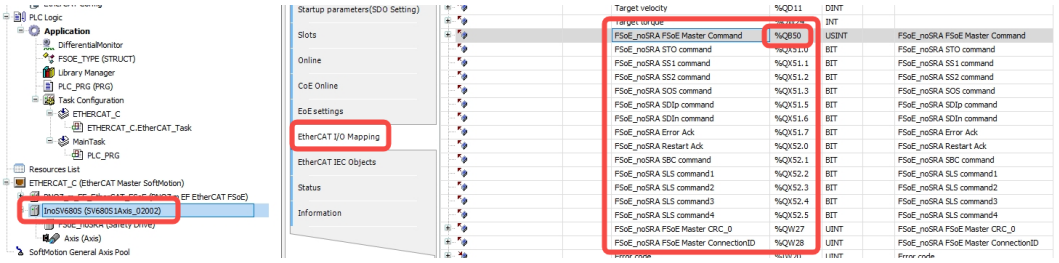


Figure 6-119 SV680S slave RPDO mapping address

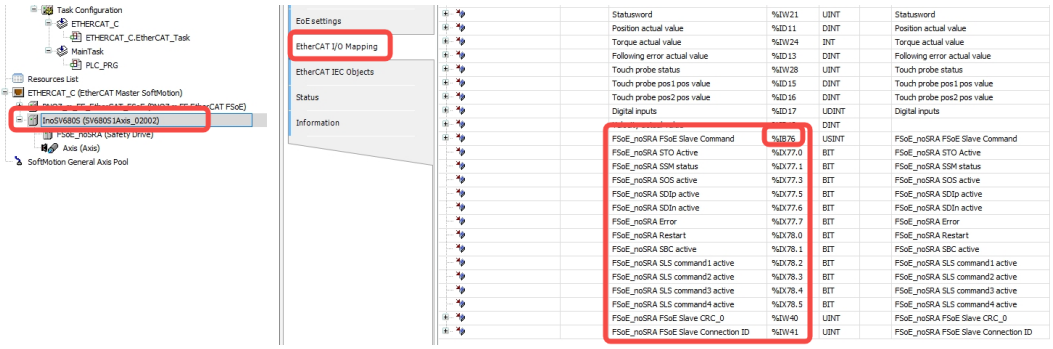


Figure 6-120 SV680S slave TPDO mapping address

20). Right-click **Application** and select **Add Object** -> **POU**.

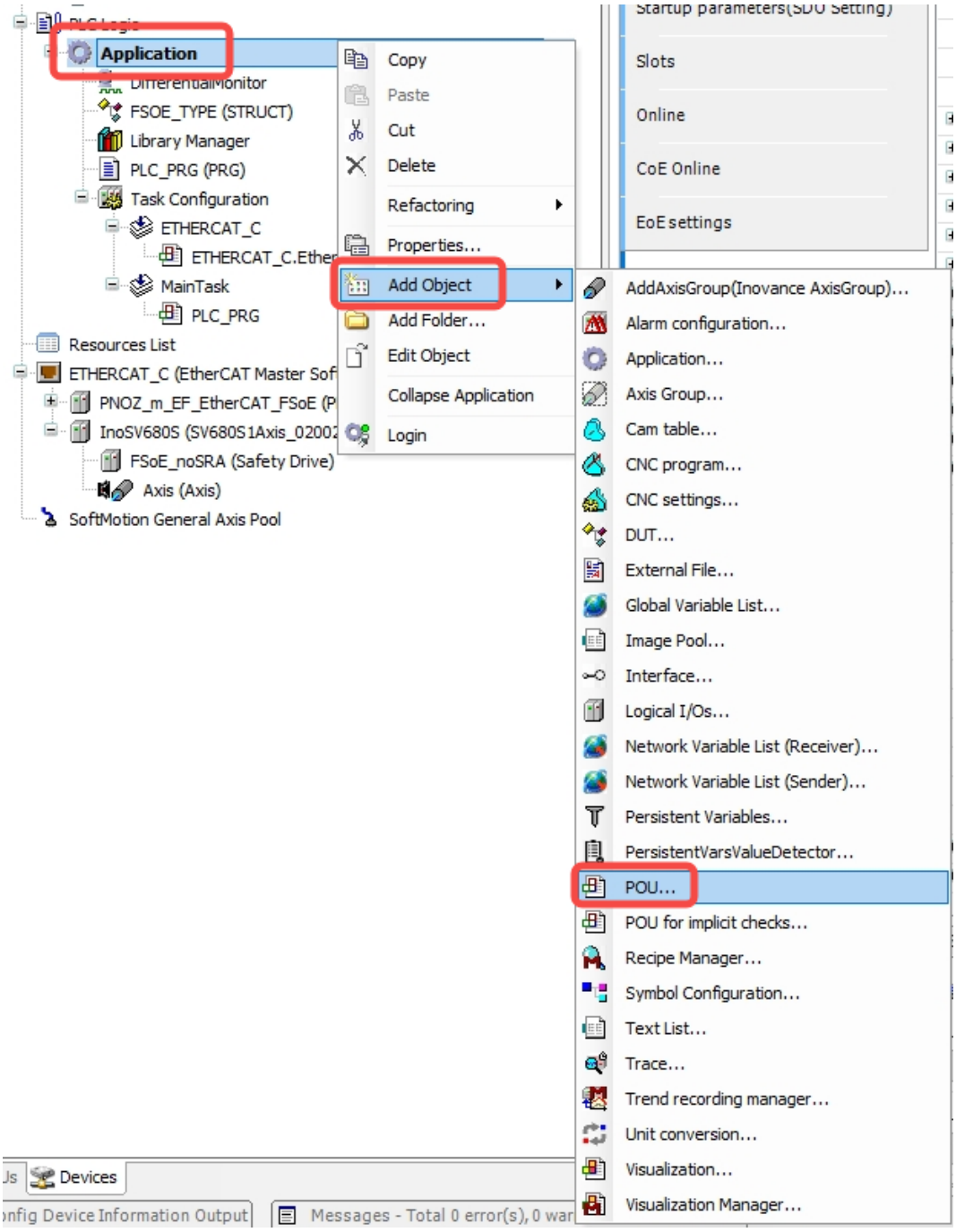


Figure 6-121 Adding a program organization unit

21). Set the name of the POU and select the type and programming language as shown below.

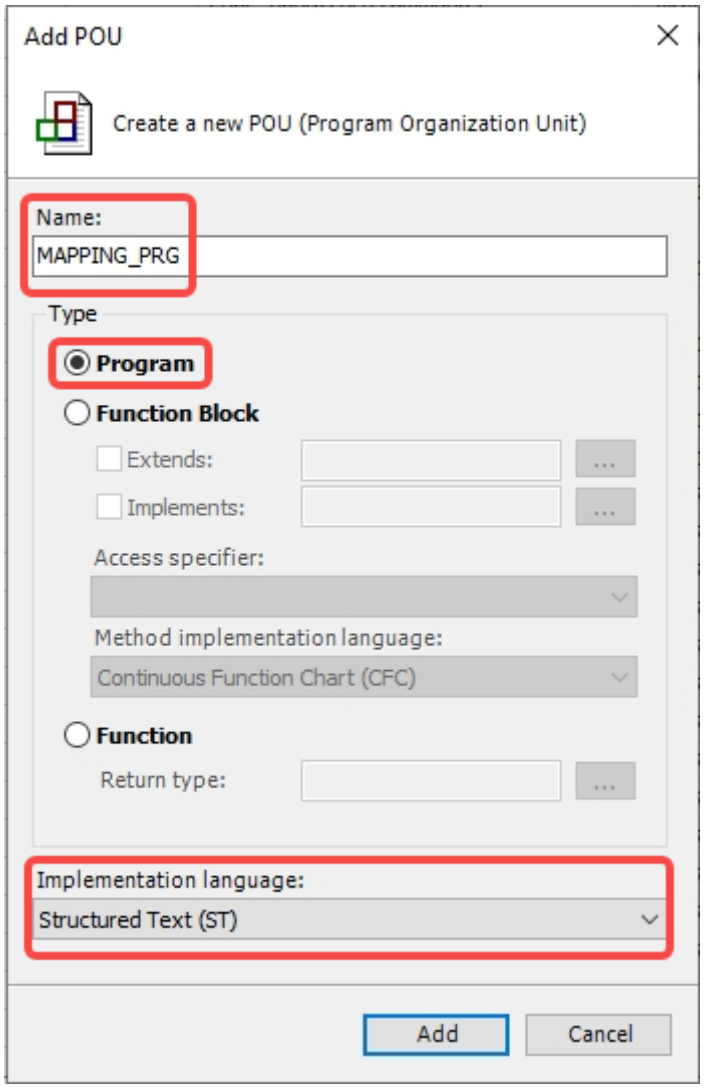


Figure 6-122 Selecting POU properties

22). Right-click EHERCAT_C under "Task Configuration" and select **Add Object** -> **Program Call.**

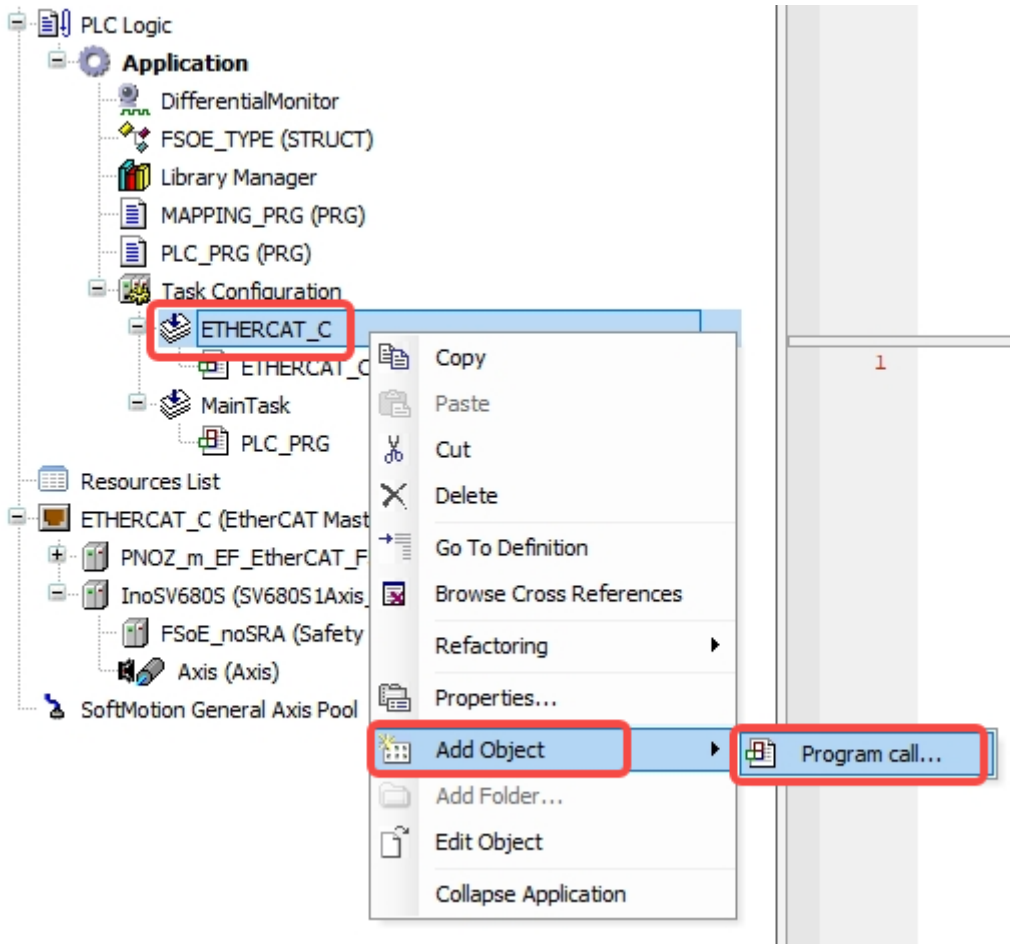


Figure 6-123 Adding a bus task program

23). Click the "..." button on the right side of the Program Call window, find the previously created program under Application, and double-click it to add it to the bus task.

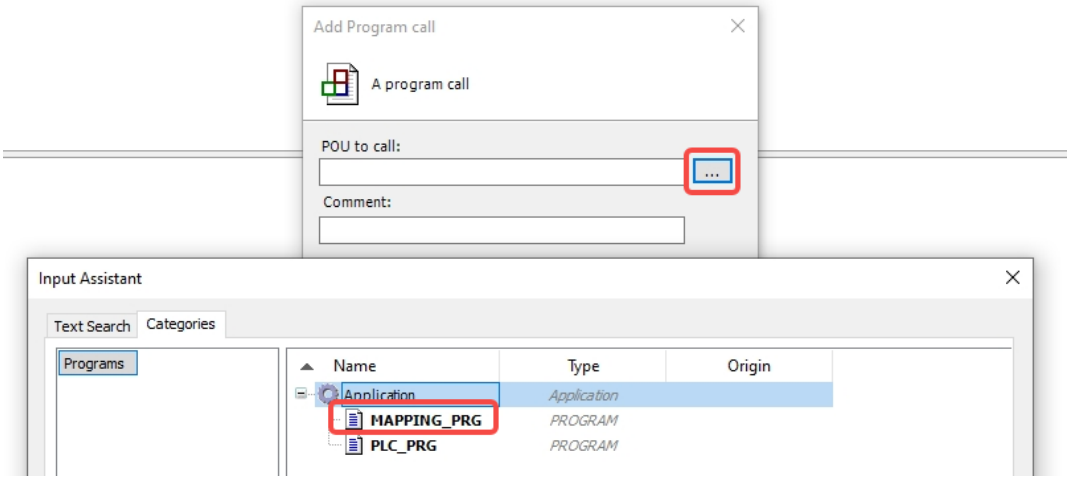


Figure 6-124 Adding a new program to the bus task

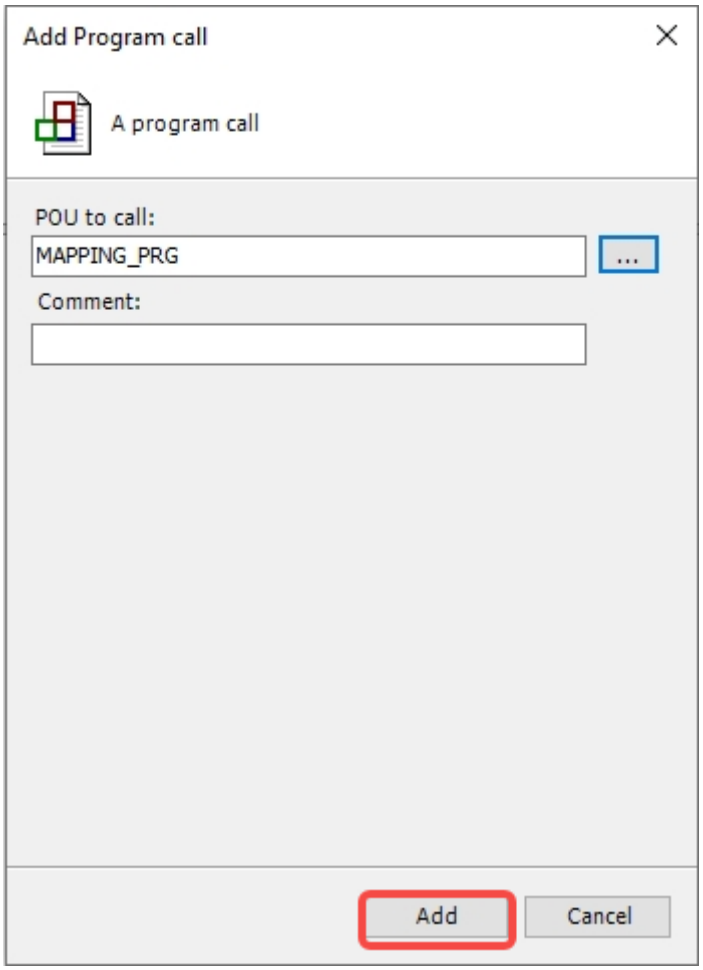


Figure 6-125 Adding a new program to the bus task

24). Create new structure variables in the program, and use AT to point them to the head address of each slave PDO mapping FSOE, and establish the PDO data connection between SV680S and safety PLC through a value assignment statement.

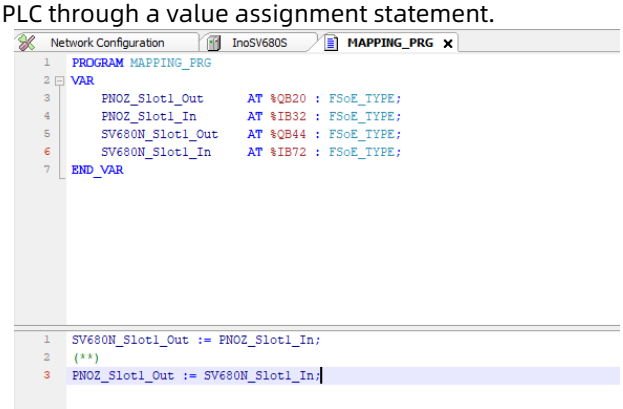


Figure 6-126 Defining structure variables and assign values

25). Click the button to compile the program. After compilation, click the button to log in, and click the **Yes** button in the pop-up window to download the program.

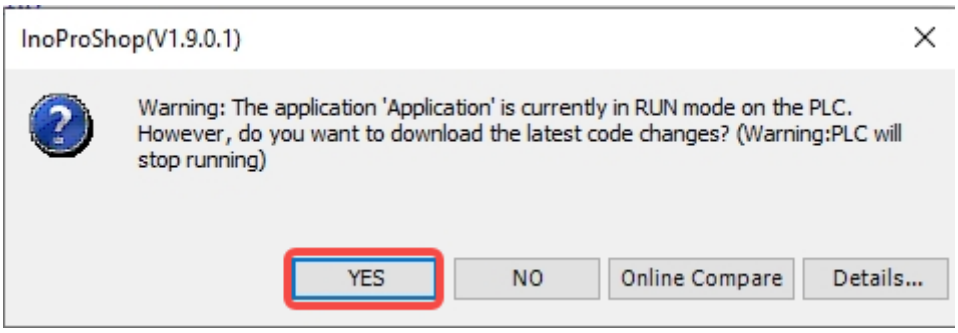


Figure 6-127 Logging in and downloading the program

26). When the download is complete, click to run the program. After a safety bus connection is established, the servo drive panel displays 8xry. If you check the current CMD of the master station and the slave station in the EtherCAT I/O mapping of the slave station device, you can see that the issued commands are all 0x36, which is 54 in decimal. If the current CMD of the master station and the slave station is always fluctuating, check whether H20.01 of the drive is configured to "3-FSOE trigger nSRA", and whether the knob address on the safety card is consistent with the FSoE slave address set in "Programming and Downloading - 2. Configuring slave information - Step C".

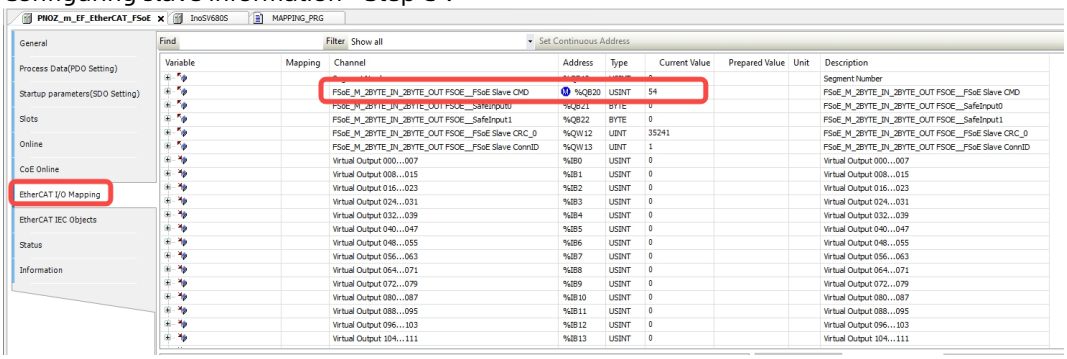
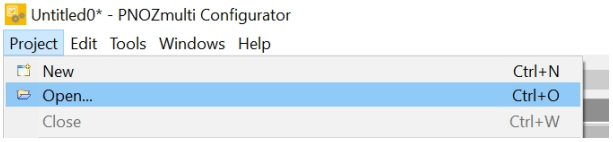


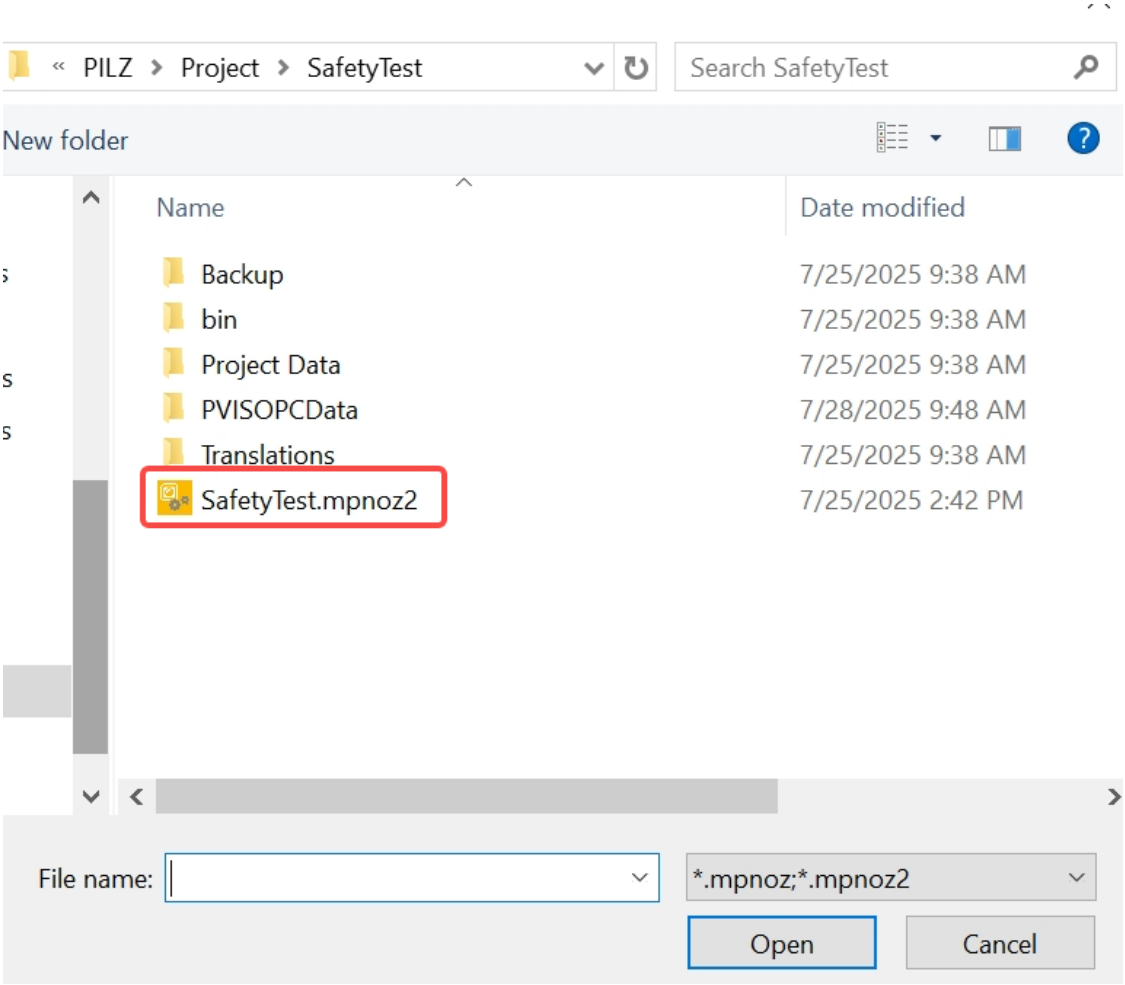
Figure 6-128 Master-slave CMD value after establishing safety bus connection

FAQ

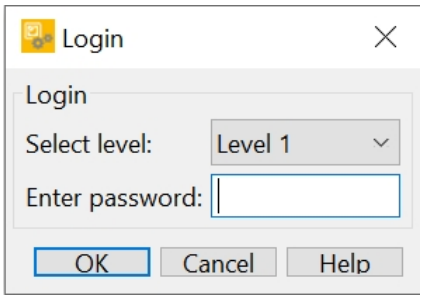
1. PLC program modification/download

To modify the program in the Pilz safety PLC, or to download a program in the Pilz safety PLC, you need to open the corresponding project in the PNOZmulti Configurator software.



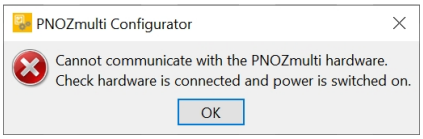


After opening the project, you only need to enter the password of any level. See "Programming and Downloading - 1. Creating a Project - Step h" for details on passwords of all levels.



After login, modify functions as needed in the user program or module program and press Ctrl + S on the keyboard or the  button on the upper left corner of the interface to save the current project, and download the program according to the steps in "Programming and Downloading - 4. Program Downloading" to the PLC. If you don't need to modify the program, just follow the steps in "Programming and Downloading - 4. Program Downloading" directly.

2. When the following window pops up in the program download step, you can check according to steps a-d.

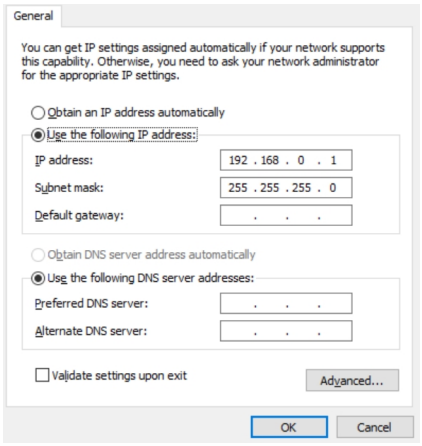


a. Check that the network cable is properly connected to the PC network port and the X1 interface of the PNOZ m B1 module.

b. Check that the IP address selected by the software panel is consistent with the IP address in the safety PLC.



c. Check whether the IPV4 address of the PC is in the same network segment as the IP address in the PLC.

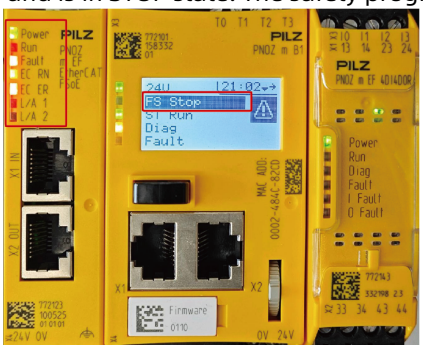


d. Check that the computer has the TwinCAT software opened or activated in the background .

If everything is OK, but the online connection still cannot be established, restart the computer and the safety PLC and try to establish the online connection again.

3. Unable to establish safety bus connection

a. Check whether there is a red light flashing on the Pilz safety PLC. The red light flashing means that the PLC is currently faulty and is in STOP state. The safety program cannot run.



b. Press the scroll wheel to check why the safety program stopped. In this case, the error message is that the project is not reset.



c. Go back to the menu bar and select **System mode**.



d. Select **Stop system** under "System mode", and press and hold the scroll wheel for 4 seconds until the countdown at the upper right corner shows 0.



e. After selection, the system will automatically enter the following interface. At this time, the system state ST changes from RUN to STOP.



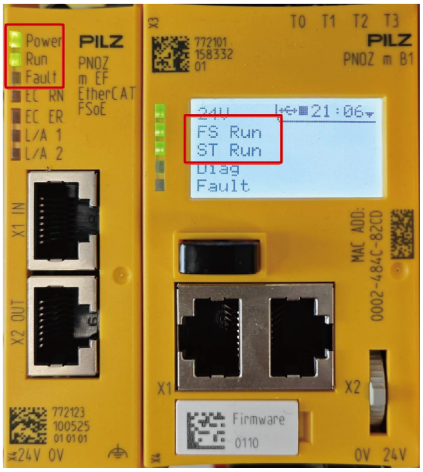
f. Go back to the menu bar and select **Project.**



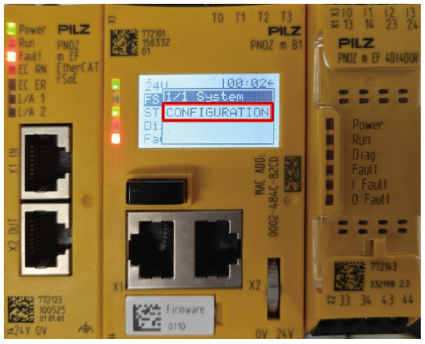
g. Select **Reset** under **Project**, and press and hold the scroll wheel for 4 seconds until the countdown in the upper right corner shows 0.



h. After the selection, the system will automatically enter the following interface. At this time, the display values of FS and ST are both RUN, the blinking red indicator is off, and the safety program can run normally.



Note: If the reason for stopping the safety program is CONFIGURATION, check whether the hardware connection between the basic module, safety bus communication module and safety input/output module is loose. Reconnect them securely and power on the Pilz safety PLC again to eliminate the fault.



6.17 Fault Reset

When the resettable safety function fault occurs, you can stop the keypad from displaying the fault using the fault reset function.

- To stop the keypad from displaying the fault/alarm, set H0d.01 (Fault reset) to 1 or activate the DI terminal assigned with DI function 2 (FunIN.2: ALM- RST, fault and alarm reset).
- For EtherCAT servo drives, enable the rising edge of the control word 6040h bit7 on the host controller to stop the keypad from displaying the fault.

Note

- For No. 1 and No. 2 resettable faults, turn off the S-ON signal before resetting the faults.
- When a non-resettable safety function fault occurs, the power must be restarted to stop the fault display.

6.18 Commissioning and Operation

6.18.1 Pre-operation Inspection

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

Table 6–15 Checklist before operation

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

6.18.2 Trial Run

Safety function in local mode control (H20.01 = 0)

1. Ensure that the wiring of the DI and DO of the safety module is correct. The DO requires an external 24V input voltage.
2. Use the software tool to configure the functions of DI and DO, for example, set DI1 to 1-STO.
3. Control the DI input voltage, observe whether the DO state changes normally and the servo drive reports any fault.
   For example, disconnect the 24V input voltage of DI1 assigned with the STO function and observe whether the STO state indicated by DO1 is active. Then restore the 24V input voltage of DI1 and observe whether the STO state output by DO1 is inactive.
4. The DI of the safety module adopts dual-channel (A&B) control. The safety function can be executed when either of the two channels is active. The safety module monitors whether there is

discrepancy at the two input signals. If the discrepancy lasts for a period of time exceeding the preset allowable time, the safety module outputs the corresponding fault information.

Safety function in bus mode control (H20.01 = 1)

1. Ensure that the safety PLC and the servo are properly connected.
2. The Beckhoff EL1904 supports up to four safety input controls, and the EL2904 supports up to four safety state output controls. Configure the RPDO corresponding to the input signal of EL1904 and TPDO corresponding to the output signal of EL2904.
   Example: Configure one EL1904 to STO RPDO and one EL2904 to STO TPDO.
3. Control the on and off of the EL1904 input signal and observe whether the EL2904 output signal changes normally and the servo drive reports any fault.
   For example, disconnect the 24V input voltage of EL1904 assigned with the STO function to let the safety type drive enter the STO state. Observe whether the STO output state indicated by EL2904 is active. Then restore the STO 24V input voltage on EL1904 to let the safety type drive exit the STO state. Observe whether the STO output state on EL2904 is inactive.

Note

In the above example, an ACK signal is not required for the safety motor to exit the STO state by default. As long as the STO command is canceled, the safety motor automatically exits the STO state.

Safety function in bus mode control (H20.01 = 3)

1. Ensure that the safety PLC and the servo are properly connected.
2. The PNOZ m EF 4DI4DOR module from Pilz supports a maximum of 4 safety input control and 4 safety status output control. The RPDO corresponding to the input signal and the TPDO corresponding to the output signal of the PNOZ m EF 4DI4DOR module can be configured using the PNOZmulti Configurator software.
3. Control the on and off of the input signal of PNOZ m EF 4DI4DOR module to observe whether the corresponding output signal changes normally, and the servo has no abnormal alarm.

For example, disconnect the 24V input voltage of the corresponding STO on the PNOZ m EF 4DI4DOR, and the drive enters the STO state. Observe whether the STO output state on the PNOZ m EF 4DI4DOR module is active. Restore the 24V input voltage to the STO, and the drive exits the STO state. Observe whether the STO output state on the PNOZ m EF 4DI4DOR module is inactive.

Note

In the above example, an ACK signal is not required for the safety motor to exit the STO state by default. As long as the STO command is canceled, the safety motor automatically exits the STO state.

6.18.3 Verification and validation

Overview

This chapter describes verification and validation of the implemented safety functionality.

Verification and validation produce documented proof of the compliance of the implementation with specified safety requirements.

Basic requirements

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

Commissioning Checklist

- Start-up test and validation
  IEC 61508, EN/IEC 62061 and EN ISO 13849 require the final assembler of the equipment to verify the operation of the safety function through acceptance testing. This acceptance test is described in the drive manual. The testing of optional safety features is described in the corresponding manuals.

  The acceptance test must be performed:

  - at initial start-up of the safety function
  - After any changes related to safety functions (wiring, assembly, settings, or other related operations)
  - after any maintenance work related to the safety function.

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

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

- Checklist

Table 6–16 Checklist of integrated STO output

No.	Item	Yes
1	Ensure that the drive runs and stops freely during commissioning.	☐
2	Stop the drive (if running), switch the input power supply off and isolate the drive from the power line by a disconnector.	☐
3	Check the STO circuit connections against the circuit diagram.	☐
4	Check that the shield of the STO input cable is grounded to the drive frame.	☐
5	Close the disconnector and switch the power supply on.	☐

No.	Item	Yes
5.1	Test the STO signal #1 when the motor is stopped: Set STO1 and STO2 to "H". Send a stop command to the drive (if running) and wait until the motor shaft is at standstill. Awake the STO function by de-energizing (low state or open-circuit) the STO input signal #1 and send a start command to the drive. Ensure that the motor stays at a standstill and the keypad of the drive displays "E150.1".	□
5.2	Set STO1 to "H" and disable the ON/RUN command of the drive. Then, reset the drive automatically and enable ON/RUN command of the drive. Finally, check whether the motor runs normally.	□
5.3	Test the STO signal #2 when the motor stops: Set STO1 and STO2 to H. Send a stop command to the drive (if running) and wait until the motor shaft is at standstill. Awake the STO function by de-energizing (low state or open-circuit) the STO input signal #2 and give a start command for the drive. Ensure that the motor stays at a standstill and the keypad of the drive displays "E150.1".	□
5.4	Set STO2 to "H" and disable the ON/RUN command of the drive. Then, reset the drive automatically and enable ON/RUN command of the drive. Finally, check whether the motor runs normally.	□
6.1	Test the STO channel 1 when the motor is running: Set STO1 and STO2 to H. Start the drive and ensure the motor is running. Awake the STO function by de-energizing (low state or open-circuit) the STO input signal 1. Ensure that the motor stops and the drive trips. Reset the fault and try to start the drive. Ensure that the motor stays at a standstill and the keypad of the drive displays "E150.1".	□
6.2	Set STO1 to "H" and disable the ON/RUN command of the drive. Then, reset the drive automatically and enable ON/RUN command of the drive. Finally, check whether the motor runs normally.	□
6.3	Test the STO channel 2 when the motor is running: Set STO1 and STO2 to H. Start the drive and ensure the motor is running. Awake the STO function by de-energizing (low state or open-circuit) the STO input signal 2. Ensure that the motor stops and the drive trips. Reset the fault and try to start the drive. Ensure that the motor stays at a standstill and the keypad of the drive displays "E150.1".	□
6.4	Set STO2 to "H" and disable the ON/RUN command of the drive. Then, reset the drive automatically and enable ON/RUN command of the drive. Finally, check whether the motor runs normally.	□
7	Document and sign the acceptance test report which verifies that the safety function is safe and acceptable for operation.	□

Verifying the achieved SIL/PL level

Verification of the functional safety system demonstrates and ensures that the implemented safety system meets the requirements specified for the system in the safety requirements specification phase.

The most convenient way to verify the required SIL/PL level reached with the implemented system is to use a specific safety calculator software.

Validation procedure

Inovance ensures that the functionality of all the required safety functions has been appropriately verified and validated.



- The system must not be considered safe until all safety functions are validated.
- The acceptance test must be performed to each safety function.

The acceptance test using the start-up checklist described below must be performed:

- at initial start-up of the safety function
- after any changes related to the safety function (wiring, components, settings, etc.)
- after any maintenance work related to the safety function. The acceptance test must include at least the following steps:

  1. having an acceptance test plan
  2. testing all commissioned functions for proper operation
  3. testing all used inputs for proper operation
  4. testing all used outputs for proper operation
  5. documenting all acceptance tests performed
  6. testing person signing and archiving the acceptance test report for further reference.

Acceptance test reports

You must store the signed acceptance test reports in the logbook of the machine. The report must include the following:

- description of the safety application (including a figure)
- a description and revisions of safety components that are used in the safety application
- a list of all safety functions that are used in the safety application
- a list of all safety related parameters and their values (the drive STO has no safety-related parameters, but listing the non-safety related parameter and its setting is recommended)
- documentation of start-up activities, references to failure reports and resolution of failures
- the test results for each safety function, check, date of the tests and confirmation by the test personnel.

You must store any new acceptance test reports performed due to changes or maintenance in the logbook of the machine.

Competence

The acceptance test of the safety function must be carried out by a competent person with expertise and knowledge of the safety function as well as functional safety, as required by IEC 61508-1 clause 6. The test procedures and report must be documented and signed by this person.

Validation checklists for start-up

Validation of the FSoE connection

1. Make sure that the EtherCAT communication is enabled.
2. Make sure that the FSoE address of the safety drive in the network is unique.
3. Make sure that the safety functions are configured to be triggered through FSoE.
4. Make sure that the FSoE-related PDOs on the master side are configured correctly.
5. Make sure the FSoE watchdog time is configured correctly.
6. Make sure that the FSoE SRA parameters are configured correctly.
7. Make sure that no faults or warnings are displayed on the operation panel.

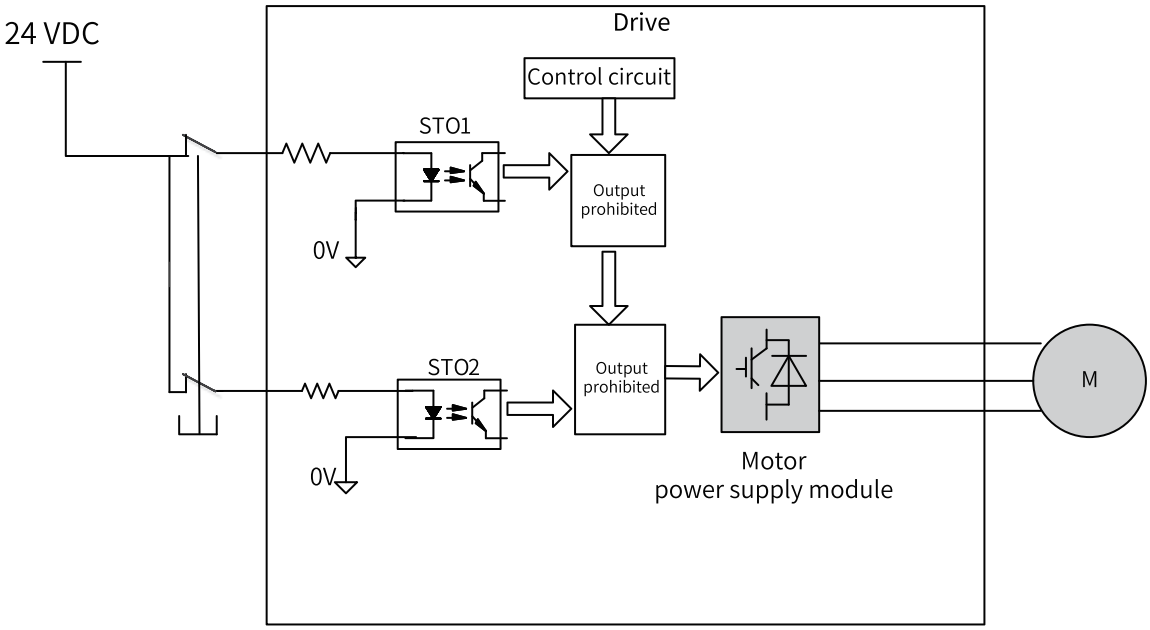
Validation of safety functions

Once the system is fully configured and wired for the safety functions, and the startup safety check has been done, you must do the following functional test procedure for each safety function:

- Have the system at the Operational state when the safety function is requested.
- Make sure that the acknowledgment method has been configured as suitable for the application (for example, manual or automatic acknowledgment).
- Activate the safety function by requesting it with the designated trigger device.
- Verify that the desired functionality takes place.
- Document the test results to the acceptance test report.
- Sign and file the acceptance test report.

7 STO Integration

7.1 Overview



By cutting off the output of the motor supply module, the power supply current and torque of the motor is off.

Figure 7-1 Schematics of the STO function

Safe Torque Off (STO) is a safety function that complies with IEC 61800-5-2:2016. It is built into Inovance SV680N-INT series servo drives.

Power off and on the drive every three months or trigger STO by disconnecting the 24 V input of CN6, so that STO can be reset regularly.

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

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

The STO function table is shown below.

STO1 input	STO2 input	PWM signal
H	H	Normal
L	H	Inhibition
H	L	Inhibition
L	L	Inhibition

STO (safe torque off)	
Assignment	Cuts off the power of the motor.
Description	The safe torque off (STO) function brings the machine safely into a no-torque state and prevents it from unexpected start. When the STO function is enabled, the servo stops according to the stop mode (H02.08).

STO (safe torque off)	
Safety state	Disables the PWM gating signal of the drive.
Operation mode	High demand mode or continuous mode.

7.2 Functions and Monitoring

Functions

The keypad displays the STO function state and fault information. The following table describes the fault codes, causes, and solutions related to the STO function. Contact Inovance technical support if the fault persists after corrective actions listed in the following table are taken.

Fault code	Fault message	Fault mechanism	Cause	Solution
E150.0	STO safety state applied	The STO input protection applies (safety state).	One or two 24 V inputs are disconnected simultaneously, triggering the STO function.	There is no need to take any corrective actions. After the STO terminal is back to normal, clear the fault by using the fault reset function. Check whether the 24 V power supply for the STO is stable. Tighten the cables that are loose or disconnected. Replace the servo drive.
E150.1	STO input state abnormal	The single-channel input of STO is ineffective.	1. The STO input power supply is abnormal.	Check whether the 24 V power supply for the STO is stable. Tighten the cables that are loose or disconnected.
			2. The STO input resistor is abnormal.	Replace the servo drive.
			3. The STO fails.	Replace the servo drive.
E150.2	Buffer 5 V voltage detection exception	The MCU monitors the 5 V power supply of the PWM Buffer to detect whether overvoltage or undervoltage occurs. If the voltage is abnormal, this fault code will be displayed.	The 5 V voltage supplied to the STOBuffer is abnormal due to undervoltage or overvoltage.	Replace the servo drive.
E150.3	STO input circuit hardware diagnosis failure	Short circuit occurs in the optocoupler in the upstream hardware circuit of STO. The drive displays E150.3.	Direct connection occurs on the upstream optocoupler of STO1 or STO2.	Replace the servo drive.

Fault code	Fault message	Fault mechanism	Cause	Solution
E150.4	STO activated	An error occurs on the PWM buffer integrated circuit during initialization detection upon power-on (the PWM signal cannot be blocked). The drive displays E150.4.	STOBuffer power-on detection error	Replace the servo drive.
E150.5	STO input signal interference	The STO signal is being disturbed, and the noise filtering condition defined by H0A.73 is not met.	The STO terminal is in poor contact or the external 24 V input voltage is unstable, which may lead to malfunction of STO.	Replace the 24 V power supply to ensure the STO terminal input voltage is stable.

Note

- For a motor with brake, if either STO1 or STO2 closes, the drive will be disabled within 30 ms (STO response time).
- For a motor without brake, if either STO1 or STO2 closes, the drive will be disabled within 5 ms (STO response time).

EDM signal DO output

When the 24 V voltage of STO1 and STO2 is cut off, the EDM DO signal is active. Otherwise, the EDM DO signal is inactive.

In this case, both STO1 and STO2 are filtered signals. When EDM is active, the PWM signal is blocked by the servo drive.

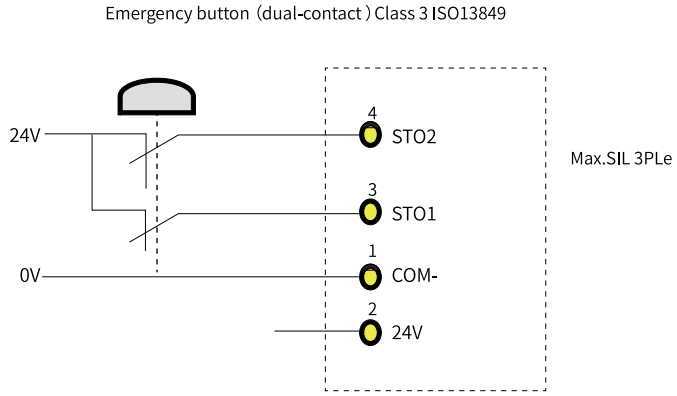
Signal name	Symbol	Optocoupler logic			
Safety input	STO1	ON	ON	OFF	OFF
	STO2	ON	OFF	ON	OFF
EDM output	EDM	OFF	OFF	OFF	ON

Note

The DO output of this EDM is only a monitoring signal to detect whether a safety function is triggered, not a safety signal output.

The EDM state of the integrated STO can only be output through the non-safe DO output of the drive, not through the DO output on the safety module.

Example



7.3 Fault Reset

Fault reset means the normal operation can be recovered when the following conditions are met from the STO state to the ready state.

- The PWM buffer is disabled as the enable terminal is pulled up during power-on, so the PWM signal is inhibited.
- The PWM buffer is disabled as the enable terminal is pulled up during initialization of the MCU, so the PWM signal is inhibited. Such condition is cleared and servo drive works normally after initialization is done.
- When all of the following conditions are met, the servo system that enters the safe state through the STO function can be back to normal with the safe state cleared after auto-reset of the drive.
  - The input state of the STO request must be "high".
  - The servo ON or servo RUN command must be inactive.
  - No hazardous faults exist.

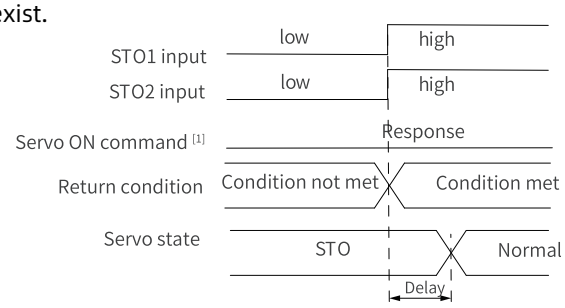


Figure 7-2 Return condition of external STO request state

Note

[1]: The servo ON command is a servo-enabled command, not an internal servo-enabled state.

- When STO_IN (STO1 or STO2 input) is restored to 24 V, the EDM and servo ready signals are immediately reset to 0. When both STO1 and STO2 are restored to 24 V at the same time, the servo ready output signal and the servo operation signal are activated after 400 ms. When the drive operates, the PWM drive signal is outputted.

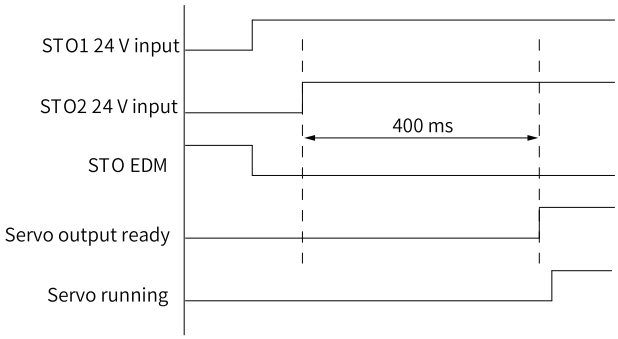
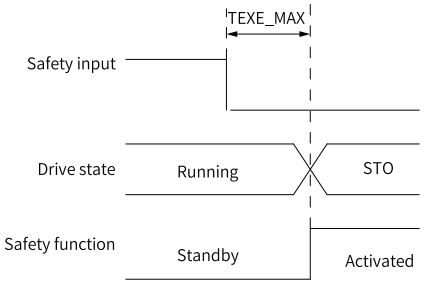


Figure 7-3 Servo drive reset sequence diagram

7.4 Safety Function Response Time

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

If either or both of them are at low level simultaneously, the PWM signal will be blocked in the next 30 ms [1].



Note

[1]: The typical response time is 30 ms. The maximum response time is 100 ms, given the discrete type of the electronic device.

7.5 Acceptance and Verification

Basic requirements

- Technicians must be trained to understand the requirements and principles of safety-related system design and commissioning.
- Maintenance personnel must be trained to understand the requirements and principles of safety-related system design and operation.
- Operators must be trained to understand the requirements and principles of safety-related system design and operation.
- The safety-related circuit on the control board that fails to operate must be replaced with a new one because the circuit is not repairable.

Commissioning checklist

- Start-up test and validation
  IEC 61508, EN/IEC 62061, and EN ISO 13849 require the final assembler of the equipment to verify the operation of the safety function through acceptance testing.

  The acceptance test must be performed at the following stages:

  - The initial start-up of the safety function.
  - After any changes related to the safety function, such as wiring, components, and settings.
  - After any maintenance work related to the safety function.

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

  Signed acceptance test reports must be stored in the logbook of the machine. The report shall include documentations of start-up activities and test results, fault reports, and troubleshooting. Any new acceptance tests that are performed due to changes or maintenance shall be recorded in the logbook.

- STO checklist

No.	Check item	Result
1	Ensure that the drive runs and stops freely during commissioning.	☐
2	Stop the drive (if running), switch off the input power supply and isolate the drive from the power line by using a circuit breaker.	☐
3	Check the STO circuit connections based on the circuit diagram.	☐
4	Check whether the shield of the STO input cable is grounded to the drive frame.	☐
5	Turn off the circuit breaker and switch on the power supply.	☐
5.1	Test the STO signal #1 when the motor stops: Set STO1 and STO2 to H. Send a stop command to the drive (if running) and wait until the motor shaft reaches a standstill. Awake the STO function by de-energizing (low state or open-circuit) the STO input signal #1 and send a start command to the drive. Ensure that the motor stays at a standstill and the keypad of the drive displays E150.1.	☐
5.2	Set STO1 to H and disable the ON/RUN command of the drive. Then, reset the drive automatically and enable the ON/RUN command of the drive. Finally, check whether the motor runs normally.	☐
5.3	Test the STO signal #2 when the motor stops: Set STO1 and STO2 to H. Send a stop command to the drive (if running) and wait until the motor shaft reaches a standstill. Awake the STO function by de-energizing (low Level or open-circuit) the STO input signal 2 and send a start command to the drive. Ensure that the motor stays at a standstill and the keypad of the drive displays E150.1.	☐
5.4	Set STO2 to H and disable the ON/RUN command of the drive. Then, reset the drive automatically and enable the ON/RUN command of the drive. Finally, check whether the motor runs normally.	☐

No.	Check item	Result
6.1	Test the STO channel 1 #1 when the motor is running: Set STO1 and STO2 to H. Start the drive and ensure the motor is running. Awake the STO function by de-energizing (low state or open-circuit) the STO input signal #1. Ensure that the motor stops and the drive trips. Reset the fault and try to start the drive. Ensure that the motor stays at a standstill and the keypad of the drive displays "E150.1".	□
6.2	Set STO1 to H and disable the ON/RUN command of the drive. Then, reset the drive automatically and enable the ON/RUN command of the drive. Finally, check whether the motor runs normally.	□
6.3	Test the STO channel 2 #1 when the motor is running: Set STO1 and STO2 to H. Start the drive and ensure the motor is running. Awake the STO function by de-energizing (low state or open-circuit) the STO input signal #2. Ensure that the motor stops and the drive trips. Reset the fault and try to start the drive. Ensure that the motor stays at a standstill and the keypad of the drive displays "E150.1".	□
6.4	Set STO2 to H and disable the ON/RUN command of the drive. Then, reset the drive automatically and enable the ON/RUN command of the drive. Finally, check whether the motor runs normally.	□
7	Sign and document the acceptance test report which verifies that the safety function is safe and acceptable for operation.	□

Special requirements

You must conduct STO diagnosis every three month by powering off and powering on the drive once or running the STO function once.

Note

There are two ways to perform STO diagnosis:

- Power off and restart;
- Trigger and then cancel STO.

You can use either of them.

8 Communication

8.1 Communication via EtherCAT

8.1.1 Communication Overview

8.1.1.1 Communication Technical Data

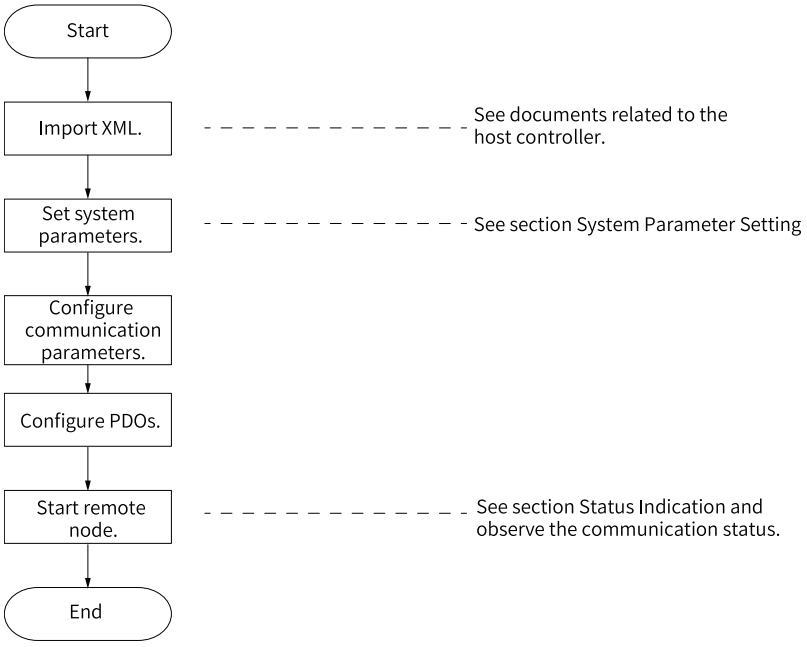
Item		Specification
Ether-CAT Basic per-for-mance of slave	Communication protocol	EtherCAT protocol
	Service supported	CoE (PDO, SDO)
	Synchronization mode	DC - Distributed clock FreeRun
	Physical layer	100Base-TX
	Baud rate	100 Mbit/s (100Base-TX)
	Duplex mode	Full duplex
	Topology	Ring, linear, star, tree
	Transmission medium	Cat5e shielded cables or Cat6e cables
	Transmission distance	Less than 100 m between two nodes (with proper environment and cables)
	Number of slaves	65535 by protocol
	EtherCAT frame length	44 bytes to 1498 bytes
	Process Data	Max. 1,486 bytes per Ethernet frame
	Synchronous jitter of two slaves	< 1 μs
	Communication code error rate	10^{-10} Ethernet standard
	Min. sync period	250μs
Ether-CAT config-uration unit	Number of FMMU units	8
	Number of storage synchronization management units	8
	Process data RAM	8 KB
	Distributed clock	64-bit
	EEPROM capacity	32 kbit

8.1.1.2 Communication Specifications

Item		Specification
Communication protocol		IEC 61158 Type 12, IEC 61800-7 CiA 402 Drive Profile
Application layer	SDO	SDO request, SDO response
	PDO	Variable PDO mapping, fixed PDO mapping
	CiA402	Profile Position Mode (PP)
		Profile Velocity Mode (PV)
		Profile Torque Mode (PT)
		Homing mode (HM)
		Cyclic synchronous position mode (CSP)
		Cyclic synchronous velocity mode (CSV)
		Cyclic synchronous torque mode (CST)
Physical layer	Transmission protocol	100Base-TX (IEEE802.3)
	Maximum distance	100 m
	Interface	RJ45 × 2 (IN, OUT)

8.1.1.3 Protocol Description

EtherCAT is an industrial Ethernet-based fieldbus system that features high performance, low cost, ease of use, and flexible topology. It is applicable to industrial applications requiring ultra-high speed I/O network. EtherCAT adopts standard Ethernet physical layer with twisted pairs or optical fibers (100Base-TX or 100Base-FX) used as the transmission media.



An EtherCAT system includes the master and the slaves. The master requires a common network adapter, and the slaves require a special slave control chip, such as ET1100, ET1200, and FPGA.

EtherCAT can process data at the I/O layer:

- No lower-layer sub-bus required
- Extremely low gateway latency

- One system covers all devices, including input and output devices, sensors, actuators, drives, and displays.
- Transmission rate: 2 × 100 Mbit/s (high-speed Ethernet, full duplex mode).
- Synchronization: synchronization jitter < 1 μs (number of nodes up to 300, cable length within 120 m)

Refresh time:

256 digital I/Os: 11 μs

1000 digital I/Os distributed in 100 nodes: 30 μs = 0.03 ms

200 analog I/Os (16-bit): 50 μs, sampling rate 20 kHz

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

12000 DI/DOs: 350 μs

To support devices of various types and wider applications, the following EtherCAT-based application protocols are established:

- CANopen over EtherCAT (CoE)
- Safety over EtherCAT (SoE, servo drive safety compliant with IEC 61800-7-204)
- Ethernet over EtherCAT (EoE)
- File over EtherCAT (FoE)

The slave device only needs to support the suitable application protocol.

Note

EtherCAT® is registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

8.1.2 Hardware Configuration

8.1.2.1 Terminal Arrangement

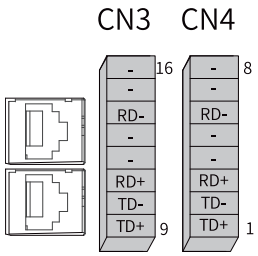


Figure 8-1 Communication Terminal pin layout of the servo drive

Table 8–1 EtherCAT communication terminal pins

Pin No.	Name	Description
1	TD+	Data transmission +
2	TD-	Data transmission –
3	RD+	Data reception +
4 and 5	-	-
6	RD-	Data reception –
7 and 8	-	-

Pin No.	Name	Description
9	TD+	Data transmission +
10	TD-	Data transmission -
11	RD+	Data reception +
12 and 13	-	-
14	RD-	Data reception -
15 and 16	-	-

8.1.2.2 EtherCAT Communication Wiring Example

CN3 and CN4 are EtherCAT connectors. Connect CN4 (IN) to the communication port of the master and CN3 (OUT) to the next slave. For details about the CN3 and CN4 terminal pins, see *"Table 8-1 EtherCAT communication terminal pins" on page 439*.

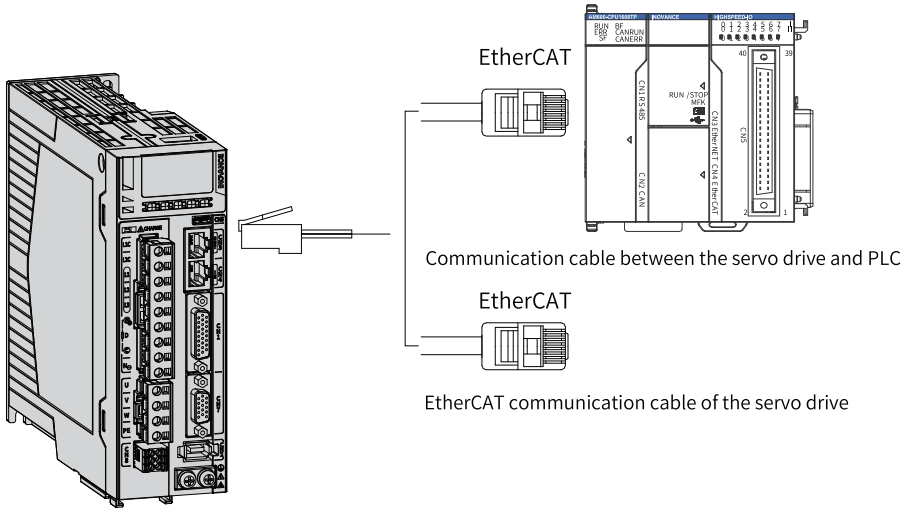


Figure 8-2 Wiring of communication cables

Topology

The communication topology of EtherCAT is flexible without any limit, as shown in *"Figure 8-3 Communication network topology" on page 441*. The drive carries IN and OUT ports.

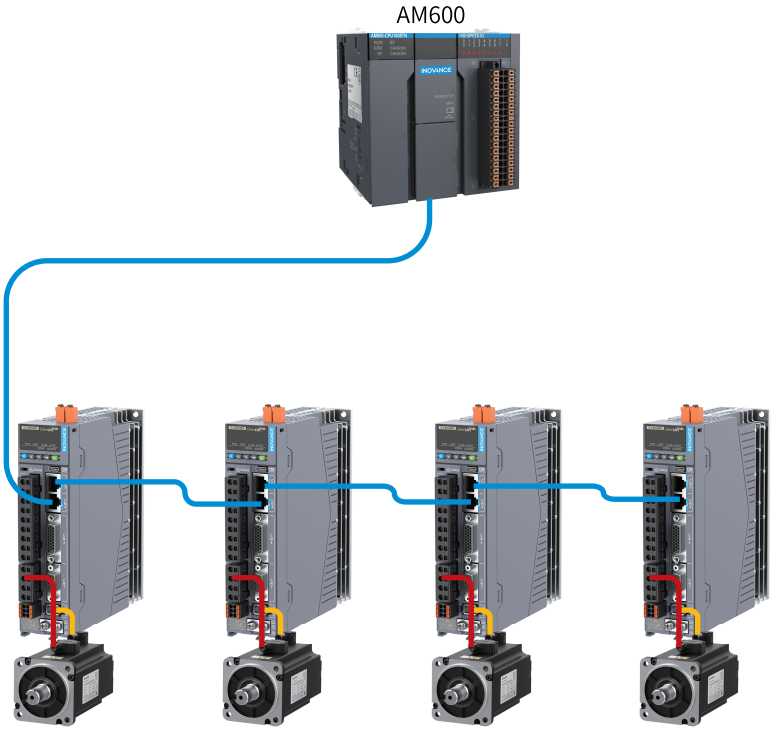
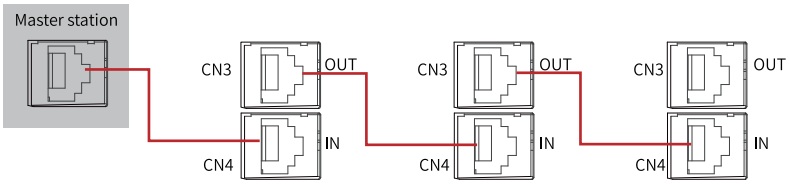
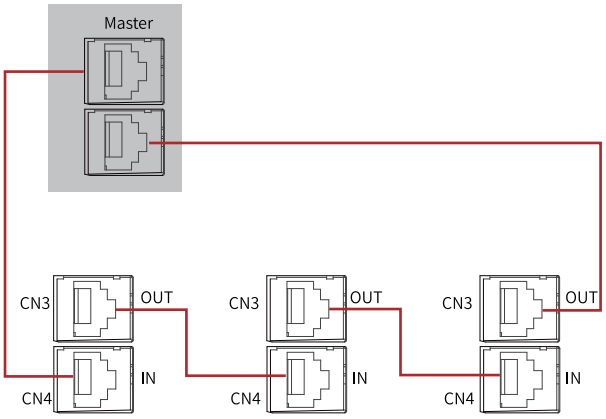


Figure 8-3 Communication network topology

Linear topology



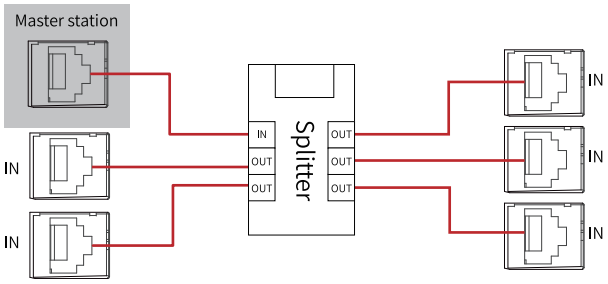
Ring topology



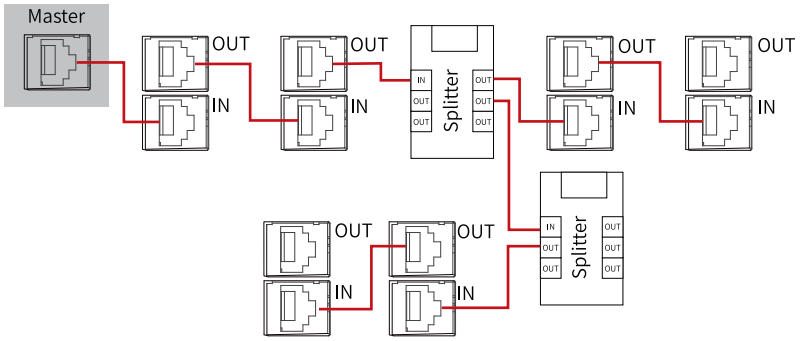
Note

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

Star topology



Tree topology



8.1.3 Communication Transmission Mode

8.1.3.1 Structure of EtherCAT Communication

Multiple kinds of application protocols are available for EtherCAT communication. The IEC 61800-7 (CiA 402)-CANopen motion control profile is used for the drive. The following figure shows the EtherCAT communication structure at the CANopen application layer.

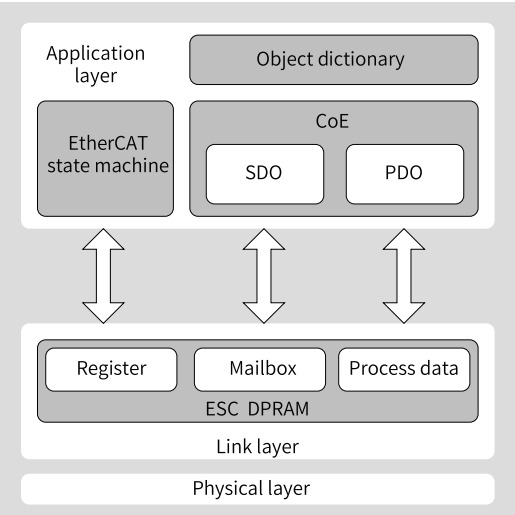


Figure 8-4 EtherCAT communication structure at CANopen application layer

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.

8.1.3.2 Communication State Machine

The following figure shows the state transition diagram of EtherCAT.

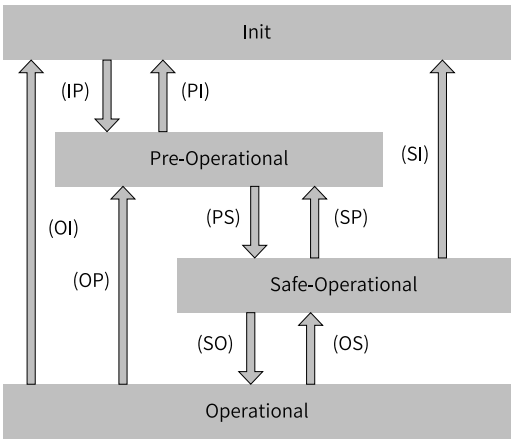


Figure 8-5 EtherCAT state machine

The EtherCAT device must support four states and coordinate the state relation between the master and slave applications during initialization and operation.

- Init: initialization, shortened as I
- Pre-Operational: pre-operational, shortened as P
- Safe-operational: shortened as S
- Operational: shortened as O

Transition from Init state to Operational state must be in the sequence of Init→Pre-Operational→Safe→Operational, and then Operational step by step. In transition from the Operational state to the Init state, certain steps can be skipped. The following table lists the state transition and the initialization process.

State	SDO	RPDO	TPDO	Description
Init (I)	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	The master configures the slave addresses, mailboxes, and distributed clocks (DCs). Request the Pre-Operational state.
Pre-Operational (P)	Yes	No	No	Mailbox data communication in the application layer (SDO)

State	SDO	RPDO	TPDO	Description
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 the 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 request the Operational state.
Operational (O)	Yes	Yes	Yes	Normal operational state Both the input and output are active. Mailbox communication can still be used.

8.1.3.3 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 SV670NS-INT series servo drive only support the DC sync mode. The synchronization period, which is controlled by SYNC0, varies with different motion modes.

Note

- The SYNC signal can be used to synchronize all the salves with an error less than 1 μs. The master must synchronize all the slaves to the same clock and continues doing so during operation to prevent clock skew caused by the difference in the crystal oscillator. This is usually achieved by synchronizing the 0x910 register in ESC.
- SYNC starting time = 0x990 register (ESC) - 0x920 Note that the DC mode (0x98 = 0x03) can be enabled only after 0x910 reaches the starting time. If the starting time of SYNC is incorrect, the 0x134 status register of ESC will report the error code of 0x2D.

8.1.3.4 Status indicator

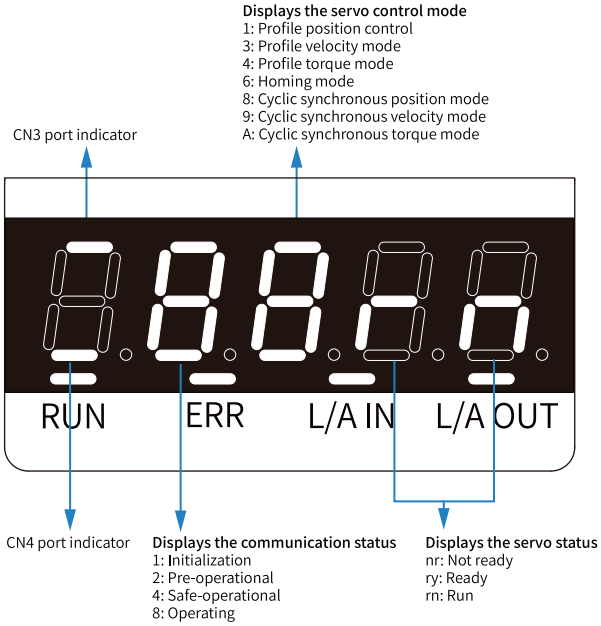


Figure 8-6 Status indicators

If a value of 0 is displayed, no value is written or a value of 0 is written to 6060h, or H02.00 (control mode) is set to 0, 1, or 2.

Communication connection status

The connection status of the two RJ45 ports are indicated by "-" on the upper and lower part of the 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.

Steady ON: Communication connection is detected in the physical layer.

Communication status

The 2nd LED indicates the status of the EtherCAT state machine of the slave in the form of characters, as described in the following table.

Status of the EtherCAT state machine

State	SDO	RPDO	TPDO	Description	Keypad display
Initialization	No	No	No	Communication initialization	1: Steady ON
Pre-operation	Yes	No	No	Network configuration initialization SDO used	2: Blinks at an interval of 400 ms
Safe-operation	Yes	No	Yes	SDO, TPDO, and distributed clock mode are available	4: Blinks with a period of 1200 ms, on for 200 ms and off for 1000 ms
In operation	Yes	Yes	Yes	Normal operating state	8: Steady ON

Display of control modes

The 3rd bit on the LED keypad indicates the operation mode of the servo drive in the form of a hexadecimal digit without blinking, as described in the following table.

The operation modes include the following:

Modes of operation (6060h)	Keypad display
1: Profile position mode	1
3: Profile velocity mode	3
4: Profile torque mode	4
6: Homing mode	6
8: Cyclic synchronous position mode	8
9: Cyclic synchronous velocity mode	9
10: Cyclic synchronous torque mode	A

Display of servo status

The 4th and 5th LEDs indicate the servo status of the slave.

Servo states include:

State	Description	Keypad display
Reset	Initialization	reset
Not ready	Initialization is completed. The control circuit is switched on but the main circuit is not switched on. Not ready	nr
Ready	The main circuit is switched on, but the S-ON signal is inactive. Ready	ry When the absolute speed value is higher than the value of H06.16, the character "y" blinks. When the communication layer is in the pre-operational or safe-operational state, the blinking frequency is the same as that of character "2" or "4". For details, see *" Communication status" on page 445*. When the communication layer is in Init or Operational state, the blinking frequency is 2 Hz.
In operation	The S-ON signal is active and the motor is energized. Run	rn When the absolute speed value is higher than the value of H06.16, the character "n" blinks. When the communication layer is in the pre-operational or safe-operational state, the blinking frequency is the same as that of character "2" or "4". For details, see *" Communication status" on page 445*. When the communication layer is in Init or Operational state, the blinking frequency is 2 Hz.

Description of indicators

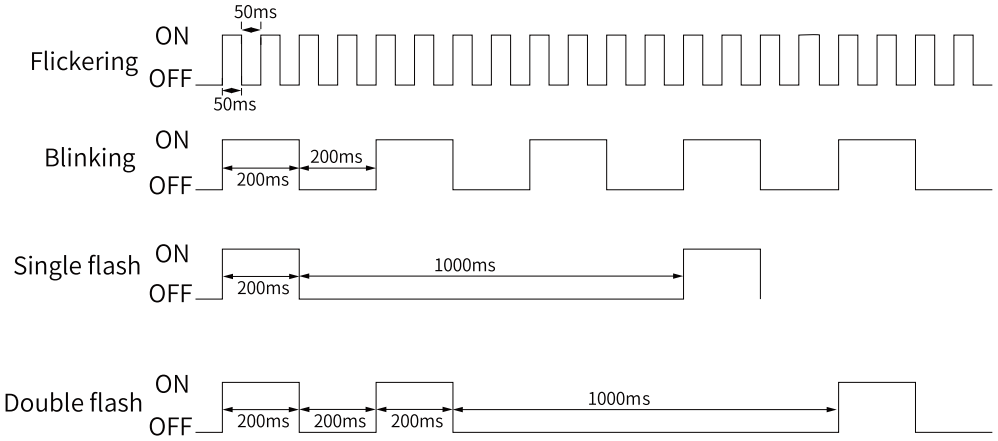


Figure 8-7 Description of indicators

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

[1]: L/A IN and L/A OUT indicate the LINK state and operation state of the physical layer of each port.

The color of the ERR indicator is red, and the other three indicators are green.

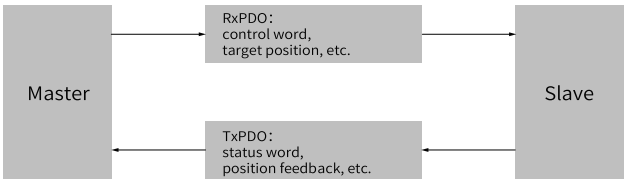
8.1.4 Communication Data Frame Structure

8.1.4.1 Process Data

The real-time data transmission of EtherCAT is achieved through the process data (Process data Object). PDOs can be divided into RPDOs (Receive PDO) and TPDOs (Transmit PDO) based on the

data transmission direction. RPDOs transmit the master data to the slave, and TPDOs returns the slave data to the master.

According to section "EtherCAT Specification - Part 5: Application Layer Service Definition" of the international EtherCAT Specification <ETG.1000.5 S(R)V1.0.4>, the master station must ignore input data before the slave station acknowledges that it has entered the SafeOP state. Therefore, process data is considered valid only after the slave has entered the SafeOP state. Reading and using process data in during the Init or PreOP state may result in undefined behaviors, such as receiving anomalous feedback or inconsistent axis positions.



The SV680N-SINT series servo drive allows users to assign the PDO list and define the PDO mapping objects.

PDO mapping

The PDO mapping indicates the mapping for application objects (realtime process data) between the object dictionary and PDO. 1600h to 17FFh are RPDOs, and 1A00h to 1BFFh are TPDOs. The SV680N-SINT series servo drive provides 7 RPDOs and 6 TPDOs, as listed in the following table.

RPDO (7)	1600h, 1601h	Mutable mapping
	1701h-1705h	Fixed mapping
TPDO (6)	1A00h, 1A01h	Mutable mapping
	1B01h-0x1B04h	Fixed mapping

Fixed PDO mapping

The SV680N-SINT series servo drive provides five fixed RPDOs and four fixed TPDOs.

The following table lists the typical examples of RPDOs and TPDOs.

Supported servo mode	PP/CSP
1701h (Outputs)	Mapping objects (4 mapping objects, 12 bytes)
	6040h (Control word)
	607Ah (Target position)
	60B8h (Touch probe function)
	60FEh sub-index 1 (Forced physical outputs)

1B01h (Inputs)	Mapped objects (9 mapped objects, 28 bytes)
	603Fh (error code)
	6041h (Status word)
	6064h (Position actual value)
	6077h (Torque actual value)
	60F4h (Following error actual value)
	60B9h (Touch probe status)
	60BAh (Probe 1 rising edge position value)
	60BCh (Probe 2 rising edge position value)
	60FDh (DI state)

Supported servo mode	PP, PV, PT, CSP, CSV, and CST
1702h (Outputs)	Mapped objects (7 mapped objects, 19 bytes)
	6040h (Control word)
	607Ah (Target position)
	60FFh (Target velocity)
	6071h (Target torque)
	6060h (Mode selection)
	60B8h (Touch probe function)
	607Fh (Max. profile velocity)
1B02h (Inputs)	Mapped objects (9 mapped objects, 25 bytes)
	603Fh (error code)
	6041h (Status word)
	6064h (Position actual value)
	6077h (Torque actual value)
	6061h (Mode display)
	60B9h (Touch probe status)
	60BAh (Probe 1 rising edge position value)
	60BCh (Probe 2 rising edge position value)
	60FDh (DI state)

Supported servo mode	PP, PV, CSP, and CSV
1703h (Outputs)	Mapped objects (7 mapped objects, 17 bytes)
	6040h (Control word)
	607Ah (Target position)
	60FFh (Target velocity)
	6060h (Mode selection)
	60B8h (Touch probe function)
	60E0h (Positive torque limit value)
	60E1h (Negative torque limit value)

1B03h (Inputs)	Mapping objects (10 mapping objects, 29 bytes)
	603Fh (error code)
	6041h (Status word)
	6064h (Position actual value)
	6077h (Torque actual value)
	60F4 (following error actual value)
	6061h (Mode display)
	60B9h (Touch probe status)
	60BAh (Probe 1 rising edge position value)
	60BCh (Probe 2 rising edge position value)
	60FDh (DI state)

Supported servo mode	PP, PV, PT, CSP, CSV, and CST
1704h (Outputs)	Mapping objects (9 mapping objects, 23 bytes)
	6040h (Control word)
	607Ah (Target position)
	60FFh (Target velocity)
	6071h (Target torque)
	6060h (Mode selection)
	60B8h (Touch probe function)
	607Fh (Max. profile velocity)
	60E0h (Positive torque limit value)
	60E1h (Negative torque limit value)

Supported servo mode	PP, PV, CSP, and CSV
1705h (Outputs)	Mapped objects (8 mapped objects, 19 bytes)
	6040h (Control word)
	607Ah (Target position)
	60FFh (Target velocity)
	6060h (Mode selection)
	60B8h (Touch probe function)
	60E0h (Positive torque limit value)
	60E1h (negative torque limit value)
	60B2h (Torque offset)

Variable PDO mapping

The SV680N-SINT series servo drive provides two variable RPDOs and two variable TPDOs.

Variable PDO	Index	Maximum number of bytes	Default mapping object
RPDO1	1600h 1601h	40	6040h (Control word) 607Ah (Target position) 60B8h (Touch probe function)
TPDO1	1A00h 1A01h	40	603Fh (error code) 6041h (Status word) 6064h (Position actual value) 60BCh (Probe 2 rising edge position value) 60B9h (Touch probe status) 60BAh (Probe 1 rising edge position value) 60FDh (DI state)

Sync Manager PDO assignment

The process data can contain multiple PDO mapping data objects during cyclic EtherCAT data communication. The CoE protocol defines the PDO mapping object list of the Sync Manager that uses data objects 1C10 to 1C2Fh. Multiple PDOs can be mapped to different sub-indexes. The SV680N-INT drive supports assignment of one RPDO and one TPDO, as described in the following table.

Index	Sub-index	Description
1C12h	01h	One of 1600h, 1601h, and 1701h to 1705h used as the actual RPDO.
1C13h	01h	One of 1A00h, 1A01h, and 1B01h to 1B04h used as the actual TPDO.

PDO configuration

PDO mapping parameters include the indicators of process data for PDOs, including indexes, sub-indexes, and the mapping object length. Sub-index 0 indicates the number (N) of mapping objects in the PDO, and the maximum length of each PDO is 4 × N bytes. One or multiple objects can be mapped simultaneously. Sub-indexes 1 to N indicate the mapping content, defined as follows.

bit	31	...	16	15	...	8	7	...	0
Definition	Index			Sub-index			Object length		

The index and sub-index together define the position of an object in the object dictionary. The object length indicates the bit length of the object in hexadecimal, as shown below.

Object length	Bit length
08h	8-bit
10h	16-bit
20h	32-bit

For example, the mapping parameter of the 16-bit control word 6040.00h is 60400010h.

- Observe the following procedure for PDO configuration:
  Perform the following procedure to configure PDO mapping:

  1. Configure the mapping group of PDO. Write 0 to sub-index 00h of 1C12h (or 1C13h).

a. Clear the original mapping group. Write 0 to sub-index 00h of 1C12h (or 1C13h) to clear the original mapping group.
b. Write the PDO mapping group. Write the value of 1600h or any of 1701h to 1705h in 1C12h, or write the value of 1A00h or any of 1B01h to 1B04h in 1C13h, depending on the scenario. Note: Only 1600h and 1A00h, and 1601h and 1A01h are configurable mapping groups.
c. Write the total number of this PDO mapping group to sub-index 0 of 1C12h (or 1C13h).

2. Configure the mapping objects of PDO. Write 0 to sub-index 00h of 1600h (or 1A00h) and 1601h (or 1A01h).

a. Clear the original mapping objects. Write 0 to sub-index 00h of 1600h (or 1A00h) and 1601h (or 1A01h) to clear the original mapping objects.
b. Write the PDO mapping content. Write the mapping content to sub-indexes 1-10 of the mapping parameter based on object parameter definitions in XML file. Only mappable objects can be configured as PDO mapping content.
c. Write the total number of mapping objects. Write the number of mapping objects in step b to sub-index 0.

Note

- Configure the PDO only when the EtherCAT state machine is in Pre-operation state ("2" displayed on the keypad). Otherwise, an error is reported.
- Do not save the PDO configuration parameters in EEPROM. Configure the mapping objects again each time upon power-on. Otherwise, the mapping objects are the default parameters of the servo drive.

An SDO fault code is returned when the following operations are performed:

- Modify PDO parameters in non pre-operational state.
- Write a value outside the range of 1600h/1601h/1701h...1705h to 1C12h. Write a value outside the range of 1A00h/1A01h/1B01h...1B04h to 1C13h.

8.1.4.2 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 SV670NS-INT supports SDO request and SDO response.

8.1.5 Communication Parameters

Parameter address structure

Parameter access address: index+subindex, both are hexadecimal.

The CiA402 protocol establishes the following restrictions on the parameter address.

Index (Hex)	Description
0000h to 0FFFh	Data type description
1000h to 1FFFh	CoE communication object
2000h to 5FFFh	Manufacturer-specific object
6000h to 9FFFh	Profile object
A000h to FFFFh	Reserved

System parameter setting

Necessary parameter settings are required for the SV670NS-INT series servo drive to be connected to the EtherCAT fieldbus network.

☆Related parameters:

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
H02.00	2002-01h	Control mode	0: Speed control mode 1: Position control mode 2: Torque control mode 7: Process segment mode 9: EtherCAT mode	9	-	At stop	"H02_en.00" on page 581
H0E.01	200E-02h	Saving objects written through communication to EEPROM	0: Not save 1: Save parameters 2: Save object dictionaries 3: Save parameters and object dictionaries 4: Save object dictionaries written before communication (OP) 255: Determined by H0E.03 and H0E.04	4	-	Real time	"H0E_en.01" on page 723
H0E.21	200E-16h	EtherCAT slave alias	0 to 65535	0	-	At stop	"H0E_en.21" on page 725

Note

Before saving parameters to EEPROM, set H0E.01 to a proper value. Otherwise, parameters will be restored to default values at next power-on. It is recommended to set H0E.01 to 0 after parameters are set properly. This is to prevent damage to the EEPROM device caused by prolonged writing process.

8.2 EtherCAT Communication Configuration Examples

8.2.1 AM600 Series Controller as the Host Controller

This section describes how to configure the SV680N-INT series servo drive for working with the AM600 series controller.

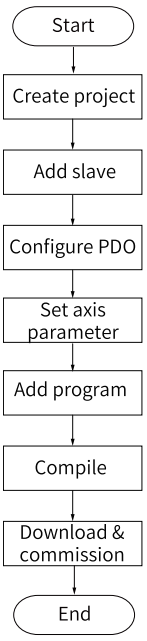
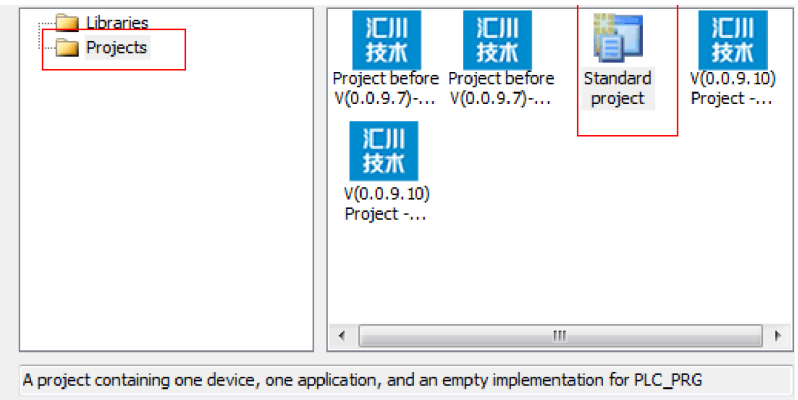
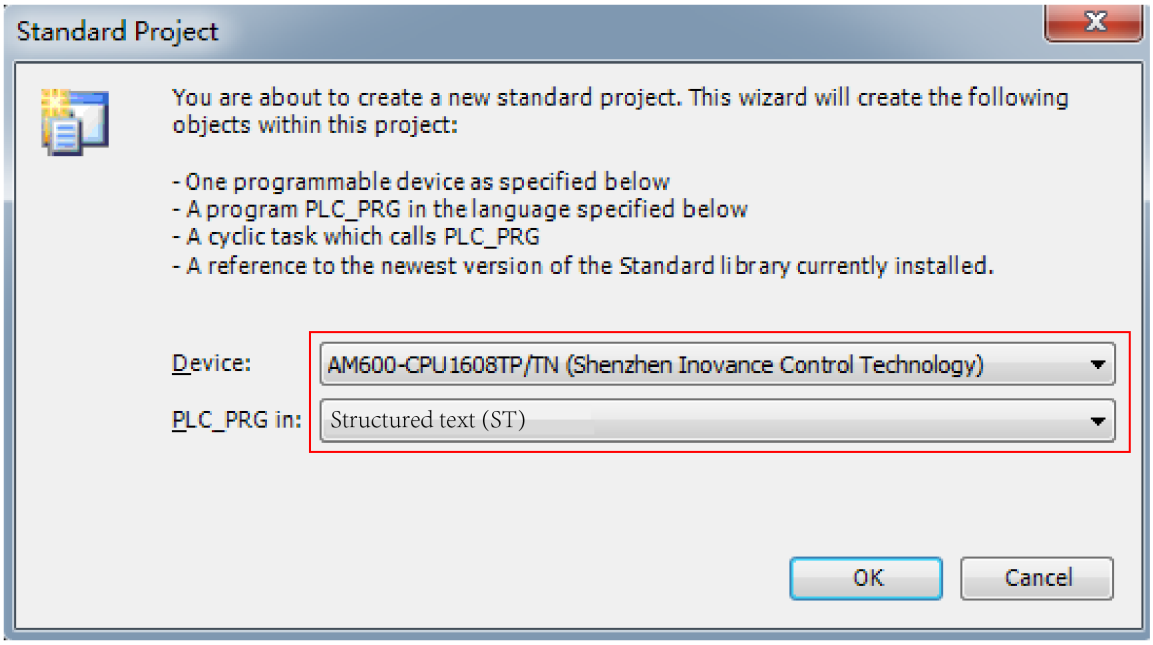


Figure 8-8 Configuration flowchart

Opening the software and creating an AM600 project

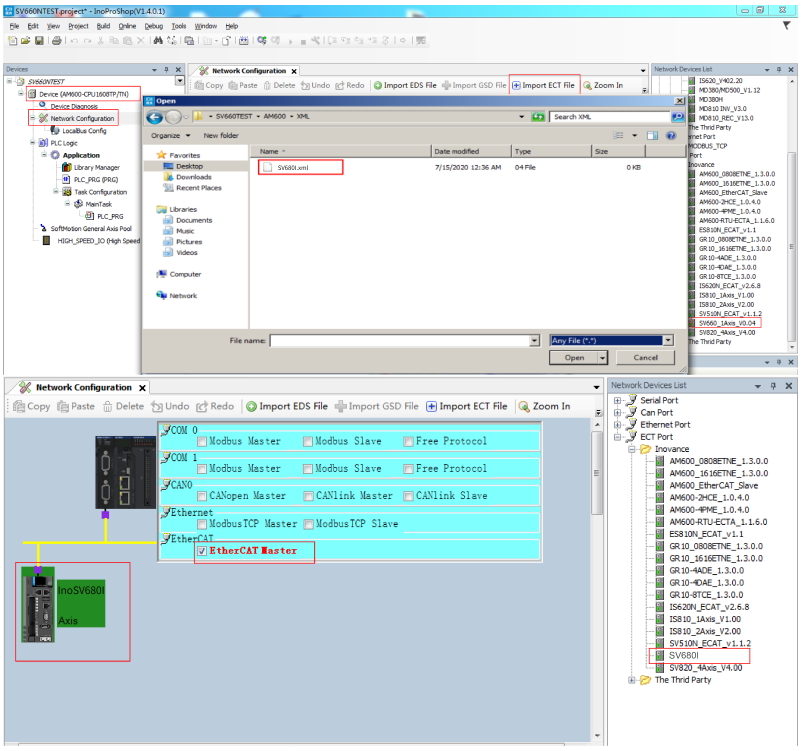
Select "AM600-CPU1608TP," as shown in the following image.





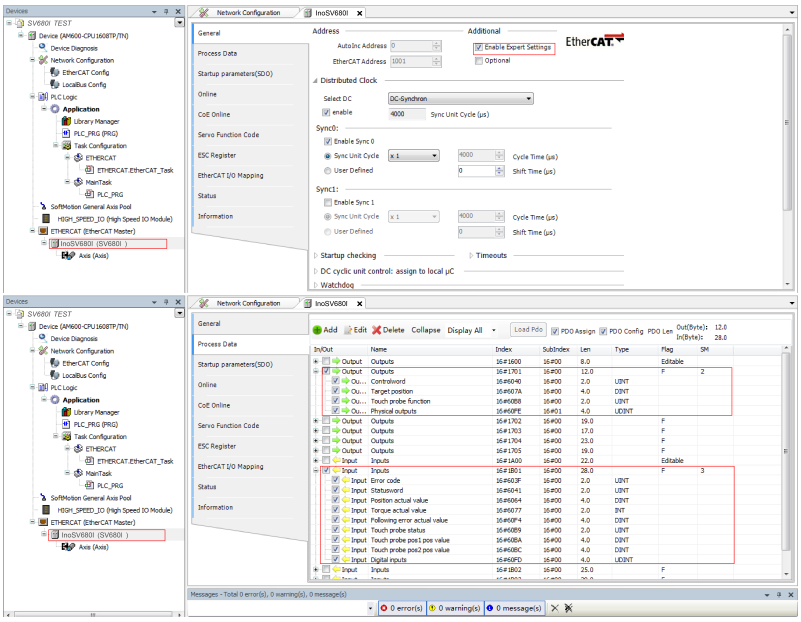
Adding the SV680N-INT servo drive as slave

Open network configuration and import the ECT file of SV680N-INT. Add an SV680N-INT servo drive as a slave, as shown in the following figure.



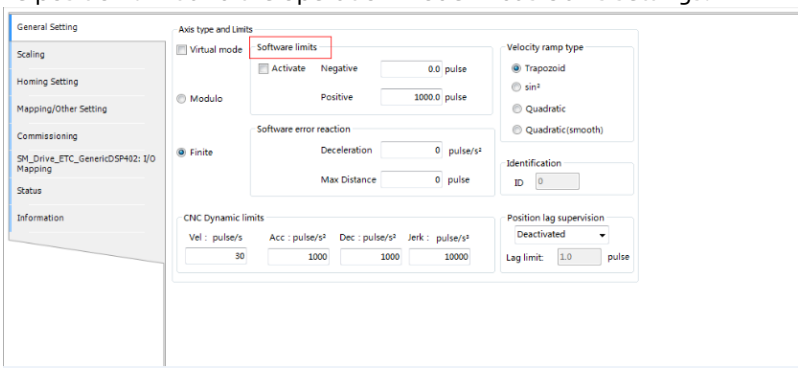
Configure PDO parameters

Select "Enable Expert Settings" and configure PDOs in the process data as needed. In this case, CSP is used as the control mode and the default values of 1600 and 1A00 are used for PDO parameters.

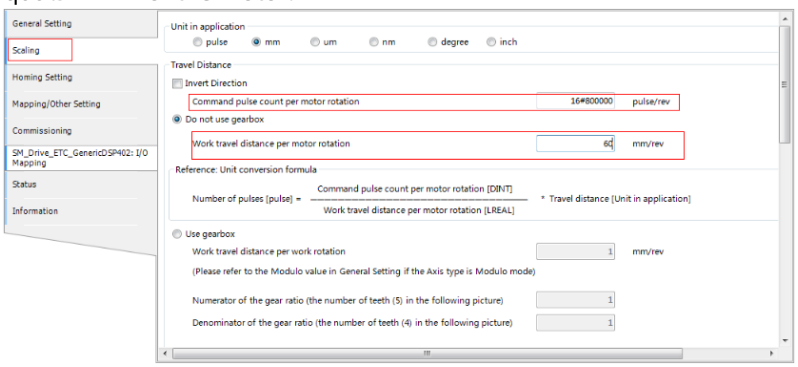


Configure axis parameters

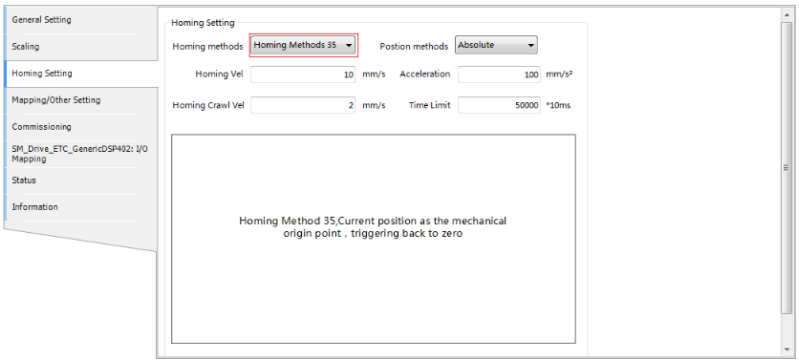
1. Set the software position limit and the operation mode in basic axis settings.



2. Select 16#4000000 for the 26-bit encoder, 16#800000 for the 23-bit encoder and 16#100000 for the 20-bit encoder during unit conversion. In this case, the single-turn travel distance is set to 60 mm. 1 mm/s equals 1 RPM of the motor.

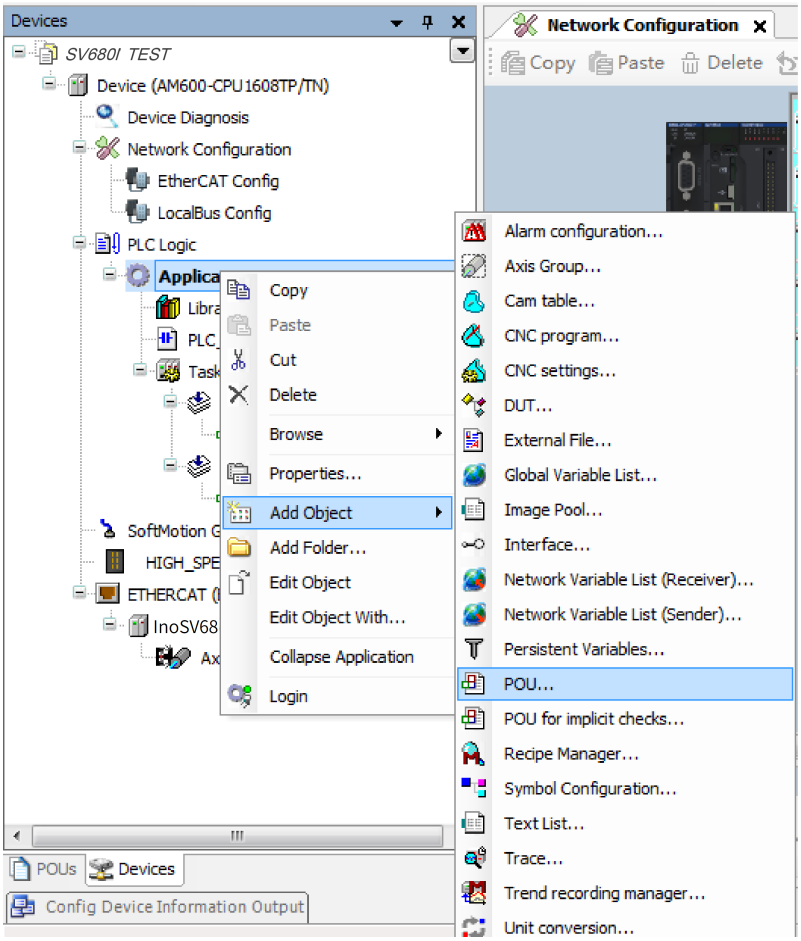


3. Select the homing mode according to actual needs. For details, see*section "Homing Mode"*in the SV680N-INT Series Servo Drive Function Guide.

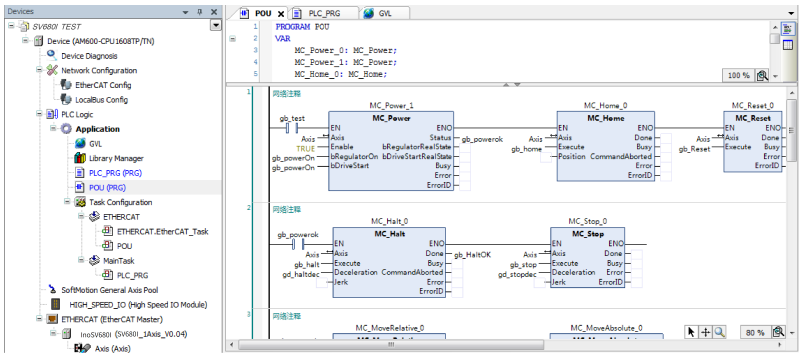


Add a program

Add a program to control the servo axis position, as shown in the following figure.

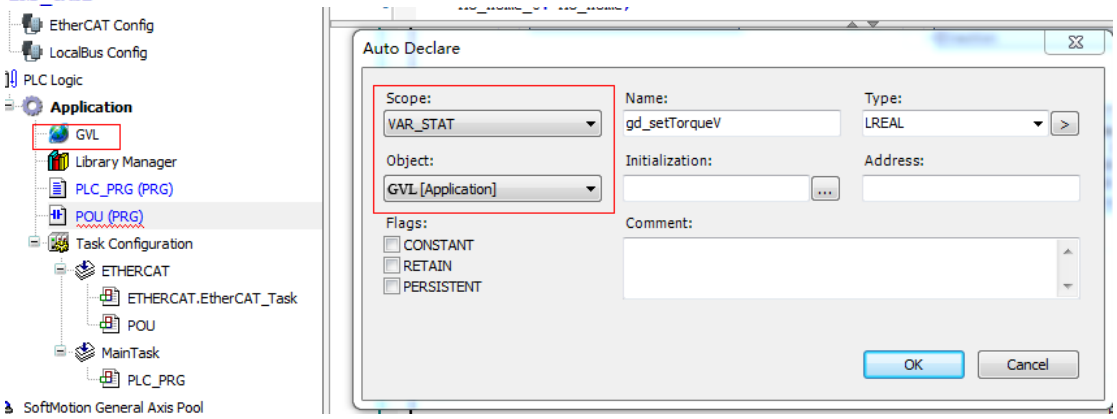


- Enable basic functions such as enabling, homing, and positioning by adding function blocks to the PLC.



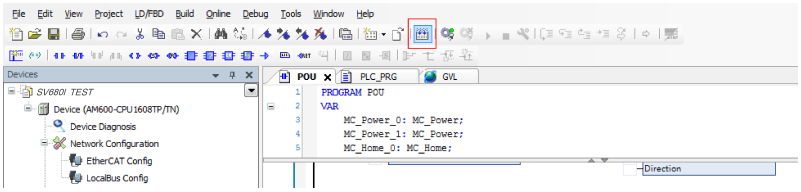
- To implement directed motion through the logic program, some variables may need to be called to different POUs. Therefore, set the variables as global variables.

```
CASE iStatus OF
    10:
    gb_powerOn:=TRUE;
    IF gb_powerok THEN
    iStatus:=20;
    END_IF
    20:
    gd_MoveAbsPos:=1000;gd_MoveAbsVel:=200;gd_MoveAbsVelacc:=200;gd_MoveAbsVeldec:=200;gb_moveAbs:=TRUE;
    IF gb_moveAbsOK THEN
    gb_moveAbs:=FALSE;iStatus:=30;
    END_IF
    30:
    gd_MoveAbsPos:=2000;gd_MoveAbsVel:=400;gd_MoveAbsVelacc:=400;gd_MoveAbsVeldec:=400;gb_moveAbs:=TRUE;
    IF gb_moveAbsOK THEN
    gb_moveAbs:=FALSE;iStatus:=40;
    END_IF
    40:
    gd_MoveAbsPos:=0;gd_MoveAbsVel:=1000;gd_MoveAbsVelacc:=1000;gd_MoveAbsVeldec:=1000;gb_moveAbs:=TRUE;
    IF gb_moveAbsOK THEN
    gb_moveAbs:=FALSE;iStatus:=50;
    END_IF
    50:
    gb_powerOn:=FALSE;
    iStatus:=0;
END_CASE
```



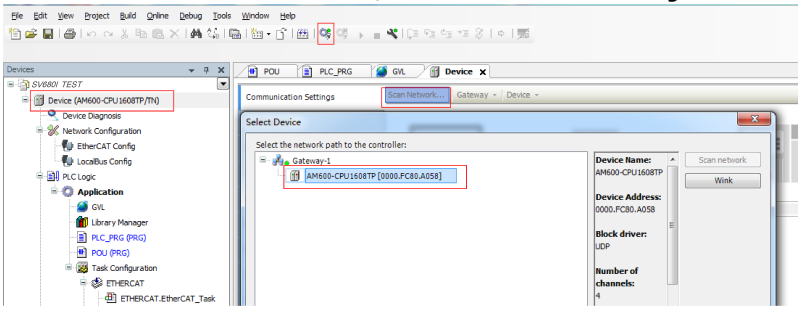
Compile the program

After compiling the program, click the icon marked by the red box in the following figure to check whether the program is correct.

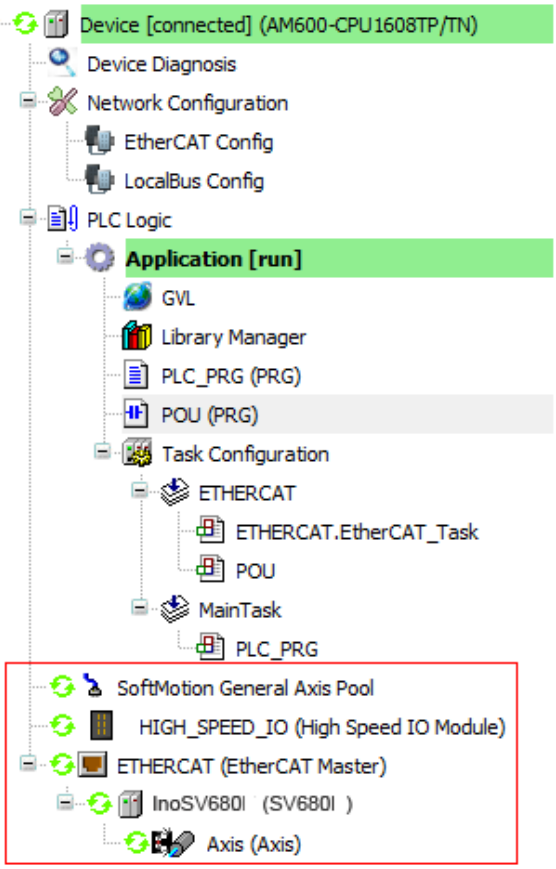


Download and commission the program

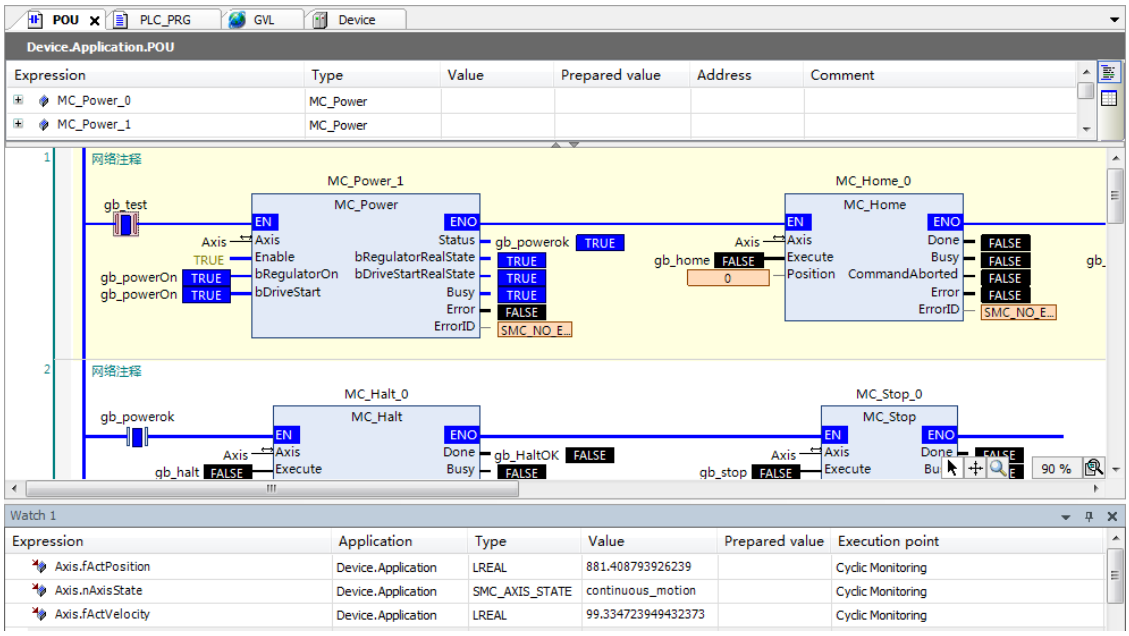
1. After checking that the program is correct, download the program to PLC. The program can be activated after running. Before downloading, scan the PLCs first to select the PLC to be downloaded, and then click the download icon, as shown in the following interface.



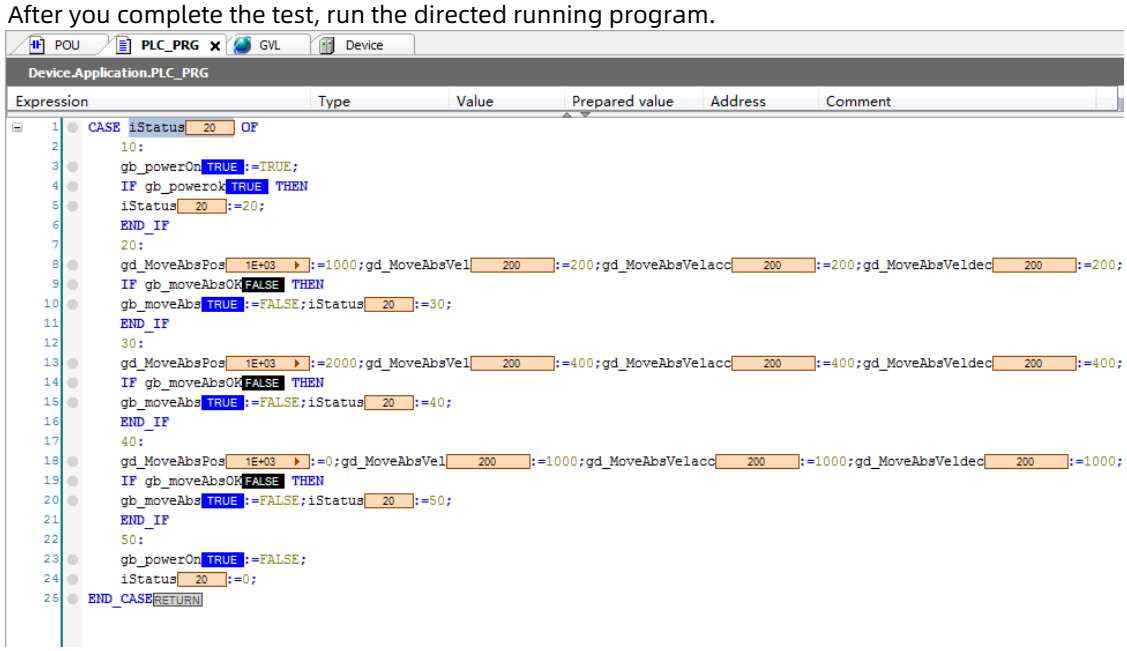
2. After log-in, ensure that the servo drive and axis are in a normal state.



3. Monitor critical parameters through the monitoring function. Start the testing program to perform basic tests such as enabling, homing, and positioning.



4. After you complete the test, run the directed running program.



8.2.2 Omron Controller as the Host Controller

This section describes how to configure the SV680N-INT series servo drive for working with an Omron NX701 controller.

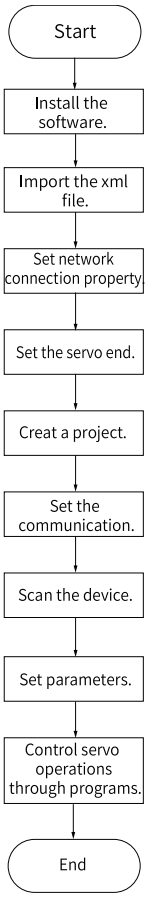


Figure 8-9 Configuration flowchart

Note

When more than 25 SV680N-INT drives are networked with Omron NX701, you need to modify the cable length defined in the Omron master station. The cable length is calculated based on the fact that one drive needs a length of 36 m.

Installing the Sysmac Studio software

Install the Sysmac Studio software.

It is recommended to install Sysmac Studio V1.10 or later.

Import the XML device description file

Import the device description file. It is recommended to use V2.5 or later.

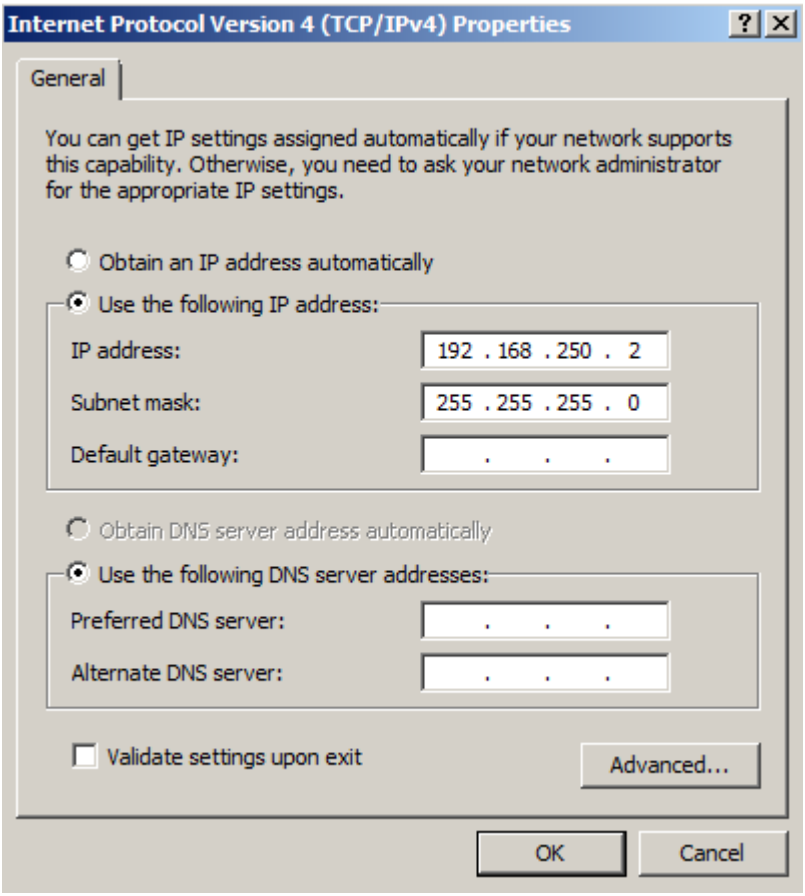
It is recommended to import the device description file of "SV680_INT_EOE_1Axis_02002_240110.xml" or later version. The file path is as follows: OMRON\Sysmac Studio\IODeviceProfiles\EsiFiles\UserEsiFiles.

If the XML file is stored in this path for the first time, the Sysmac Studio software must be restarted.

Setting the network connection attributes

- If the PC is connected to the controller through a USB, skip this step.

- If the PC is connected to the controller through Ethernet, set the TCP/IP attribute of the PC, as shown below.

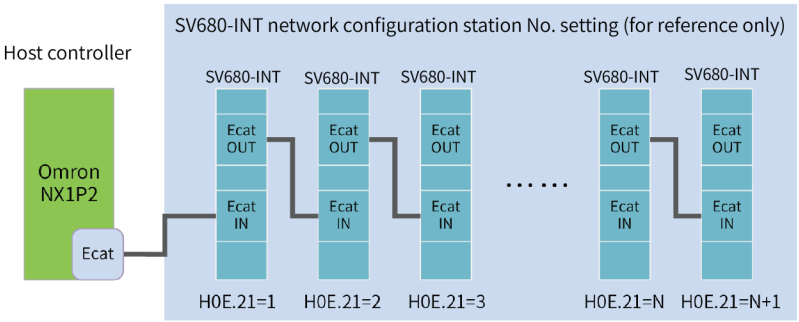


Configuring the servo drive

Pay attention to the setting of H0E.21.

Param.	Name	Value range	Unit	Default value	Mode	Setting mode	Effective time	Value
H0E.21	EtherCAT slave alias	0 to 65535	-	0	-	At stop	Upon the next power-on	Values other than 0

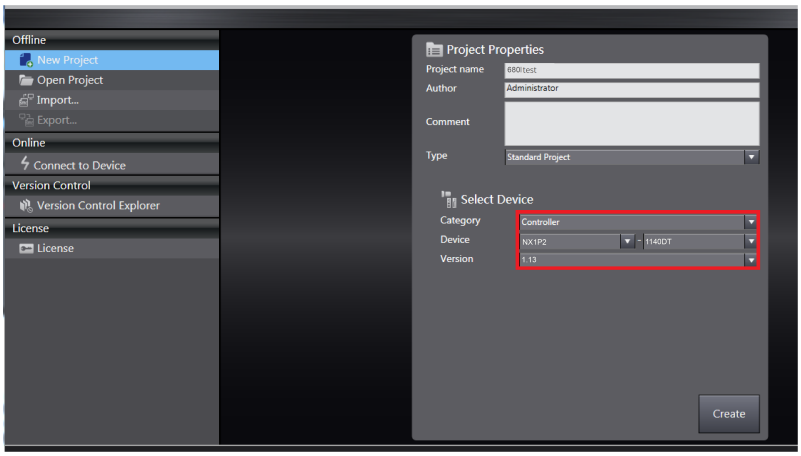
When an Omron controller is used, set the EtherCAT communication station number in H0E.21. It is recommended to set the station number according to the actual connection sequence to facilitate management.



Create a project

Device: Set a device according to the actual controller model.

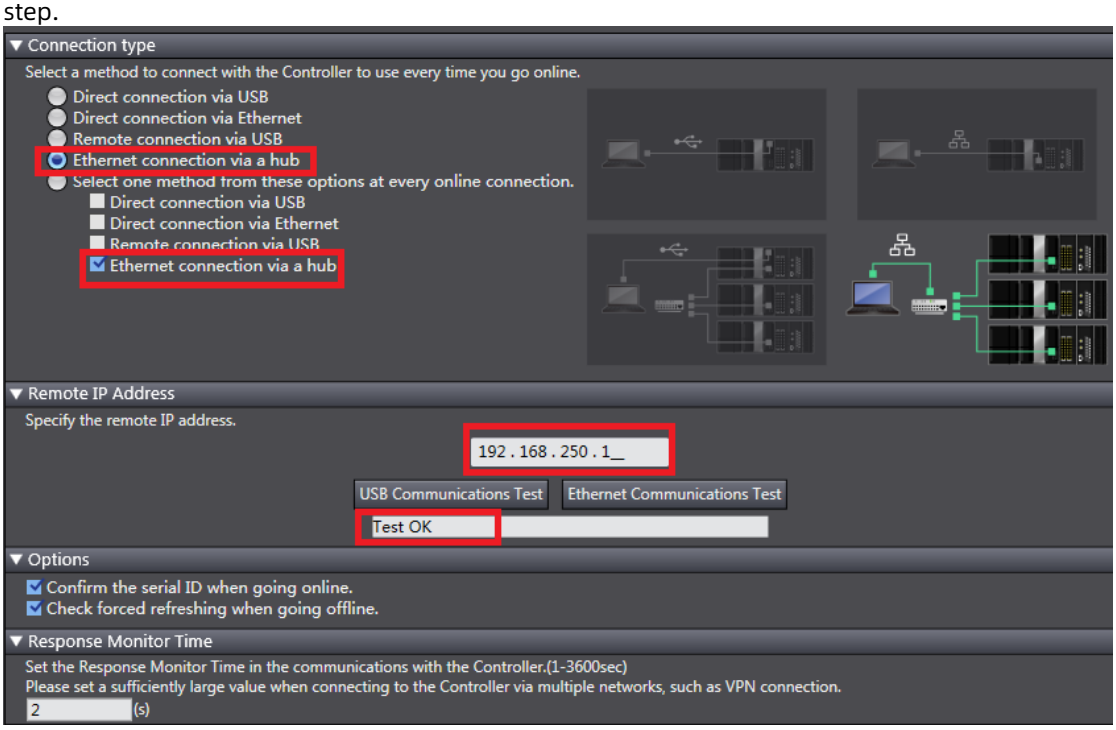
Version: 1.09 or a later version. NX1P2-1140DT supports only 1.13.



Communication setting

Enter the main interface and choose "Controller"→"Communication Setup" to set the connection mode for the computer and controller.

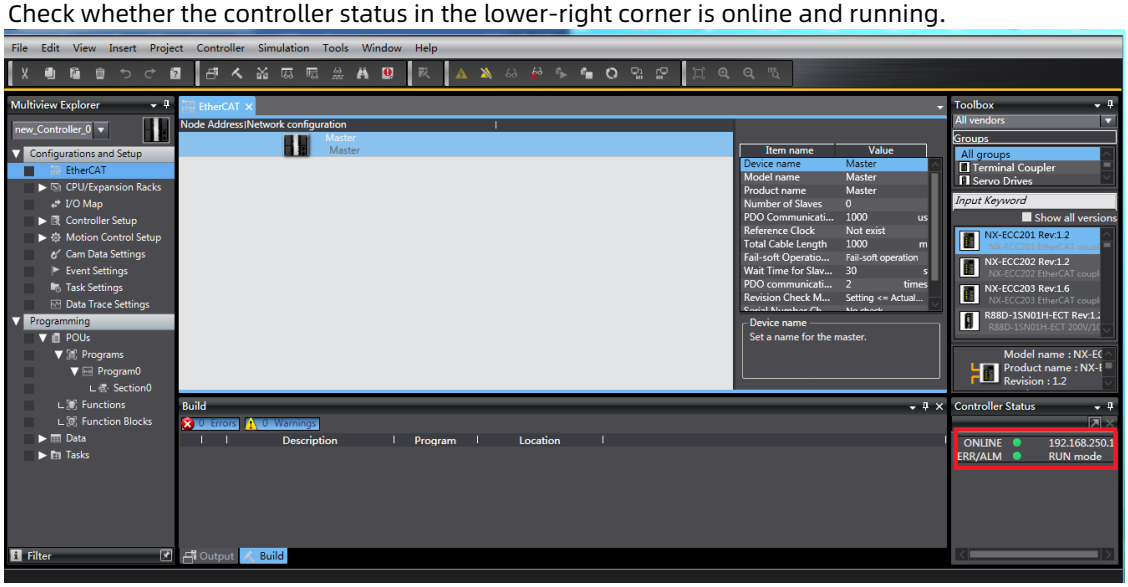
- Select "Remote connection via USB"to perform"USB Communication Test" directly. If the test is successful, proceed to the next step.
- Select "EtherNet connection via a hub",buttonset the IP address to 192.168.250.1 (controlled by NX), and then click "Ethernet Communication Test". If the test is successful, proceed to the next step.



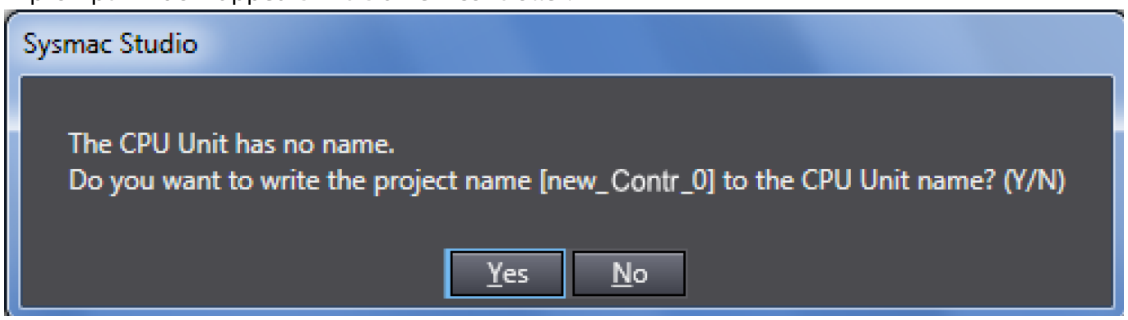
Scanning the device

Switch the controller to the online and running mode.

1. Check whether the controller status in the lower-right corner is online and running.

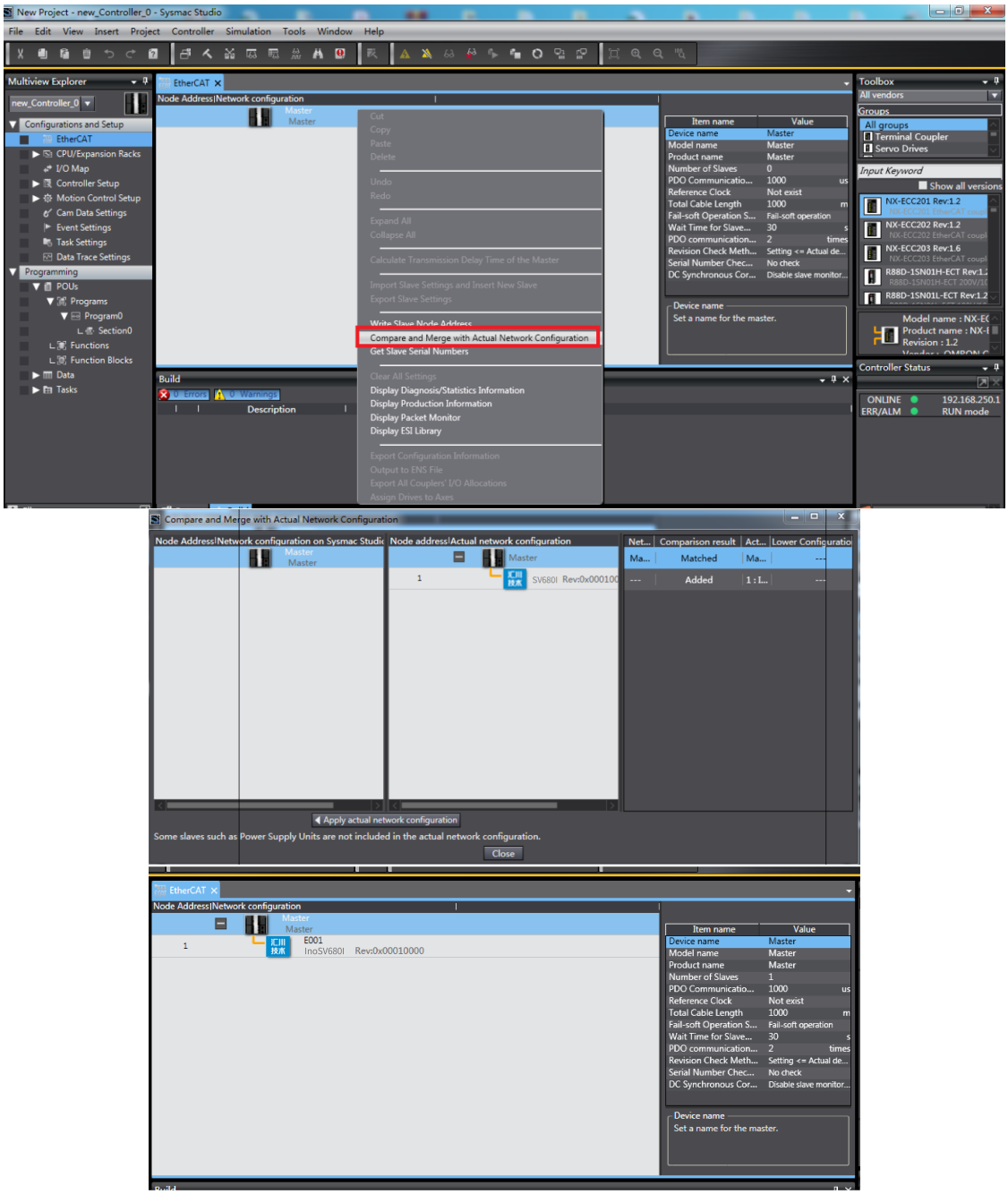


2. A prompt window appears if it is a new controller.



3. Click "Yes" in the window. The name shown in the window is the project name.
   Scan the device and add the slave station.

   Click "Configurations and Setup"and right-click"EtherCAT"→"Master", and then select "Compare and Merge with Actual Network Configuration". The controller scans all the slaves in the network (error will be reported if the station number is 0). After scanning, click "Apply actual network configuration" in the pop-up window to add the slave. You can view the added slave station on the main interface.

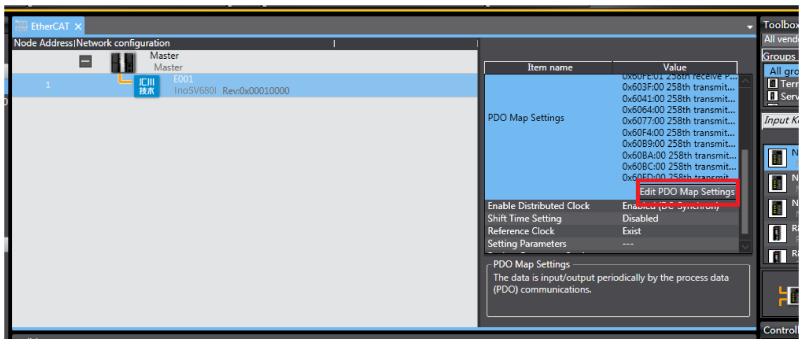


Parameter Settings

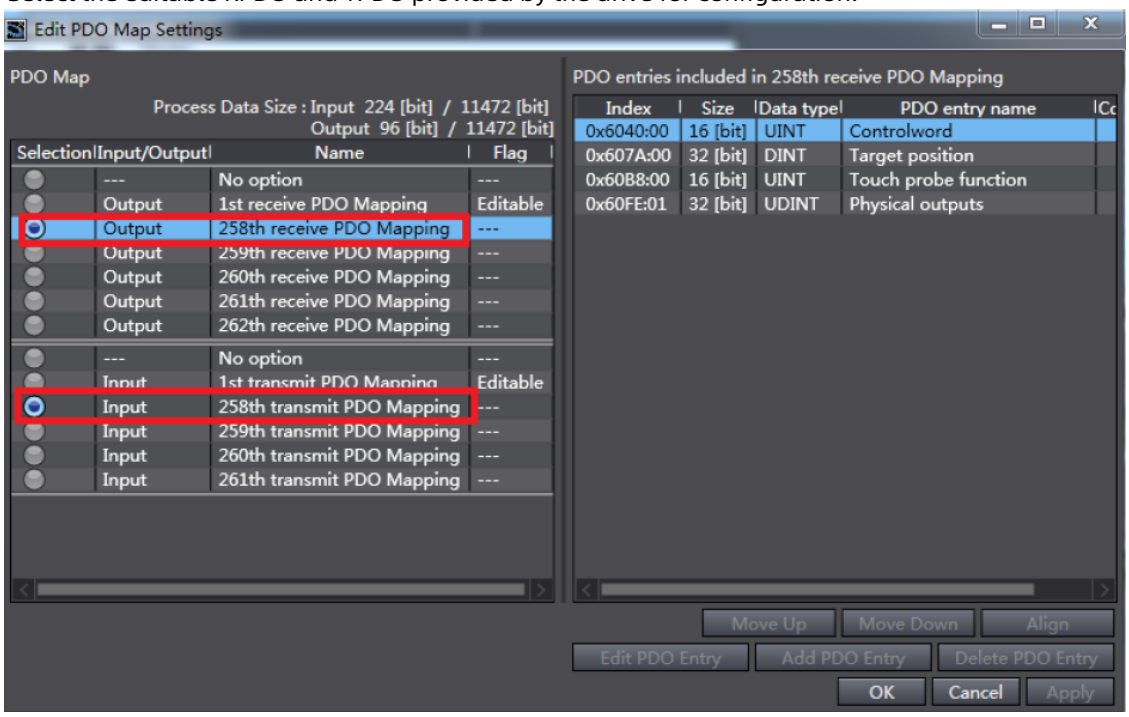
Switch the controller to offline mode, and set the PDO mapping, axis parameters, and distributed clock.

Setting PDO mapping

1. Configure the PDO mappings.



2. Select the editable RPDO and TPDO provided by the drive for configuration.

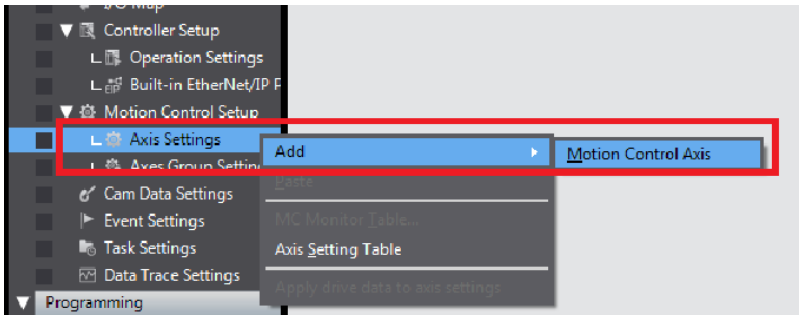


3. Modify the PDO mapping object through "Add PDO Entry" and "Delete PDO Entry". The frequently used mapping parameters are shown in the following interface.

Index	Size	Data type	PDO entry name
0x603F:00	16 [bit]	UINT	Error code
0x6041:00	16 [bit]	UINT	Statusword
0x6064:00	32 [bit]	DINT	Position actual value
0x6077:00	16 [bit]	INT	Torque actual value
0x60F4:00	32 [bit]	DINT	Following error actual value
0x60B9:00	16 [bit]	UINT	Touch Probe Status
0x60BA:00	32 [bit]	DINT	Touch Probe pos 1 pos value
0x60BC:00	32 [bit]	DINT	Touch Probe pos 2 pos value
0x60FD:00	32 [bit]	UDINT	Digital inputs

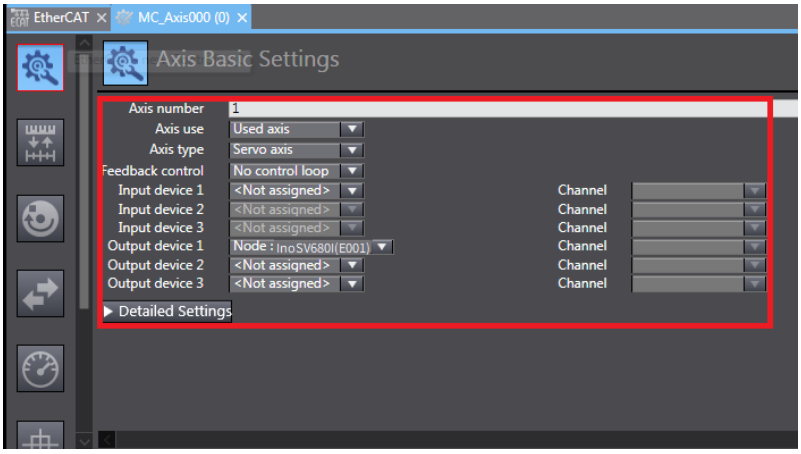
Setting axis parameters

1. Right-click "Motion Control Setup"and choose"Axis settings" > "Motion Control Axis", as shown in the following figure.



2. You can click MC_Axis000 to rename it. For example, if it is named as "Rewind axis", the axis variable "Rewind axis" used in the NX program represents control on this SV680N-INT servo axis.
3. Double-click MC_Axis000 and configure an SV680N-INT device at the corresponding station in a corresponding Axis Basic Settings interface.

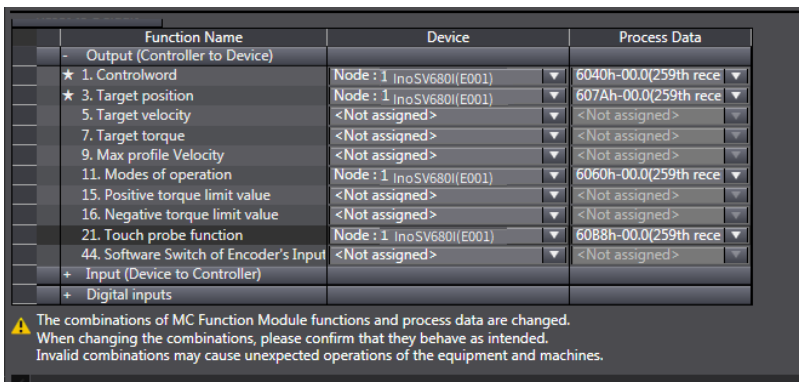
a. Assign axes

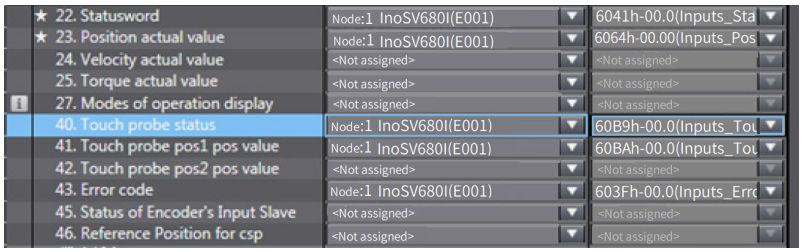


- Axis number: Ethernet the communication station number of the servo drive, which is also the value of H0E.21.
- Axis use: the axis in use.
- Axis type: the servo axis.
- Output device 1: Select the SV680-INT servo drive.

b. Complete detailed settings

- Select the PDO mapping objects configured in step "Parameter Settings" to assign output parameters (controller to device) and input parameters (device to controller). Note that the object name, node number, and index number must be set correctly. Each mapping object selected in step "Parameter Settings" must be assigned correctly. Otherwise, an error will be reported.





- 60FDh must be mapped to the same as that in the Omron controller, as shown in the following figure. bit0 to bit2 of SV680N indicate the negative position limit, the positive position limit, and the home respectively. bit16 to bit20 indicate the status of DI1 to DI5.

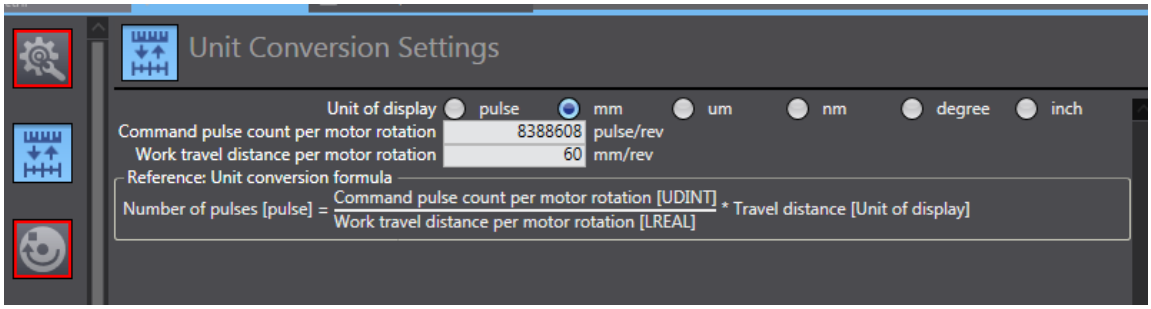


Note

Currently, all SV680N-INT axis configurations must be performed manually due to the limitation on Omron background configurations.

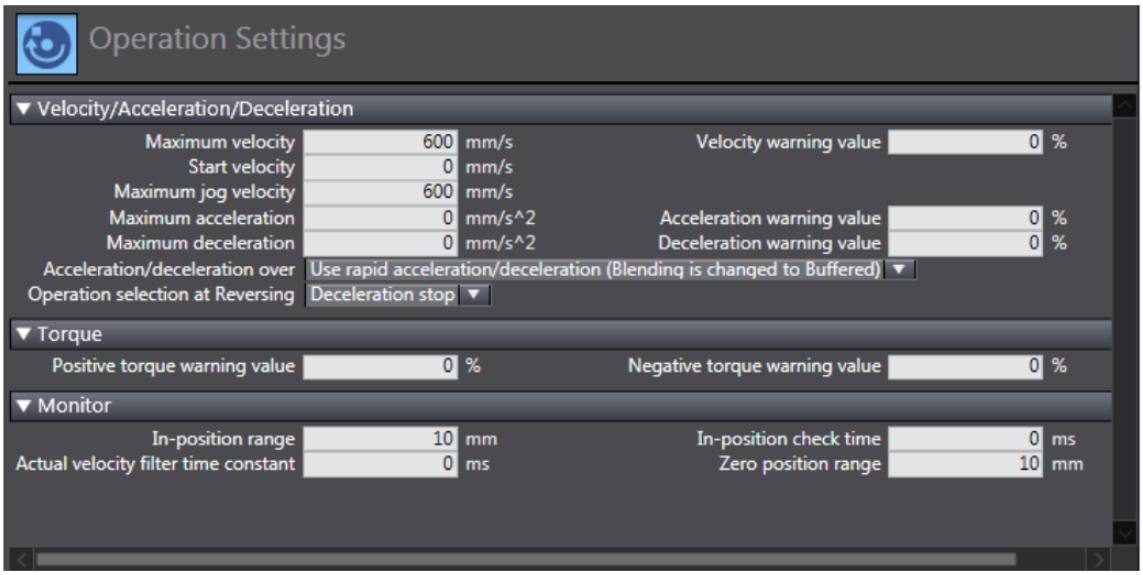
Setting unit conversion

Set "Command pulse count per motor rotation" based on the resolution of the motor encoder. For example, specify 67108864 PPR for a motor equipped with a 26-bit encoder. To facilitate commissioning, set Work travel distance per motor rotation to 60 mm/rev, which indicates that 1 mm/s equals to 1 rpm of the motor.



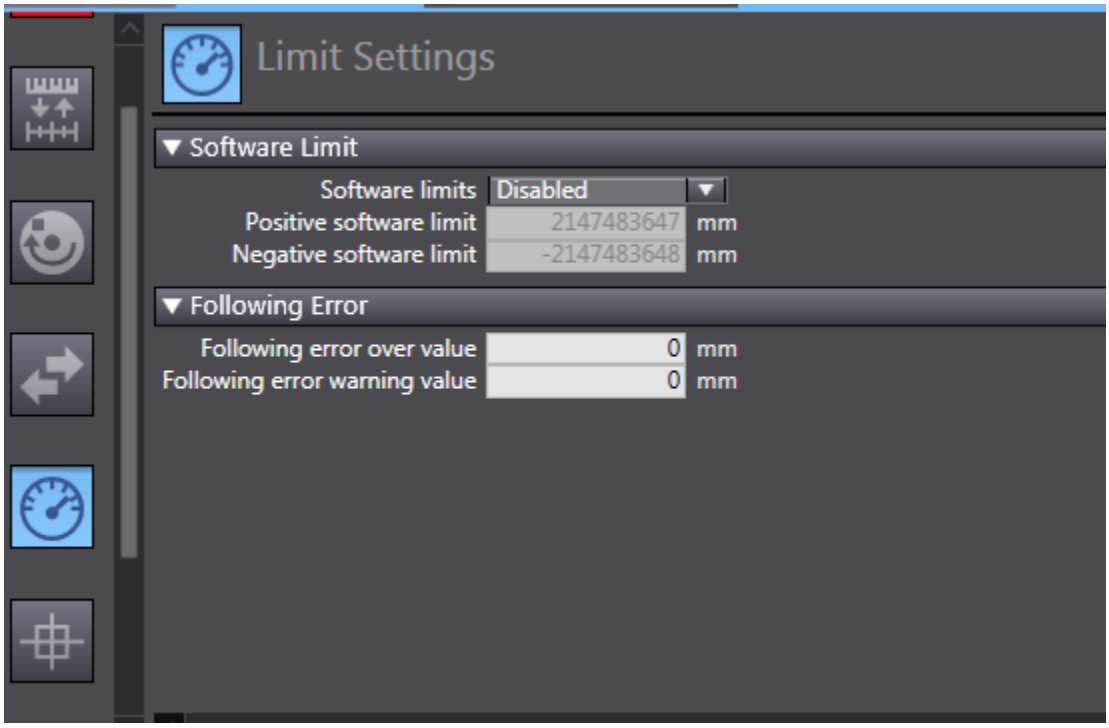
Set "Display Unit" based on the actual running unit when setting the gear ratio. All the position-type parameters in the host controller will be displayed in this unit.

Operation settings



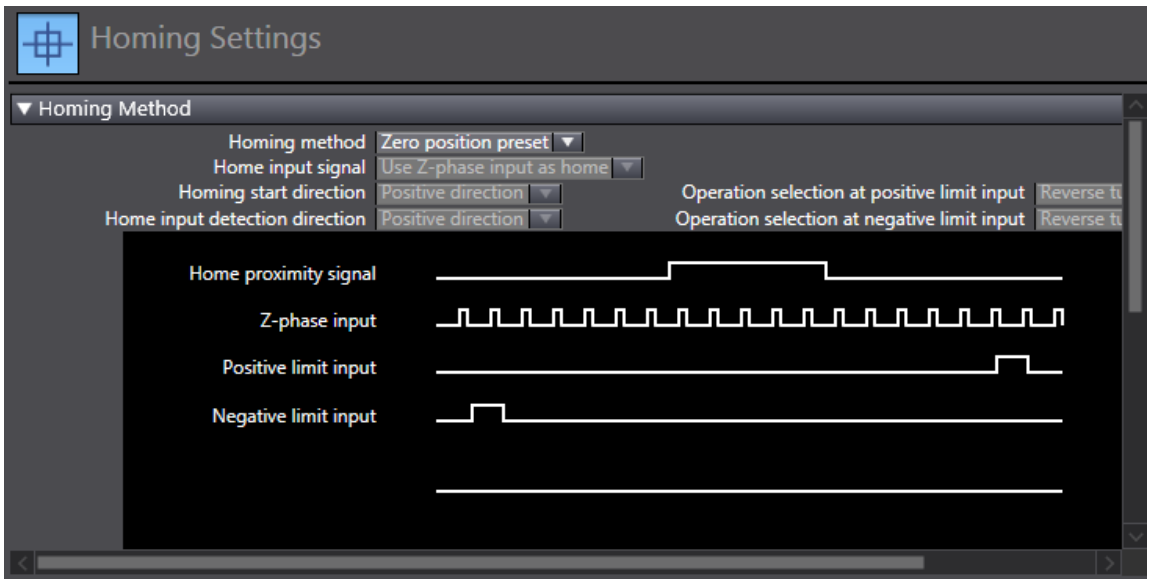
- Velocity/Acceleration/Deceleration: Set the maximum speed of the load according to actual conditions. If the motor speed converted exceeds 1900 rpm, a parameter setting error marked by a red box will be reported by the host controller software. If the acceleration or deceleration rate is 0, the motion profile will be generated based on the maximum acceleration or deceleration rate. The acceleration and deceleration rates do not need to be set in most cases, unless required.
- Torque: If the alarm value is 0, no alarm will be reported. There is no need to set the alarm value in general cases.
- Monitor: Set "Positioning Range" and "Zero Position Range" based on actual motor and mechanical conditions. If the specified value is excessively small, positioning or homing may fail.

Position limit settings



You can enable the function of software position limit as needed. The software position limit will be activated after homing.

Homing settings



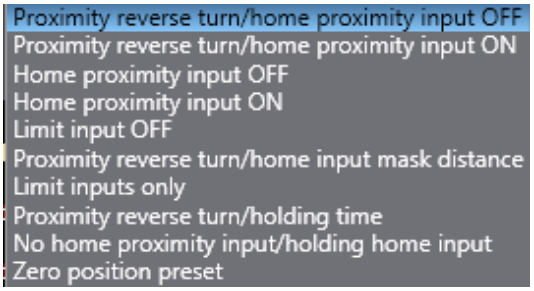
The homing mode involves the servo drive and the host controller. Set the homing mode according to the following table.

NX software description	Servo drive function	Terminal assignment
Home proximity signal	Home switch (FunIN.31)	-
Positive limit input	P-OT (FunIN.14)	DI1
Negative limit input	N-OT (FunIN.15)	DI2

Select the homing mode of the host controller and set the homing speed, acceleration, and home offset based on actual mechanical conditions.

- Introduction to homing
  Function block: MC_Home and MC_HomeWithParameter

  1. Set MC_Home as shown in the preceding figure. Set MC_HomeWithParameter in the function block.
  2. The two function blocks both include 10 types of homing modes.

MC_Home	MC_HomeWithParameter
	Specify the homing action to be modified. 0: Proximity reverse turn/home proximity input OFF 1: Proximity reverse turn/home proximity input ON 4: Home proximity input OFF 5: Home proximity input ON 8: Limit input OFF 9: Proximity reverse turn/Home input mask distance 11: Limit inputs only 12: Proximity reverse turn/Holding time 13: No home proximity input/Holding home input 14: Zero position preset

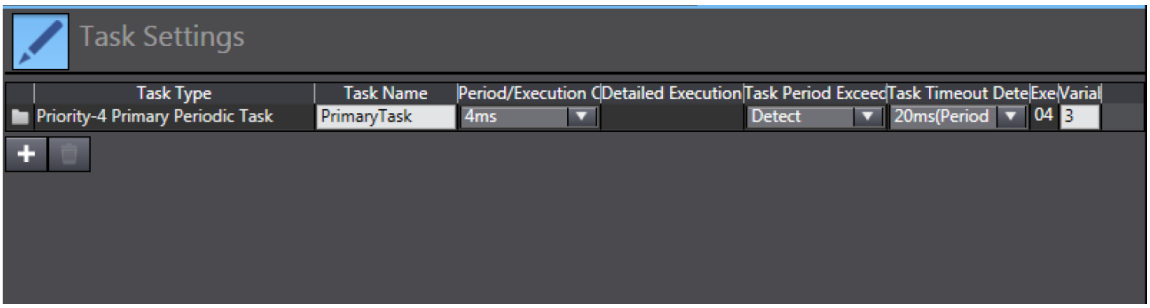
- Home proximity input OFF: The host controller searches for the home signal after reaching the falling edge of the home proximity switch.
- Home proximity input ON: The host controller searches for the home signal after reaching the rising edge of the home proximity switch.
- Proximity reverse turn: If the home proximity signal is ON when homing is enabled, the host controller reverses the running direction immediately after reaching the falling edge of the home proximity signal.
- Home input mask distance: The home signal is masked by the host controller within the set distance after the homing signal (for example, edge change of home proximity) is received, and the home signal is received only after the specified distance passes.
- Holding time: The home signal is masked by the host controller within the specified period of time after the homing signal (for example, edge change of home proximity) is received, and the home signal is received only after the specified period of time ends.
- Zero position preset: The host controller uses the current position as the home and the motor does not act. The host controller writes the home offset to the position reference and actual reference.

Note

The low-speed searching for the home signal applies in all homing modes. In case of operations at a high speed, the home signal is hidden during deceleration from the high speed to a low speed.

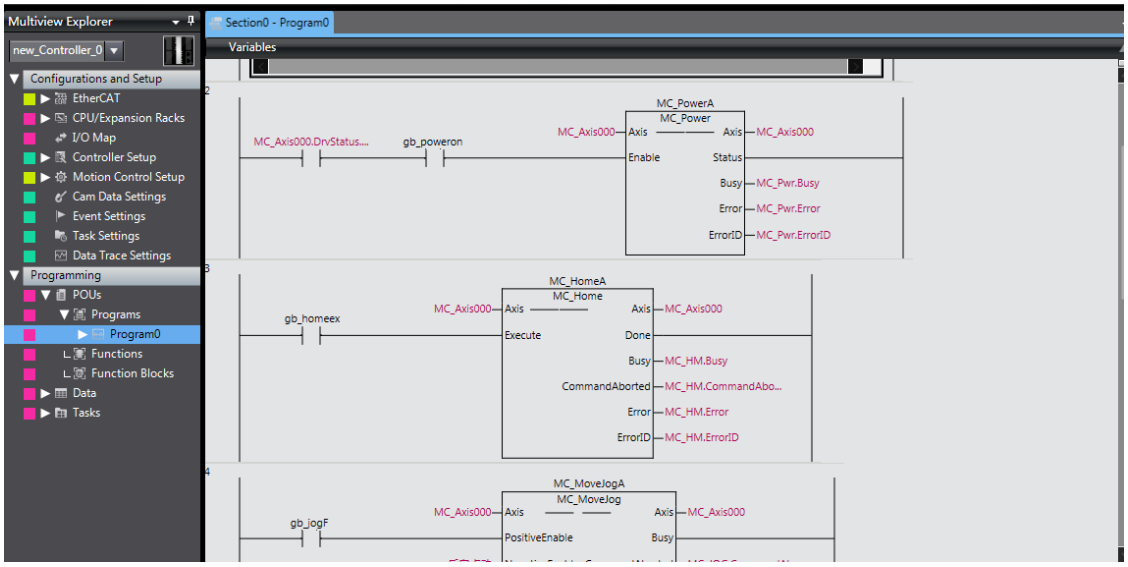
Distributed clock settings

The default clock is 1 ms. The synchronization clock (cycle of primary fixed-cycle tasks) named "PDO communication cycle" can be modified in "Task Settings". The modification takes effect after the drive switches to the online status at next power-on.



Program-controlled servo operations

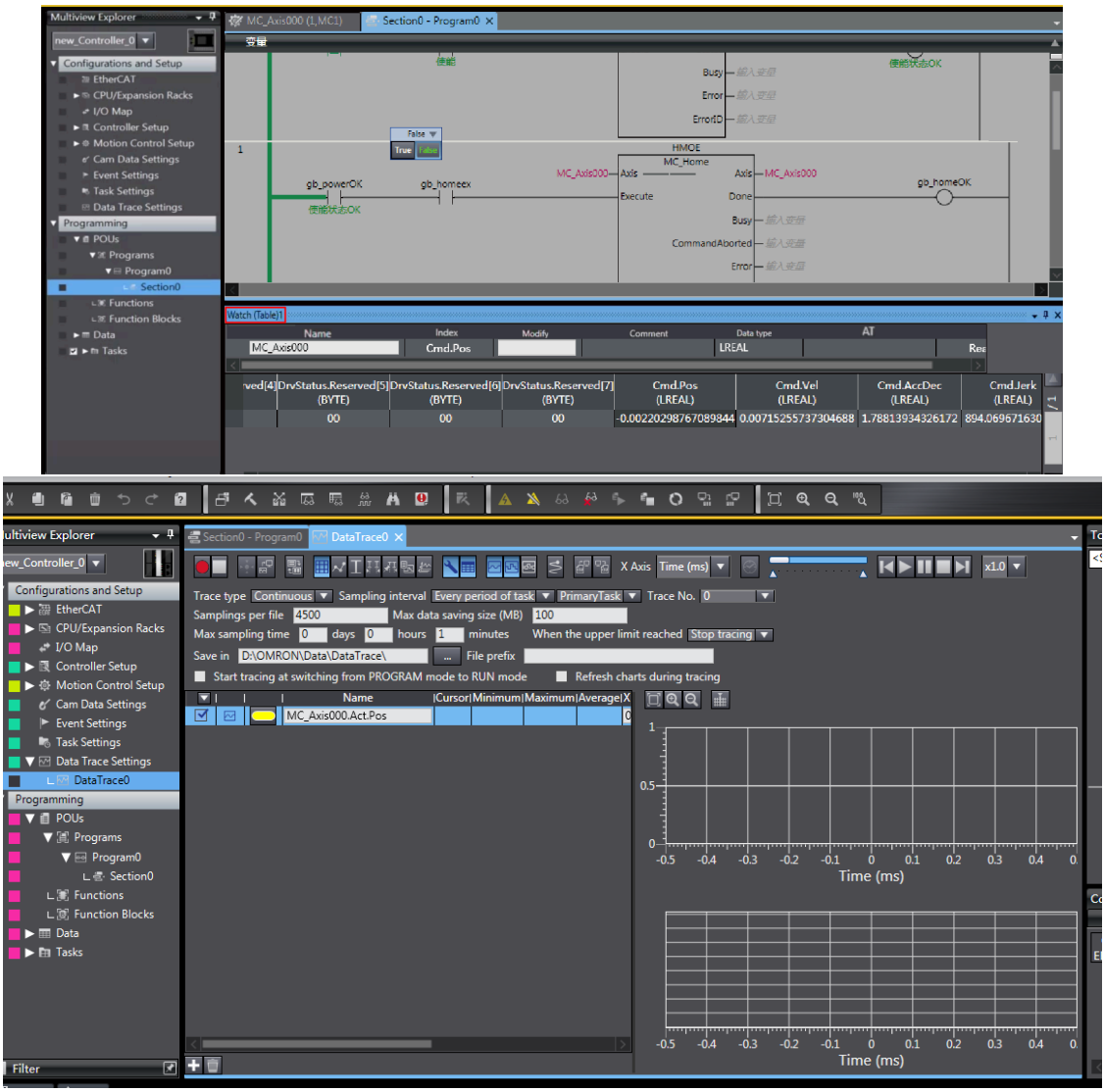
1. After the configuration is completed, control operations of the servo drive via the PLC program. If the MC_POWER module is used, it is recommended to add the servo status bit MC_Axis000. DrvStatus. Ready (MC_Axis000 is the axis name). MC_Axis000 is the axis name. This prevents the situation that communication configuration is not ready but the PLC program is running.



2. After all the setting and programming procedures are done, switch to the online state, and click "" to download the program to the controller.

   Click "" to use the synchronization function. This function compares the difference between the current program and the program in the controller, allowing users to determine whether to download the program to the controller, upload it from the controller "", or leave it unchanged based on the differences.

   You can monitor the data through the monitoring list or collect the data waveform by using the data tracking function during operation.



8.2.3 Beckhoff Controller as the Host Controller

This section describes how to configure the SV680N-INT servo drive for working with Beckhoff TwinCAT3.

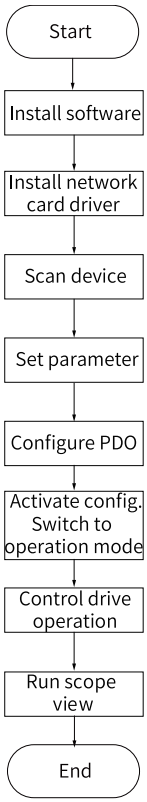


Figure 8-10 Configuration flowchart

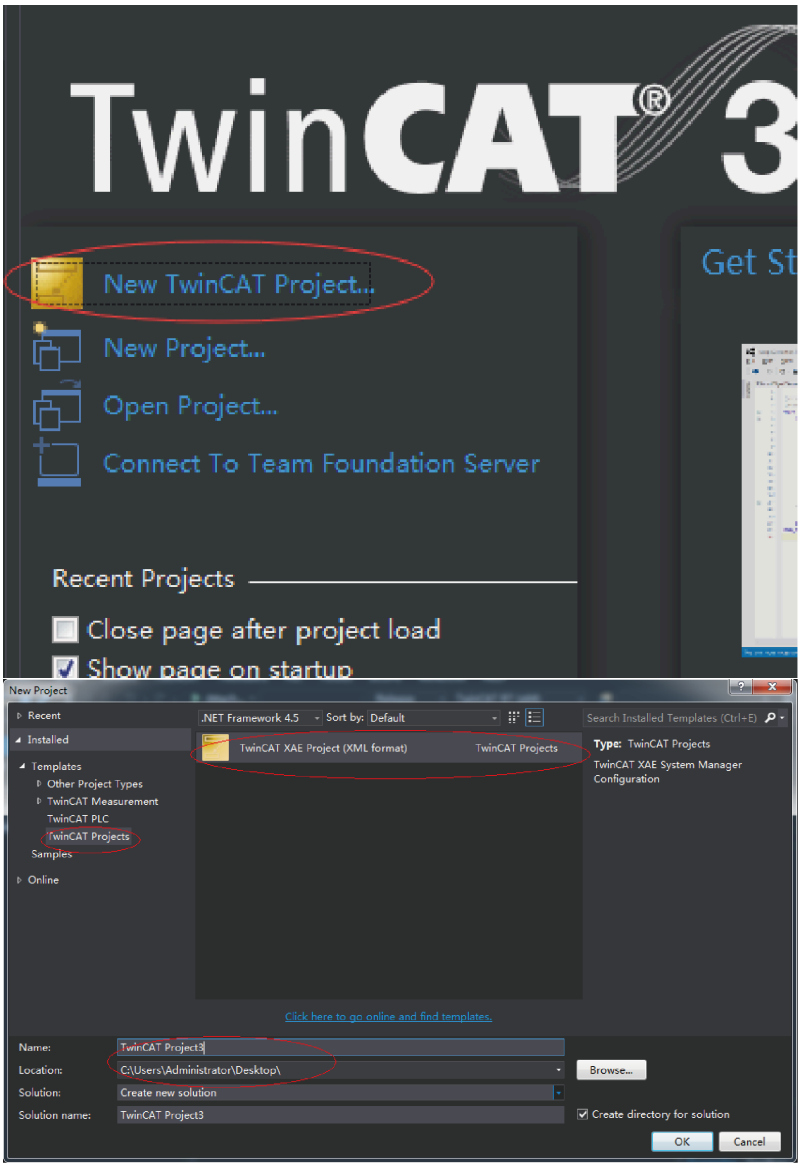
Installing the TwinCAT software

The TwinCAT3 software, which can be downloaded from the official website of Beckhoff, supports 32/64-bit win7 systems.

Note

Use Fast Ethernet Card with Intel chip. Use of network cards of other brands may result in the risk of EtherCAT operation failure.

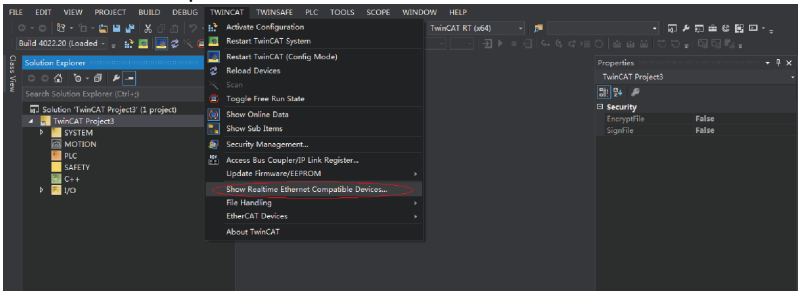
1. Copy the SV680N-INT EtherCAT configuration file (SV680_1Axis_V0.04-0506) to the TwinCAT installation directory: TwinCAT\3.1\Config\Io\EtherCAT.
2. Open TwinCAT3 and create a New Twincat3 Project.



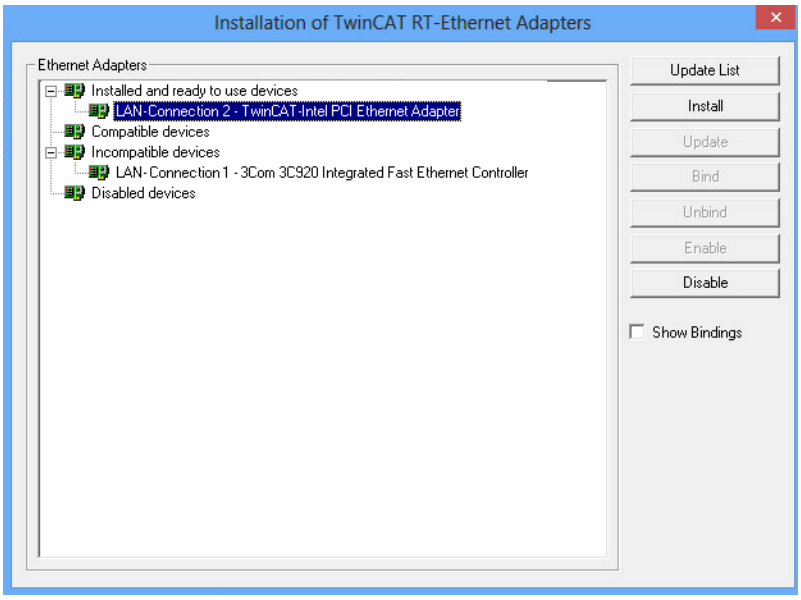
Installing the network adapter driver

Install the TwinCAT network card driver.

1. Click TwinCAT in the top menu bar and select "Show Real Time Ethernet Compatible Devices...",as shown in the following figure. In the "Installed and ready to use devices" dialog box, select the local connection under "Incompatble devices"andclick "Install".

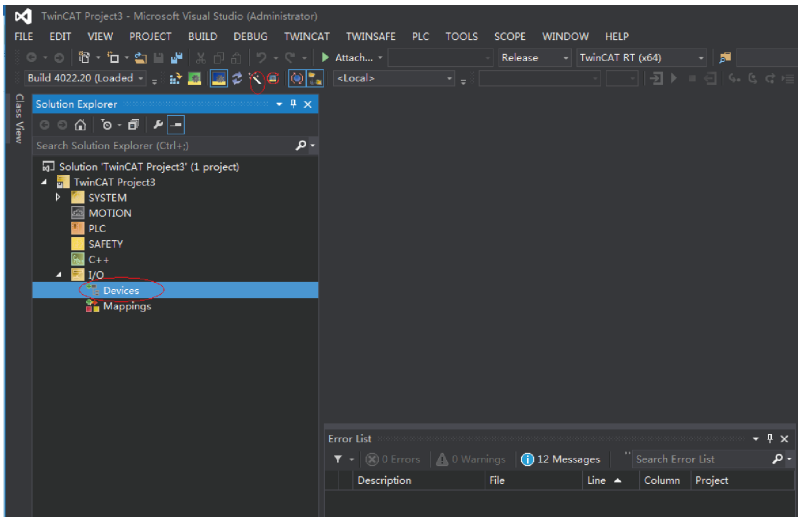


2. After the driver is installed, it is displayed under "Installed and ready to use devices".

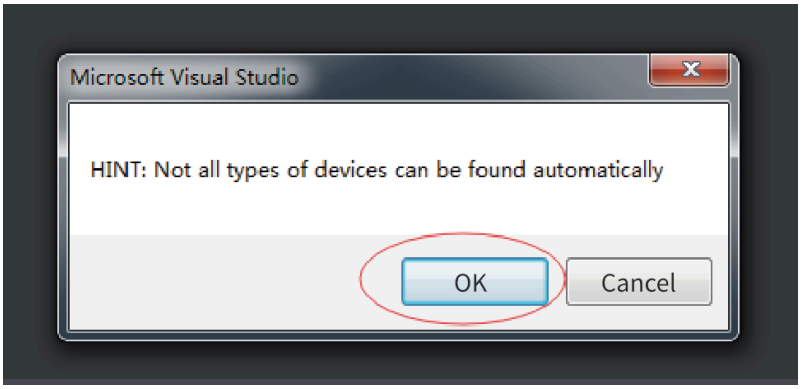


Scanning for devices

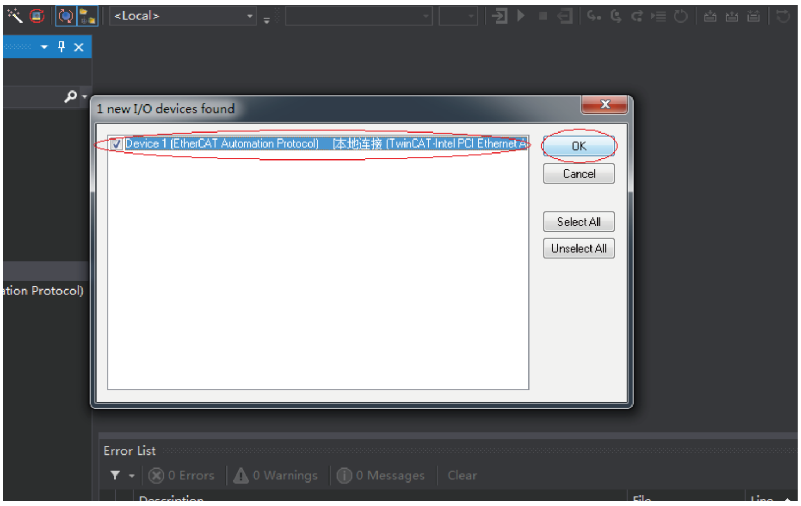
1. Create a project and search for devices. Select "Devices" and click "", as shown in the following figure.



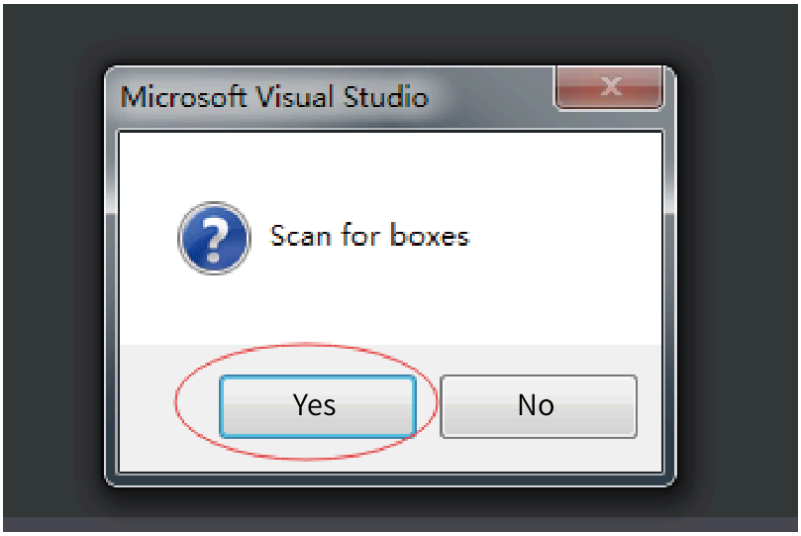
2. Click "OK".



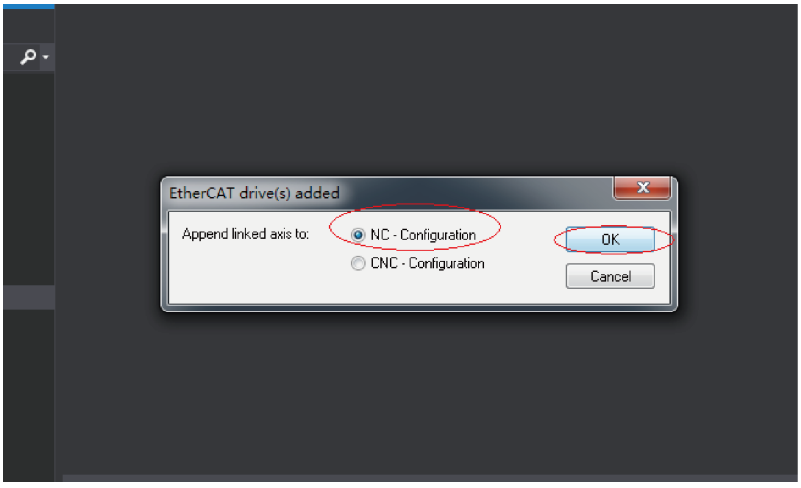
3. Click "OK".



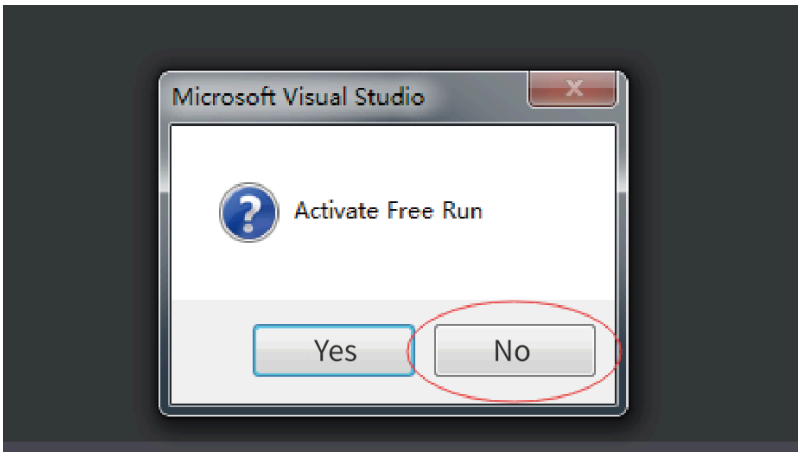
4. Click "Yes".



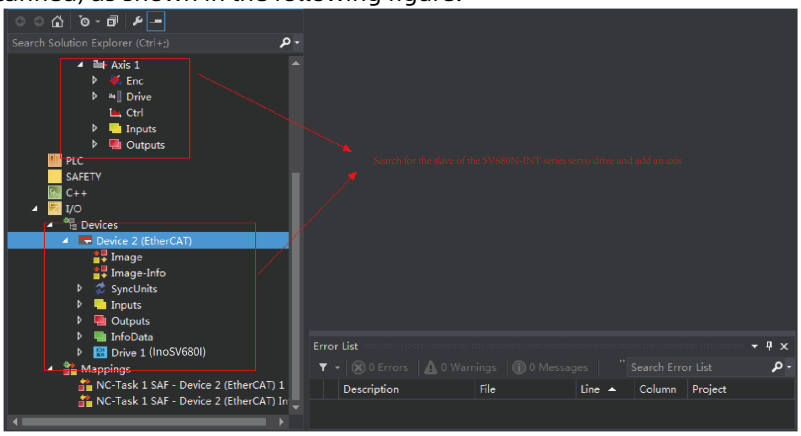
5. Click "OK".



6. Click "No".

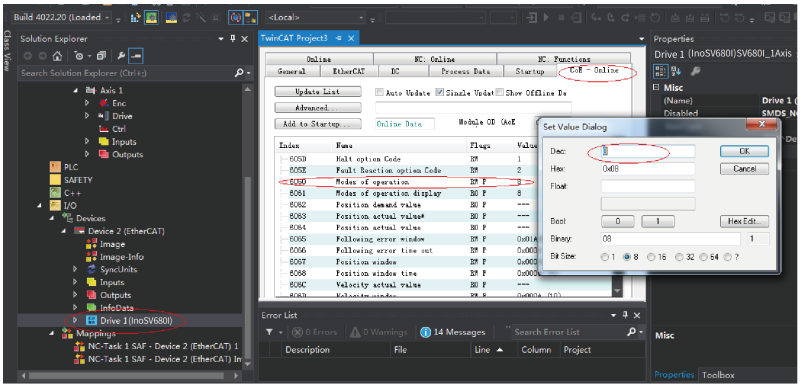


7. Devices are scanned, as shown in the following figure.



Configuring servo drive parameters

Configure the parameters through SDO communication in the "CoE-Online" interface. When H0E.01 (200E-02h) is set to 3, the parameter values modified through SDO communication will be saved upon power failure. To modify 6060h to the CSP mode (8), follow the procedures shown in the following image.

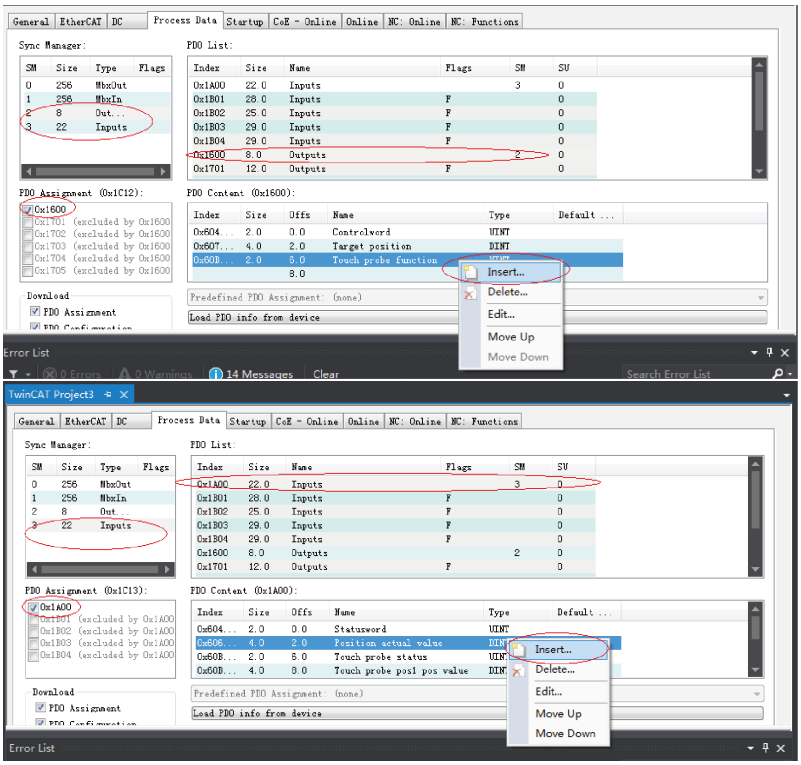


Note

This operation is available only when H02.00 is set to 9.

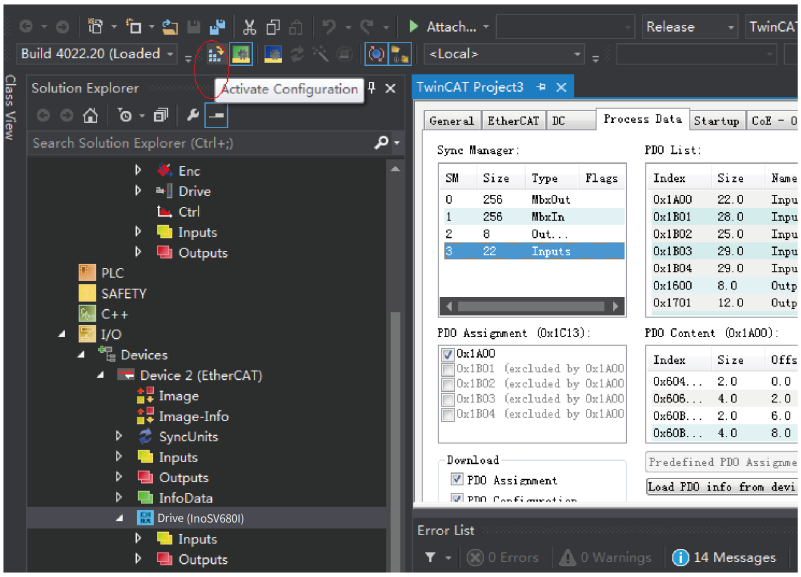
Configure PDO parameters

Select 0x1600 and 0x1A00 as shown in the following figure. Change the current PDO only if it does not fulfill your needs. To modify the PDO, right click the PDO Content window, click "Delete" to delete the redundant PDO or click "Insert" to add the PDO needed. To modify the PDO, right-click in the "PDO Content" section, and click "Delete" to delete the redundant PDO or click "Insert" to add the PDO that you need to use.

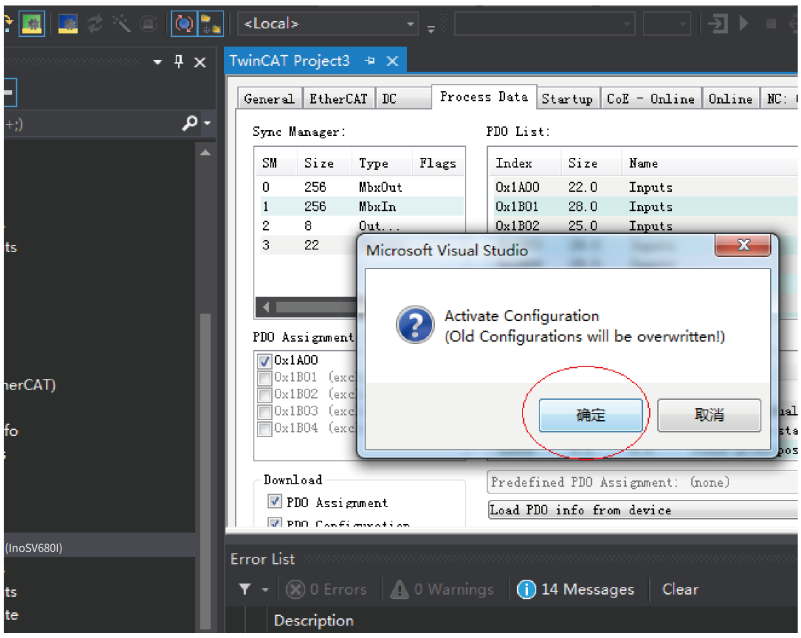


Activate the configuration and switch to the operation mode.

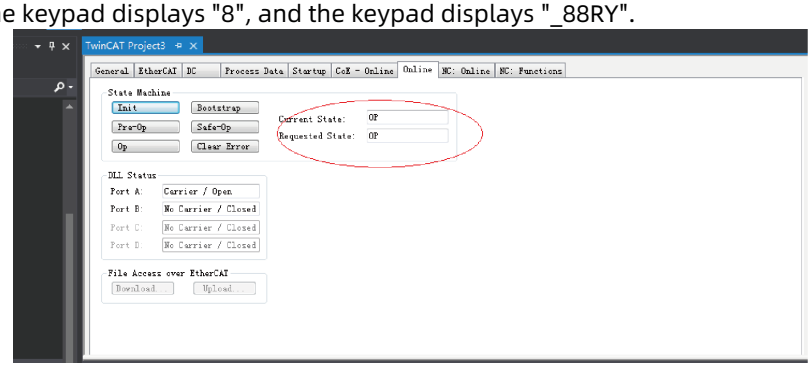
1. Click "".



2. Click "OK".



3. After you click "OK", the device enters OP status as shown in the Online interface. Meanwhile, the 3rd LED on the keypad displays "8", and the keypad displays "_88RY".



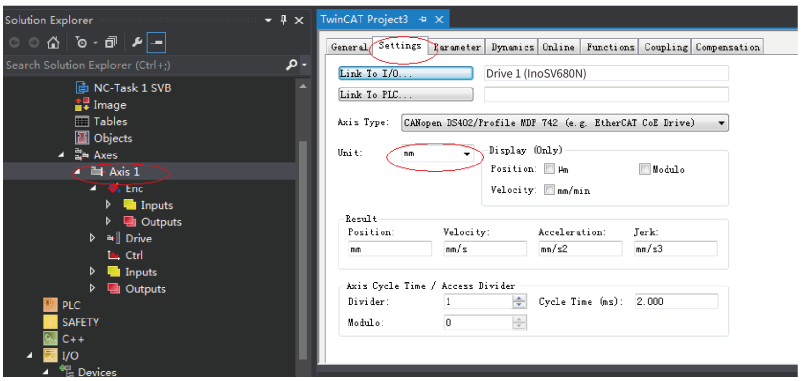
Control servo drive operation.

Control the servo drive through NC or PLC programs.

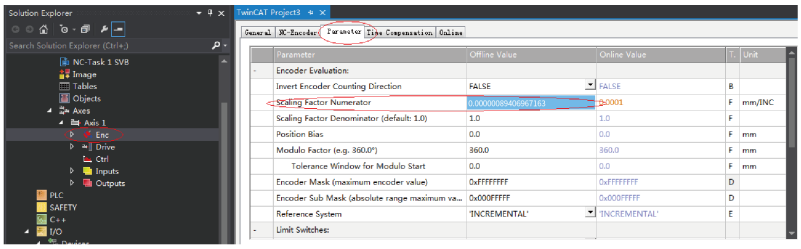
1. Run the servo in CSP mode.

a. Set the unit.

Set the unit to "mm" during the test.



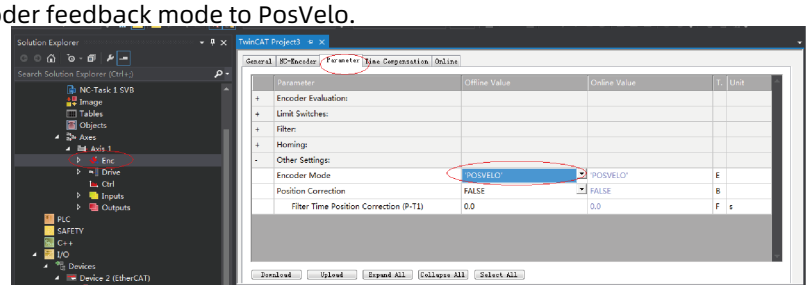
b. Set the scaling factor.



Scaling factor: distance for the encoder pulses of each position feedback.

For example, 67108864 PPR corresponds to a distance of 60 mm, and the scaling factor is: 60/67108864 = 0.00000089406967163 mm/Inc.

c. Set the encoder feedback mode to PosVelo.



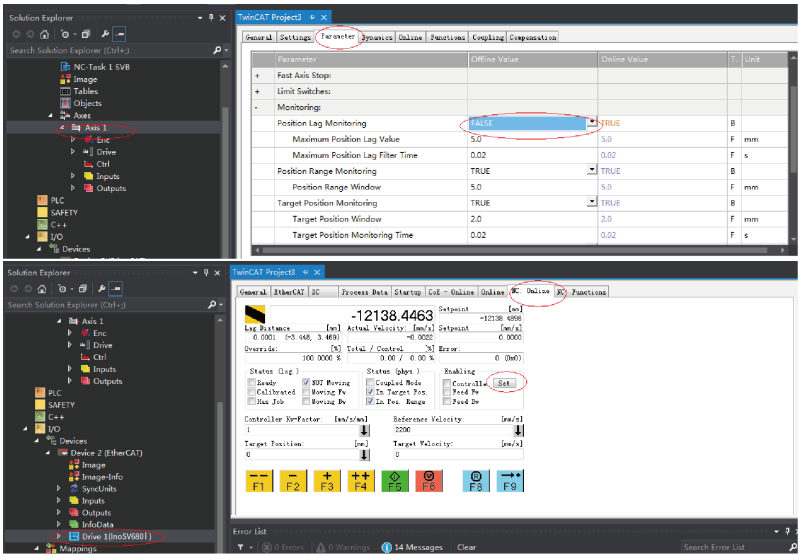
Descriptions for Other Settings:

Encoder mode: There are three encoder modes: Pos, PosVelo, and PosVeloAcc.

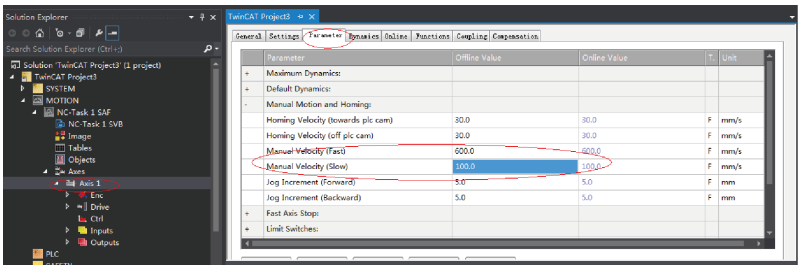
- Pos: The encoder only calculates the position and is used when the position loop is within the servo drive.
- PosVelo: The encoder only calculates the position and speed and is used when the position loop is in the TWinCAT NC.
- PosVeloAcc: The TWinCAT NC uses the encoder to determine the position, speed, and acceleration.

d. Run jogging tests.

Temporarily hide the system deviation.

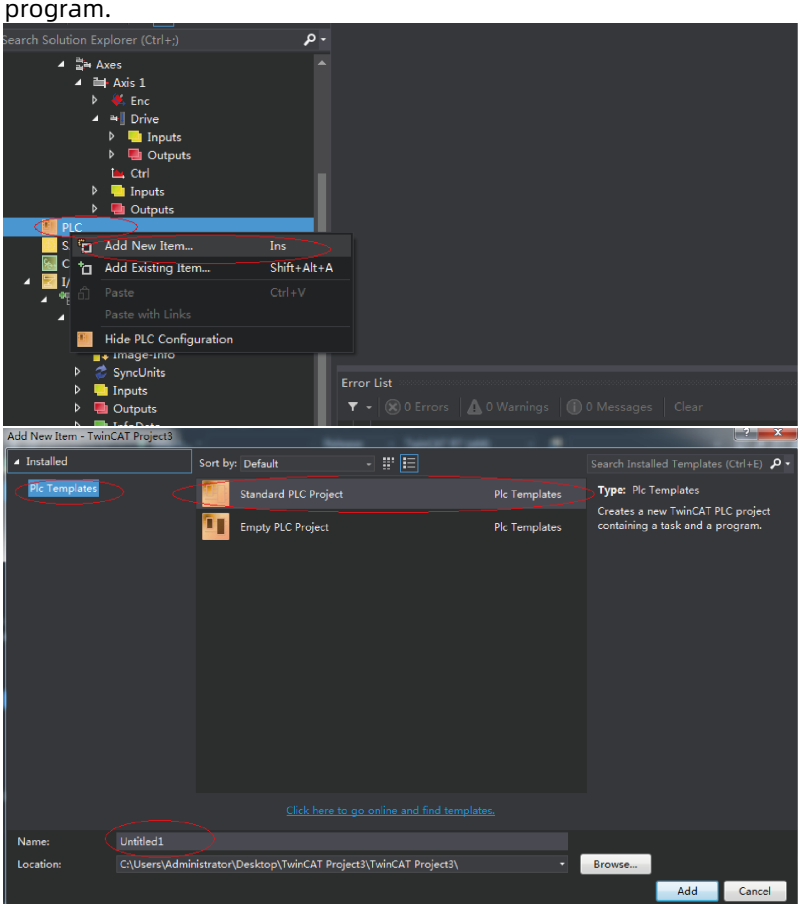


Click Set. In the dialog box that appears, click "All" to enable the servo drive. Click F1 to F4 to perform jogging. The jog speed is set as shown in the following figure.

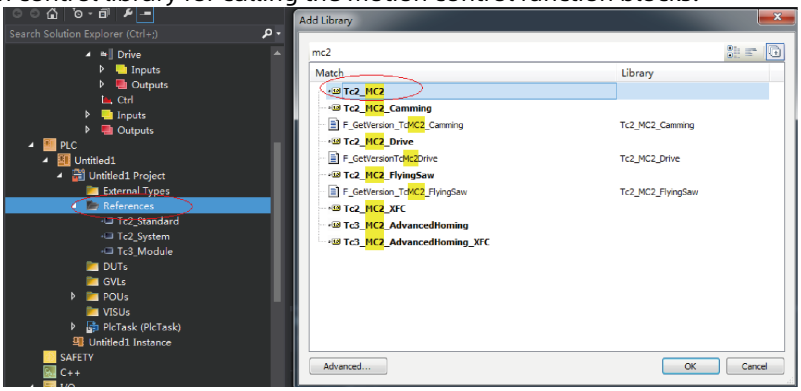


2. Control the servo drive operations through the PLC.

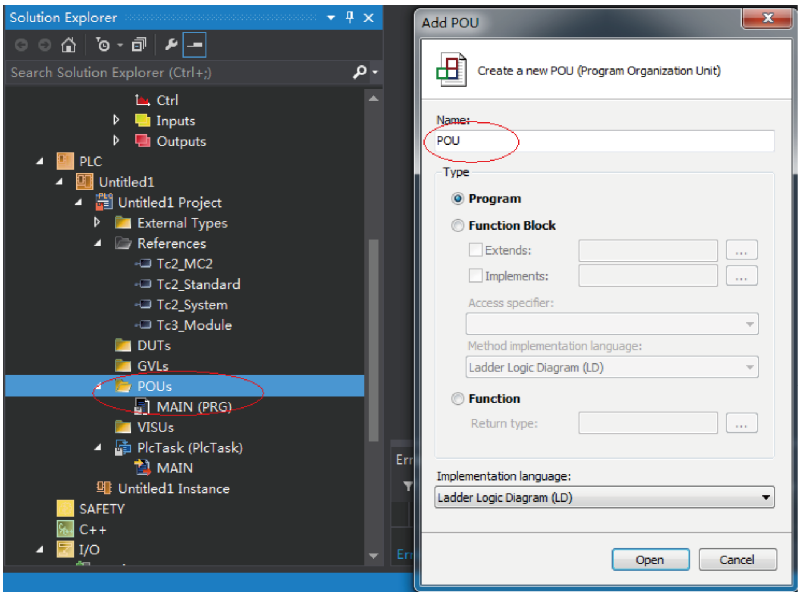
a. Create a PLC program.



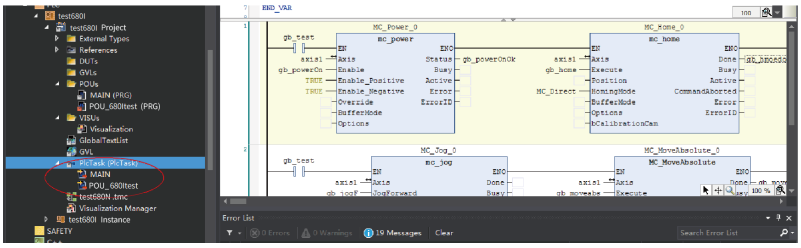
b. Add a motion control library for calling the motion control function blocks.



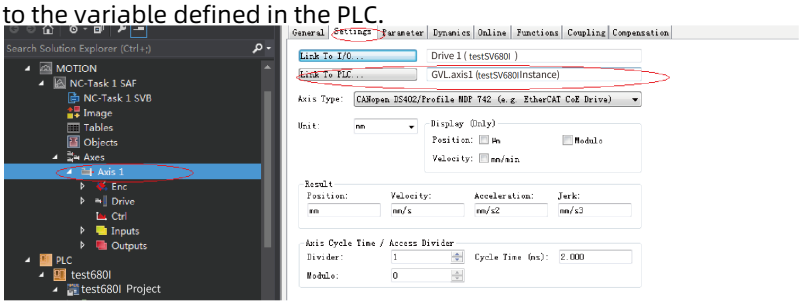
c. Create a POU program.



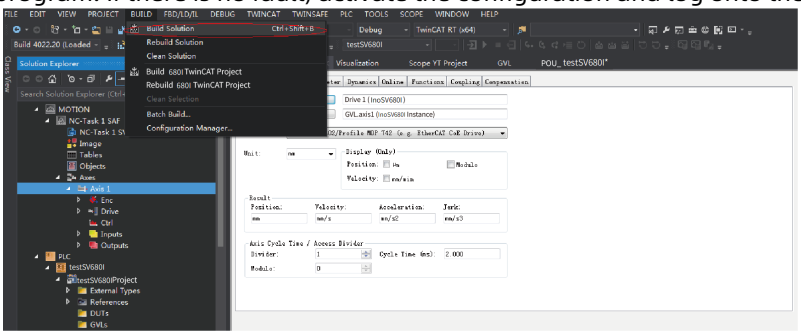
d. Call the motion module to implement some simple actions and input the final program to PLCtask.

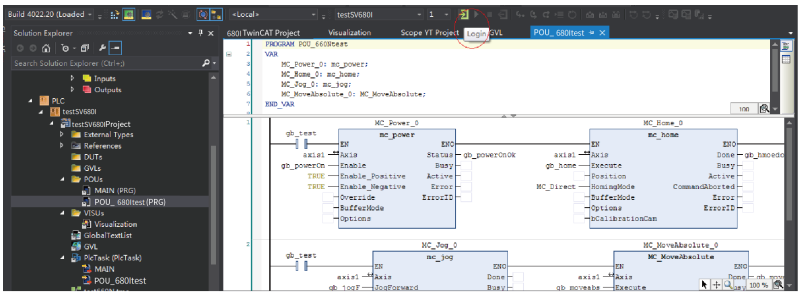


e. Link the axis to the variable defined in the PLC.

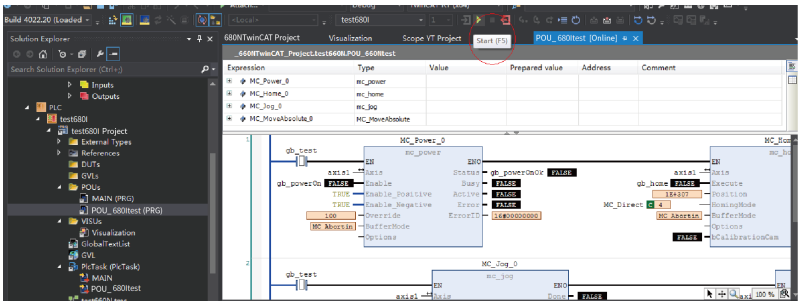


f. Compile the program. If there is no fault, activate the configuration and log onto the PLC.



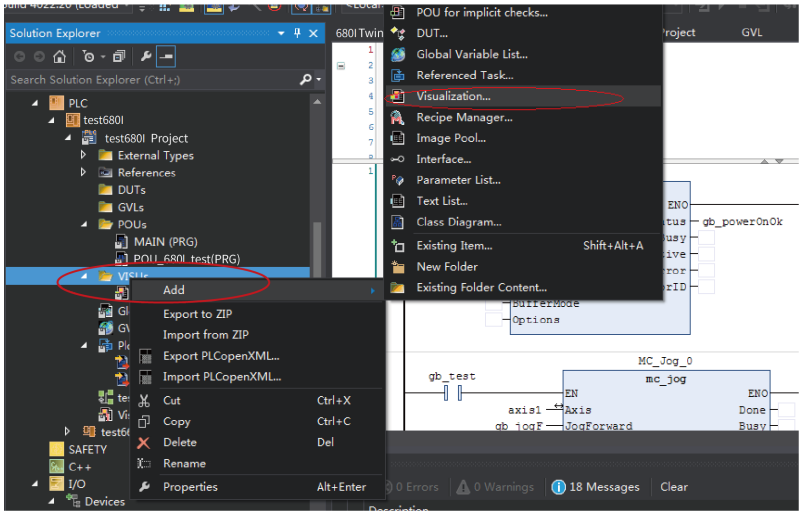


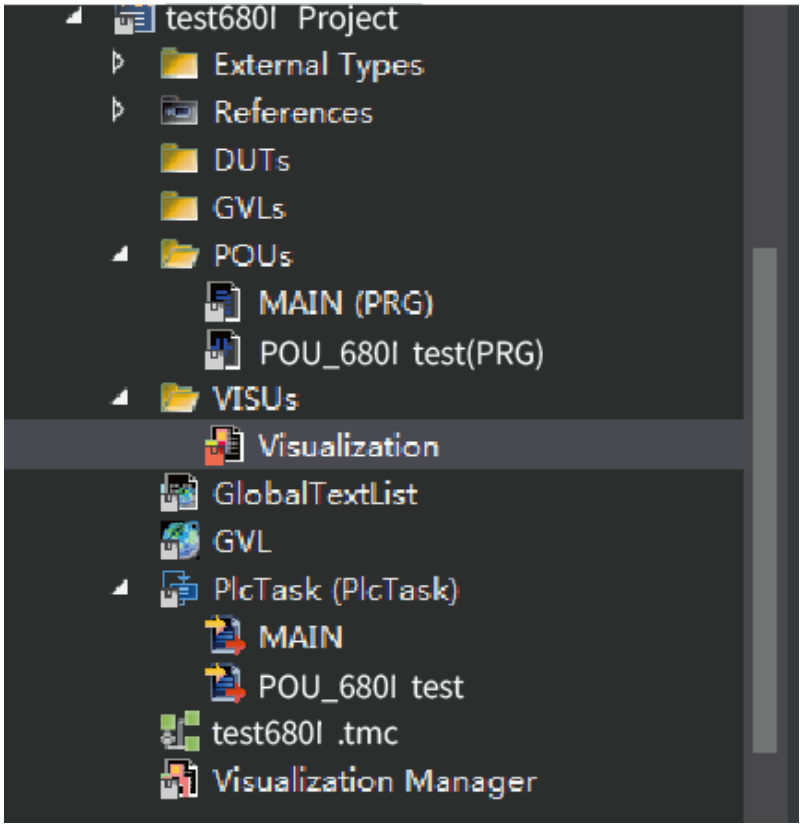
g. Click "Start" to run the servo drive.



3. Control the servo drive operations through the HMI.

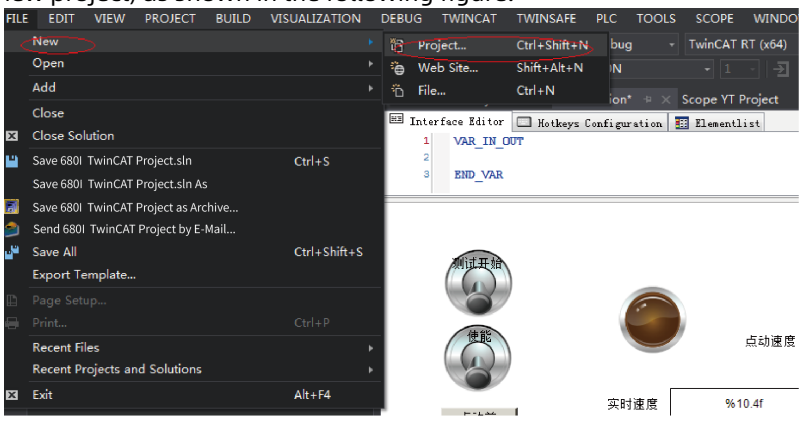
Add the HMI interface to control the servo drive through the HMI interface.

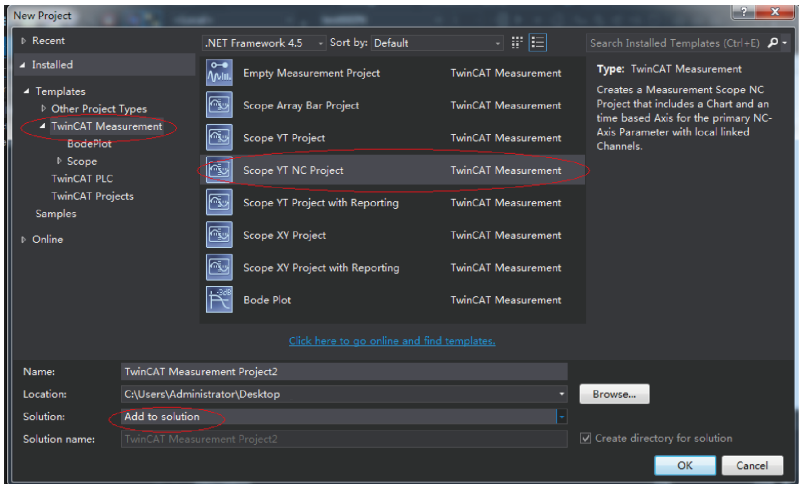




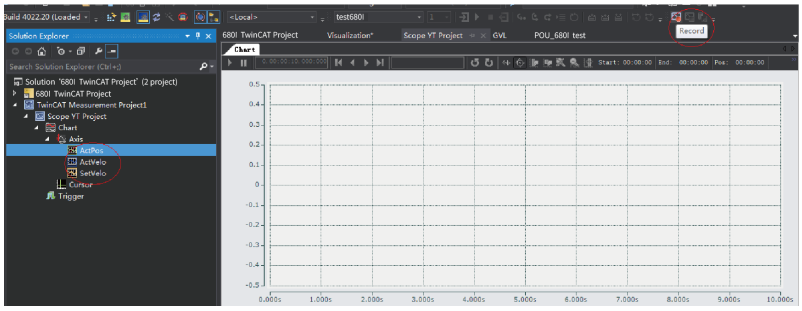
Use the scope view function.

1. Add a scope view project, as shown in the following figure.





2. Add the parameters to be monitored and monitor these parameters during the operation of the PLC.



8.2.4 KEYENCE KV7500 as the Host Controller

8.2.4.1 Configuring the Servo Drive

- Servo drive version
  It is recommended to use the device description file "SV680N-INI-Ecat_v0.09.xml" or later for trial run.
- Related parameters
  bit0: negative limit; bit1: positive limit; bit2: home switch; bit16 to bit20 correspond to DI1 to DI5 respectively.

8.2.4.2 Configuring KEYENCE KV7500 Software Tool

As software tool versions earlier than KV STUDIO 9.45 do not support extension of KEYENCE EtherCAT module "KV-XH16EC", the version of the KEYENCE software tool used must be KV STUDIO 9.45 or later.

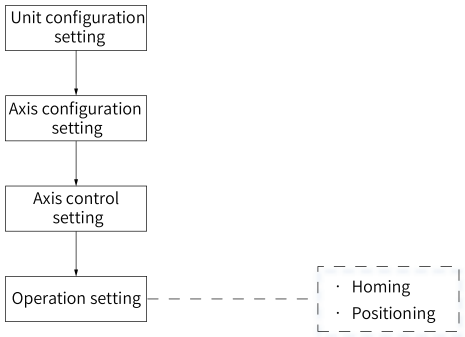
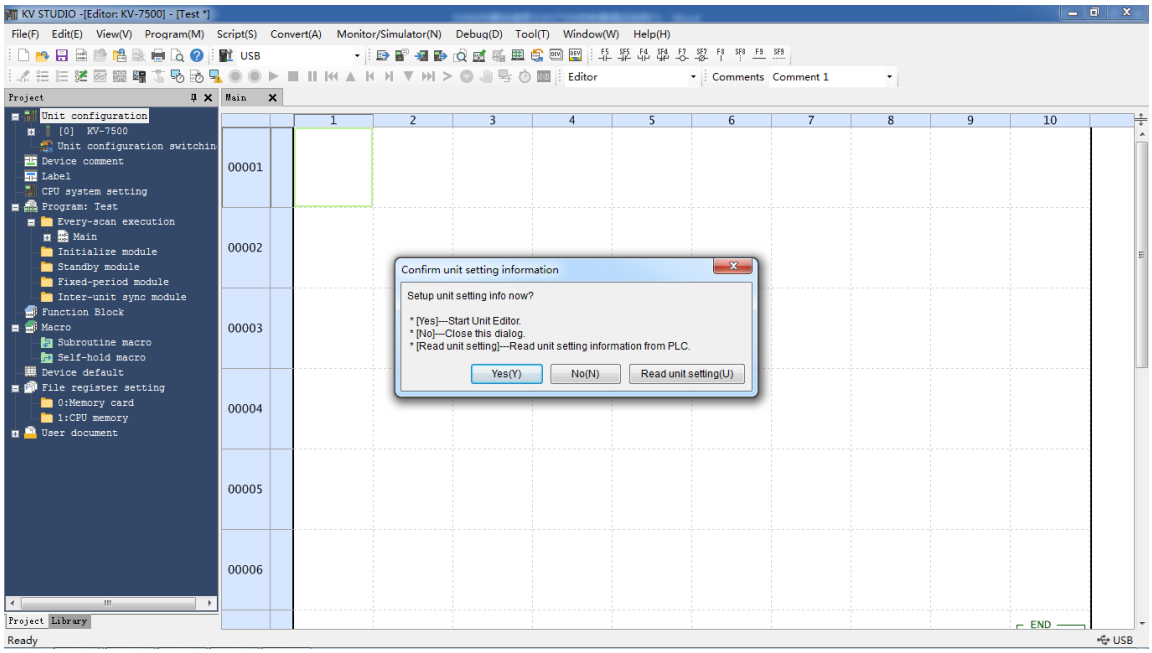


Figure 8-11 Configuration flowchart

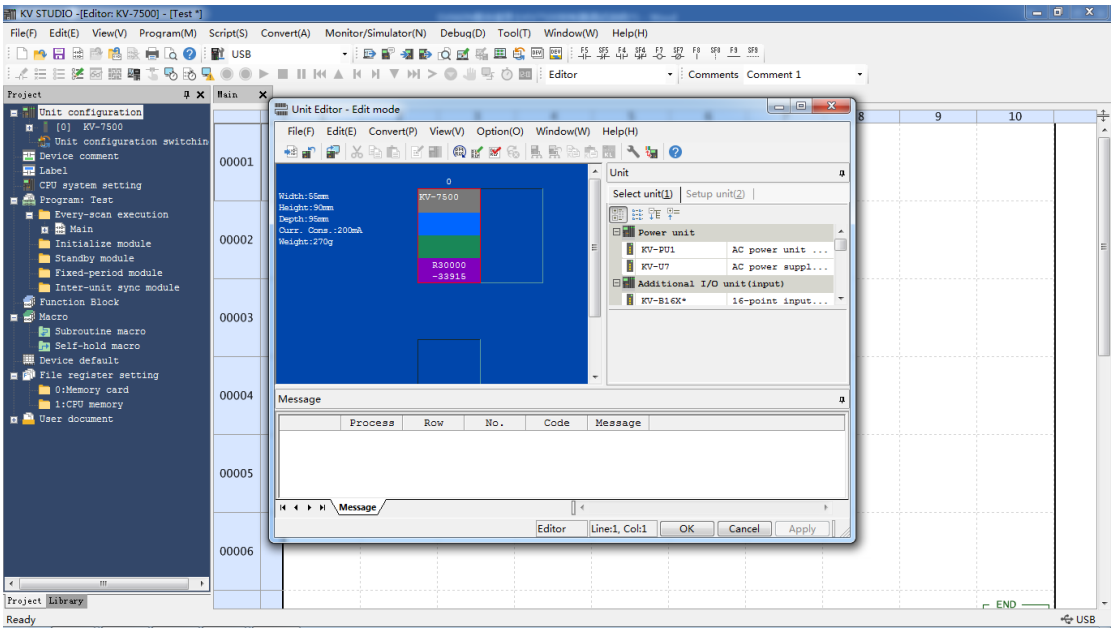
Unit configuration setting

Create a project and click "OK" to display the following dialog box.

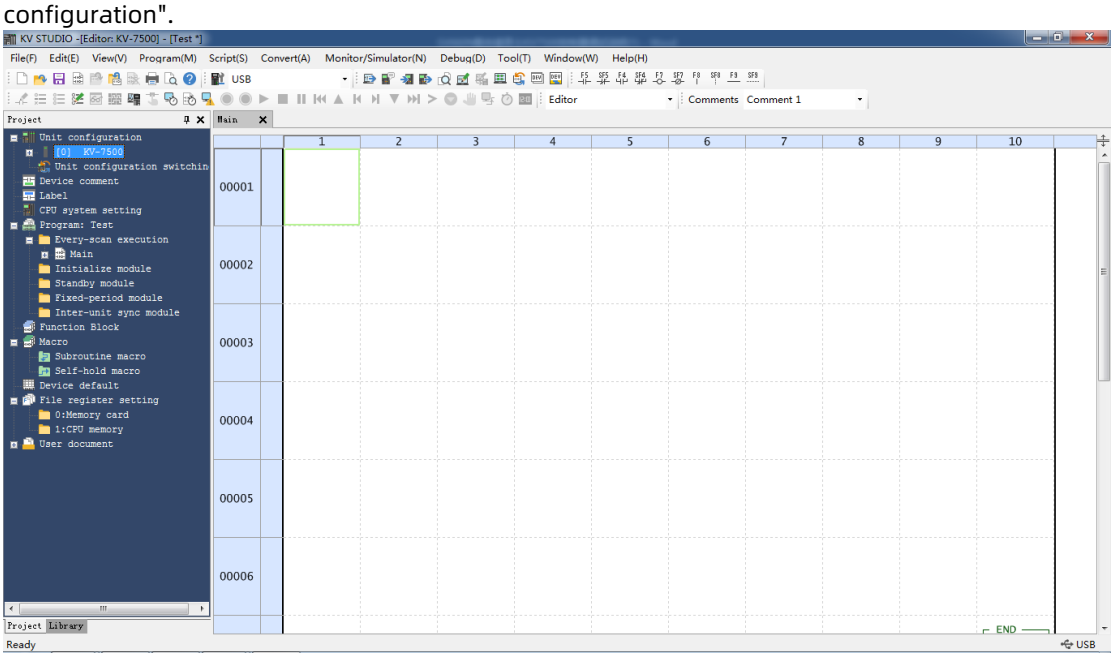


Click "Yes", "No", or "Read unit setting" as needed.

- Click "Read unit setting" when the physical PLC unit is connected properly and able to communicate with the software tool. The software tool obtains unit configurations automatically according to the physical connection.
- If you click "Yes", the "Unit editor" dialog box opens, allowing you to select units for configuration through dragging or double-clicking.

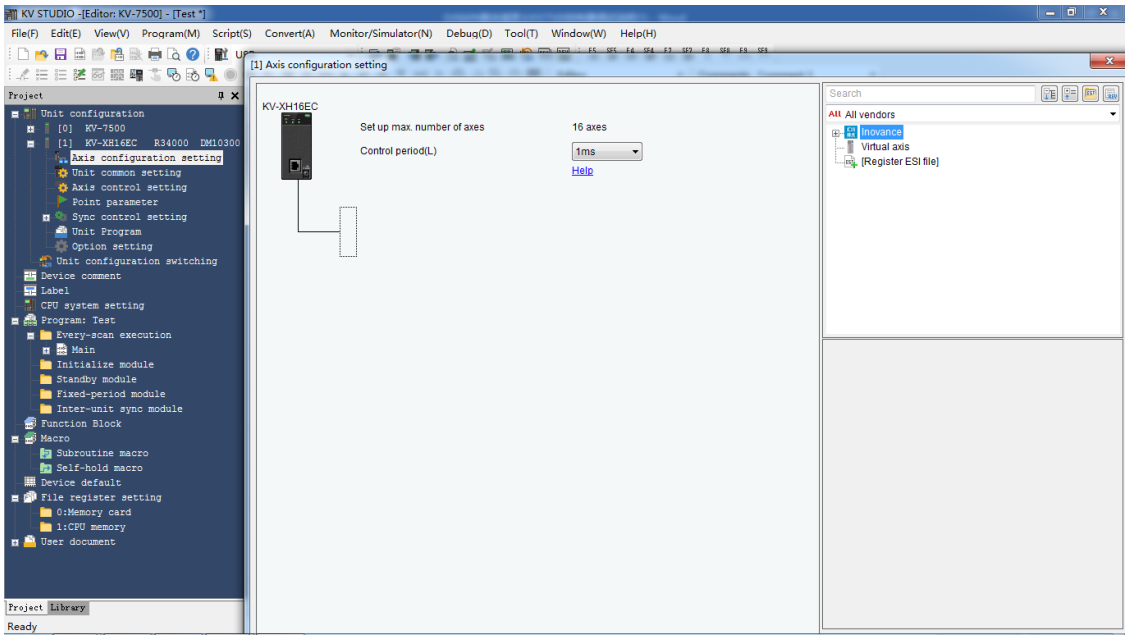


- If you click "No", you can click "Tool > Unit editor" or double-click "[0] KV7500" under "Unit configuration".



Axis configuration setting

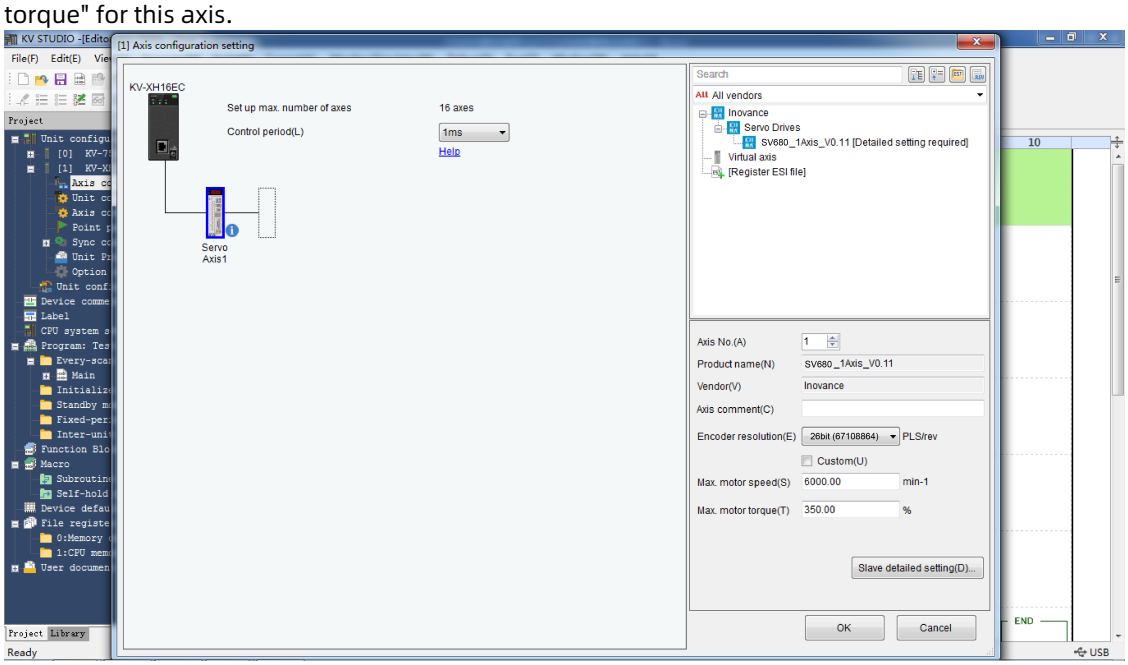
1. Click Axis configuration setting.
2. Double-click "Register ESI file".



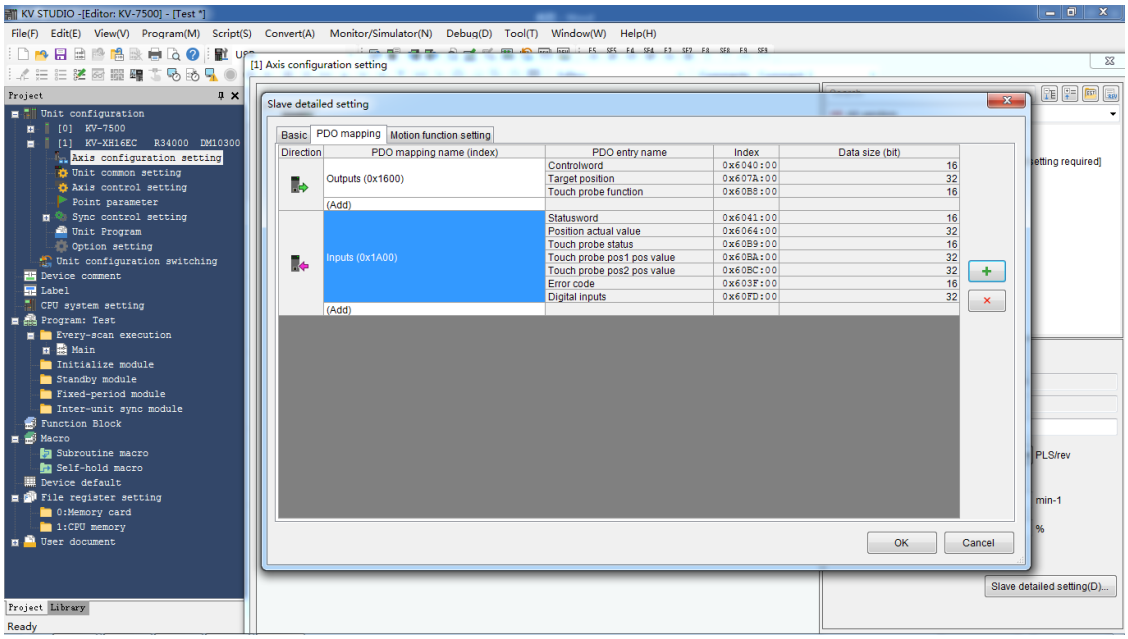
3. Find the storage directory of the device description file ".xml" and open it.
4. Import the XML file.



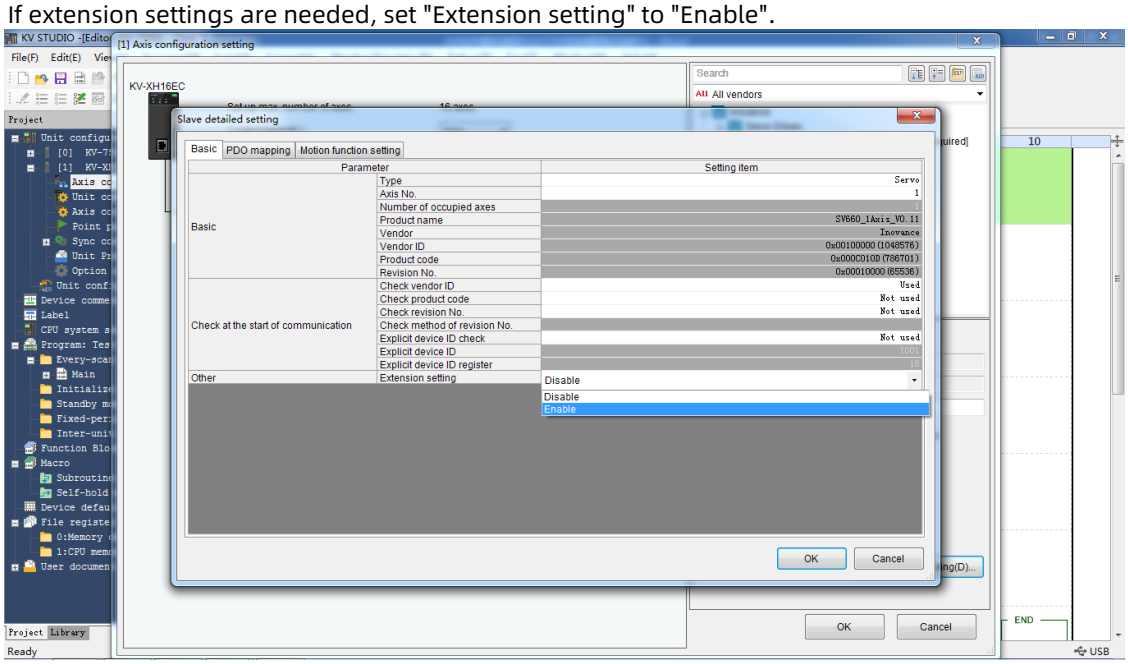
5. After the device description file is imported, you can add axes. You can also set the control period in the Axis configuration settings. The default control cycle is 1 ms and the minimum control cycle is 250 us.
6. You can add axes by dragging or double-clicking the axes. Select the corresponding axis and set critical information, such as the "Encoder resolution", "Max. motor speed", and "Max. motor torque" for this axis.



7. You can add PDO settings in the detailed settings of the slave.

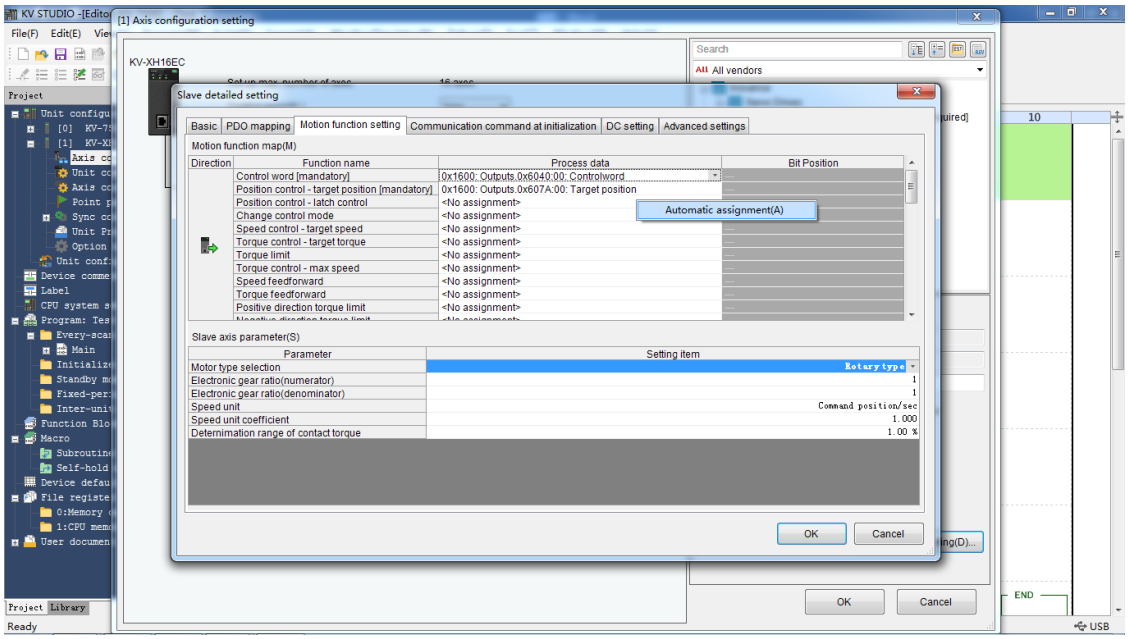


8. If extension settings are needed, set "Extension setting" to "Enable".

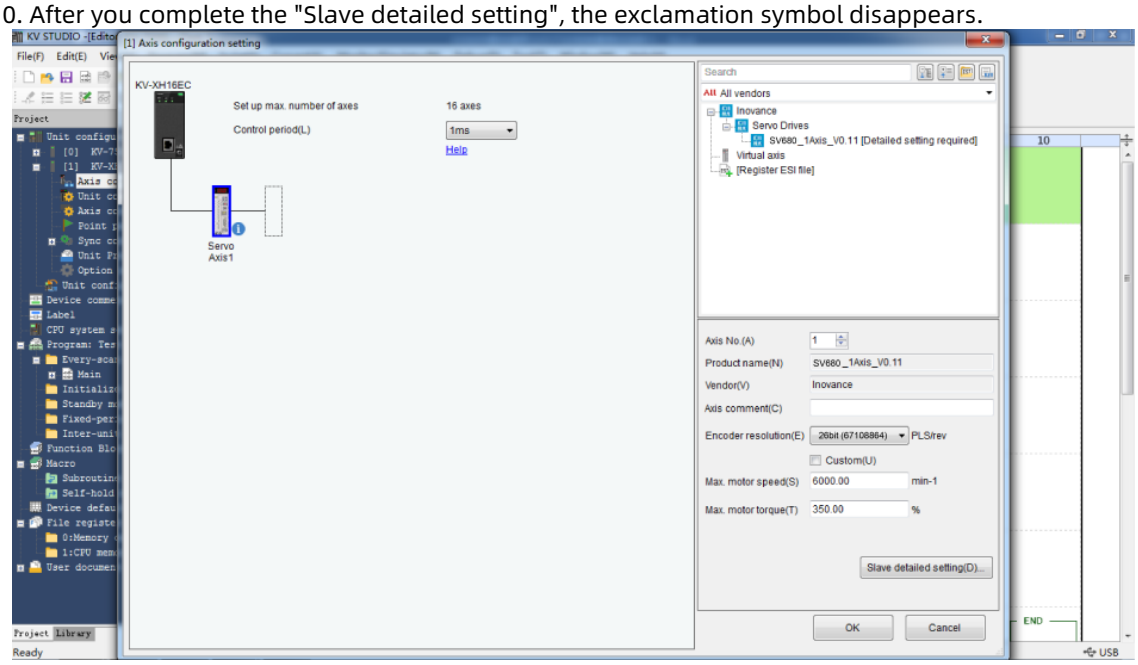


9. For motion function settings, you can double-click or click on the combo box (small triangle icon) to select the PDO configuration needed from the dropdown list.
   You can also right-click and choose "Automatic assignment" > "Yes". This way, the assigned contents will automatically correspond to the preceding PDO content.

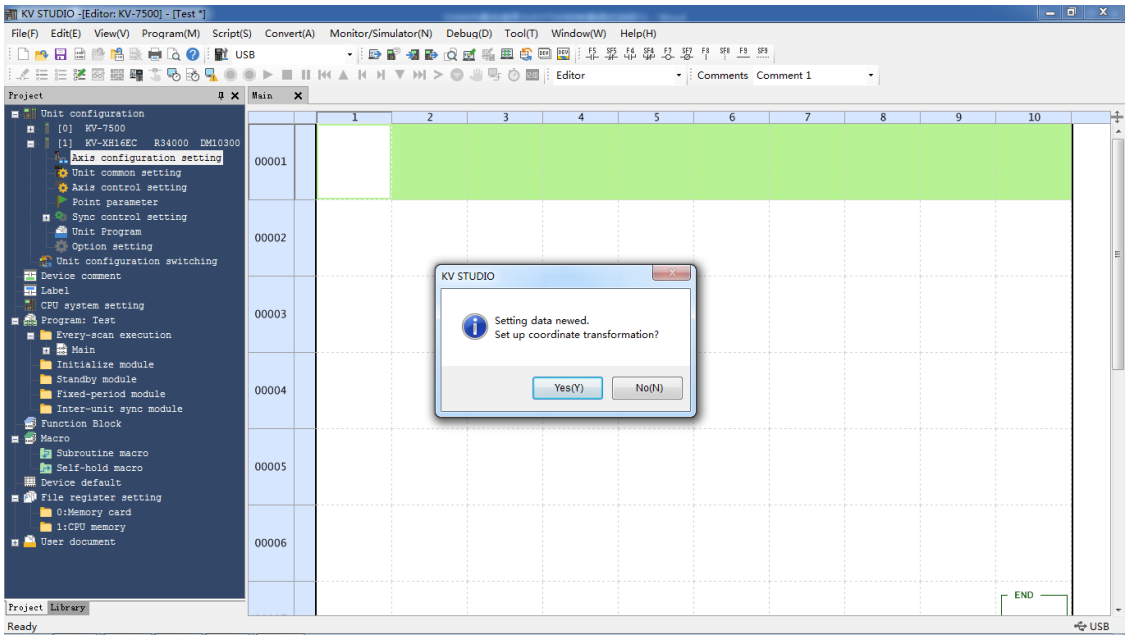
   During manual assignment, do not neglect any contents in the PDO mapping. Otherwise, a pop-up window will be displayed to remind you of the missing contents when you click "OK". For Communication command at initialization, DC setting, and Advanced settings, use the default values. After settings are completed, click "OK".



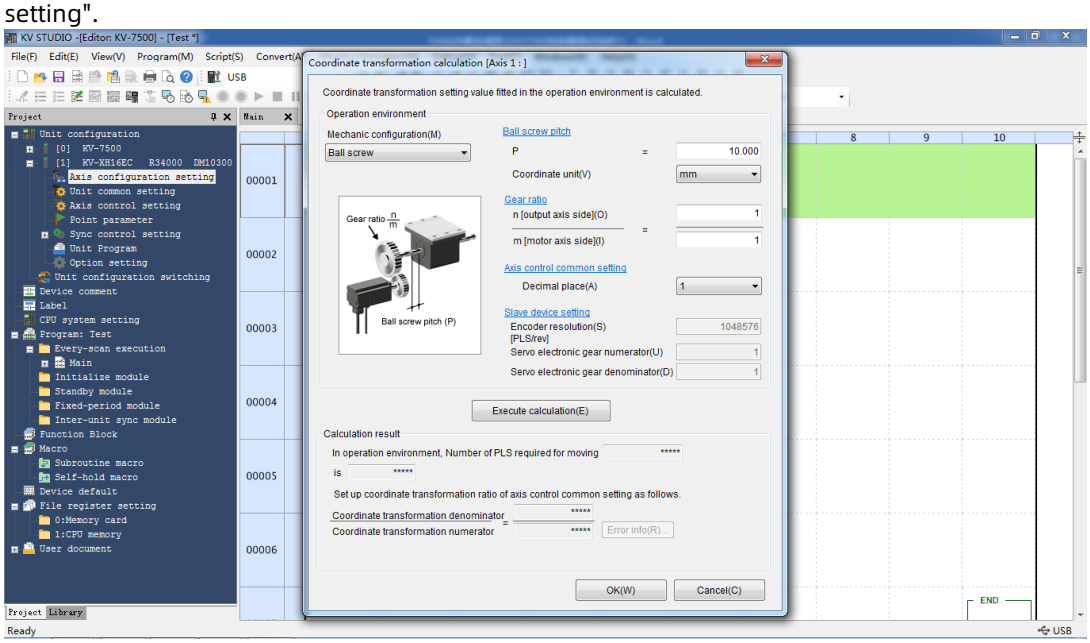
10. After you complete the "Slave detailed setting", the exclamation symbol disappears.



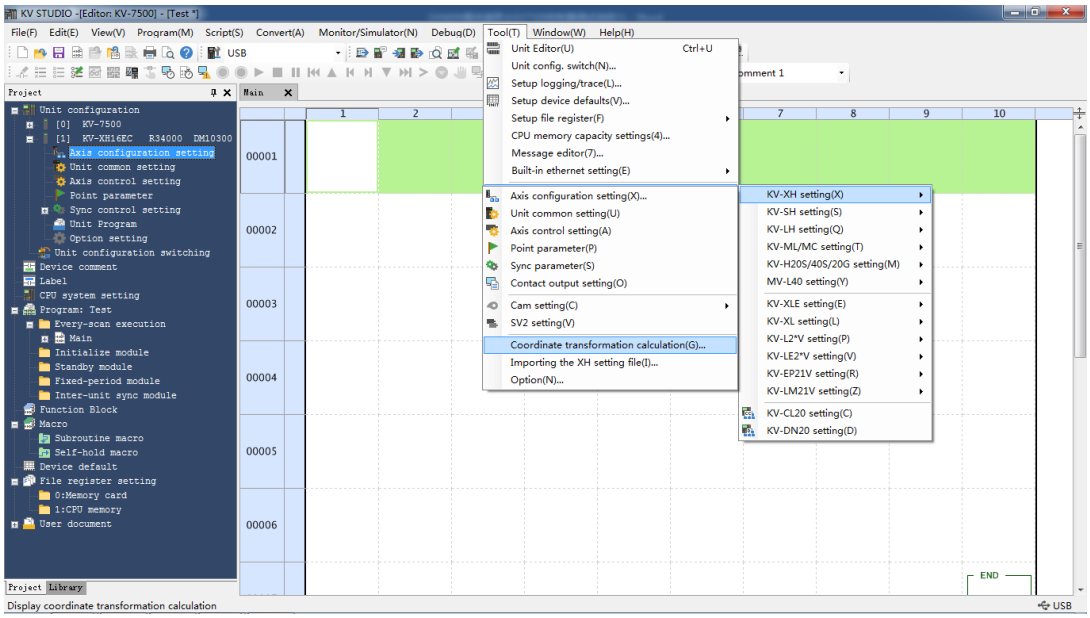
11. After you add the axes, click "OK". Then, the following dialog box appears, prompting you whether to set up coordinate (namely electronic gear ratio) transformation.



- Click "Yes". The coordinate transformation dialog box appears. Set the mechanical parameters and the coordinate unit based on actual conditions and click "Execute calculation". The software automatically calculates the denominator and numerator for coordinate transformation and automatically writes parameters to "Axis control Working condition setting".

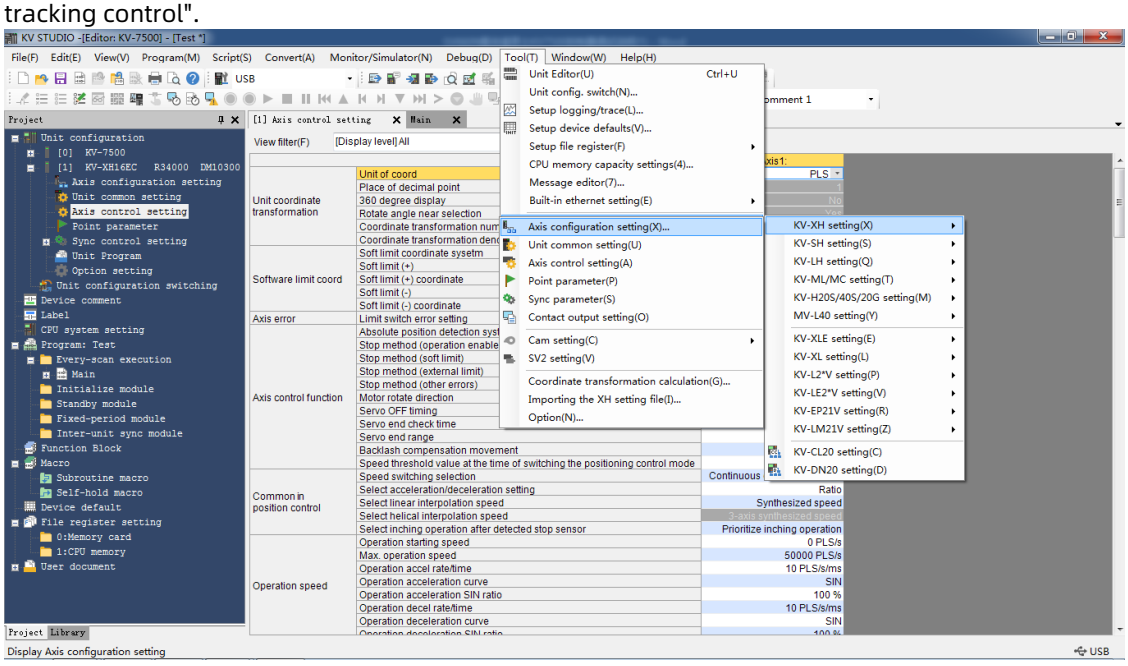


- If you click "No", you can click "Tool" > "Coordinate transformation calculation" > "KV-XH setting" > "Coordinate transformation calculation".



Axis control setting

1. Axis control settings can be opened from "Tools"→"Axis configuration setting"→"KV-XH setting", or click "Axis control setting" under "Project".
2. In the axis control settings, you can configure parameters including "Unit coordinate transformation", "Software limit coord", "Axis error", "Axis control function", "Common in position control", "Operation speed", "JOG", "Homing", "Absolute position control", and "Synchronous tracking control".



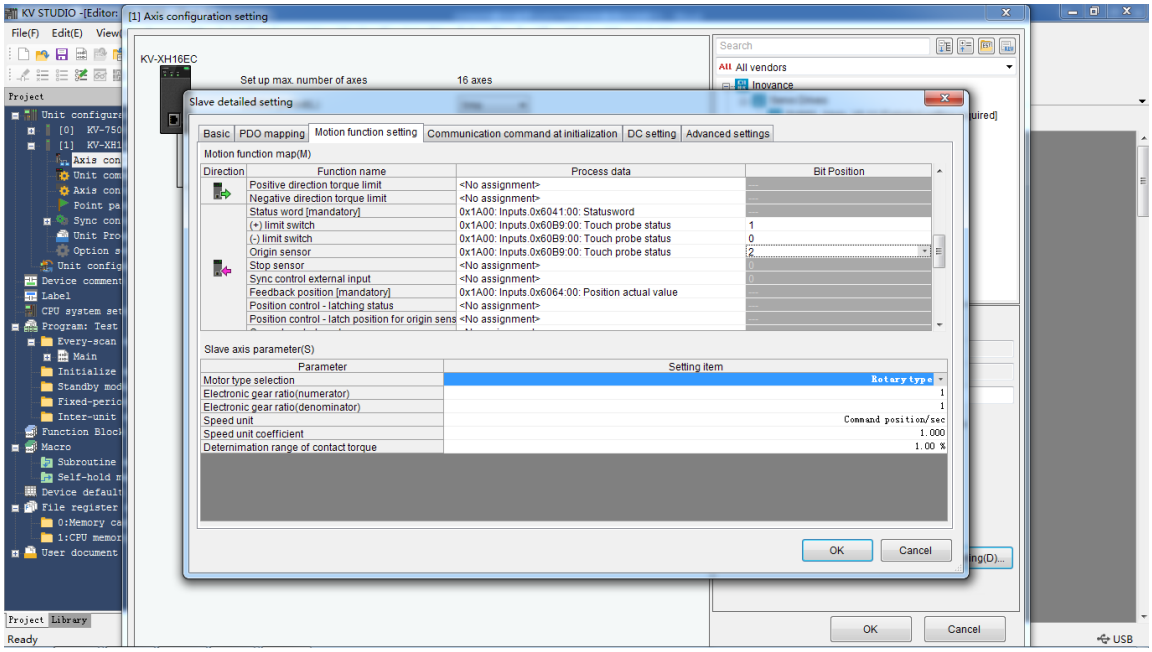
Operation setting

Homing

Before performing homing, assign (+) limit switch, (-) limit switch, and Origin sensor in Motion function setting under Axis configuration setting to each bit of 60FDh. 60FDh is defined as follows:

bit0: negative limit; bit1: positive limit; bit2: home switch; bit16 to bit20 correspond to DI1 to DI5 respectively.

In automatic assignment, you need to manually assign (+) limit switch, (-) limit switch, and Origin sensor, you can assign them to corresponding bits of 60FDh based on the relation shown in the following figure or to bit16 to bit20. In this case, you also need to assign them to corresponding DIs of the servo drive.



Set the restriction parameters for homing in "Axis control setting"→"Origin return". The following homing methods are available. For detailed trajectories, see KEYENCE instruction manual for positioning/motion control unit KV-XH16EC.

Default	Value range	Description
DOG type (with phase Z)	DOG type (with phase Z)	Decelerating upon DOG signal input and homing through phase Z signal.
	DOG type (without phase Z)	Decelerating upon DOG signal input and homing through falling edge of DOG signal.
	DOG-type jogging (with phase Z)	Pausing after moving based on Dog ON upon DOG signal input. Then, move to the homing direction through position-type speed control and homing with phase Z signal.
	DOG-type jogging (without phase Z)	Moving based on Dog ON upon DOG signal input before homing.
	DOG type (contact)	Homing executed when the ON duration of the torque limit signal keeps longer than the compression torque time upon DOG signal input.
	Origin sensor and phase Z	Homing executed in the initial phase Z position after the origin sensor is ON.
	Rising edge of origin sensor	Homing executed through the rising edge of the origin sensor.
	Middle point of origin sensor (without phase Z)	Taking the middle point of the ON range of origin sensor as the origin and comparing it with that in "Rising edge of origin sensor". Even if the light-receptive performance of the origin sensor degrades, the homing position can hardly change with the time.
	Rising edge of limit switch	Homing executed with the limit switch in the negative direction (direction in which the current coordinate decreases) acting as the origin sensor.
	Immediate homing of phase Z	Homing executed with phase Z signal
	Data setting type	Taking current coordinate as the origin coordinate.

The following homing methods are available.

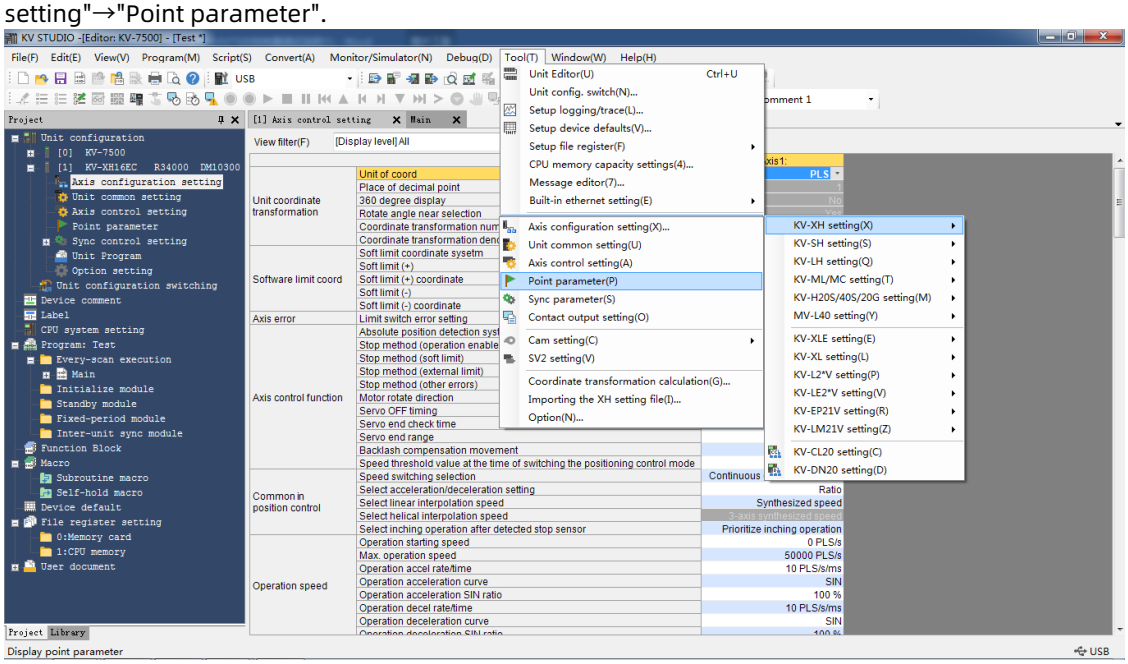
No.	Homing mode	SV680N-INT
1	DOG-type (with phase Z)	√
2	DOG-type (without phase Z)	√
3	DOG-type jogging (with phase Z)	×
4	DOG-type jogging (without phase Z)	×
5	DOG-type (contact)	Homing is available, but the reference coordinate after homing is not 0. Updating to the xml coordinate of SV680N zeroes out the reference coordinate.
6	Origin sensor and phase Z	√
7	Rising edge of origin sensor	√
8	Middle point of origin sensor	×
9	Rising edge of limit switch	Homing is available, but the reference coordinate after homing is not 0.
10	Immediate homing of phase Z	√

Positioning

Set the unit coordinate transformation properly before positioning. The unit coordinate transformation is "PLS" by default, which allows no modification on the numerator or denominator. If N revolutions are required by the servo drive, the number of commands that need to be sent by the host controller is N × Pulses per revolution. If coordinate transformation calculation has been

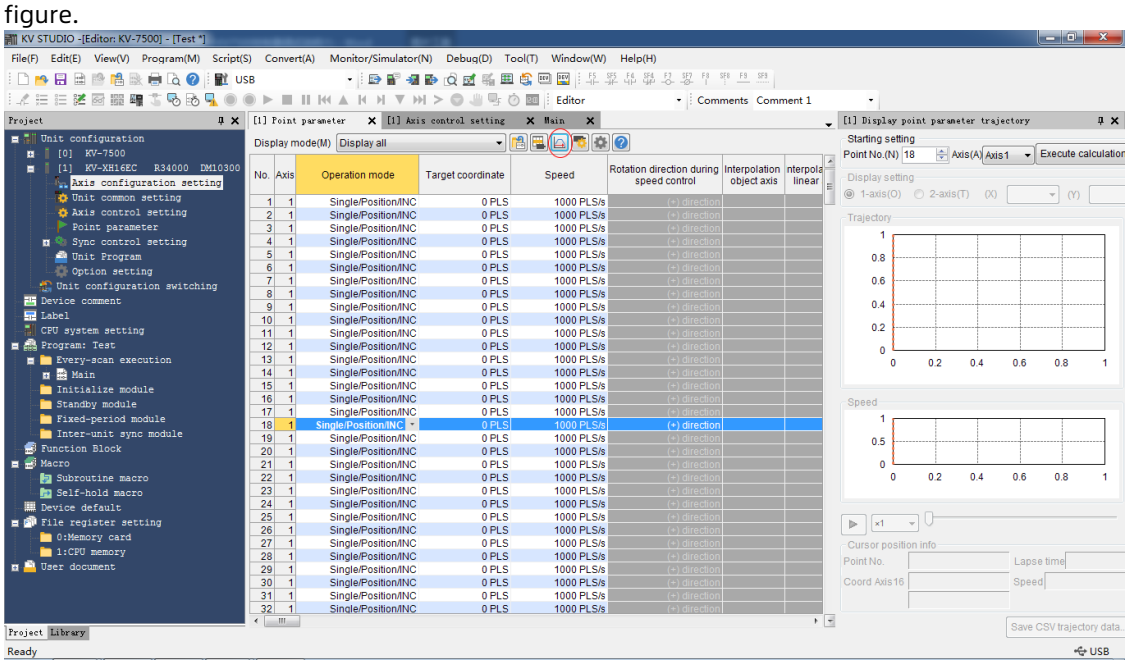
executed, the unit coordinate transformation parameters will correspond to the unit transformation results automatically.

1. To set the motion profile of the servo drive, choose "Tools"→"Axis configuration setting"→"KV-XH setting"→"Point parameter".



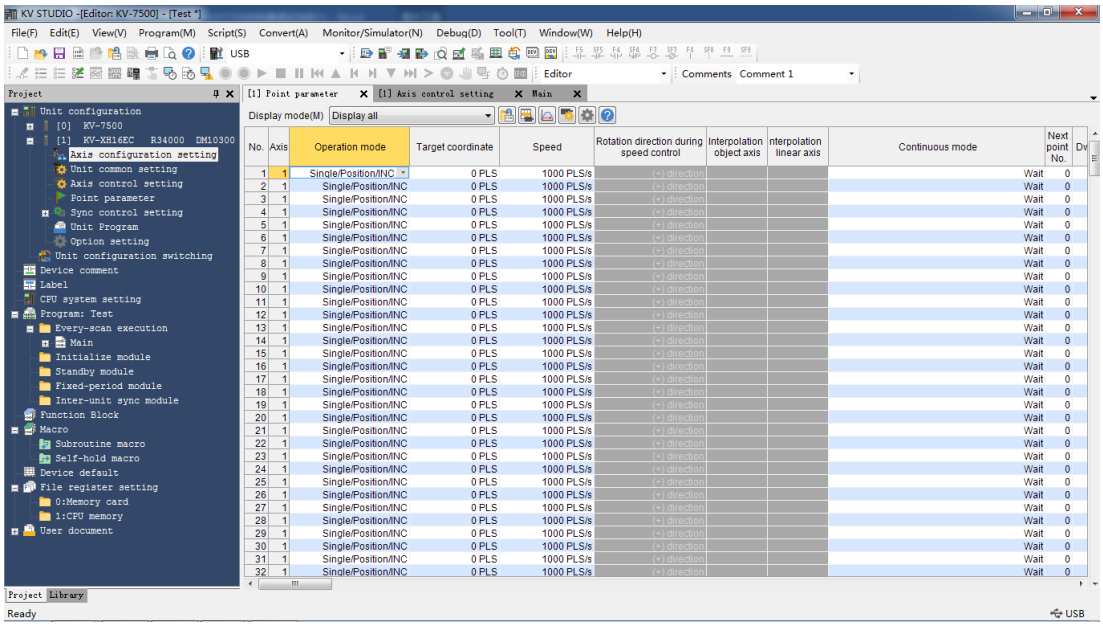
Set the target coordinate and speed per positioning segment as needed. After settings are completed, you can call the corresponding point number through the program to start operation.

2. You can preview the parameter trajectory by clicking the short-cut icon shown in the following figure.

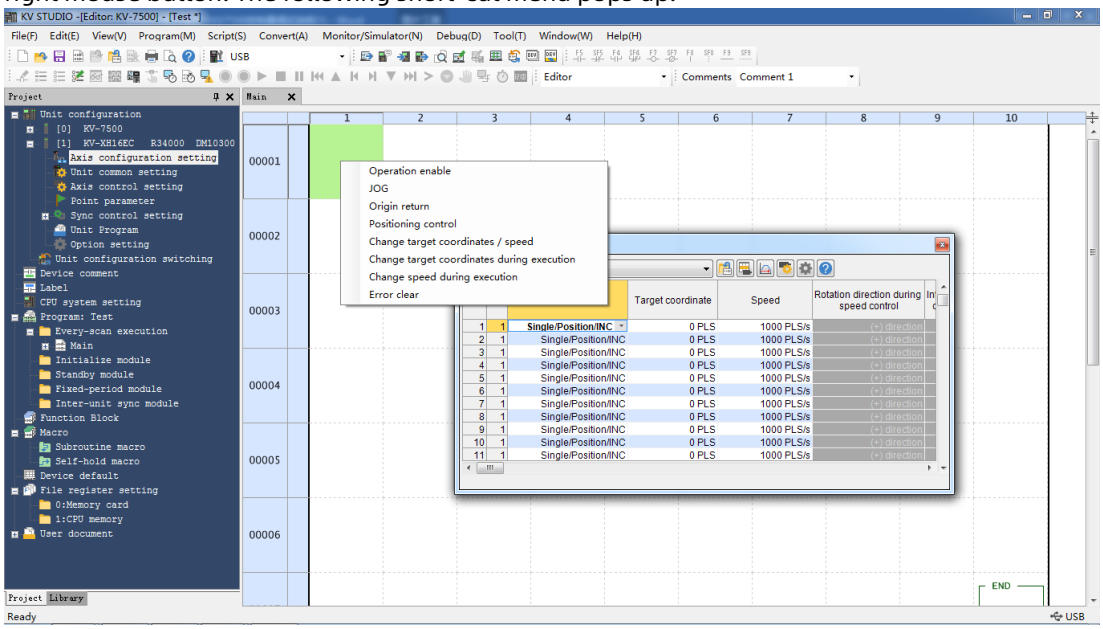


3. You can write ladder diagrams through regular methods. You can also use the following short-cut method provided by KEYENCE.

   a. Drag down the Point parameter window while pressing the left mouse button, and zoom out the window to place it in a proper area.

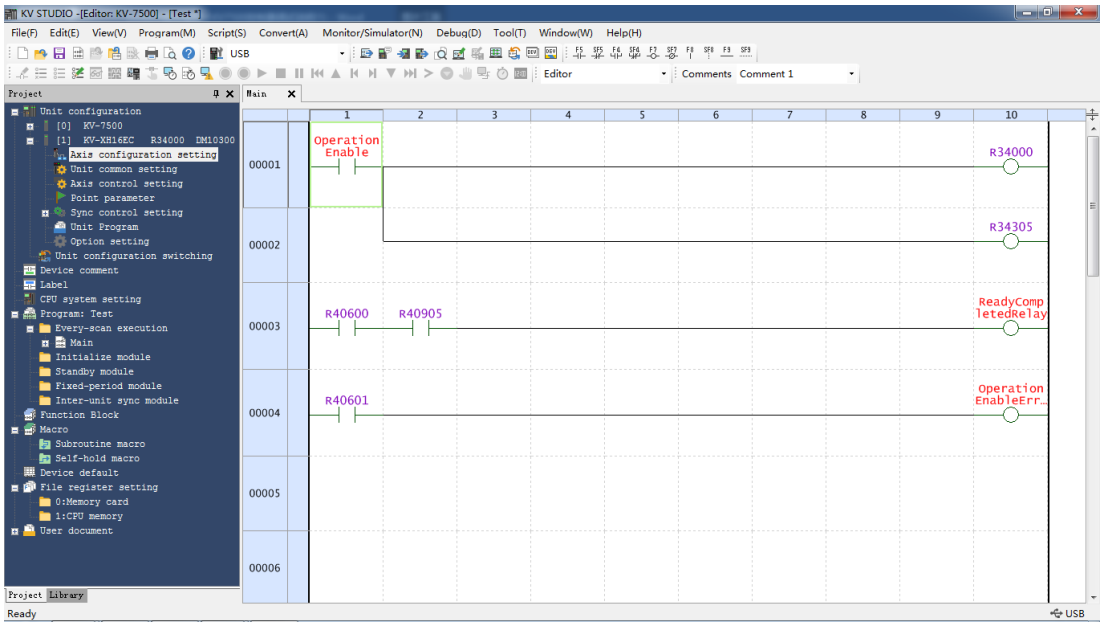


b. Move the pointer to the point parameter, such as No.1-Axis1, and wait until the mouse pointer changes from an arrow to a hand. Then, drag towards the program editor while pressing the right mouse button. The following short-cut menu pops up.



c. Select the desired function.

If the operation is enabled, click it to automatically generate a DEMO program. Then, designate the part in red as the required relay. After you complete these operations, this function is compiled.

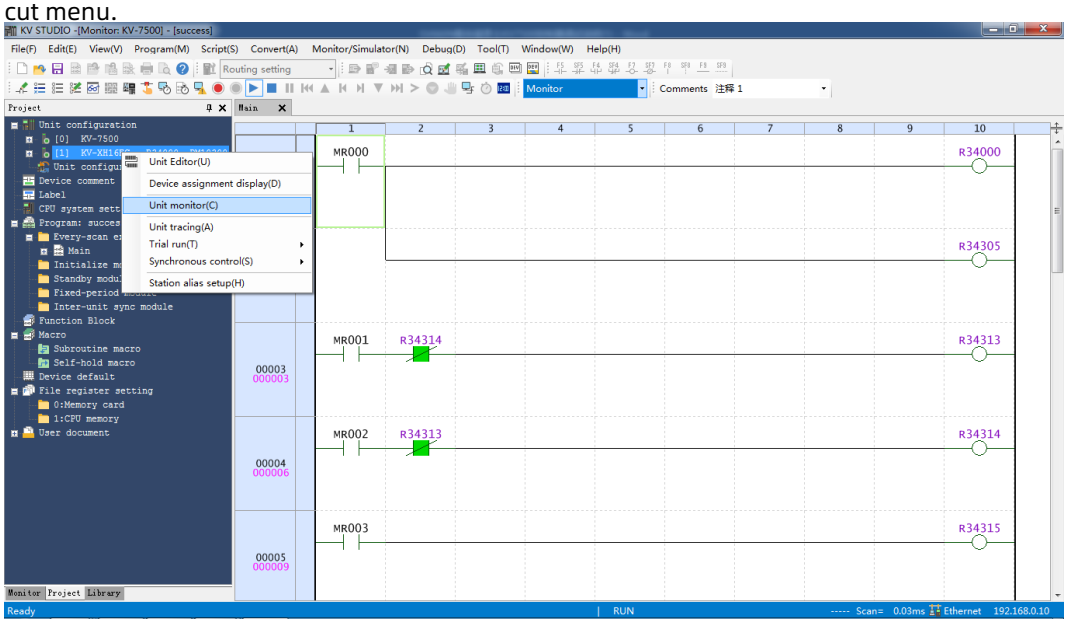


4. Configure the unit monitor.

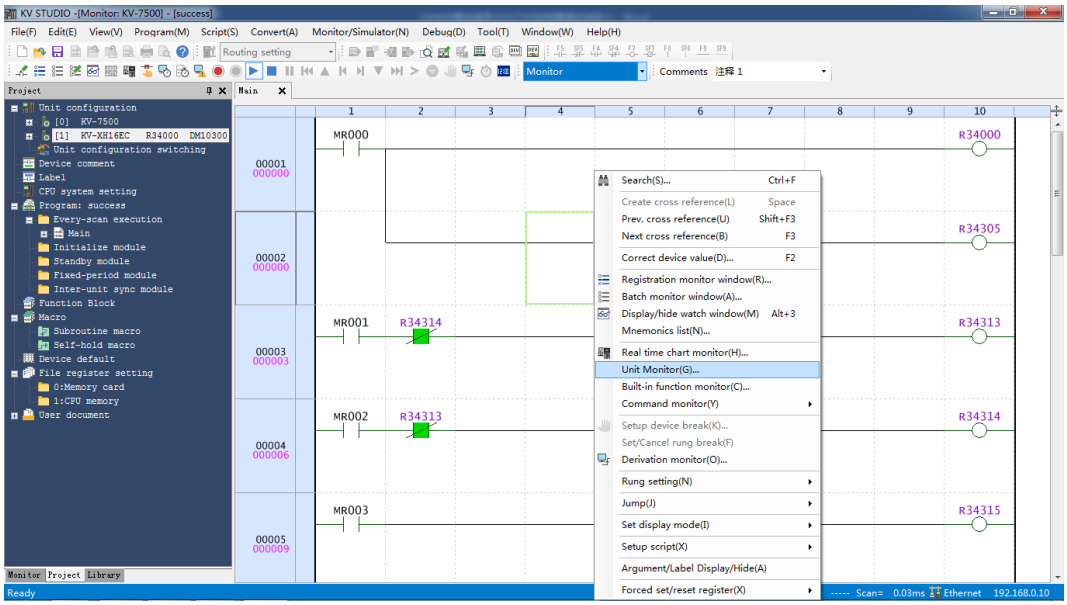
   The unit monitor supports monitoring on the operating state of KV-XH16EC or the internal data.

   a. Open the Unit monitor. You can open the unit monitor in the following three ways:

   - Click the unit to be monitored, right-click the unit, and then select "Unit monitor" in the short-cut menu.

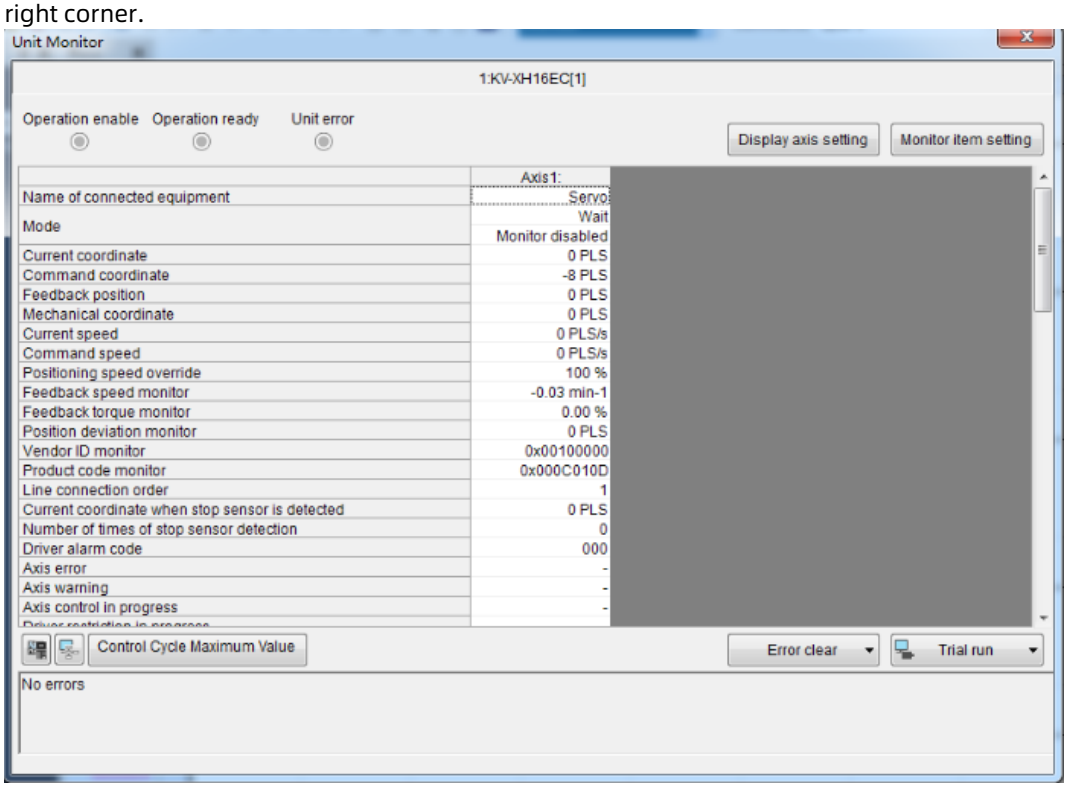


   - Double-click the unit to open the unit monitor.
   - Right-click in a blank section of the main program and select "Unit monitor" in the pop-up menu.

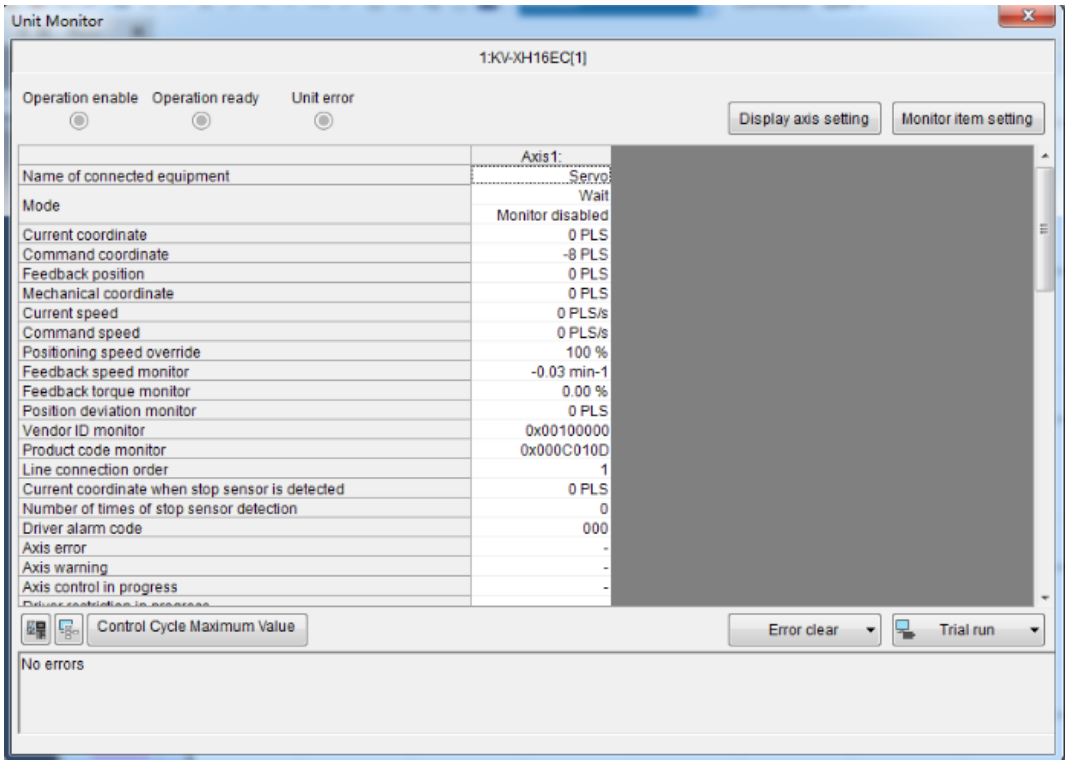


b. The unit monitor displays the operating state of each axis.

- To change the operating state of the monitor item, click "Monitor item setting" in the upper-right corner.



- To check whether I/O signals such as limit switch signals and origin sensor signals are normal, open "Unit monitor" and find the corresponding monitoring position.
  If the corresponding message is received, a small black circle will be displayed.



The error state of the unit can also be displayed in the unit monitor. The axis error can be cleared using the "Error clear" button in the bottom right.

8.2.4.3 Trial Run

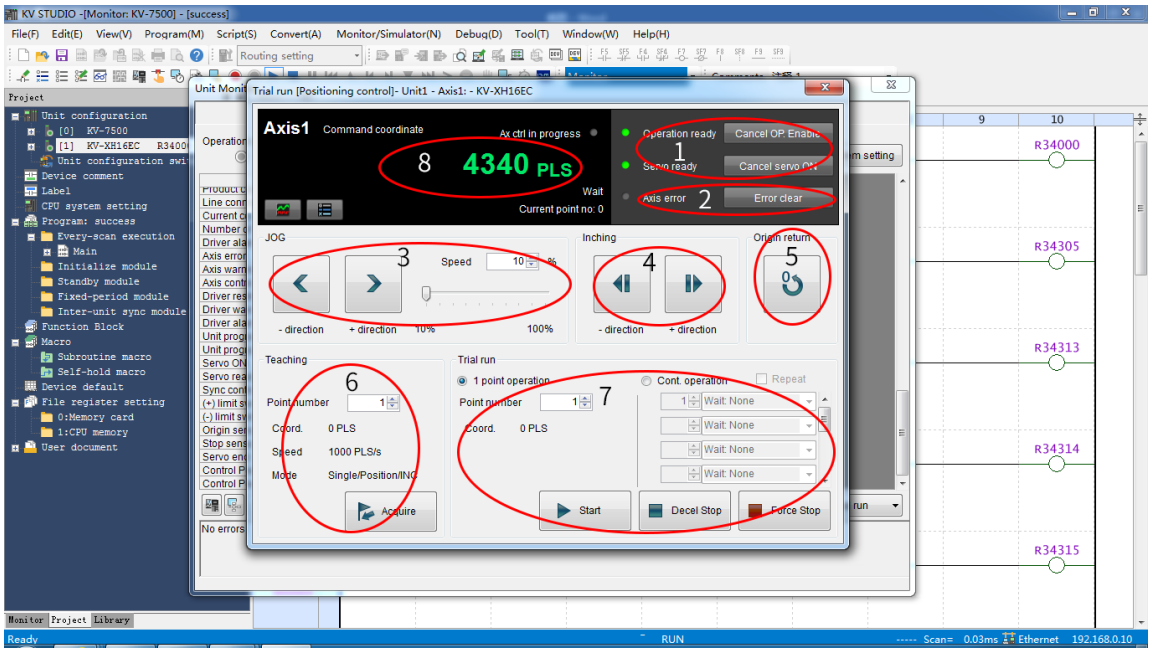
During a trial run, actions can be directly acknowledged, without the need to program ladder diagrams.

1. You can find the "Trial run" button at the bottom right of the unit monitor interface.
2. Select a control mode.
3. Select the axis for the trial run.

Note

If a trial run is executed in speed control mode or torque control mode, an alarm will be reported. To execute a trial run, set the control mode to position control.

The following example shows how to perform a trial run in positioning control mode.



1. Enable operation to switch on the drive.

   Unrelated to the status of the ladder diagram program. OP enable and Servo ON can be executed through commissioning. After you complete the preceding operations, the "Operation ready" and "Servo ready" indicators turn green. To ensure safety, set the CPU unit to PROG mode and execute operations again after stopping ladder diagram program.

   Confirm the following items if the "Servo ready" indicator is not in green:

   - Whether an error occurs on the axis.
   - Whether a warning occurs on the servo drive.
   - Whether the main circuit power supply of the servo drive is switched on.
   - Whether the Ethernet cable is connected.

2. Axis error: Click "Clear" to clear errors.

   Check the error details and clear the error. After troubleshooting errors, click "Clear" to clear the errors.

3. Perform jogging.

   Click the "FWD" and "REV" buttons to perform JOG operation in forward/reverse directions respectively. The jogging speed is the value in "General Axis Control Settings"→"JOG High Speed" multiplied by a ratio. You can set the ratio at a 1% increment between 10% and 100%.

4. Perform inching.

   Click the FWD and REV buttons to perform inching in forward and reverse directions respectively. The inching runs at the speed specified in "General Axis Control Settings"→"JOG Start Speed". The equipment inches with the movement specified in "General Axis Control Settings"→"JOG Inch Movement".

5. Perform homing.

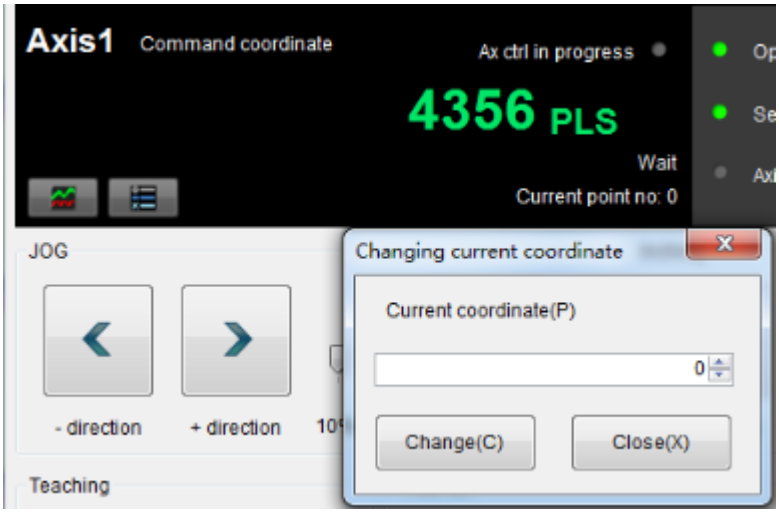
   Click "Origin return" to perform homing.

6. Configure teaching.

Click "Acquire" to save the current command coordinate value to the buffer memory of the target coordinate of the designated point number. The teaching function is available only in online edit mode. The teaching value will also be updated to the buffer memory and the point parameter.

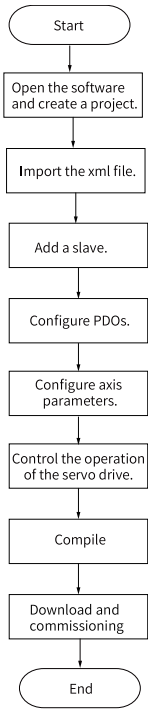
7. Perform a trial run.
   Specify a point number and click Start to perform point positioning. To stop the trial run, click "Decel Stop" or "Force Stop" to stop smoothly with the speed gradually reduced to zero or stop immediately with shock being incurred. Clicking "1 point operation" enables the servo drive to perform positioning of one point. Clicking "Cont. operation" enables the servo drive to perform positioning of ten points at most. Clicking "Repeat" enables the servo drive to return to the point in the first row and perform positioning repeatedly after positioning of the point in the last row is completed. The time interval between points can be set to a value within 0.1s to 20.0s.

8. Change the current coordinate.
   Click "Command coordinate" and the "Changing current coordinate" dialog box opens. Enter the coordinate that you want to change and click "Change" to change the current coordinate of the axis in trial run, and then close the "Changing current coordinate" dialog box. If you click "Close" after changing the current coordinate, the "Changing current coordinate" dialog box will be closed with the current coordinate unchanged.



8.2.5 EASY Series Controller as the Master

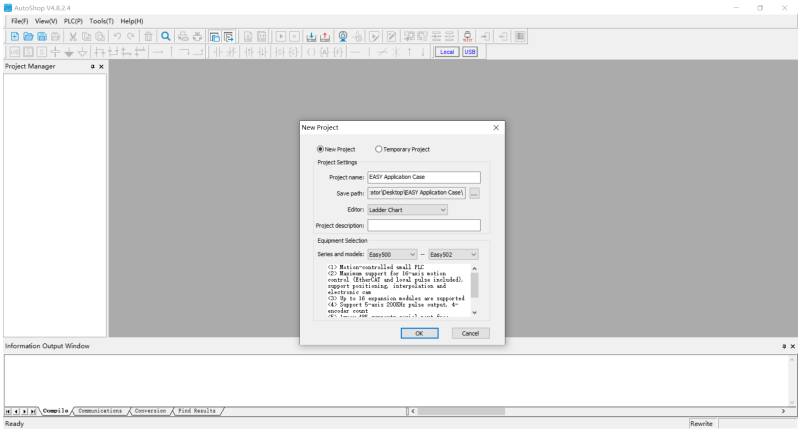
This section describes how to configure the SV680N-INT series servo drive for working with the EASY series controller that is used as the master.



1. **Opening the software tool and create an EASY project.**

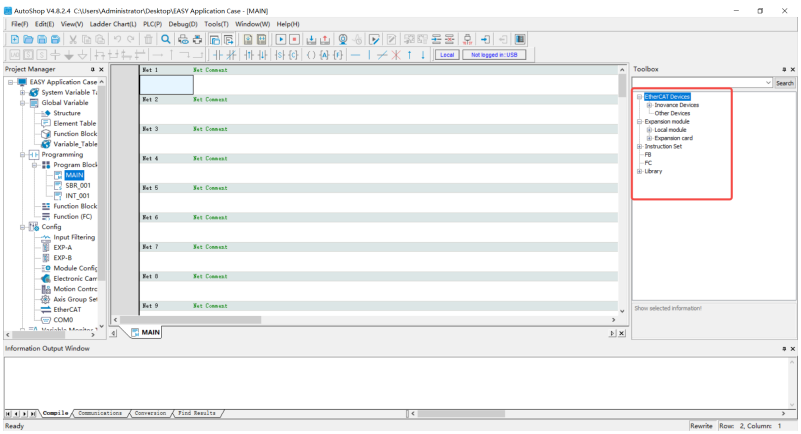
   a. Open the Autoshop software, click "New project", select the editor type in the dialog box that appears, and then select Easy500 as the PLC type.

   b. Enter a project name, select a storage path, and then click "OK" to create a new project and enter the main project interface.

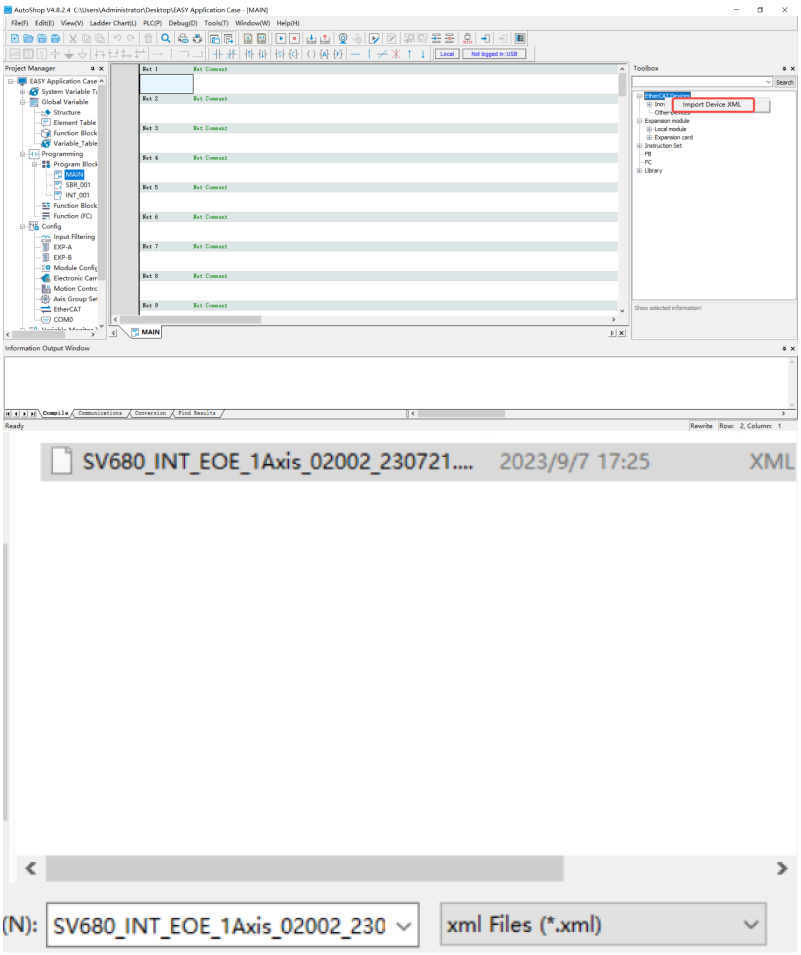


2. **Import the device description (XML) file.**

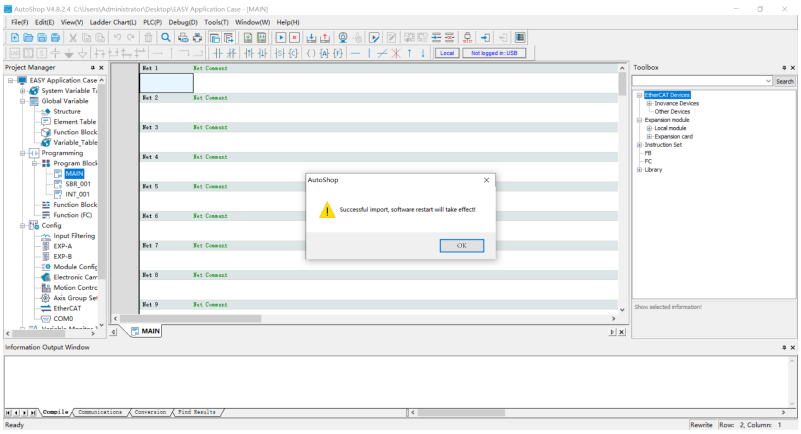
   a. Open the tool box and find the "EtherCAT Devices" list.



b. Right-click "EtherCAT Devices". In the dialog box that appears, select the XML file to be imported.

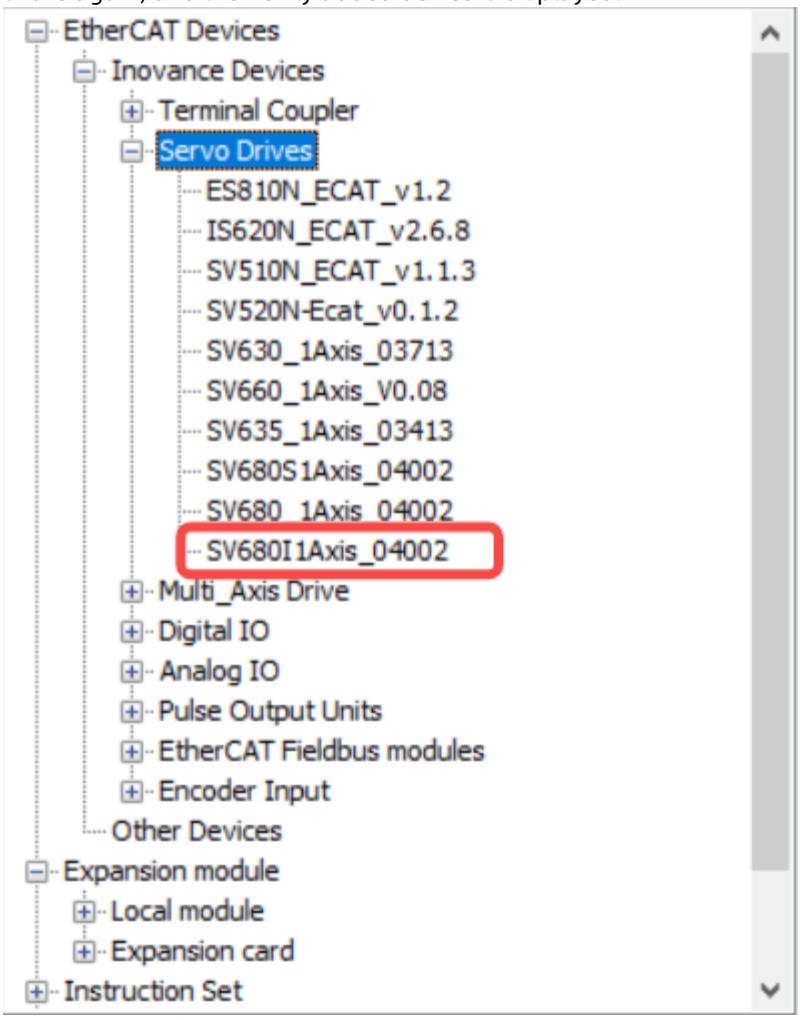


c. The imported XML file takes effect at next power-on.



After clicking "OK", you need to restart the software manually to activate the newly added devices.

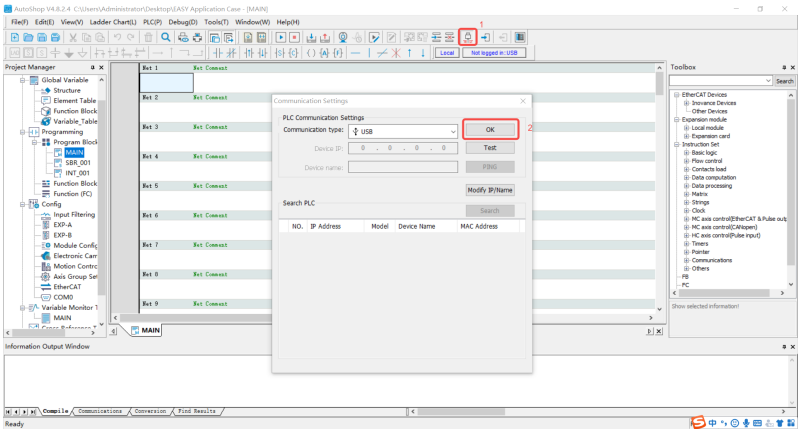
d. Open the software again, and the newly added device is displayed.



3. **Add a slave station.**

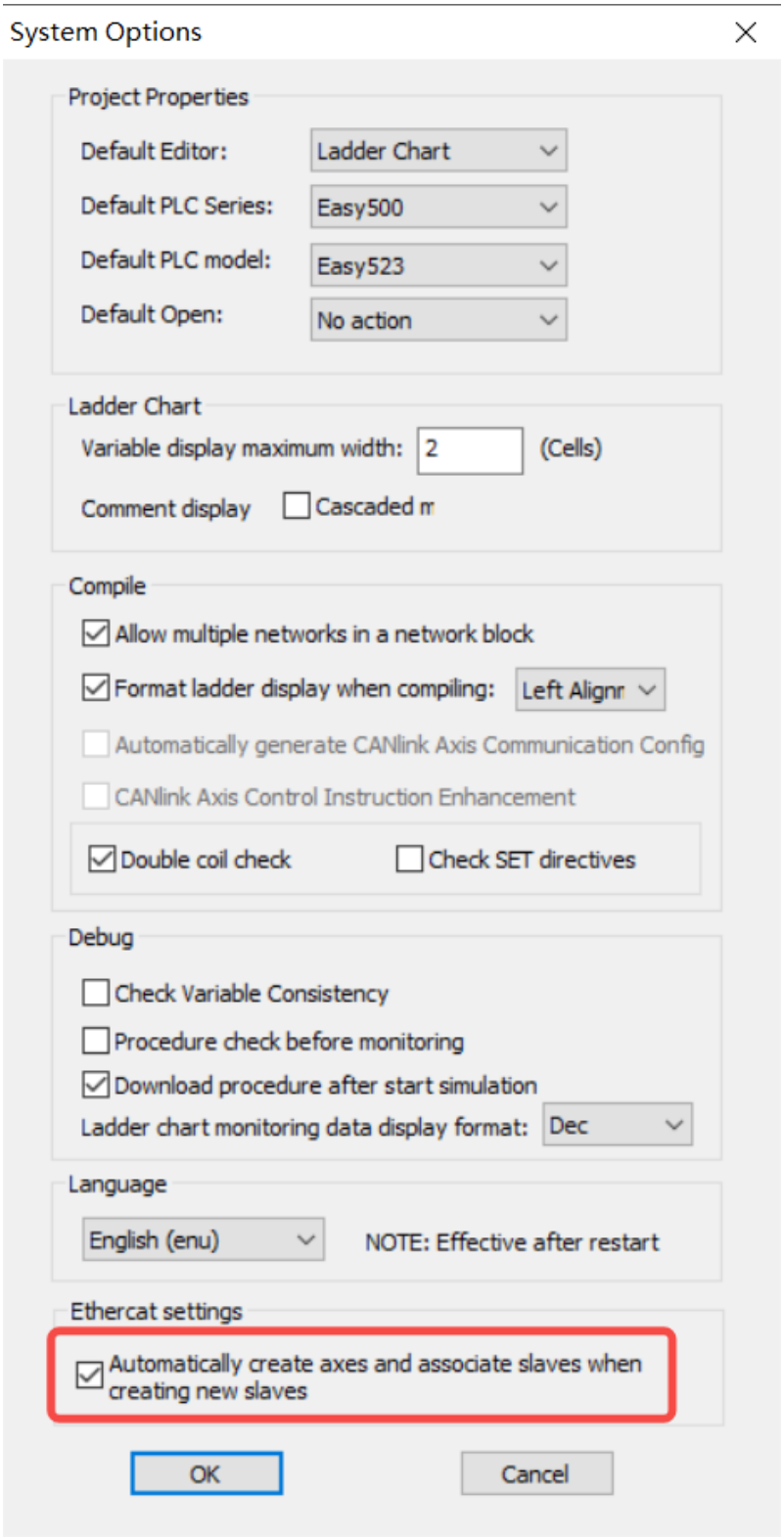
The PLC needs to be connected via Ethernet.

a. Select the target host.

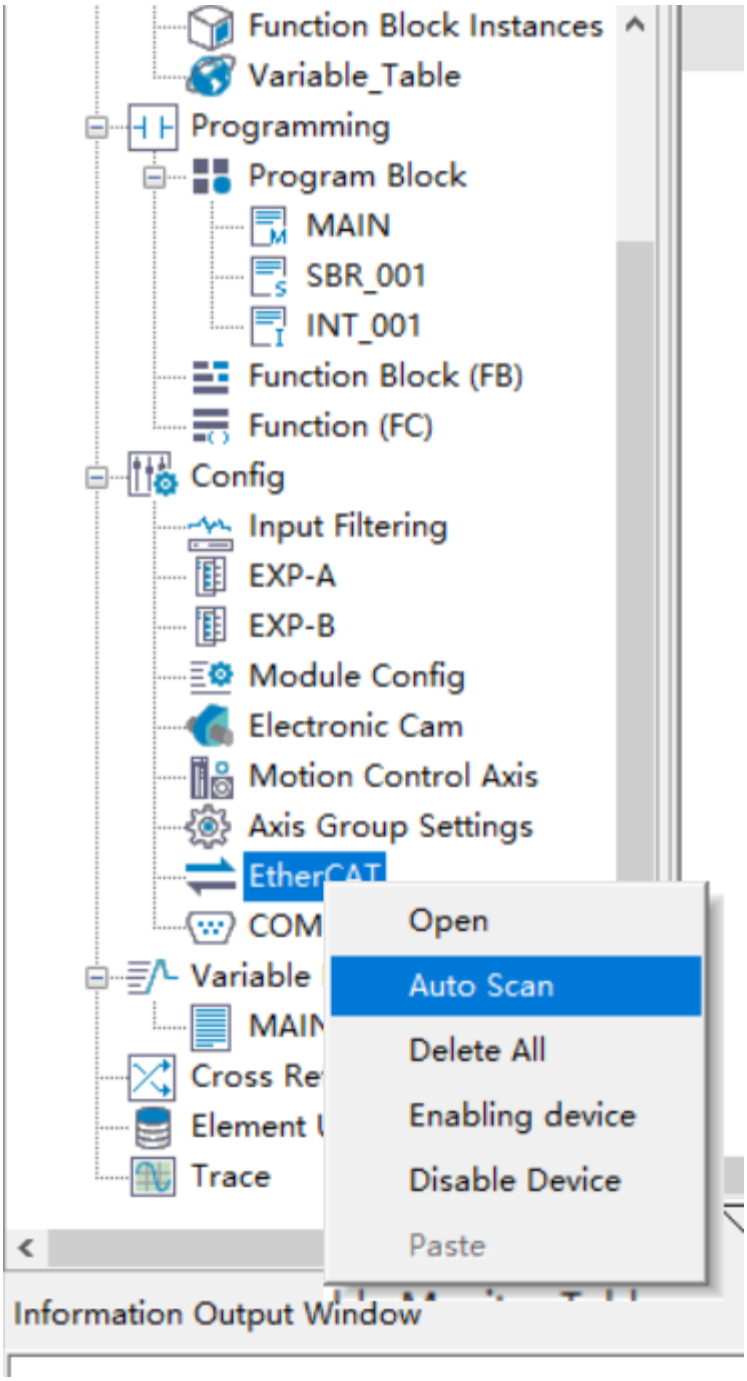


b. Determine whether to automatically associate the motion control axis.

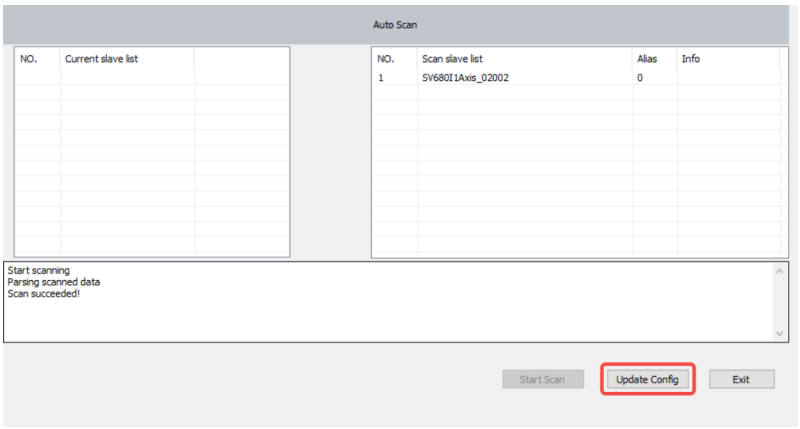
If you select the "Automatically create axes and associate slaves when creating new slaves" EtherCAT option, a motion control axis will be added automatically for each EtherCAT slave of drive type. If you do not select this option, no motion control axis will be added automatically. In this example, this option is selected.



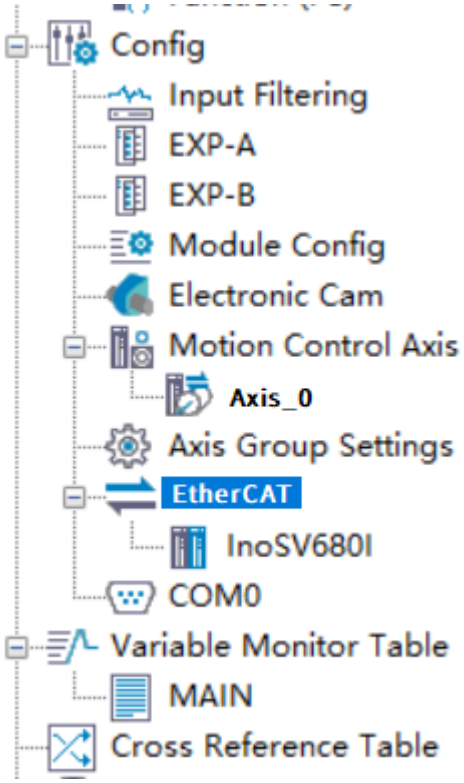
c. Right-click the "EtherCAT" tab and select "Auto Scan" in the pop-up menu.



d. In the dialog box that appears, select "Start scanning". After scanning is completed, click "Update Config" to update the scanned device to the configuration list.

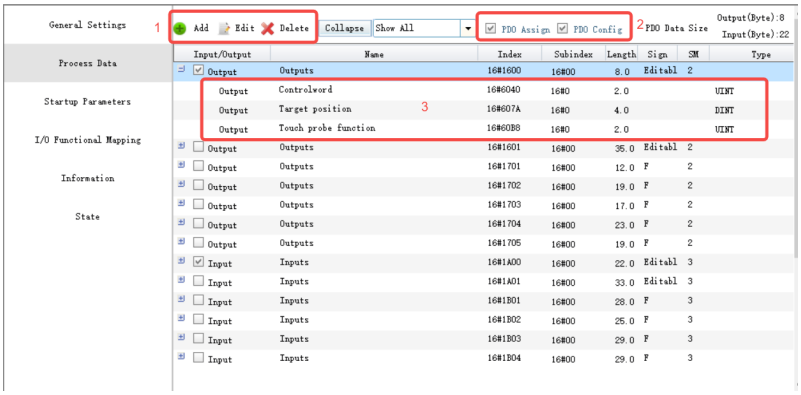


e. After the configuration list is updated, the following figure is displayed and SV680I is automatically associated with the motion control axis.



4. **Configure PDO parameters**

You can edit PDOs on the "PDO Data" page, as shown in the following figure.

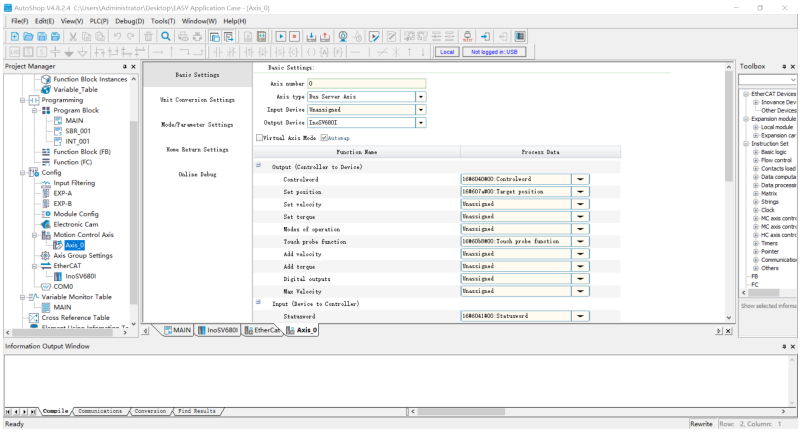


PDOs are divided into output PDOs and input PDOs based on the data flow. The output PDO indicates the process data sent by the EtherCAT master to the EtherCAT slave (such as the control word 0x6040). The input PDO indicates the process data sent by the EtherCAT slave to the master. Each slave may have multiple groups of PDOs or a single group of PDOs. As shown in the preceding figure, some PDOs can be edited, deleted, or added.

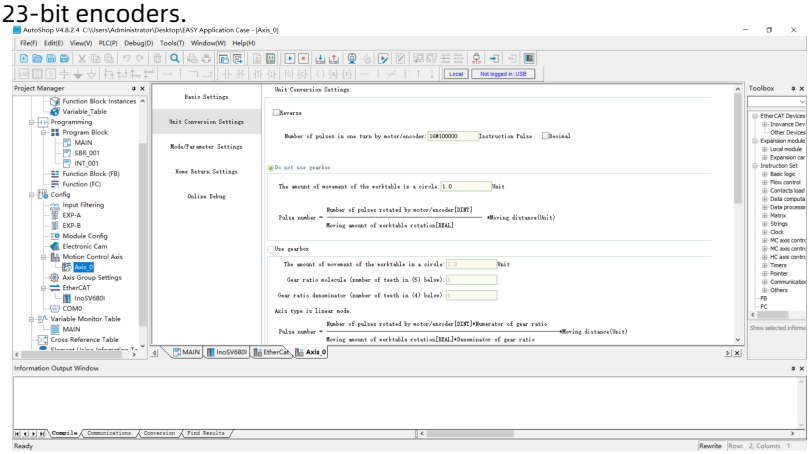
PDO control is performed according to the control requirements in the process data.

5. **Configure axis parameters**

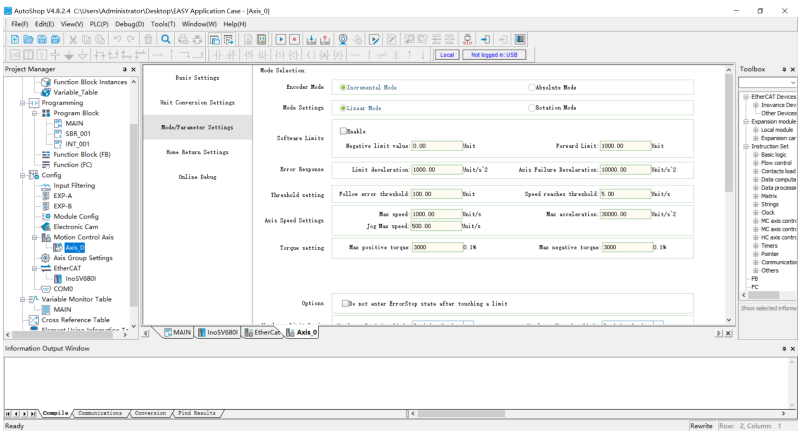
a. You can set the axis type, select the physical drive device, and other functions in the basic axis settings. The following figure shows the basic setting interface.



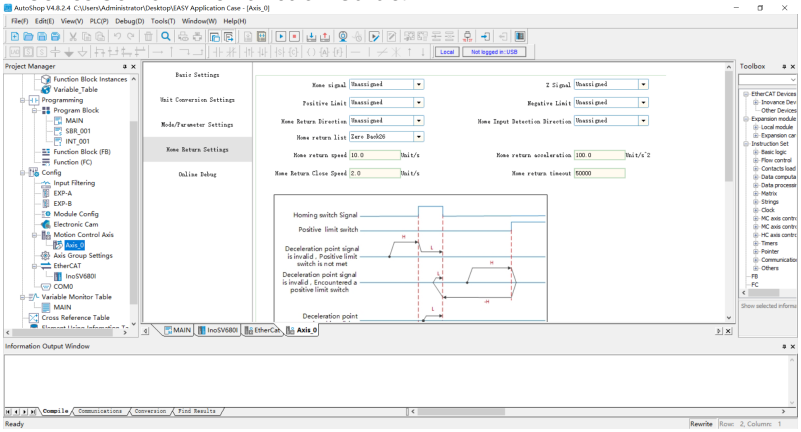
b. In the unit conversion setting, 16#4000000 is selected for 26-bit encoders and 16#800000 is selected for 23-bit encoders.



c. Set the software position limit and the operation mode in basic axis settings. The basic setting interface is as follows. The parameter list varies with the type of axis selected.

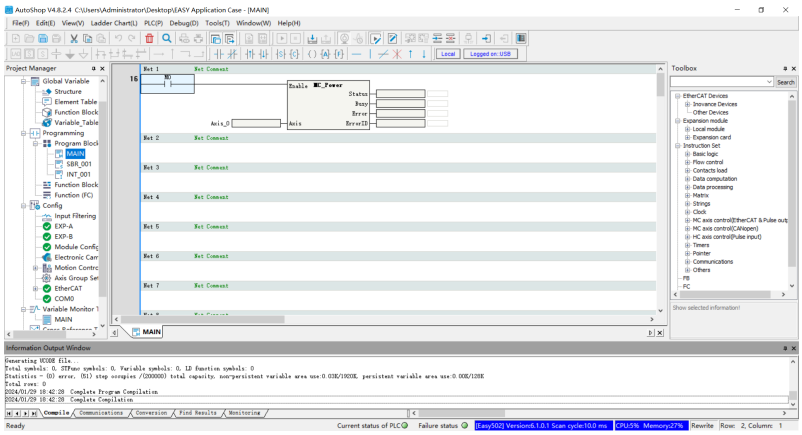


d. Select the homing mode according to actual needs. For details, see "Homing Mode" in the*SV680N-INT Series Servo Drive Function Guide*.



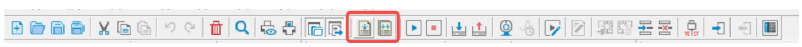
6. **Control servo drive operation.**

After the configuration is completed, control operations of the servo drive via the PLC program.



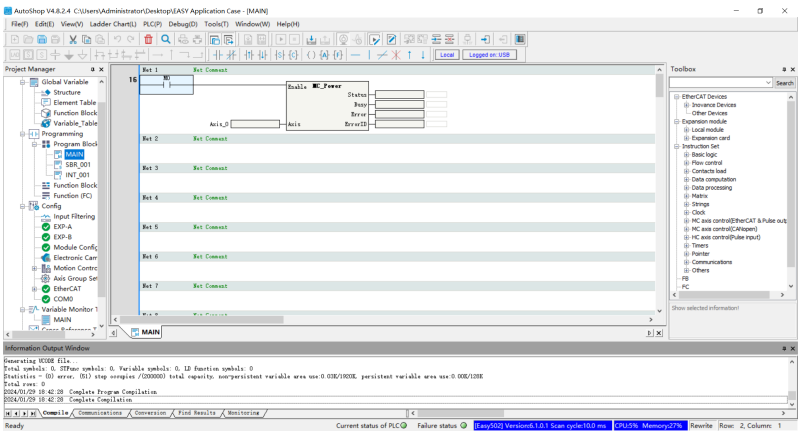
7. **Compile the program**

After compiling the program, click the icon marked by the red square box to check whether the program is correct.



8. **Download and commission the program**

After verifying that the program is correct, download the program to PLC. The program can be activated after running. Then, click the Start button to switch the PLC to the "Running" state.


AutoShop V4.8.2.4 C:\Users\Administrator\Desktop\EASY Application Case - [MAIN]
File(F) Edit(E) View(V) Ladder Chart(L) PLC(P) Debug(D) Tools(T) Window(W) Help(H)
Local
Logged on: USB
Project Manager
Global Variable
Structure
Element Table
Function Block
Variable_Table
Programming
Program Block
MAIN
SBR_001
INT_001
Function Block
Function (FC)
Config
Input Filtering
EXP-A
EXP-B
Module Config
Electronic Cam
Motion Control
Axis Group Set
EtherCAT
COM0
Variable Monitor T
MAIN
Net 1
Net Comment
16
M0
MC_Power
Enable
Status
Busy
Error
ErrorID
Axis_0
Axis
Net 2
Net 3
Net 4
Net 5
Net 6
Net 7
MAIN
Toolbox
Search
EtherCAT Devices
Inovance Devices
Other Devices
Expansion module
Local module
Expansion card
Instruction Set
Basic logic
Flow control
Contacts load
Data computation
Data processing
Matrix
Strings
Clock
Timers
Pointer
Communications
Others
PB
PC
Show selected information!
Information Output Window
Generating XCOE file...
2024/01/29 18:42:28 Complete Program Compilation.
2024/01/29 18:42:28 Complete Compilation.
Compile
Communications
Conversion
Find Results
Monitoring
Ready
Current status of PLC
Failure status
[Easy502] Version:6.1.0.1 Scan cycle:10.0 ms
CPU:5% Memory:27%
Rewrite
Row: 2, Column: 1

9 Tuning

9.1 Overview

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

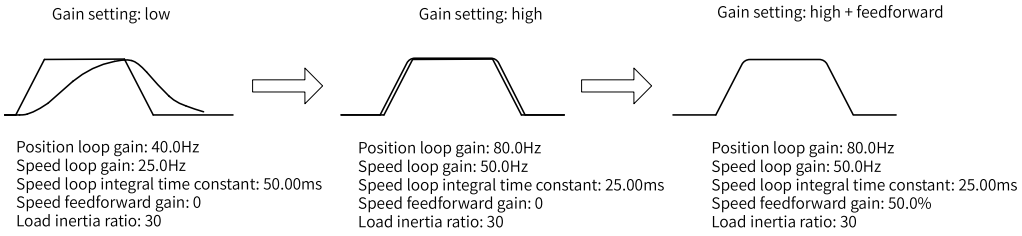


Figure 9-1 Example of gain tuning

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

Note

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

The following figure shows the general flowchart for gain tuning.

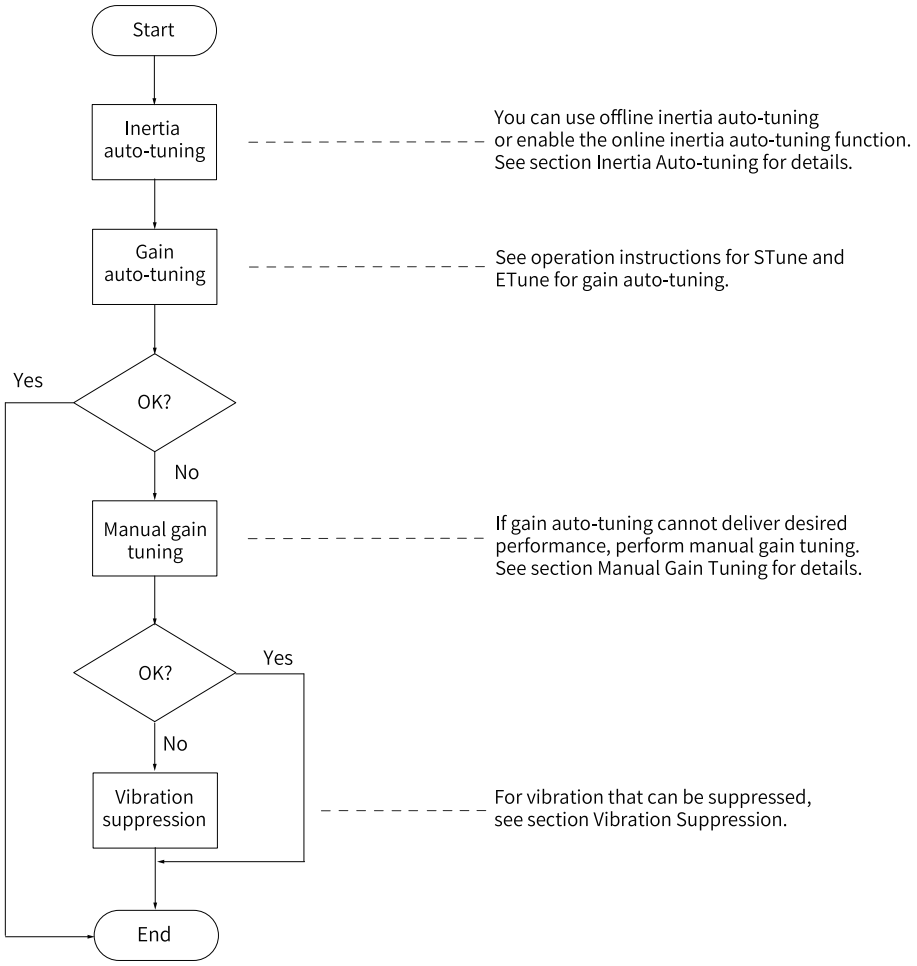


Figure 9-2 Steps

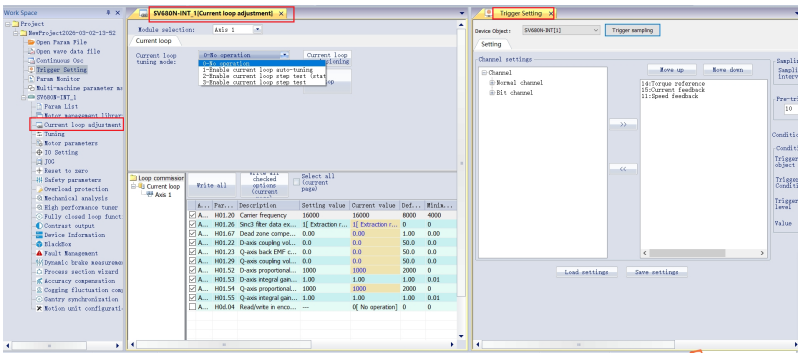
9.2 Speed current loop adjustment

Current loop parameter tuning

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

The software tool provides current loop tuning control to facilitate commissioning of current loop gain parameters.

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

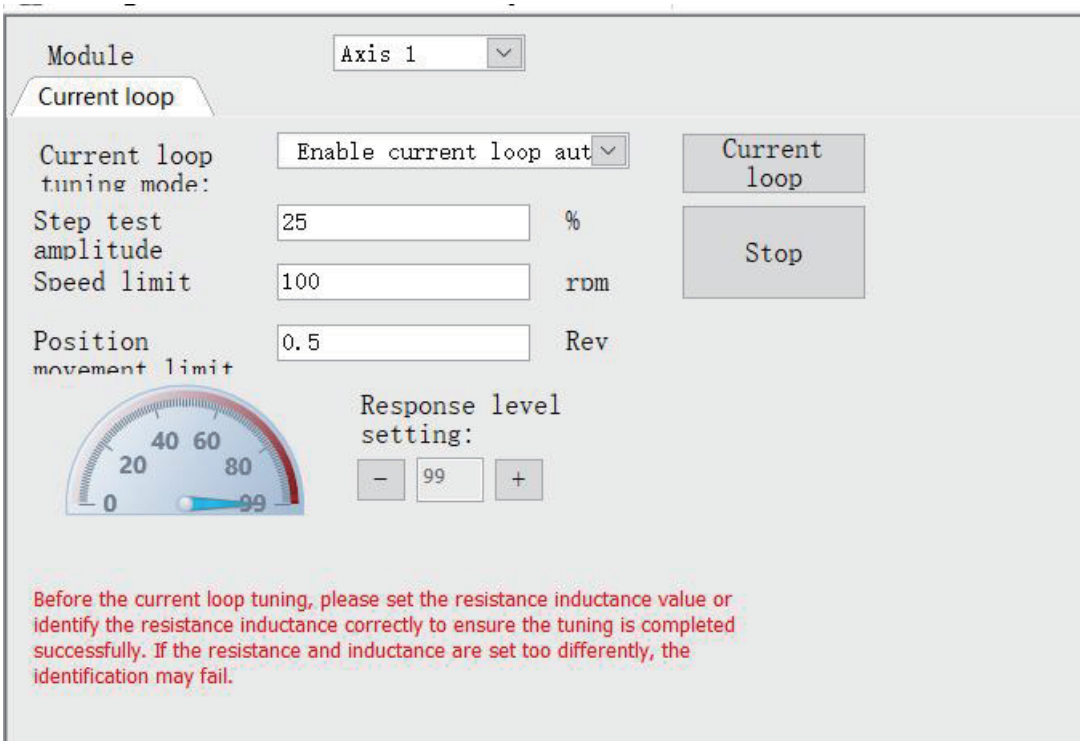


Three current loop tuning modes are available, as described below.

1. **Auto-tuning of current loop**

   This mode provides a static auto-tuning mode of the current loop. After this mode is started, the drive executes gain parameter tuning for the current loop automatically.

   You can set the response level. The higher the response level, the higher the response level and bandwidth of the current loop can be.



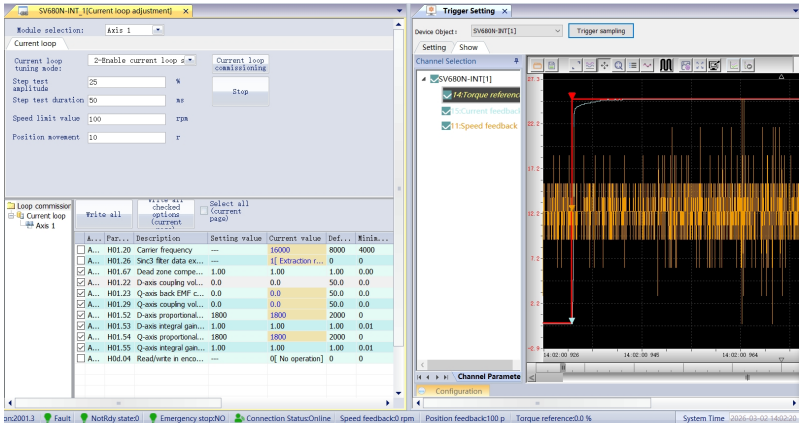
Note

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

Related parameters	Description
Auto-tuning step test amplitude	Excitation signal amplitude during auto-tuning
Speed limit	Maximum speed that the current excitation can reach to maintain stability
Displacement limit	Maximum distance that the current excitation can act to maintain stability
Response level setting	Expected current loop response level

2. **Static step test of current loop**

   This mode provides a static current loop step response observation mode. You can perform manual tuning on current loop gain parameters in this mode and verify the current loop response.



Related parameters	Description
Static step test amplitude	Step excitation signal amplitude
Step test duration	Step excitation signal duration
Speed limit	Maximum speed that the current excitation can reach to maintain stability
Displacement limit	Maximum distance that the current excitation can act to maintain stability

3. **Current loop step test**

   This mode provides a dynamic current loop step response observation mode. The method used is the same as static step test. You can perform manual tuning on loop gain parameters and verify the current loop response.

Note

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

Current loop gain switchover

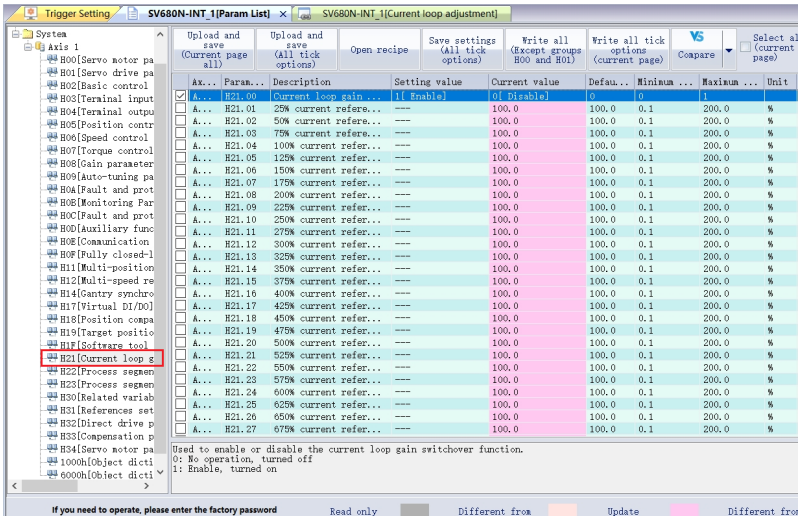
The current loop gain switchover is an advanced mode for current loop commissioning, which is used as a supplement to current loop parameter commissioning. The mode allows you to make necessary adjustment to cope with low response level or instability of the current loop due to differences in motor inductance saturation characteristics.

When inductance saturation is present in the normal operation range of the controlled motor, the current loop response may be affected due to excessive difference in inductance saturation as current loop gains are usually matched based on the calculated inductance parameter values. In this case, you can make necessary adjustment through current loop gain switchover.

The SV680N-INT series servo drive provides 32 groups of current loop gain switchover coefficients for use, which are not enabled by default. You can use them as needed.

- Theoretically, gain switchover coefficient under different loads can be obtained directly through inductance saturation characteristic curve provided by the motor manufacturer.

- In actual applications, you can also adjust the gain coefficient manually based on the actual conditions under different load rates.



9.3 Inertia Auto-tuning

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

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

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

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

The following two inertia auto-tuning modes are available:

- Offline Inertia Auto-tuning
  To enable offline inertia auto-tuning, use H0d.02 (Offline inertia auto-tuning) and make the motor rotate and execute inertia auto-tuning through the keypad. Offline inertia auto-tuning does not involve the host controller
- Online Inertia Auto-tuning
  Send a command to the servo drive through the host controller to make motor act accordingly to finish inertia auto-tuning. Online inertia auto-tuning involves the host controller.

Note

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

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

9.3.1 Offline Inertia Auto-tuning

Check the following 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 higher than the value of H09.09. If not, decrease H09.06 or H09.07 until the requirements are met.

Procedure for offline inertia auto-tuning:

1. Switch off the S-ON signal.
2. In parameter display mode, switch to H0d.02 and press SET to enable offline inertia auto-tuning.
3. Press the UP/DOWN key to perform offline inertia auto-tuning.
4. To make the motor stop at zero speed, release the UP/DOWN key. Pressing the UP/DOWN key again starts a new inertia auto-tuning. The initial direction of operation is determined by the UP/DOWN key. For applications allowing unidirectional operations only, set H09.05 to 1.
5. Wait until the value displayed on the keypad is stabilized.
6. Hold the SET key down until the operating panel displays "SAVE".
7. Press the MODE key to exit.

For applications requiring large load inertia, set H08.15 (Initial value of 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.

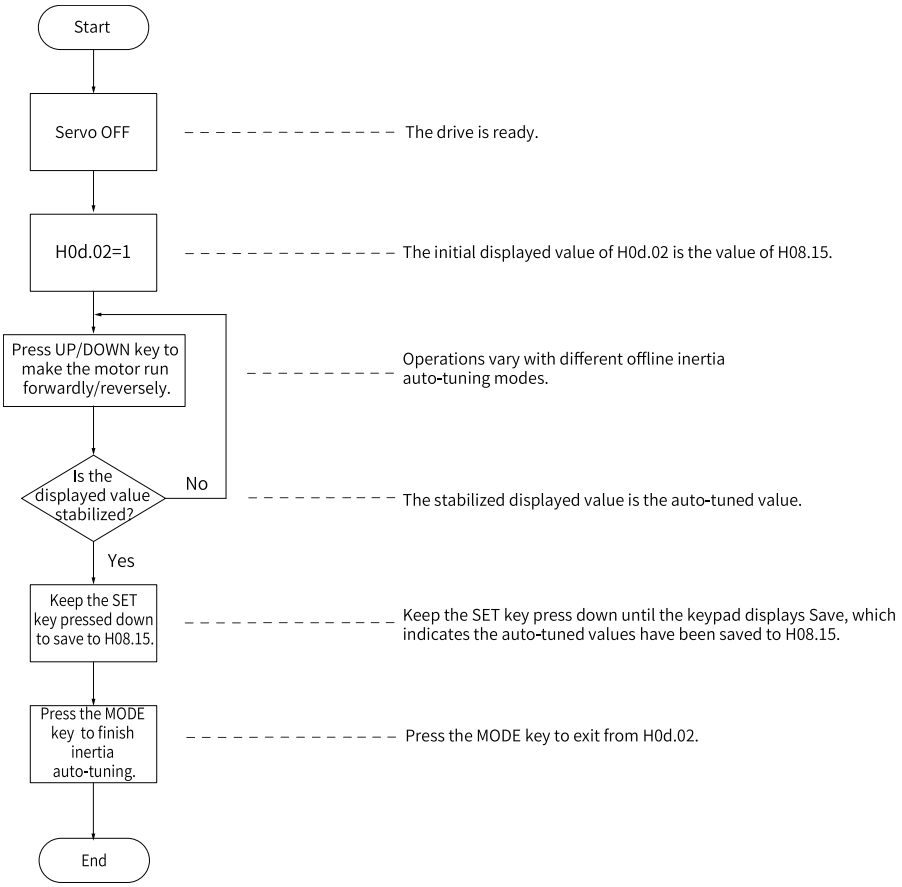


Figure 9-3 Offline inertia auto-tuning flowchart

☆Related parameters:

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
H09.05	2009-06h	Offline inertia auto-tuning mode	0: Bi-directional 1: Unidirectional	0	-	At stop	"H09_en.05" on page 662
H09.06	2009-07h	Maximum speed of inertia auto-tuning	100 to 1000	500	[mm/s]/ [rpm]	At stop	"H09_en.06" on page 662
H09.07	2009-08h	Time constant for accelerating to max. speed during inertia auto-tuning	10 to 5000	125	ms	At stop	"H09_en.07" on page 663
H09.08	2009-09h	Interval time after an individual inertia auto-tuning	50 to 10000	800	ms	At stop	"H09_en.08" on page 663

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
H09.09	2009-0Ah	Motor movement distance per inertia auto-tuning	0.00 to 100.00	1.00	[mm]/ [Rev]	Real time	"H09_en.09" on page 663
H0d.02	200d-03h	Inertia auto-tuning	0 to 65	0	-	Real time	"H0d_en.02" on page 718

9.3.2 Online Inertia Auto-tuning

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

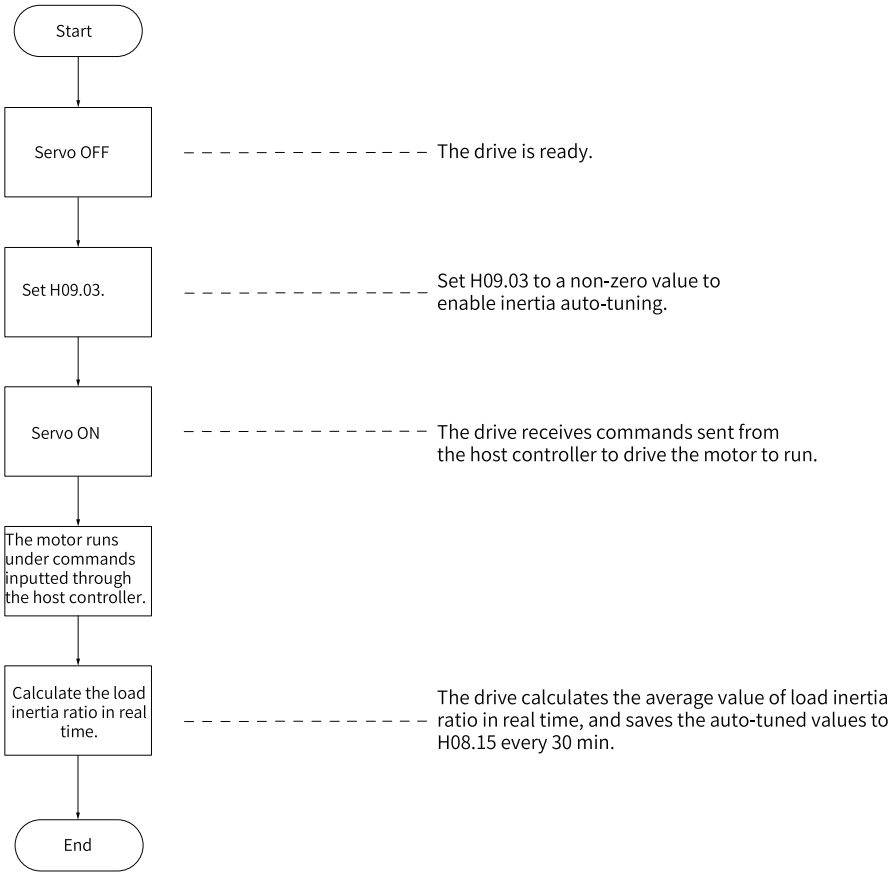


Figure 9-4 Online inertia auto-tuning flowchart

Note

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

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

☆Related parameter

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
H09.03	2009-04h	Online inertia auto-tuning mode	0: Disabled 1: Enabled, changing slowly 2: Enabled, changing normally 3: Enabled, changing quickly	0	-	Real time	"H09_en.03" on page 662

9.4 Automatic Gain Tuning

9.4.1 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 enabled by default and will be disabled automatically 5 minutes after the drive receives an operation command.

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 not available (due to low operating speed or low acceleration rate), turn off STune after initial power-on.

Note

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

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

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

Operation description

- **Operation flowchart**

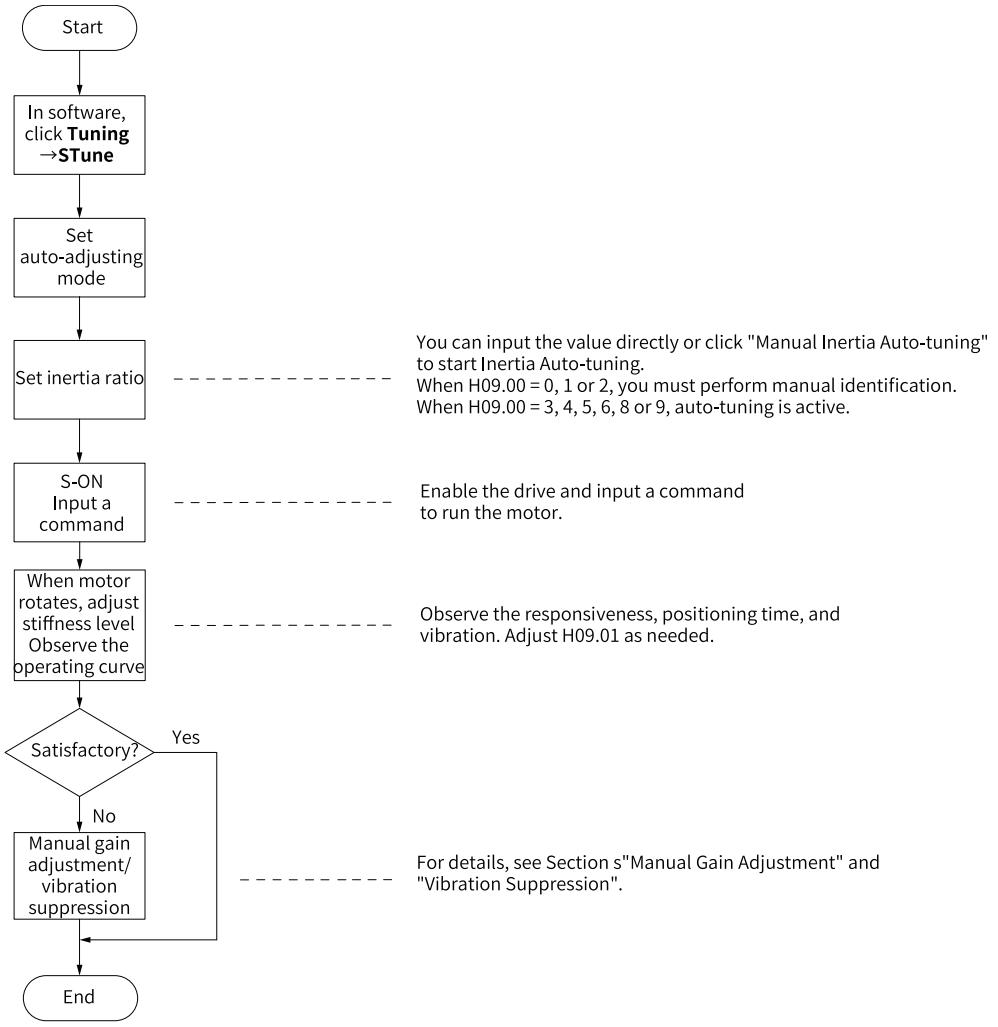


Figure 9-5 Operation flowchart

- **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, 5, 6, 8, and 9, you can perform adjustment through the wizard-type interface directly, without the need for setting an inertia ratio.

Mode	Name	Function
0	Invalid	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.

Mode	Name	Function
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.
5	STune mode 5	Gains are set automatically based on the set stiffness level. This mode applies to applications where linear motors are used.
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.
8	New model tracking mode +Inertia auto-tuning	Gains are set automatically based on the set stiffness level. This mode applies to applications requiring quick positioning.
9	Model tracking B+ Inertia auto-tuning + Friction compensation	Gains are set automatically based on the set stiffness level. This mode applies to applications requiring quick positioning.

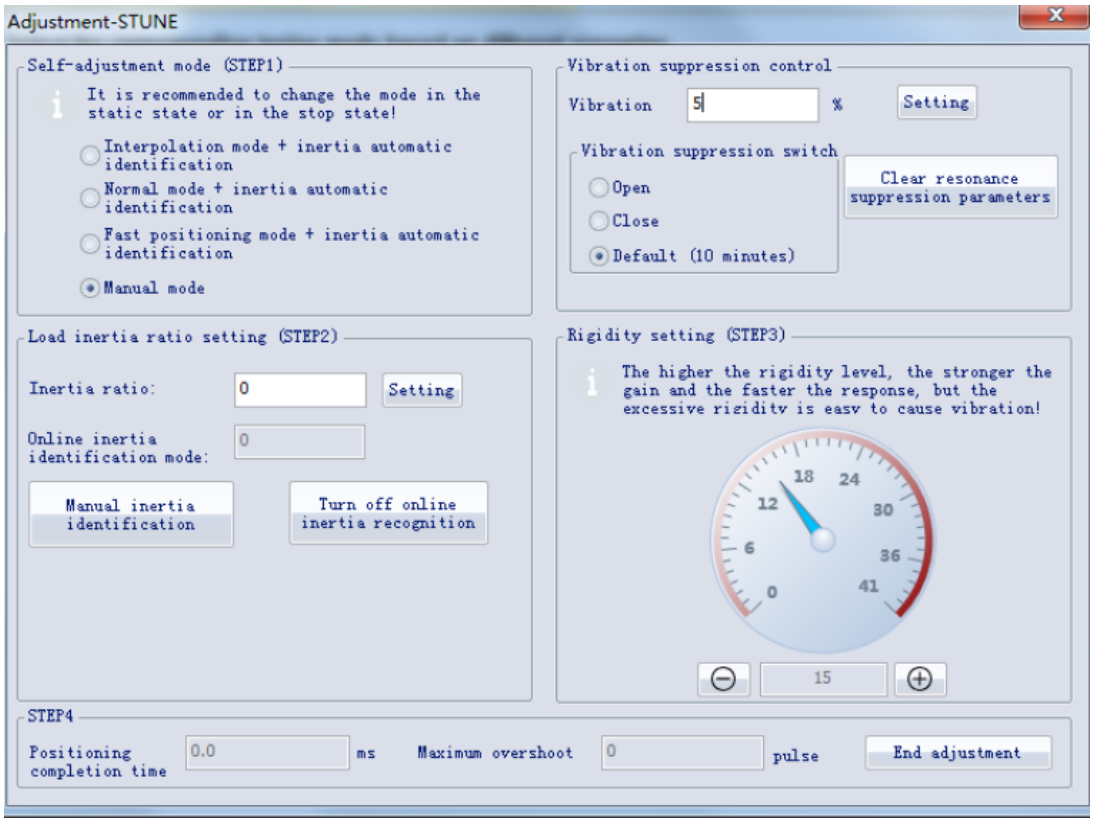
2. Adjust the stiffness level gradually during operation of the load. The present stiffness level value will be written to the drive automatically. Keep monitoring the operating waveform after increasing the stiffness level (increase by one level at a time) until desired performance is achieved.
3. In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

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

   You can change the STune time through H09.37.
4. In STune modes 3, 4, 5, 6, 8, and 9, resonance will be suppressed automatically. If the performance of automatic resonance suppression is inadequate, set H09.58 to 1 to clear resonance suppression parameters, reduce the stiffness level, and perform STune again.
5. 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, 4, and 5, determine the minimum value of H08.02 [Position loop gain]. Then set H09.00 of each axis to 0 and set H08.02 of each axis to the same value.

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



Note

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

Remarks

Recommended range of load inertia ratio

- In applications requiring high response, the inertia ratio should be lower than 500% and cannot exceed 1000%.
  - For belt pulley or gear rack without high requirements on connection rigidity and accuracy, the inertia ratio cannot exceed 1000%.
  - For direct connection of lead screws or couplings, the inertia ratio cannot exceed 500%.
  - In applications requiring high positioning accuracy or response, the inertia ratio cannot exceed 200%.
- In applications requiring medium-level accuracy and dynamic response, the inertia ratio cannot exceed 3000%.
- When the inertia ratio exceeds 3000%, it is hard to make adjustment or control trajectories. It is only applicable to mechanisms for point-to-point control and rotary motion. The acceleration/deceleration time cannot be excessively low.

Stiffness level 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 9–1 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 connections.

The following seven gain auto-tuning modes are available.

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

  Table 9–2 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 9-2" on page 525*, the 2nd gain set (H08.03 to H08.05 and H07.06) are also automatically updated and saved based on the stiffness level set in H09.01. In addition, the position loop gain in the 2nd gain set has a higher stiffness level than that in the 1st gain set.

  Table 9–3 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	-

  Set an initial value for speed feedforward parameters, which can also be changed manually.

  Table 9–4 Parameters with fixed values in the positioning mode

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

  Set an initial value for gain switchover parameters, which can also be changed manually.

  Gain switchover is activated automatically in the positioning mode.

Param.	Name	Value	Remarks
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 hysteresis is 30. In other modes, the original setting is used.

Note

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

- In STune mode 3, 4, 5, 6, 8, and 9, resonance suppression 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.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
H09.18	2009-13h	Frequency of the 3rd notch	50 to 8000	8000	Hz	Real time	"H09_en.18" on page 665
H09.19	2009-14h	Width level of the 3rd notch	0 to 20	2	-	Real time	"H09_en.19" on page 665
H09.20	2009-15h	Depth level of the 3rd notch	0 to 99	0	-	Real time	"H09_en.20" on page 666
H09.21	2009-16h	Frequency of the 4th notch	50 to 8000	8000	Hz	Real time	"H09_en.21" on page 666
H09.22	2009-17h	Width level of the 4th notch	0 to 20	2	-	Real time	"H09_en.22" on page 666

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
H09.23	2009-18h	Depth level of the 4th notch	0 to 99	0	-	Real time	"H09_en.23" on page 666
H09.58	2009-3Bh	STune resonance suppression reset selection	0: Disable 1: Enable	0	-	Real time	"H09_en.58" on page 673

Note

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

Solutions to common faults

E661.0: STune failure

During STune operation, the gain drops to the lower limit. Position loop gain < 5; Speed loop gain < 5; Model loop gain < 10

- Set the notch manually when vibration cannot be suppressed automatically.
- Modify the electronic gear ratio to improve the command resolution. Increase the command filter time in the parameter configuration interface.
- Increase the value of H09.11 properly.
- Check whether the current fluctuates periodically.

☆Related parameters:

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
H09.58	2009-3Bh	STune resonance suppression reset selection	0: Disable 1: Enable	0	-	Real time	"H09_en.58" on page 673

9.4.2 ETune

Overview

ETune is a wizard-type auto-adjustment function used to guide users to set corresponding curve trajectories and response parameters. After the curve trajectories and response parameters are set, the servo drive automatically performs auto-tuning to generate the optimal gain parameters. The

auto-tuned parameters can be saved and exported as a recipe for use in other devices of the same model.

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

Procedure

- **Procedure flowchart**

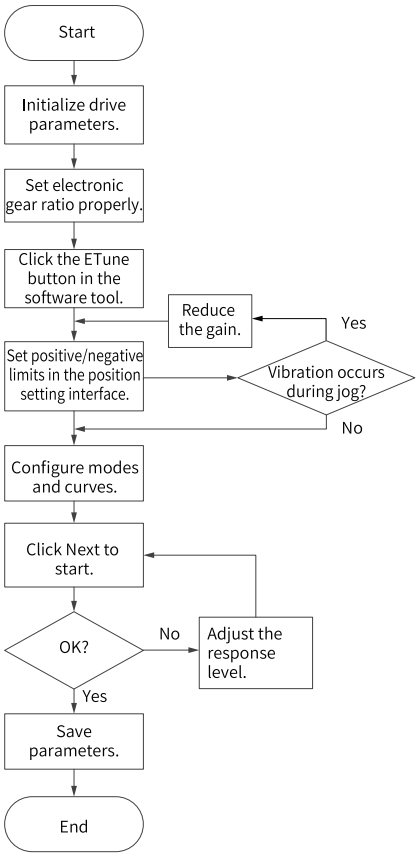
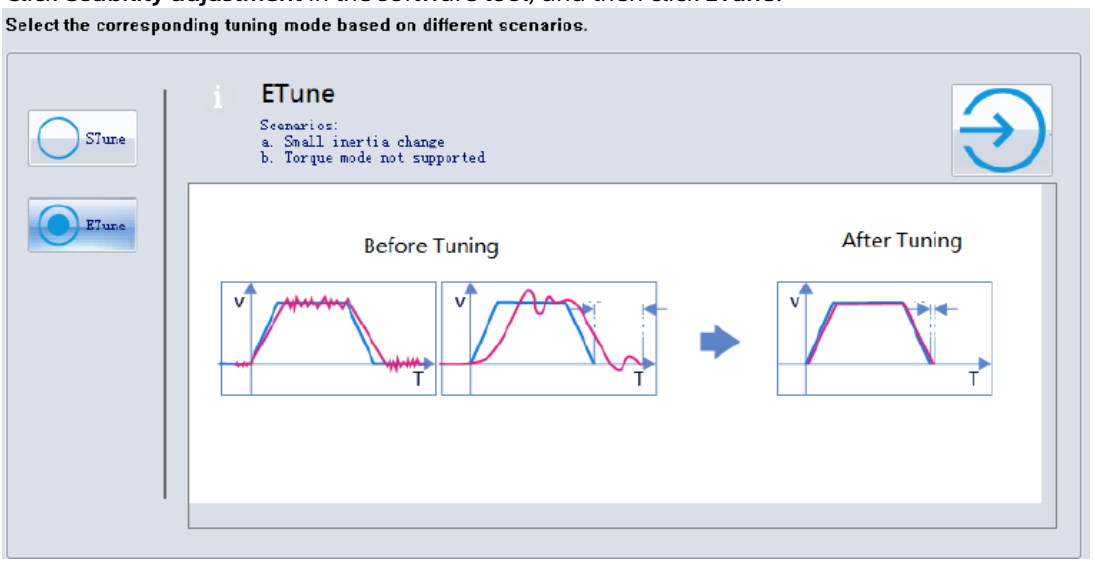


Figure 9-6 Procedure flowchart

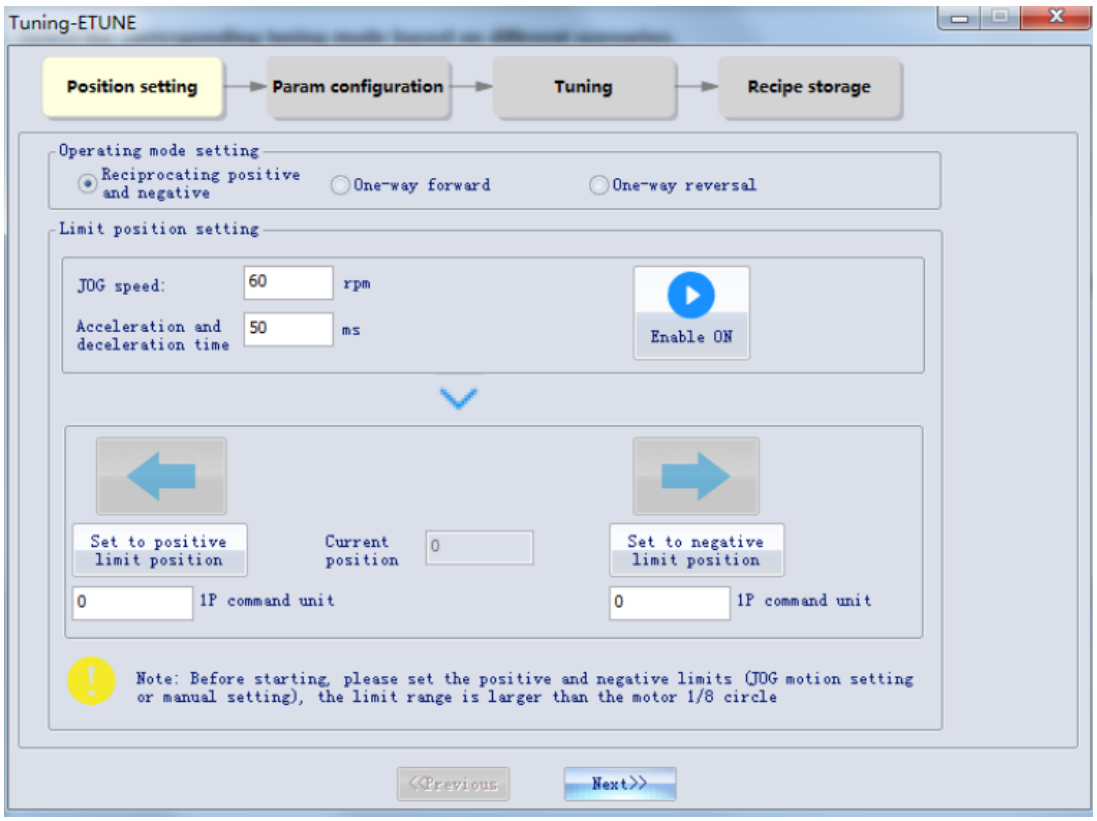
- **Steps and descriptions**

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



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

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



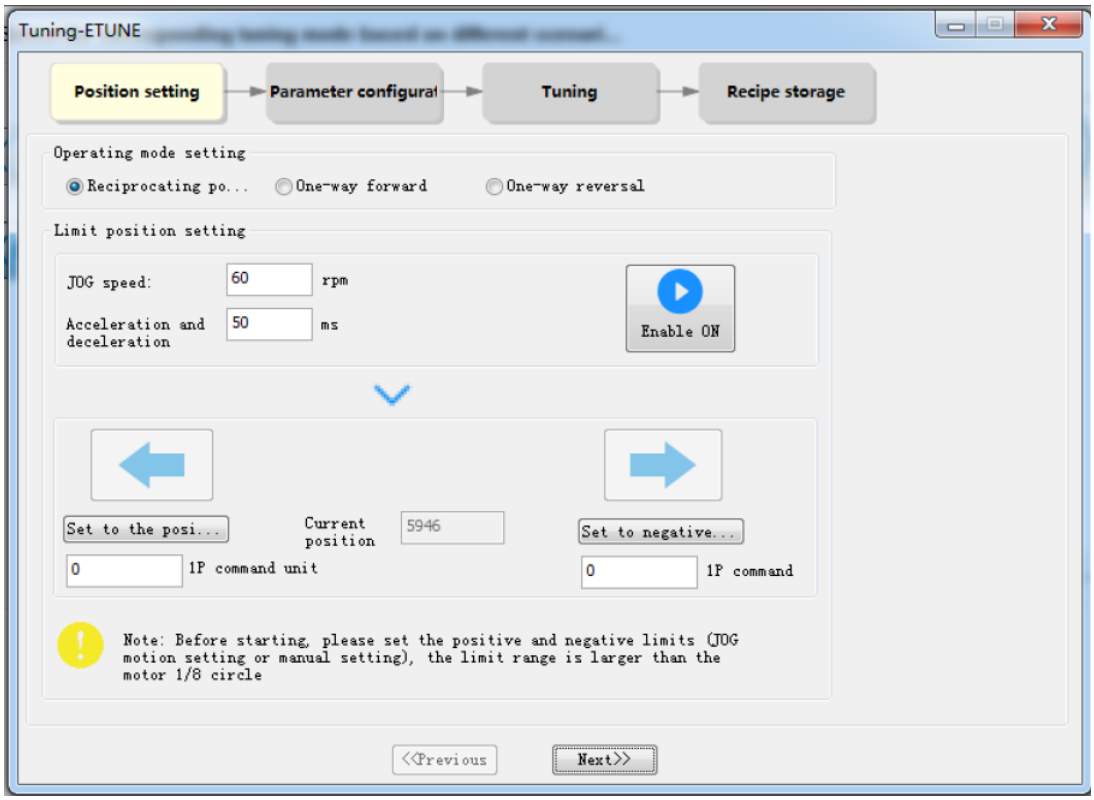
3. Specify the positive and negative limit positions allowed by the motor. The difference between the positive and negative limits defines the position reference pulses for the motor, which is also the value before multiplication/division by the electronic gear ratio.

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

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

Note

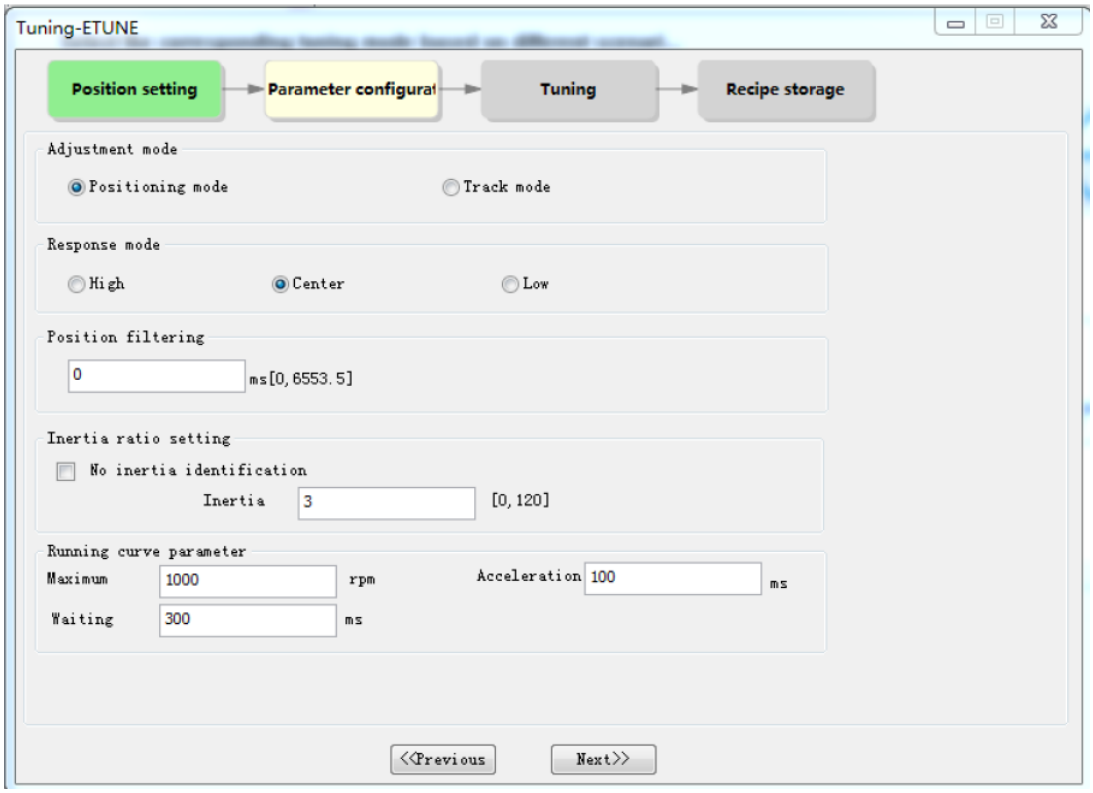
The difference between the positive and negative position limits must be larger than 1/8 of one revolution. The larger the value of the limit position, the better the adaptability of the auto-tuned parameters, but the longer will ETune adjustment take.



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

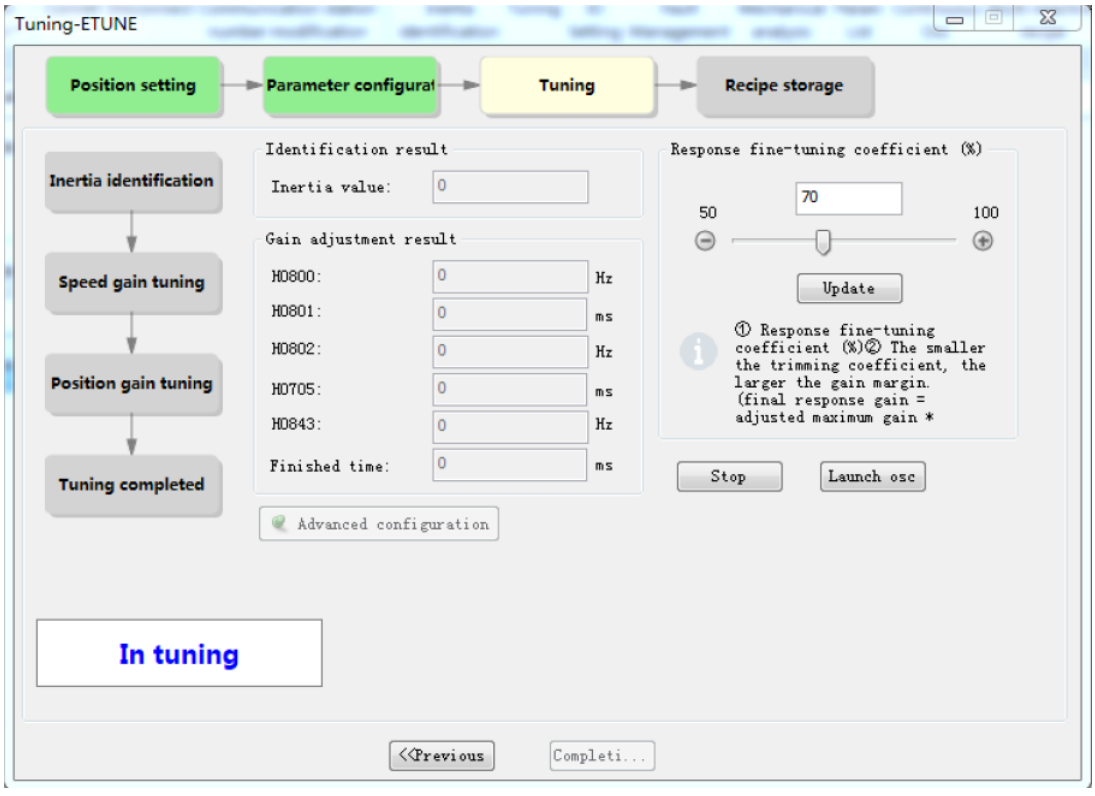
   The adjustment mode is divided into Positioning mode and Track mode.

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

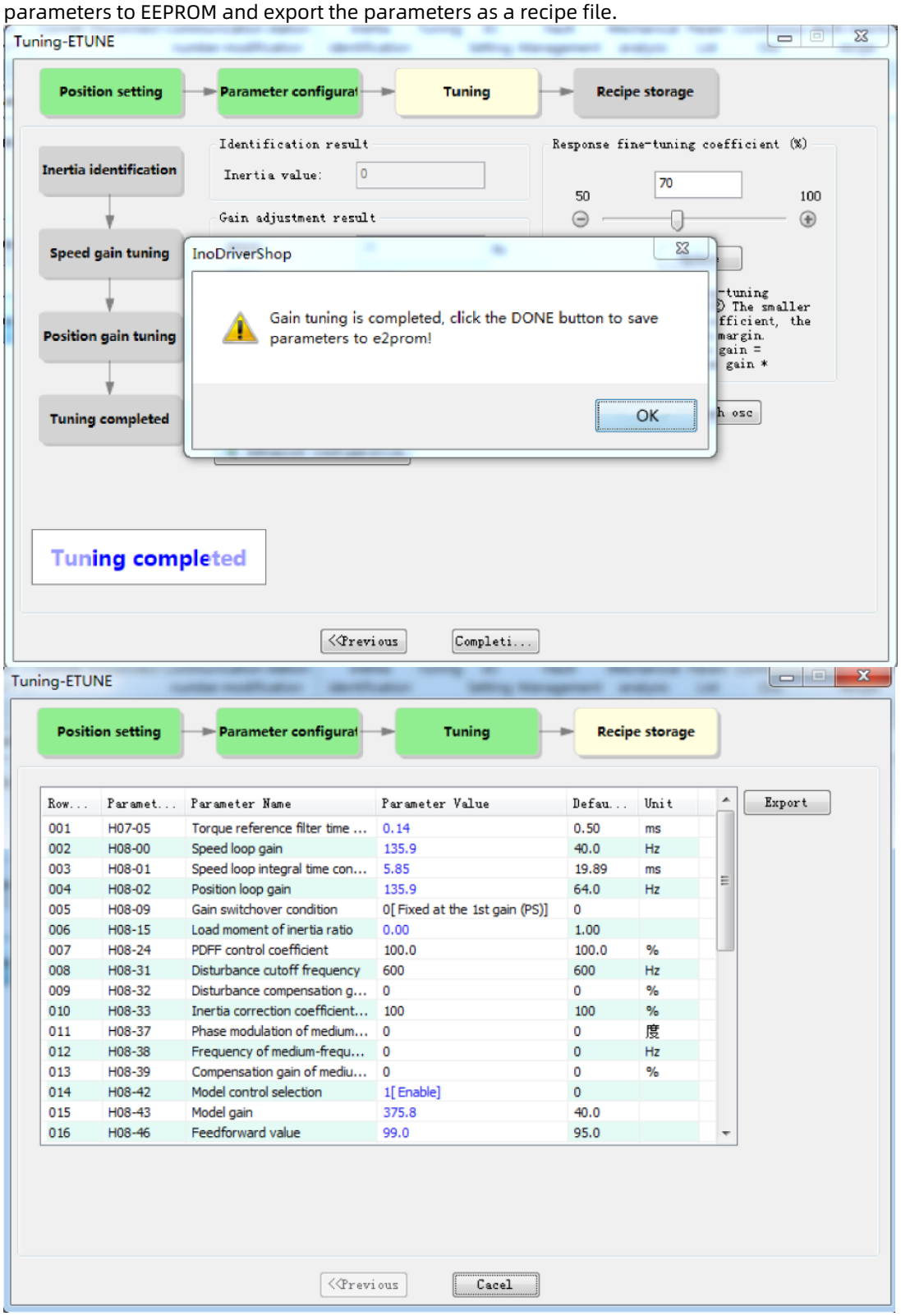


5. Click **Next** to start auto-tuning.

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



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



Precautions

- You can adjust the maximum speed and acceleration/deceleration time of the motion profile based on actual conditions. The acceleration/deceleration time can be increased properly because positioning will be accelerated after auto-tuning.
- If the acceleration/deceleration time is too short, overload may occur. In this case, increase the acceleration/deceleration time properly.
- For vertical axes, take anti-drop measures beforehand and set the stop mode upon fault to "Stop at zero speed".
- For lead screw transmission, shorten the travel distance if the tuning duration is too long.
- Set the response mode to "High" for high-stiffness devices or scenarios with high response requirements. Set the response mode to "Medium" for medium-stiffness devices or scenarios with medium response requirements. Set the response mode to "Low" for low-stiffness devices.
- If the fault is reported due to resonance during tuning, perform tuning again after switching to a lower response level.

Solutions to common faults

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

9.5 Manual Gain Tuning

9.5.1 Technical Data

When 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.

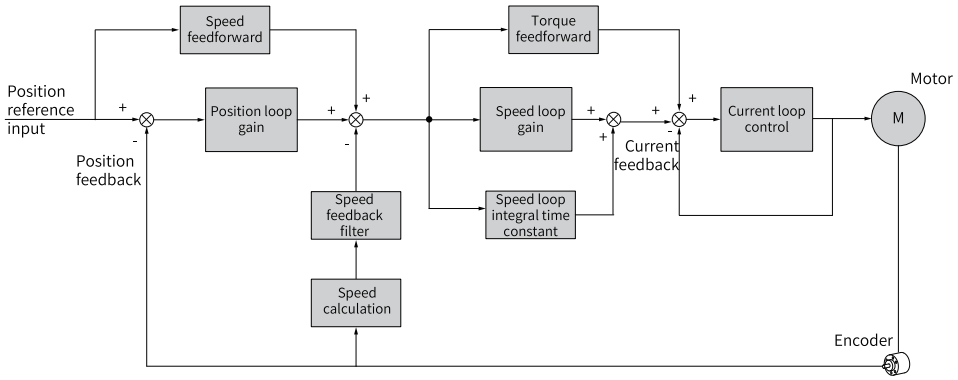


Figure 9-7 Basic control for manual gain tuning

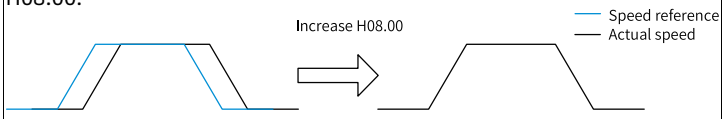
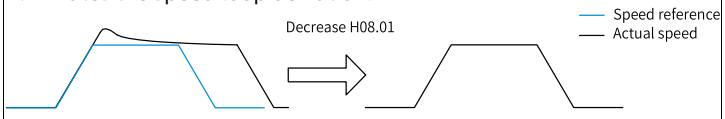
Caution

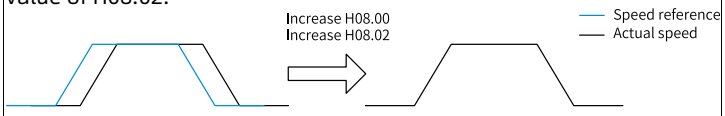
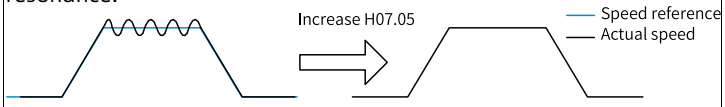
The response level of the inner loop must be higher than that of the outer loop. If it is not observed, the system may be unstable.

The current loop gain has been set with the highest level of responsiveness by default, avoiding the need for adjustment. you only need to adjust the position loop gain, speed loop gain and other auxiliary gains. The default current loop gain may be improper when a third-party motor is used. Therefore, auto-tuning of current loop gain is required. 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 9–5 Description of gain tuning 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 556*.
2	H08.01	Speed loop integral time constant	Function: Eliminates the speed loop deviation.  Note: Set this parameter according to the following formula: 500 ≤ H08.00 x H08.01 ≤ 1000 For example, if H08.00 is set to 40.0 Hz, the setpoint of H08.01 must meet the following requirement: 12.50 ms ≤ H08.01 ≤ 25.00 ms Decreasing the setpoint strengthens the integral action and shortens the positioning time, but an excessively low setpoint may easily lead to mechanical vibration. An excessively high setpoint prevents the speed loop deviation from being cleared. When H08.01 is set to 512.00 ms, the integral is invalid.

Step	Param.	Name	Description
3	H08.02	Position loop gain	Function: It sets the position reference maximum frequency followed by the position loop. The maximum follow-up frequency of the position loop equals the value of H08.02.  Note: To ensure system stability, the maximum follow-up frequency of the speed loop must be 3 to 5 times higher than that of the position loop. $3 \leqslant \frac{2 \times \pi \times H08.00}{H08.02} \leqslant 5$ For example, when H08.00 is set to 40.0 Hz, the position loop gain must meet the following requirement: 50.2 Hz ≤ H08.02 ≤ 83.7 Hz Adjust the setting based on the positioning time. Increasing the setpoint shortens the positioning time and improves the anti-interference capacity of a motor at standstill. An excessively high setpoint may easily lead to system instability and oscillation.
4	H07.05	Torque reference filter time constant	Function: Eliminates the high-frequency noise and suppresses mechanical resonance.  Note: Ensure the cutoff frequency of the torque reference low-pass filter is 4 times higher than the maximum follow-up frequency of the speed loop, as shown in the following formula: $\frac{1000}{2 \times \pi \times H07.05} \geqslant (H08.00) \times 4$ For example, when H08.00 is set to 40.0 Hz, the setpoint of H07.05 must be lower than or equal to 1.00 ms. If vibration occurs after H08.00 is increased, adjust H07.05 to suppress the vibration. For details, see "*Vibration suppression*" *on page 556*. 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.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
H07.05	2007-06h	Torque reference filter time constant 1	0.00 to 30.00	0.50	ms	Real time	"*H07_en.05*" *on page 638*
H08.00	2008-01h	Speed loop gain	0.0 to 2000.0	40.0	Hz	Real time	"*H08_en.00*" *on page 645*

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
H08.01	2008-02h	Speed loop integral time constant	0.15 to 512.00	19.89	ms	Real time	"H08_en.01" on page 645
H08.02	2008-03h	Position loop gain	0.0 to 2000.0	64.0	Hz	Real time	"H08_en.02" on page 646

9.5.2 Gain Switchover

Gain switchover can be triggered by the internal servo state or external DI signals. It is active only in position control and speed control to 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 set (H08.00 to H08.02 and H07.05) is used, but you can switch between proportional control and proportional integral control through FunIN.3 (GAIN_SEL, gain switchover) for the speed loop.

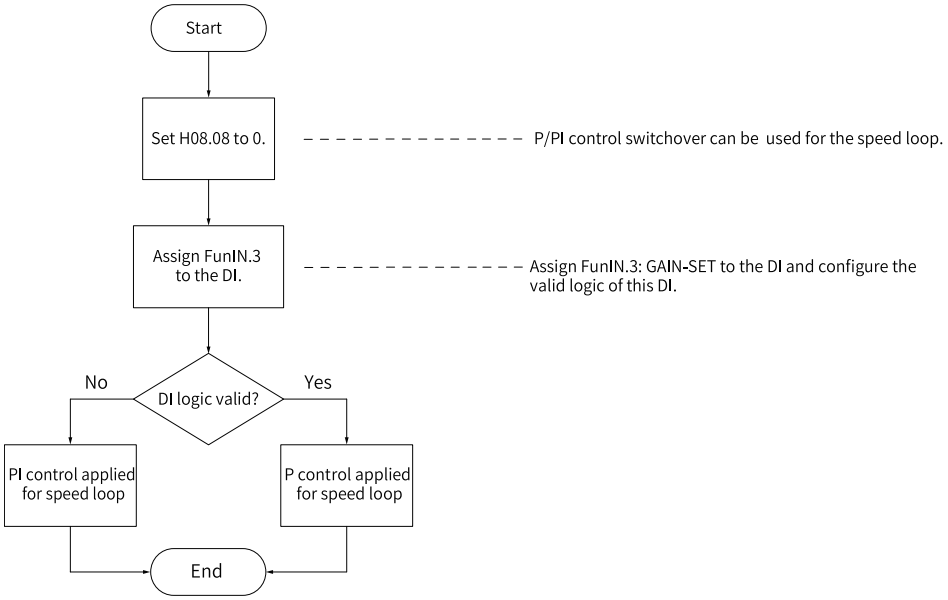


Figure 9-8 Gain switchover flowchart when H08.08 is set to 0

H08.08 = 1

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

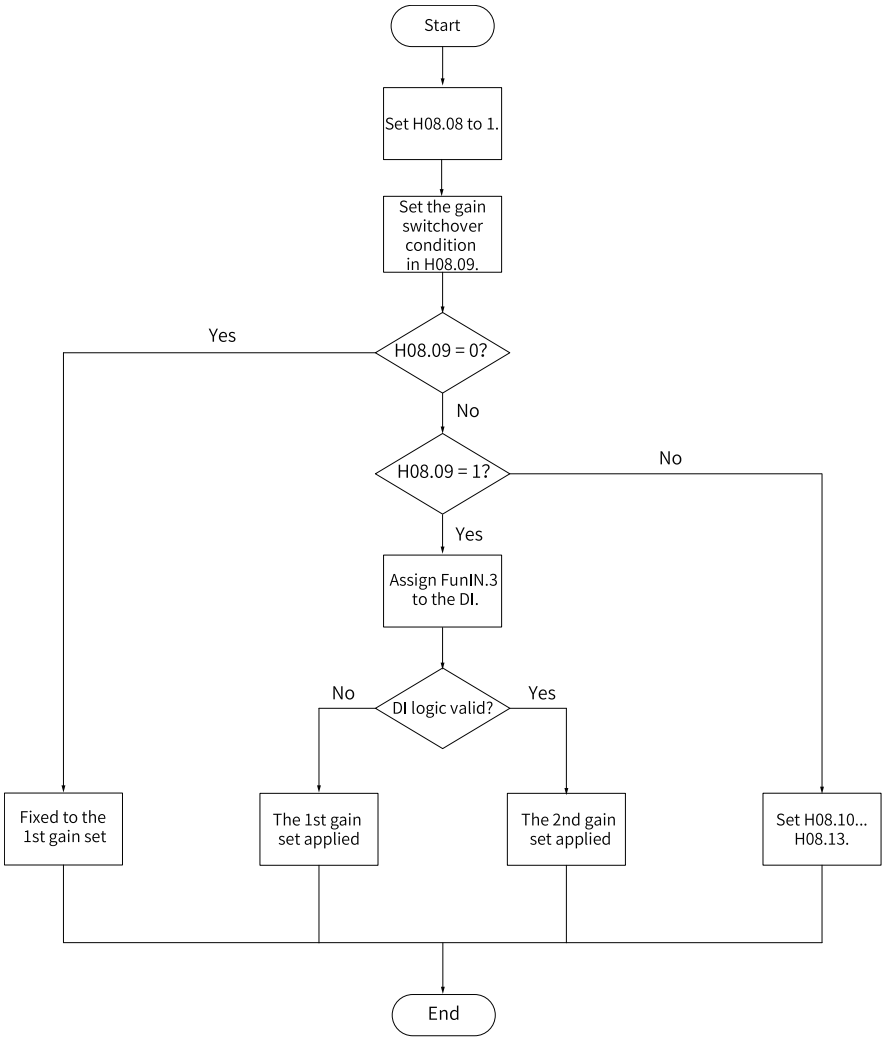
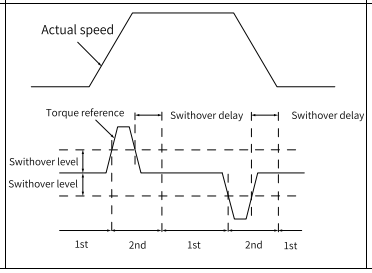
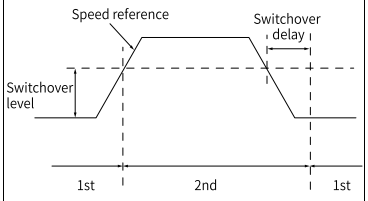
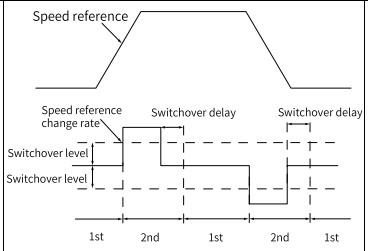
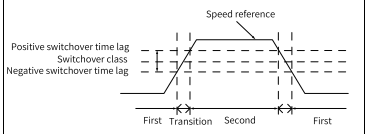
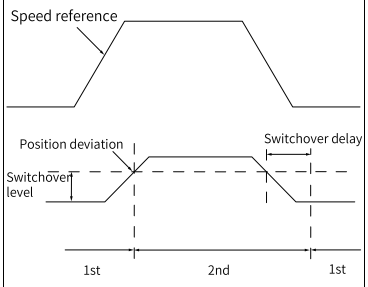
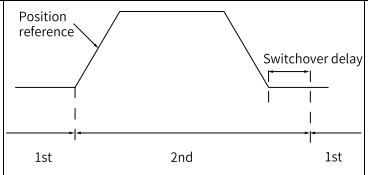
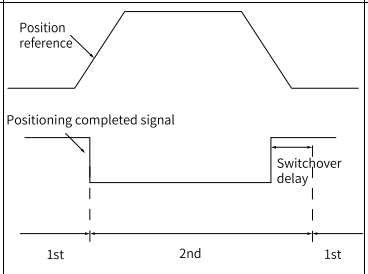
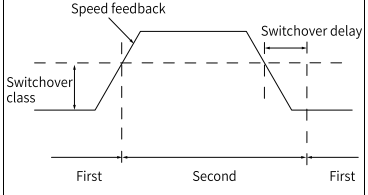


Figure 9-9 Gain switchover flowchart when H08.08 is set to 1

10 kinds of gain switchover conditions are available. The following table describes the diagrams and related parameters of different conditions.

Table 9–6 Conditions for gain switchover

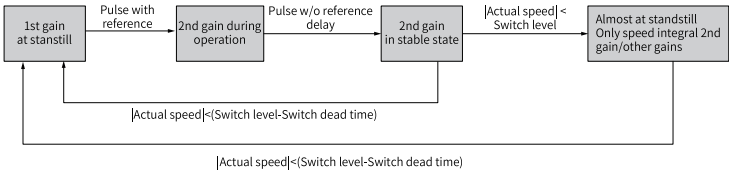
Gain switchover condition			Related parameters		
H08.09 Setpoint	Condition	Diagram	Delay time (H08.10)	Gain switchover level (H08.11)	Switchover hysteresis (H08.12)
0	Fixed to the 1st gain set	-	Inactive	Inactive	Inactive
2	Torque reference		Active	Active (%)	Active (%)

Gain switchover condition			Related parameters		
H08.09 Setpoint	Condition	Diagram	Delay time (H08.10)	Gain switchover level (H08.11)	Switchover hysteresis (H08.12)
3	Speed reference		Active	Active	Active
4	Speed reference change rate		Active	Active (10 rpm/s)	Inactive (10 rpm/s)
5	High/Low-speed threshold of speed reference		Inactive	Active (rpm)	Active (rpm)
6	Position deviation		Active	Active (encoder unit)	Active (encoder unit)
7	Position reference		Active	Inactive	Inactive
8	Positioning uncompleted		Active	Inactive	Inactive
9	Actual speed		Active	Active (rpm)	Active (rpm)
10	Position reference +Actual speed	See the following note for details.	Active	Active (rpm)	Active (rpm)

Caution

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

Note



☆Related parameters:

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
H08.08	2008-09h	2nd gain mode setting	0: Fixed to the 1st gain set, switched between P and PI as defined by bit26 of external 60FEh 1: Switched between the 1st and 2nd gain sets as defined by H08.09	1	-	Real time	"H08_en.08" on page 647
H08.09	2008-0Ah	Gain switchover condition	0: Fixed to the 1st gain set (PS) 1: Switched as defined by bit26 of 60FEh 2: Torque reference too large (PS) 3: Speed reference too large (PS) 4: Speed reference change rate too large (PS) 5: Speed reference low/high speed threshold (PS) 6: Position deviation too large (P) 7: Position reference available (P) 8: Positioning unfinished (P) 9: Actual speed (P) 10: Position reference + Actual speed (P)	0	-	Real time	"H08_en.09" on page 647
H08.10	2008-0Bh	Gain switchover delay	0.0 to 1000.0	5.0	ms	Real time	"H08_en.10" on page 648
H08.11	2008-0Ch	Gain switchover level	0 to 20000	50	-	Real time	"H08_en.11" on page 648
H08.12	2008-0Dh	Gain switchover hysteresis	0 to 20000	30	-	Real time	"H08_en.12" on page 648
H08.13	2008-0Eh	Position gain switchover time	0.0 to 1000.0	3.0	ms	Real time	"H08_en.13" on page 649

9.5.3 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.

9.5.4 Feedforward Gain

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.

Speed feedforward

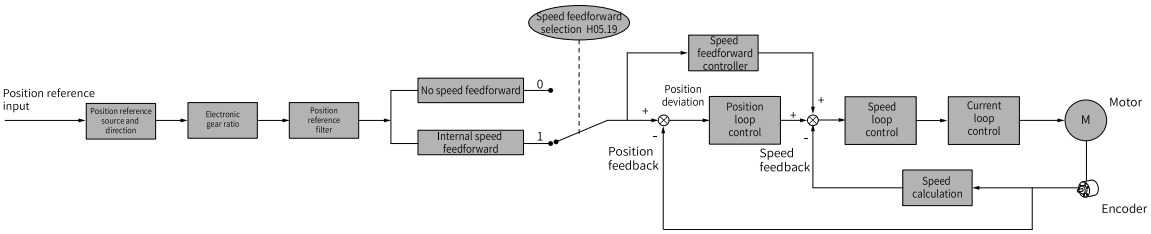


Figure 9-10 Operating procedure for speed feedforward control

Operating procedure for speed feedforward:

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

Param.	Name	Setpoint	Remarks
H05.19	Speed feedforward control	0: No speed feedforward	-
		1: Internal speed feedforward	Defines the speed corresponding to the position reference (encoder unit) as the speed feedforward signal source.
		2: 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.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
H08.18	2008-13h	Time constant of speed feedforward filter	0.00 to 64.00	0.50	ms	Real time	"H08_en.18" on page 649
H08.19	2008-14h	Speed feedforward gain	0.0% to 100.0%	0.0	%	Real time	"H08_en.19" on page 650

Zero phase control

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

The loop calculation model is shown in the following figure.

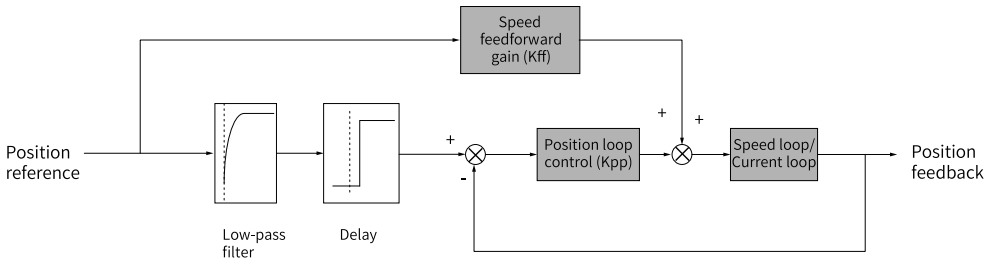


Figure 9-11 Zero phase control

☆Related parameters:

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
H05.04	2005-05h	First-order low-pass filter time constant	0.0 to 6553.5	0.0	ms	At stop	"H05_en.04" on page 609
H05.19	2005-14h	Speed feedforward control	0: No speed feedforward 1: Internal speed feedforward 2: H05.72 3: Zero phase	1	-	At stop	"H05_en.19" on page 610
H08.17	2008-12h	Zero phase delay	0.0 to 4.0	0.0	ms	Real time	"H08_en.17" on page 649

Torque feedforward

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.

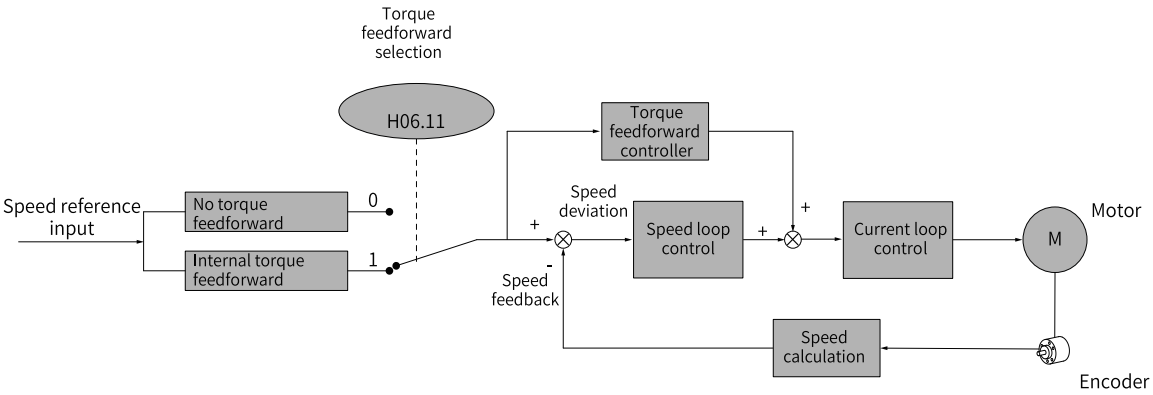


Figure 9-12 Torque feedforward function

The procedure for setting torque feedforward is as follows:

1. Set the torque feedforward signal source.
   Set H06.11 (Torque feedforward control) to 1 to activate torque feedforward and locate the corresponding signal source.

Param.	Name	Setpoint	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 the value of H08.21 improves response but may cause overshoot during acceleration/deceleration. • Decreasing the value of H08.20 suppresses overshoot during acceleration/deceleration. Increasing the value of H08.20 suppresses the noise. Note: • 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 until a balanced performance is achieved.
H08.21	Torque feedforward gain	See this section for details.

9.5.5 PDFF Control

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

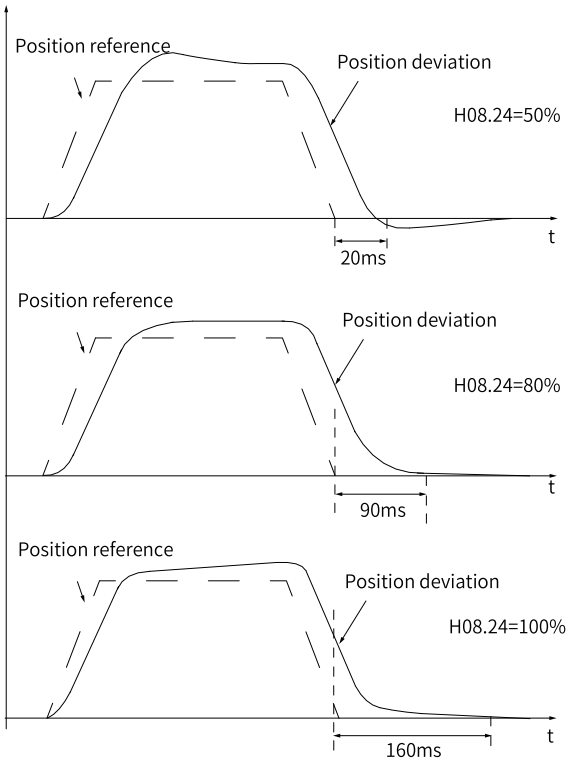


Figure 9-13 Example of PDFF control

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

Parameter	Name	Description
H08.24	PDFF control coefficient	Function: • Defines the control method of the speed loop in the non-torque control modes. Note: • Setting H08.24 to an excessively low value slows down the responsiveness of the speed loop. • When the speed feedback overshoots, gradually decrease the setpoint of H08.24 from 100.0 to a certain value at which the PDFF control achieves the desired effect. • When H08.24 is set to 100.0, the speed loop control method does not change and the default proportional integral control is used.

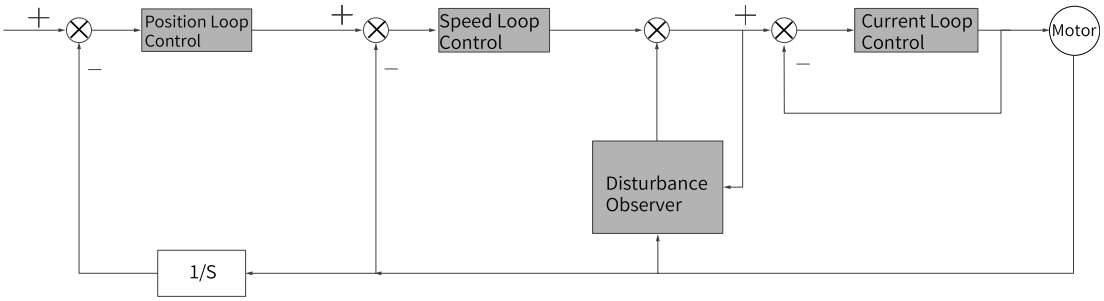
9.5.6 Torque Disturbance Observer

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



Note

1/S: Integral term

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

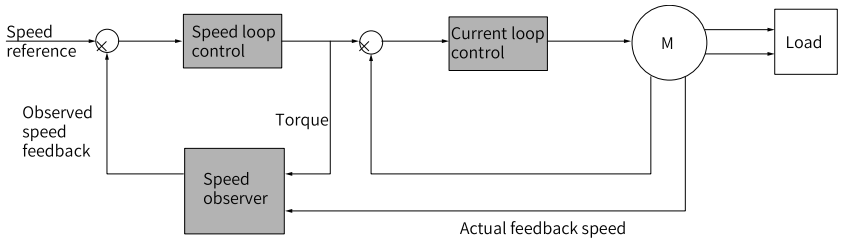
Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode:	Page
H08.31	2008-20h	Disturbance cutoff frequency	1 to 4000	600	Hz	Real time	"H08_en.31" on page 653
H08.32	2008-21h	Disturbance compensation gain	0 to 100	0	%	Real time	"H08_en.32" on page 653
H08.33	2008-22h	Disturbance observer inertia correction coefficient	1% to 1600%	100	%	Real time	"H08_en.33" on page 654

9.5.7 Speed Observer

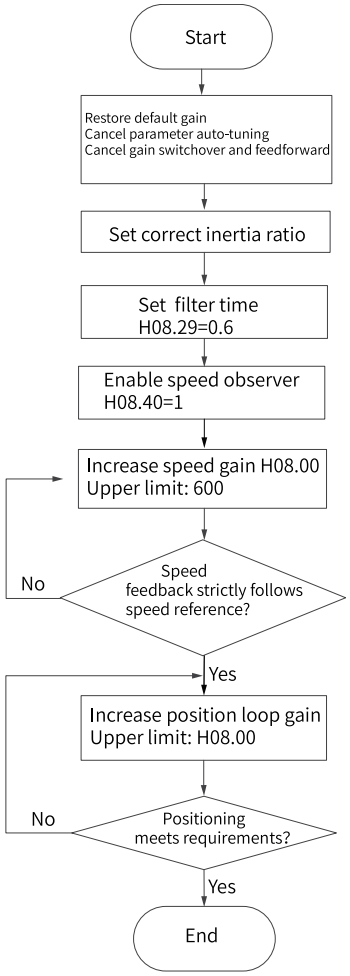
The speed observer, which facilitates quick positioning, applies in applications with slight load characteristic change and constant inertia.

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

The block diagram for the speed observer is as follows.



Commissioning procedure



Note

- Before using the speed observer, set H08.15 (Load inertia ratio) to a proper value or perform inertia auto-tuning. A wrong inertia ratio can cause vibration.
- Setting H08.27, H08.28, or H08.29 to excessively low or high values can result in motor vibration.

Related parameters

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Remarks
H08.00	2008-01h	Speed loop gain	0.0 to 2000.0	40.0	Hz	Real time	"*H08_en.00* *on page 645*"
H08.27	2008-1Ch	Speed observer cutoff frequency	50 to 600	170	Hz	Real time	"*H08_en.27* *on page 652*"

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Remarks
H08.28	2008-1Dh	Speed observer inertia correction coefficient	1 to 1600	100	%	Real time	"H08_en.28" on page 653
H08.29	2008-1Eh	Speed observer filter time	0.00 to 10.00	0.80	ms	Real time	"H08_en.29" on page 653
H08.40	2008-29h	Speed observer selection	0: Disable 1: Enable	0	-	Real time	"H08_en.40" on page 655

9.5.8 Model Tracking

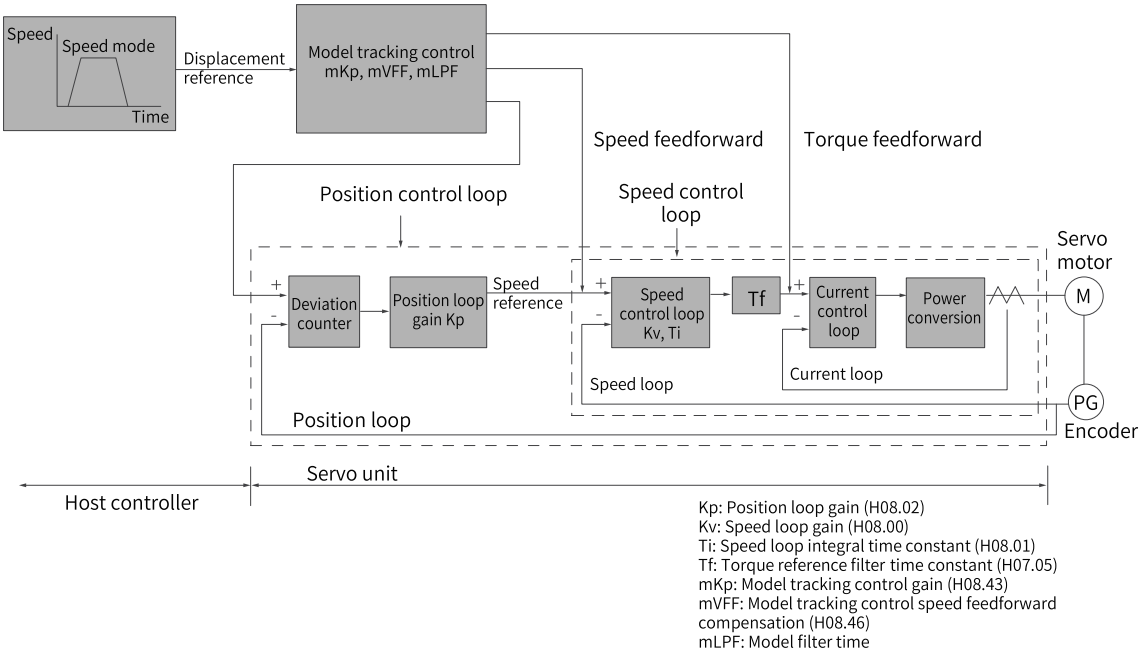
The model tracking control, which is only available in the position control mode, can be used to improve responsiveness and shorten the positioning time. It is only available in the position control mode.

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

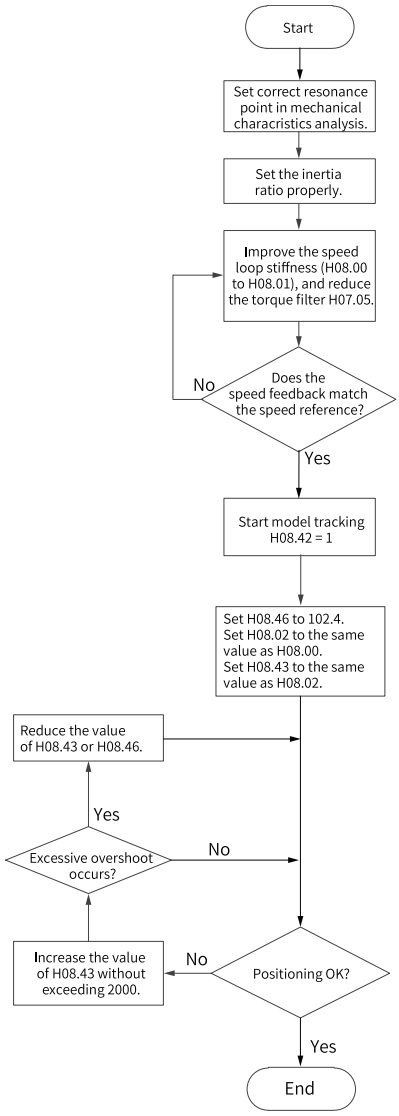
However, manual tuning is needed in the following situations:

- 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



Note

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

Related parameters

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
H07.05	2007-06h	Torque reference filter time constant 1	0.00 to 30.00	0.50	ms	Real time	"*H07_en.05*" *on page 638*
H08.00	2008-01h	Speed loop gain	0.0 to 2000.0	40.0	Hz	Real time	"*H08_en.00*" *on page 645*
H08.01	2008-02h	Speed loop integral time constant	0.15 to 512.00	19.89	ms	Real time	"*H08_en.01*" *on page 645*
H08.02	2008-03h	Position loop gain	0.0 to 2000.0	64.0	Hz	Real time	"*H08_en.02*" *on page 646*

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
H08.42	2008-2Bh	Model control selection	0: Disable 1: Enable 2: Reserved 3: New model tracking 4: Model tracking B	0	-	Real time	"H08_en.42" on page 655
H08.43	2008-2Ch	Model gain	0.1 to 2000.0	40.0	-	Real time	"H08_en.43" on page 655
H08.46	2008-2Fh	Feedforward value	0.0 to 102.4	95.0	-	Real time	"H08_en.46" on page 655

9.5.9 Friction Compensation

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

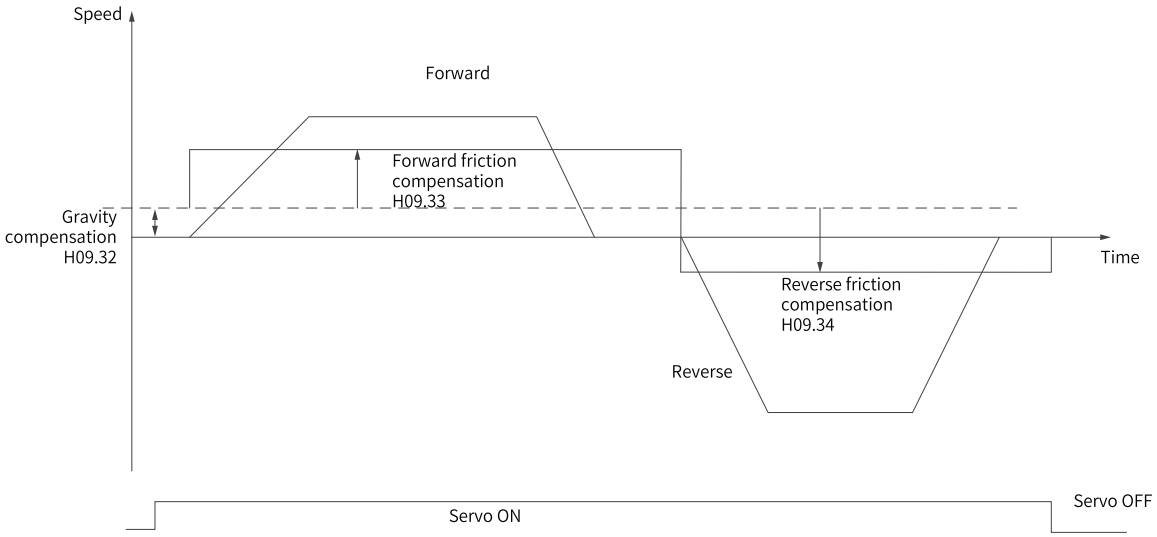
Note

Friction compensation is effective only in the position mode.

☆Related parameters

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode:	Page
H09.32	2009-21h	Gravity compensation value	-100.0% to +100.0%	0.0	%	Real time	"H09_en.32" on page 667
H09.33	2009-22h	Positive friction compensation value	0.0% to 100.0%	0.0	%	Real time	"H09_en.33" on page 668
H09.34	2009-23h	Negative friction compensation value	-100.0% to 0.0%	0.0	%	Real time	"H09_en.34" on page 668
H09.35	2009-24h	Friction compensation speed	0.0 to 20.0	2.0	-	Real time	"H09_en.35" on page 668
H09.36	2009-25h	Friction compensation speed	0: Slow mode+Speed reference 1: Slow mode+Model speed 2: Slow mode+Speed feedback 3: Slow mode+Observe speed 16: Quick mode +Speed reference 17: Quick mode +Model speed 18: Quick mode +Speed feedback 19: Quick mode+Observe speed	0x0	-	Real time	"H09_en.36" on page 668

The diagram for friction compensation is as follows.



Note

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

9.5.10 Encoder Scale Fluctuation Suppression

Ideally, the position information fed back by the encoder corresponds to the position of the motor rotor linearly. However, a fluctuating position information can be incurred due to physical characteristics of the encoder scale, as shown below.

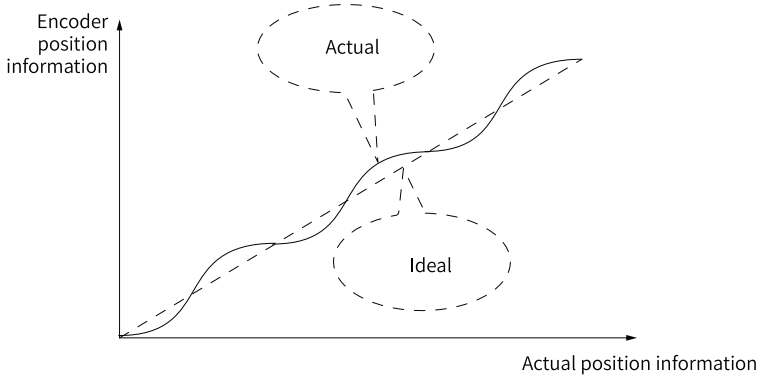


Figure 9-14 Encoder feedback

Therefore, the actual position information can be equivalent to the superposition of a linear Gliner part and a fluctuating Gwave part. The fluctuation transmission part is usually associated with the encoder scale pitch. The fluctuation frequency also changes at different running speeds, which means the fluctuation frequency increases linearly with the speed.

This fluctuation position information is converted into position feedback and speed feedback to be introduced to the control loop, resulting in a fluctuation component in the output of the entire control system. When the control loop gain is high, the fluctuation component can be amplified, which may incur additional vibration noise.

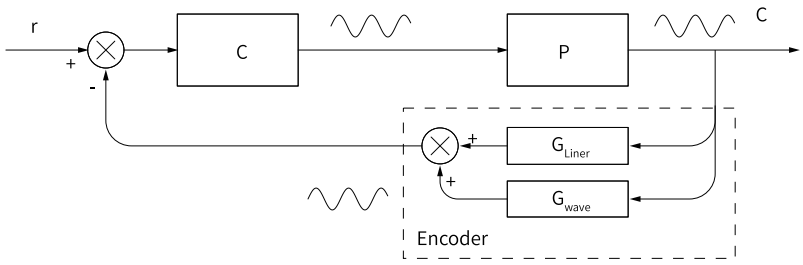


Figure 9-15 Control system loop with fluctuation

Given the preceding conditions, the SV670NS-INT drive is designed with a scale fluctuation suppressor to "isolate" the fluctuation component incurred by the encoder feedback, suppressing fluctuation component in the output due to speed fluctuation and preventing position fluctuation or speed fluctuation from being introduced to the control loop, which can lead to operation noise. The following diagram shows the operation schematics.

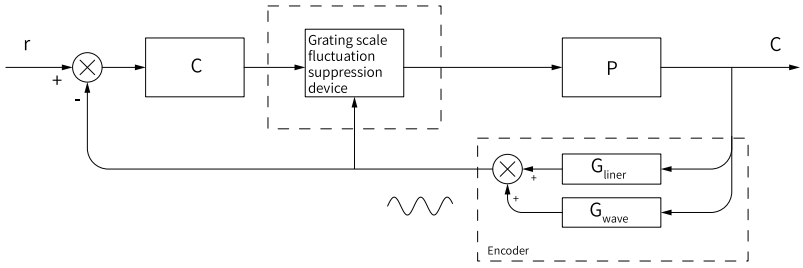


Figure 9-16 Schematics of the scale fluctuation suppressor

See the following for details.

1. Check the scale pitch and set the pitch value to H00.45 and H00.46 respectively. If the scale pitch is unknown, you can determine the scale fluctuation pitch based on the speed fluctuation frequency and average speed during operating at constant speed.
2. When fluctuation suppression is enabled, set the number of scale fluctuation suppressors and the corresponding mode based on actual conditions. The adaptive mode is used for variable speed conditions in reciprocating or unidirectional operation. The hysteresis mode is used for constant speed conditions in reciprocating operation.

Param.	Name	Default value	Value range	Description
H00.45	Encoder pitch 1	2	0.00 to 655.35	Unit: [mm]/[deg]
H00.46	Encoder pitch 2	0.5	0.00 to 655.35	Unit: [mm]/[deg]
H08.90	Encoder pitch fluctuation suppres-sion device	0	0 to 4	Encoder pitch fluctuation suppression device 0: Disable 1: Enable the first group of suppressor only, with adaptive mode applied 2: Enable the first group of suppressor only, with hysteresis mode applied 3: Enable the two groups of suppressor, with adaptive mode applied 4: Enable the two groups of suppressor, with hysteresis mode applied

Note

- This function applies to applications with slow acceleration and deceleration in a long travel range (especially in applications where a DDL motor works with a magnetic grating encoder at a constant speed in a long distance). It can significantly reduce speed fluctuation and noise caused by magnetic grating pitch.This function does not generate the its best performance in applications with small grating pitch or excessive line count.

9.5.11 Motor Cogging Torque Fluctuation Compensation

The motor cogging torque fluctuation compensation is used to compensate for the torque fluctuation caused by the motor cogging force, which suppresses the speed fluctuation caused by cogging torque fluctuation under low control loop gains, ensuring stable system margin and reducing the speed fluctuation.

The SV670NS-INT drive has two the following application modes for rotary motors (general-purpose ROT/direct-drive DDR[1]).

Note

[1]: DDR refers to a direct drive torque motor.

- **Application mode when used together with ROT/DDR motor equipped with Inovance absolute encoder**
  In this mode, compensation data is obtained at the motor delivery stage, without the need for additional operations. You can select whether to enable cogging torque fluctuation compensation through H06.28.

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode
H06.28	2006-1Dh	Cogging torque fluctuation compensation	0 to 1	1	-	At stop

- **Application mode when used together with ROT/DDR motor equipped with incremental encoder (Inovance communication-type incremental encoder with T5 interpolator, ABZ quadrature pulse encoder (TTL signal))**
  In this mode, motor cogging torque fluctuation compensation can be enabled only after compensation table is generated successfully upon motor cogging torque fluctuation auto-tuning. The auto-tuning process and compensation process are activated only after angle auto-tuning and homing are done. See the following for details.

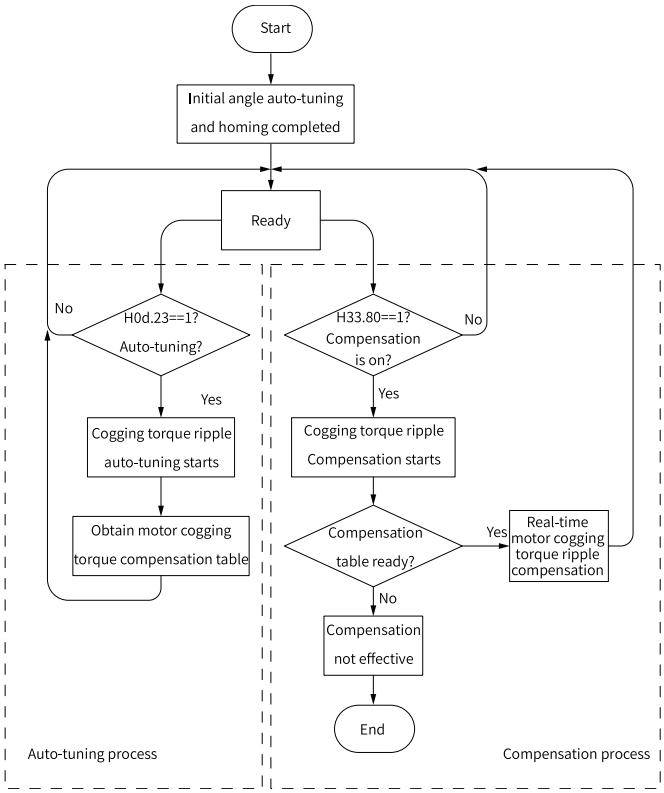


Figure 9-17 Flowchart of application mode for ROT/DDR motor equipped with incremental encoder

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode
H33.80	2033-51h	Position for saving motor cogging torque fluctuation compensation data	0: Saved in the encoder 1: Saved in the Flash	0	-	At stop
H0d.23	200d-18h	Motor cogging torque fluctuation auto-tuning	0: Disable 1: Enable	0	-	At stop

When motor cogging torque fluctuation auto-tuning is enabled (H0d.23 = 1), the drive drives the motor to rotate for several revolutions to generate the cogging torque fluctuation compensation table.

Note

During this process, you need to ensure that the motor has enough operating range to avoid collision. To avoid external disturbance, it is recommended to perform auto-tuning with the motor disconnected from the load.

After auto-tuning is done, motor cogging torque fluctuation compensation is enabled automatically (H06.28 = 1), which is activated at next power-on after angle auto-tuning and homing are done. You can disable this function manually when compensation is not needed (H06.28 = 0).

9.6 Parameter Tuning in Different Control Modes

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

9.6.1 Parameter Adjustment in Speed Control Mode

Parameter adjustment in speed control mode is the same as that in position control mode, except for the position loop gain (H08.02 and H08.05). For details, see *"9.6.2 Parameter Adjustment in Position Control Mode" on page 554*.

9.6.2 Parameter Adjustment in Position Control Mode

Obtain the value of H08.15 (load inertia ratio) by performing inertia auto-tuning.

Gain Parameters in Position Control Mode:

- 1st gain set:

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

- 2nd gain set:

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

- Common gain set

Parameter code	Parameter name	Description	Default value
H08.18	Time constant of speed feedforward filter	Defines the filter time constant of the speed feedforward signal.	0.50 ms
H08.19	Speed feedforward gain	Defines the speed feedforward gain.	0.0%
H08.20	Torque feedforward filter time constant	Defines the filter time constant of the torque feedforward signal.	0.50 ms
H08.21	Torque feedforward gain	Defines the torque feedforward gain.	0.0%
H08.22	Speed feedback filtering option	Defines the speed feedback filtering function.	0
H08.23	Cutoff frequency of speed feedback low-pass filter	Defines the cutoff frequency of the first-order low-pass filter for speed feedback.	8000 Hz
H08.24	PDFF control coefficient	Defines the coefficient of the PDFF controller.	100.0%
H09.30	Torque disturbance compensation gain	Defines the torque disturbance compensation gain.	0.0%
H09.31	Filter time constant of torque disturbance observer	Defines the filter time constant of the disturbance observer.	0.5 ms
H09.04	Low-frequency resonance suppression mode	Defines the low-frequency resonance suppression mode.	0
H09.38	Frequency of low-frequency resonance suppression 1 at the mechanical end	Defines the frequency of the low-frequency resonance suppression filter.	100.0 Hz
H09.39	Low-frequency resonance suppression 1 at the mechanical end	Defines the setting of low-frequency resonance suppression filter.	2

Perform automatic gain tuning to obtain the initial values of the 1st or 2nd gain set and the common gain set.

Manually fine-tune the following gains.

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

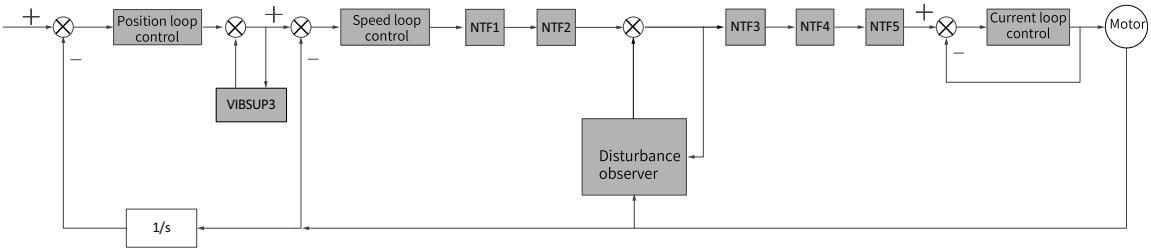
9.6.3 Parameter Adjustment in Torque Control Mode

Parameter adjustment in torque control mode vary with the following conditions:

- If the actual speed reaches the upper speed limit, the adjustment method is the same as that described in *"9.6.1 Parameter Adjustment in Speed Control Mode" on page 554*.
- If the actual speed does not reach the upper speed limit, the adjustment method is the same as that described in *"9.6.1 Parameter Adjustment in Speed Control Mode" on page 554*, except for the position and speed loop gain and speed loop integral time constant.

9.7 Vibration Suppression

The block diagram for vibration suppression is as follows.



Where:

- NTF1–5: 1st notch to 5th notch
- VIBSUP3: Suppression of medium- and low-frequency vibration
- 1/s: Integral term

☆Related parameters:

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
H08.53	2008-36h	Medium- and low-frequency jitter suppression frequency 3	0.0 to 300.0	0.0	Hz	Real time	*"H08_en.53" on page 656*
H08.54	2008-37h	Medium- and low-frequency jitter suppression compensation 3	0 to 200	0	%	Real time	*"H08_en.54" on page 656*
H08.56	2008-39h	Medium- and low-frequency jitter suppression phase modulation 3	0 to 600	100	%	Real time	*"H08_en.56" on page 657*

Note

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

9.7.1 Mechanical Resonance Suppression

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

Mechanical resonance can be suppressed in the following two methods:

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

To suppress the mechanical resonance, set the filter time constant to enable the torque reference to be attenuated in the frequency range above the cutoff frequency.

Filter cutoff frequency fc (Hz) = 1/[2π x H07.059 (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.

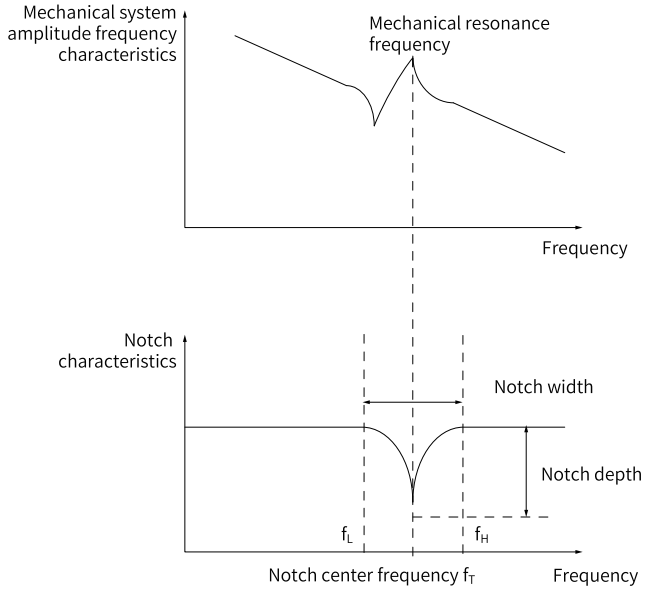


Figure 9-18 Operating principle of the notch

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

Table 9–7 Description of notch parameters

Item	Manual notch			Manual/Adaptive notch	
	1st notch	2nd notch	5th notch	3rd notch	4th notch
Frequency	H09.12	H09.15	H09.41	H09.18	H09.21
Width level	H09.13	H09.16	H09.42	H09.19	H09.22
Depth level	H09.14	H09.17	H09.43	H09.20	H09.23

Note

- When the frequency is 8000 Hz (default), the notch is inactive.
- The adaptive notch is preferred for resonance suppression. The manual notch can be used in cases where the adaptive notch cannot deliver desired performance.

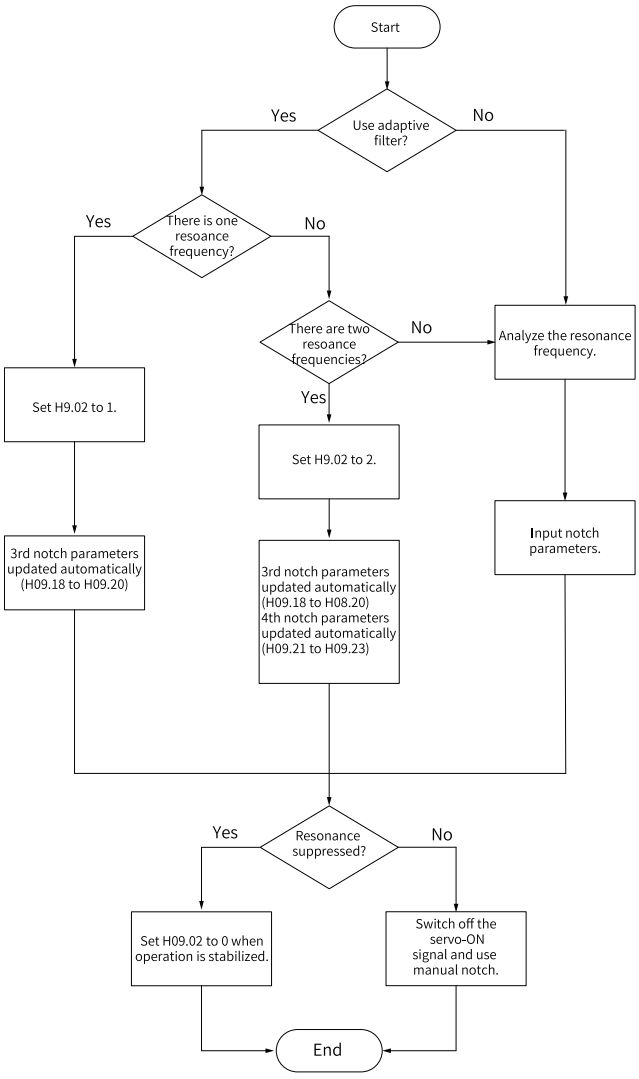


Figure 9-19 Using the notch

- Procedure for setting the adaptive notch:

  1. Set H09.02 (Adaptive notch mode selection) to 1 or 2 based on the number of resonance frequencies.
  2. When resonance occurs, set H09.02 to 1 first to enable one adaptive notch. If new resonance occurs after gain tuning, set H09.02 to 2 to enable two adaptive notches.
  3. Parameters of the 3rd, 4th, and 5th 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. After the servo drive runs stably for a period of time, set H09.02 to 0 and the parameters of the adaptive notch are fixed to the last updated values.

   This is to prevent notch parameters from being updated to wrong values due to misoperation. Wrong values will 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, You can also use all the five notches as manual ones (H09.02 = 0).

Note

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

- Procedure for setting the manual notch:

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

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

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

  Where:

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

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

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

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

When the depth level is 0, the input is completely suppressed at the center frequency. When the depth level is 99, the input can be fully passed at the center frequency. Therefore, the lower the depth level is, the higher the notch depth is, and the stronger the suppression effect will be. Note that an excessively low depth level may lead to system oscillation.

Note

If the amplitude frequency characteristic curve obtained through the mechanical analysis function does not have obvious peak, it indicates that vibration occurs actually. Such vibration may not be mechanical resonance, and cannot be suppressed by the notch. It occurs because the gain reaches the limit, and can be suppressed only by reducing the gain or the filter time of torque reference.

The following figure shows the frequency characteristics of the notch.

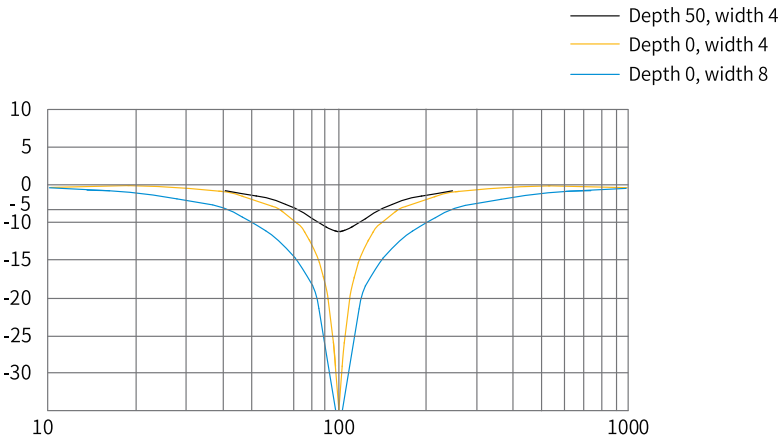


Figure 9-20 Notch frequency characteristics

☆Related parameters:

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
H09.02	2009-03h	Adaptive notch mode	0: Adaptive notch no longer updated 1: One adaptive notch activated (3rd notch) 2: Two adaptive notches activated (3rd and 4th notches) 3: Resonance point tested only (displayed in H09.24) 4: Adaptive notch cleared, values of 3rd and 4th notches restored to default	0	-	Real time	"H09_en.02" on page 661
H09.12	2009-0Dh	Frequency of the 1st notch	50 to 8000	8000	Hz	Real time	"H09_en.12" on page 664
H09.13	2009-0Eh	Width level of the 1st notch	0 to 20	2	-	Real time	"H09_en.13" on page 664
H09.14	2009-0Fh	Depth level of the 1st notch	0 to 99	0	-	Real time	"H09_en.14" on page 664

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
H09.15	2009-10h	Frequency of the 2nd notch	50 to 8000	8000	Hz	Real time	"H09_en.15" on page 664
H09.16	2009-11h	Width level of the 2nd notch	0 to 20	2	-	Real time	"H09_en.16" on page 665
H09.17	2009-12h	Depth level of the 2nd notch	0 to 99	0	-	Real time	"H09_en.17" on page 665
H09.18	2009-13h	Frequency of the 3rd notch	50 to 8000	8000	Hz	Real time	"H09_en.18" on page 665
H09.19	2009-14h	Width level of the 3rd notch	0 to 20	2	-	Real time	"H09_en.19" on page 665
H09.20	2009-15h	Depth level of the 3rd notch	0 to 99	0	-	Real time	"H09_en.20" on page 666
H09.21	2009-16h	Frequency of the 4th notch	50 to 8000	8000	Hz	Real time	"H09_en.21" on page 666
H09.22	2009-17h	Width level of the 4th notch	0 to 20	2	-	Real time	"H09_en.22" on page 666
H09.23	2009-18h	Depth level of the 4th notch	0 to 99	0	-	Real time	"H09_en.23" on page 666
H09.24	2009-19h	Auto-tuned resonance frequency	0 to 5000	0	Hz	Read only	"H09_en.24" on page 667
H09.41	2009-2Ah	Frequency of the 5th notch	50 to 8000	8000	Hz	Real time	"H09_en.41" on page 670
H09.42	2009-2Bh	Width level of the 5th notch	0 to 20	2	-	Real time	"H09_en.42" on page 670
H09.43	2009-2Ch	Depth level of the 5th notch	0 to 99	0	-	Real time	"H09_en.43" on page 670

9.7.2 Low-Frequency Resonance Suppression at the Mechanical End

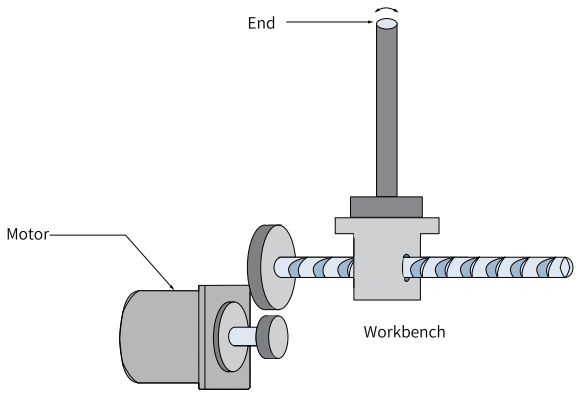


Figure 9-21 Low-frequency vibration at the mechanical end

If the mechanical load end is long and heavy, vibration may easily occur in this part during emergency stop, affecting the positioning effect. Such vibration is called low-frequency resonance as its frequency is generally within 100 Hz, which is lower than the mechanical resonance frequency mentioned in *"9.7.1 Mechanical Resonance Suppression" on page 557*. Use the low-frequency resonance suppression function to reduce such vibration.

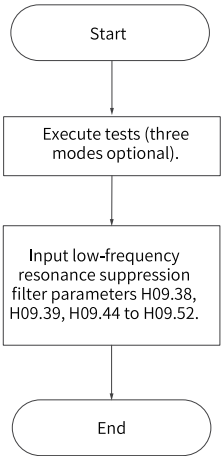


Figure 9-22 Procedure for setting low-frequency resonance suppression filter

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

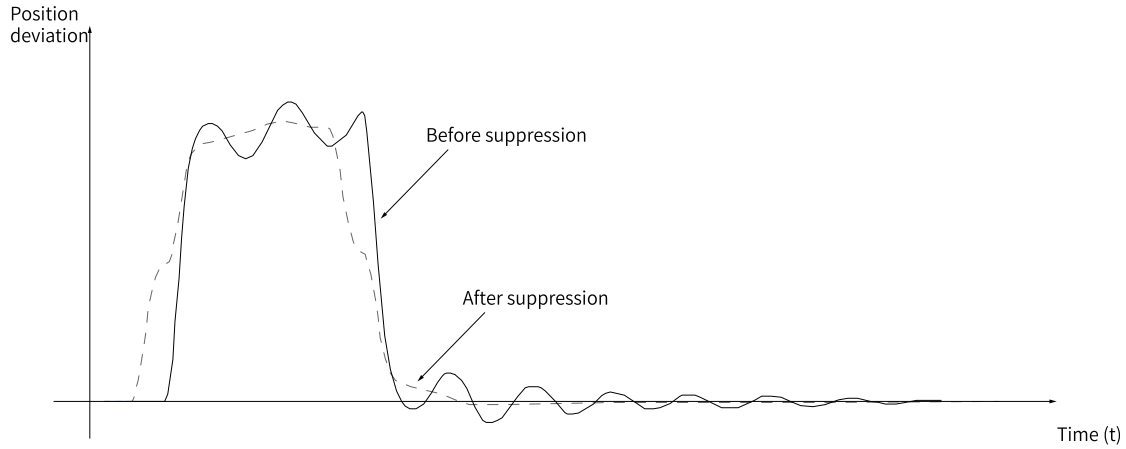


Figure 9-23 Low-frequency resonance suppression effect

☆Related parameters:

Param.	Comm. address	Name	Setpoint	Default value	Unit	Change mode	Page
H09.38	2009-27h	Frequency of low-frequency resonance suppression 1 at the mechanical end	1.0 to 100.0	100.0	Hz	At stop	"H09_en.38" on page 669
H09.39	2009-28h	Low-frequency resonance suppression 1 at the mechanical end	0 to 3	2	-	At stop	"H09_en.39" on page 669
H09.44	2009-2Dh	Frequency of low-frequency resonance suppression 2 at the mechanical end	0.0 to 200.0	0.0	Hz	At stop	"H09_en.44" on page 670
H09.45	2009-2Eh	Response of low-frequency resonance suppression 2 at the mechanical end	0.01 to 10.00	1.00	-	At stop	"H09_en.45" on page 671
H09.47	2009-30h	Width of low-frequency resonance suppression 2 at the mechanical end	0.00 to 2.00	1.00	-	At stop	"H09_en.47" on page 671
H09.49	2009-32h	Frequency of low-frequency resonance suppression 3 at the mechanical end	0.0 to 200.0	0.0	Hz	At stop	"H09_en.49" on page 671
H09.50	2009-33h	Response of low-frequency resonance suppression 3 at the mechanical end	0.01 to 10.00	1.00	-	At stop	"H09_en.50" on page 671
H09.52	2009-35h	Width of low-frequency resonance suppression 3 at the mechanical end	0.00 to 2.00	1.00	-	At stop	"H09_en.52" on page 672

9.8 Mechanical Characteristic Analysis

Overview

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

Steps

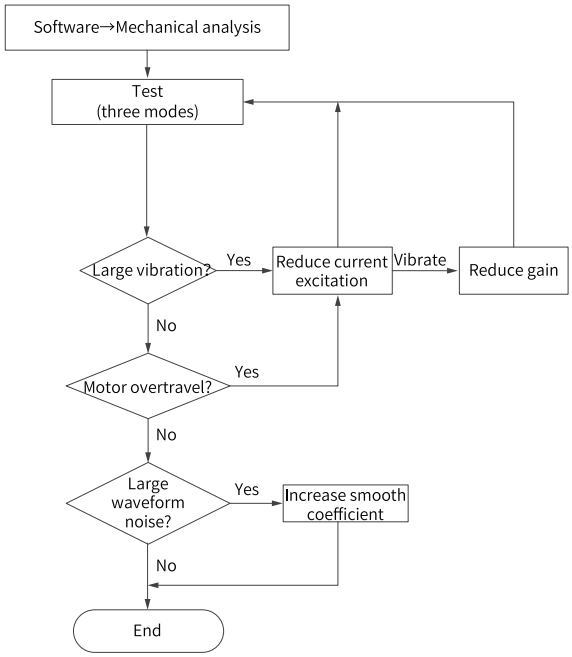


Figure 9-24 Operating procedure for mechanical characteristic analysis

Note

- To avoid large vibration during the test, set the current excitation to 10% during initial execution.
- The analysis waveform may be distorted if the current excitation is too low.
- If vibration generated during testing cannot be suppressed by reducing the current excitation, the causes and solutions may be: 1) The gain values are too high. Reduce the speed gain or set notch parameters based on the auto-tuned resonance point. 2) The set inertia ratio is too high. Set the inertia ratio properly.
- After setting the notch, the waveform under mechanical characteristic test mode is the same with that before the setting, but the speed closed loop and speed open loop modes will be attenuated.

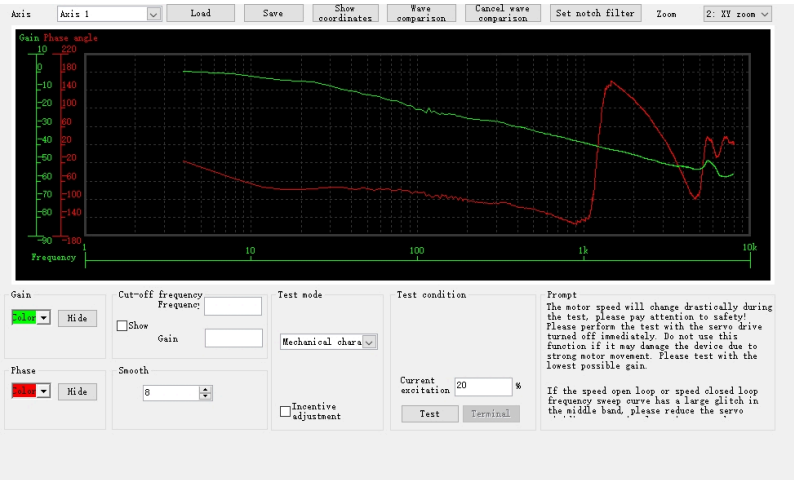


Figure 9-25 Example of the waveform obtained

An example of the waveform obtained with the mechanical characteristic analysis is shown in *"Figure 9-25 Example of the waveform obtained" on page 565*.

9.9 High-performance Tuning

Overview

High-performance tuning is an upgrade function of mechanical characteristic analysis. In addition to analyzing mechanical resonance frequencies and system bandwidth, it can also simulate the effect of adding filters and tuning parameters on loop control. Up to 8 kHz response characteristic analysis is available and measurement and simulation of mechanical characteristics, current loops, and frequency-domain characteristics of speed/position control (open-loop and closed-loop) are supported.

Note

- Before frequency domain measurement, you need to set H02.00 to the corresponding speed mode or position mode. Other modes may trigger an abnormal servo state alarm.
- During the measurement, do not disconnect the drive from the software, otherwise the measurement process will be interrupted.

Procedure

1. **Generate a measurement curve**

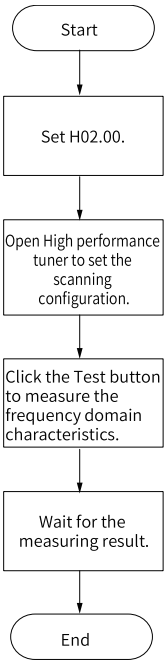


Figure 9-26 Process for generating a measurement curve

a. In the **Work Space** section, select **High performance tuner** and click **Sweep configuration**.

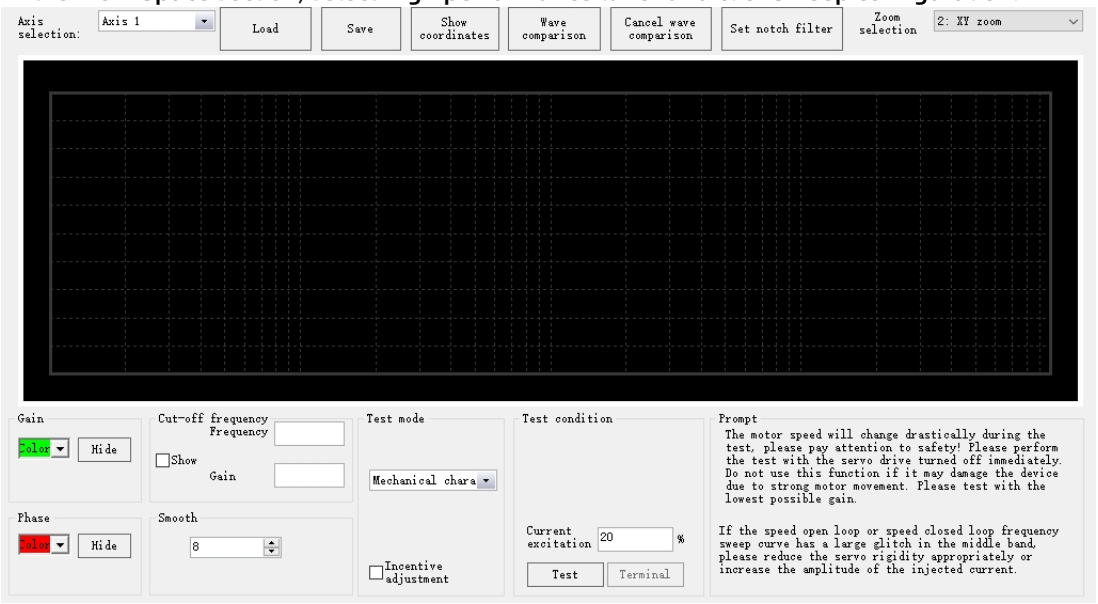


Figure 9-27 Sweep configuration

☆Related parameters:

Parameter code	Parameter name	Unit
H09.71	Low starting frequency	Hz
H09.72	End frequency	Hz
H09.73	Low-frequency points	-
H09.74	Excitation amplitude	%
H09.75	High starting frequency	Hz
H09.76	High frequency points	-

b. After the sweep completes, the frequency-domain characteristics are generated. In the following figure, the red and orange curves indicate the measured values and the green and brown curves indicate the simulation values.

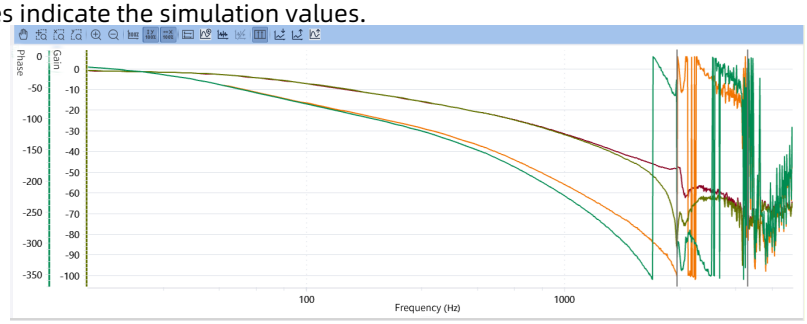


Figure 9-28 Frequency-domain curves (red and orange curves: measured values, green and brown curves: simulation values)

Note

- To avoid large vibration during the test, set the current excitation to 10% during initial execution.
- The analysis waveform may be distorted if the current excitation is too low.
- If vibration is present during the test, and cannot be eliminated by reducing current excitation, possible causes and measures are:
  - 1) The gain is too high. Reduce the speed gain or set the notch based on the auto-tuned resonance point.
  - 2) The set inertia ratio is too high. Rectify the setting.

2. **Tune loop control**

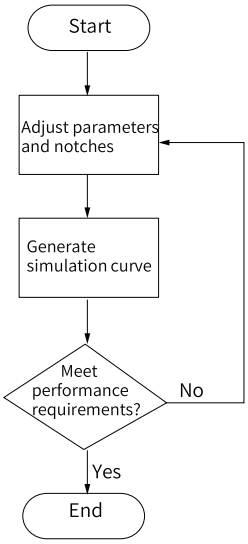


Figure 9-29 Process of loop tuning

After you tune the parameter settings and four notches, a simulation curve is generated, which reflects the effect of parameter tuning on the system.

☆Related parameters:

Parameter code	Parameter name	Type
H08.00	Speed loop gain	Gain
H08.01	Speed loop integral time	Gain
H08.02	Position loop gain	Gain
H08.05	Inertia ratio	Gain

Parameter code	Parameter name	Type
H07.05	Torque reference filter	Filter
H09.77 to H09.81	Biquad filter	Filter
H09.12 to H09.23	Notch	Filter

Note

Notch filter 1 becomes a notch only when it is not enabled. It can be configured as first-order low-pass, second-order low-pass, lead-lag, or custom biquad filter.

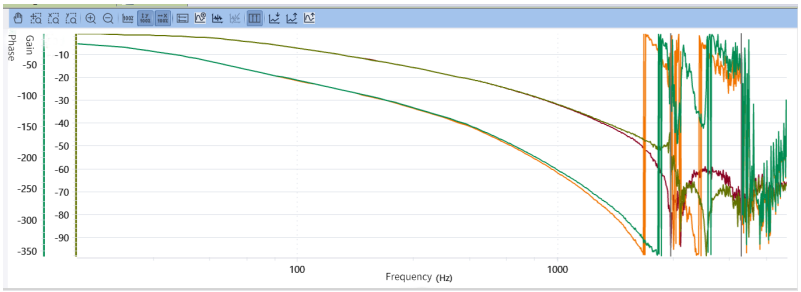


Figure 9-30 Comparison between the simulation curve of notch 2 and the measurement curve

10 Parameter Description

10.1 H00 Servo Motor Parameters

H00.00 **Motor code**

Comm. address:	2000-01h	Effective mode:	Next power-on
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	14102	Change mode:	At stop

Value range:

20000: Linear motor - Pulse-type encoder

14203: Linear motor - BiSS-C encoder

14206: Linear motor - SSI encoder

14207: Linear motor - EnDat2.2 encoder

14202: Linear motor - Inovance communication-type 23-bit encoder

14205: Linear motor - Inovance T5 interpolator

20001: DDR motor - Pulse-type encoder

14210: DDR motor - Inovance T5 interpolator

14201: DDR motor - Inovance communication-type 23-bit encoder

14211: DDR motor - BiSS-C encoder

14212: DDR motor - EnDat2.2 encoder

14213: DDR motor - SSI encoder

20002: Rotary motor - Pulse-type encoder

14000: Rotary motor - Inovance communication-type 20-bit encoder

14101: Rotary motor - Inovance communication-type 23-bit encoder

14102: Rotary motor - Inovance communication-type 26-bit encoder

14020: Rotary motor - Harmonic 20-bit encoder - 2.5 M baud rate

14021: Rotary motor - Harmonic 17-bit encoder - 2.5 M baud rate

14022: Rotary motor - Harmonic 17-bit encoder - 4 M baud rate

14120: Rotary motor - Nikon 20-bit encoder - 2.5 M baud rate

14121: Rotary motor - Nikon 17-bit encoder - 2.5 M baud rate

14122: Rotary motor - Nikon 17-bit encoder - 4 M baud rate

14130: Rotary motor - TAMAGAWA 17-bit encoder

14131: Rotary motor - TAMAGAWA 23-bit encoder

14140: Rotary motor - EnDat2.2 encoder

14150: Rotary motor - SSI encoder

14160: Rotary motor - BiSS-C encoder

Parameter description

Indicates the corresponding number of each motor type.

H00.02 **Customized No.**

Comm. address:	2000-03h	Effective mode:	-
Min.:	0.00	Unit:	-
Max.:	42949672.95	Data type:	UInt32

Default:	0.00	Change mode:	Read only

Range:
0.00 to 42949672.95
Parameter description
Used to differentiate the customized MCU version, which is not applicable to standard models.

H00.04 **Encoder version**

Comm. address:	2000-05h	Effective mode:	-
Min.:	0.0	Unit:	-
Max.:	6553.5	Data type:	UInt16
Default:	0.0	Change mode:	Read only

Range:
0.0 to 6553.5
Parameter description
This parameter is saved in the encoder and used to differentiate the encoder software version.

H00.05 **Serial-type motor code**

Comm. address:	2000-06h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0 to 65535
Parameter description
Displays the code of the serial-type motor, which is determined by the motor model and unchangeable.

H00.06 **FPGA customized No.**

Comm. address:	2000-07h	Effective mode:	-
Min.:	0.00	Unit:	-
Max.:	655.35	Data type:	UInt16
Default:	0.00	Change mode:	Read only

Range:
0.00 to 655.35
Parameter description
Differentiates the customized FPGA software version, which is not applicable to standard models.

H00.07 **STO version**

Comm. address:	2000-08h	Effective mode:	-
Min.:	0.0	Unit:	-
Max.:	6553.5	Data type:	UInt16
Default:	0.0	Change mode:	Read only

Range:
0.0 to 6553.5
Parameter description
Displays the software version of the STO function.

H00.08 **Serial encoder type**

Comm. address:	2000-09h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
14100: Multi-turn absolute encoder
Others: Single-turn absolute encoder

H00.14 **Rated speed**

Comm. address:	2000-0Fh	Effective mode:	Next power-on
Min.:	50	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	UInt16
Default:	3000	Change mode:	At stop

Range:
50 [mm/s]/[rpm] to 10000 [mm/s]/[rpm]
Parameter description
Defines the rated motor speed.

H00.15 **Maximum speed**

Comm. address:	2000-10h	Effective mode:	Next power-on
Min.:	50	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	UInt16
Default:	6000	Change mode:	At stop

Range:
50 [mm/s]/[rpm] to 10000 [mm/s]/[rpm]
Parameter description
Defines the maximum motor speed.

H00.18 **Stator resistance**

Comm. address:	2000-13h	Effective mode:	Next power-on
Min.:	0.001	Unit:	Ω
Max.:	65.535	Data type:	UInt16
Default:	0.500	Change mode:	At stop

Range:
0.001 Ω to 65.535 Ω

Parameter description
Defines the motor stator resistance.

H00.19 **Stator inductance Lq**

Comm. address:	2000-14h	Effective mode:	Next power-on
Min.:	0.01	Unit:	mH
Max.:	655.35	Data type:	UInt16
Default:	3.27	Change mode:	At stop

Range:
0.01mH to 655.35mH
Parameter description
Defines motor stator inductance Lq.

H00.20 **Stator inductance Ld**

Comm. address:	2000-15h	Effective mode:	Next power-on
Min.:	0.01	Unit:	mH
Max.:	655.35	Data type:	UInt16
Default:	3.87	Change mode:	At stop

Range:
0.01 mH to 655.35 mH
Parameter description
Defines motor stator inductance Ld.

H00.22 **Torque coefficient Kt**

Comm. address:	2000-17h	Effective mode:	Next power-on
Min.:	0.01	Unit:	[N/Arms]/[N·m/Arms]
Max.:	655.35	Data type:	UInt16
Default:	0.51	Change mode:	At stop

Range:
0.01 [N/Arms]/[N·m/Arms] to 655.35 [N/Arms]/[N·m/Arms]
Parameter description
Defines the motor torque coefficient Kt.

H00.40 **Motor control type**

Comm. address:	2000-29h	Effective mode:	/
Min.:	0	Unit:	-
Max.:	3	Data type:	UInt16
Default:	2	Change mode:	Read only

Range:
0: General-purpose rotary motor (ROT)
1: Direct drive rotary motor (DDR)
2: Direct drive linear motor (DDL)
3: Voice coil motor (VOL)
Parameter description

Motor types supported are as follows.
0: General-purpose rotary motor (ROT)
1: Direct drive rotary motor (DDR)
2: Direct drive linear motor (DDL)
3: Voice coil motor (VOL)

H00.41 **Primary encoder configuration**

Comm. address:	2000-2Ah	Effective mode:	-
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	1	Change mode:	Read only

Range:
0: CN2
1: CN7
Parameter description
Defines the primary encoder connection terminal.

H00.43 **Number of BiSS-C/SSI/EnData 2.2 data bits**

Comm. address:	2000-2Ch	Effective mode:	Next power-on
Min. value:	0	Unit:	-
Max. value:	40	Data type:	UInt16
Default value:	32	Change mode:	At stop

Value range:
0 to 40
Parameter description
Defines the length of the data configured based on the BiSS-C/SSI/EnDat2.2 protocol. For rotary motors, set both the total position data length and the single-turn data length. For linear motors, you only need to set the total position data length.

H00.44 **Number of BiSS-C/SSI status word bits**

Comm. address:	2000-2Dh	Effective mode:	Next power-on
Min. value:	0	Unit:	-
Max. value:	31	Data type:	UInt16
Default value:	2	Change mode:	At stop

Value range:
0 to 31
Parameter description
Defines the length of the status word configured based on the BiSS-C/SSI protocol.

H00.45 **Encoder pitch 1**

Comm. address:	2000-2Eh	Effective mode:	Next power-on
Min.:	0.00	Unit:	[mm]/[deg]
Max.:	655.35	Data type:	UInt16
Default:	2.00	Change mode:	At stop

Range:

0.00 [mm]/[deg] to 655.35 [mm]/[deg]

Parameter description

Defines the encoder pitch characteristics, which should be used together with encoder pitch fluctuation suppressor 1 (see details in H08.90).

H00.46 Encoder pitch 2

Comm. address:	2000-2Fh	Effective mode:	Next power-on
Min.:	0.00	Unit:	[mm]/[deg]
Max.:	655.35	Data type:	UInt16
Default:	0.50	Change mode:	At stop

Range:

0.00 [mm]/[deg] to 655.35 [mm]/[deg]

Parameter description

Defines the encoder pitch characteristics, which should be used together with encoder pitch fluctuation suppressor 2 (see details in H08.90).

H00.47 Encoder type

Comm. address:	2000-30h	Effective mode:	Next power-on
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: Optical scale

1: Magnetic scale

Parameter description

Pulse encoder type:

0: Optical scale

1: Magnetic scale

H00.48 Linear motor pole pitch (N-S)

Comm. address:	2000-31h	Effective mode:	Next power-on
Min.:	0.01	Unit:	mm
Max.:	655.35	Data type:	UInt16
Default:	16.00	Change mode:	At stop

Range:

0.01 mm to 655.35 mm

Parameter description

Defines the distance between N-S of the linear motor.

H00.49 Direct drive motor encoder resolution

Comm. address:	2000-32h	Effective mode:	Next power-on
Min.:	0.001	Unit:	um/p
Max.:	65.535	Data type:	UInt16

Default:	1.000	Change mode:	At stop

Range:
0.001 um/p to 65.535 um/p
Parameter description
Defines the resolution of the linear motor read head.

H00.54 **Bit inversion of BiSS-C CRC check value/SSI parity selection**

Comm. address:	2000-37h	Effective mode:	Next power-on
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	1	Change mode:	At stop

Value range:
0 to 1
Parameter description
BiSS-C:

0: CRC check value not inverted by bit

1: CRC check value inverted by bit

SSI:

0: Even parity

1: Odd parity

H00.55 **Rated torque (Uint32)**

Comm. address:	2000-38h	Effective mode:	Next power-on
Min.:	0.00	Unit:	[N]/[N·m]
Max.:	42949672.95	Data type:	UInt32
Default:	2.00	Change mode:	At stop

Range:
0.00 [N]/[N·m] to 42949672.95 [N]/[N·m]
Parameter description
Defines the rated motor torque.

H00.57 **Maximum torque (Uint32)**

Comm. address:	2000-3Ah	Effective mode:	Next power-on
Min.:	0.00	Unit:	[N]/[N·m]
Max.:	42949672.95	Data type:	UInt32
Default:	7.00	Change mode:	At stop

Range:
0.00 [N]/[N·m] to 42949672.95 [N]/[N·m]
Parameter description
Defines the maximum motor torque.

H00.59 **Encoder counting direction**

Comm. address:	2000-3Ch	Effective mode:	Next power-on
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: Forward

1: Reverse

Parameter description

Motor phase sequence:

0: Forward

1: Reverse

H00.63 **Maximum current (Uint32)**

Comm. address:	2000-40h	Effective mode:	Next power-on
Min.:	0.00	Unit:	A
Max.:	42949672.95	Data type:	UInt32
Default:	3.00	Change mode:	At stop

Range:

0.00 A to 42949672.95 A

Parameter description

Defines the maximum current.

H00.65 **Rated current (Uint32)**

Comm. address:	2000-42h	Effective mode:	Next power-on
Min.:	0.00	Unit:	A
Max.:	42949672.95	Data type:	UInt32
Default:	1.00	Change mode:	At stop

Range:

0.00 A to 42949672.95 A

Parameter description

Defines the rated current.

H00.67 **Moment of inertia (Uint32)**

Comm. address:	2000-44h	Effective mode:	Next power-on
Min.:	0.00000	Unit:	[g]/[0.00001kg·cm²]
Max.:	42949.67295	Data type:	UInt32
Default:	0.00001	Change mode:	At stop

Range:

0.00000 [g]/[0.00001kg·cm²] to 42949.67295 [g]/[0.00001kg·cm²]

Parameter description

Defines the moment of inertia.

H00.69 **Linear back EMF coefficient (Uint32)**

Comm. address:	2000-46h	Effective mode:	Next power-on
Min.:	0.00	Unit:	[V/(m/s)]/[100mV/rpm]
Max.:	42949672.95	Data type:	UInt32
Default:	33.00	Change mode:	At stop

Range:

0.00 [V/(m/s)]/[100mV/rpm] to 42949672.95 [V/(m/s)]/[100mV/rpm]

Parameter description

Defines the linear back EMF coefficient.

10.2 H01 Drive Parameters

H01.00 **MCU software version**

Comm. address:	2001-01h	Effective mode:	-
Min.:	0.0	Unit:	-
Max.:	6553.5	Data type:	UInt16
Default:	0.0	Change mode:	Read only

Range:

0.0 to 6553.5

Parameter description

Displays the MCU software version.

H01.01 **FPGA software version**

Comm. address:	2001-02h	Effective mode:	-
Min.:	0.0	Unit:	-
Max.:	6553.5	Data type:	UInt16
Default:	0.0	Change mode:	Read only

Range:

0.0 to 6553.5

Parameter description

Displays the FPGA software version.

H01.02 **Servo drive series No.**

Comm. address:	2001-03h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:

0 to 65535

Parameter description

Displays the servo drive series.

H01.06 **Board card software version**

Comm. address:	2001-07h	Effective mode:	-
Min.:	0.0	Unit:	-
Max.:	6553.5	Data type:	UInt16
Default:	0.0	Change mode:	Read only

Range:

0.0 to 6553.5

Parameter description

Displays the board card software version.

H01.10 **Drive series No.**

Comm. address:	2001-0Bh	Effective mode:	Next power-on
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	3	Change mode:	At stop

Range:

2: S1R6

3: S2R8

5: S5R5

6: S7R6

7: S012

8: S018

9: S022

10: S027

10001: T3R5

10002: T5R4

10003: T8R4

10004: T012

10005: T017

10006: T021

10007: T026

10029: T1R4

10031: T2R3

Parameter description

Displays the drive series No.

H01.11 **DC-AC voltage class**

Comm. address:	2001-0Ch	Effective mode:	-
Min.:	0	Unit:	V
Max.:	65535	Data type:	UInt16
Default:	220	Change mode:	Read only

Range:

0 V to 65535 V

Parameter description
Displays the DC-AC voltage class.

H01.12 **Rated power of the drive**

Comm. address:	2001-0Dh	Effective mode:	-
Min.:	0.00	Unit:	kW
Max.:	42949672.95	Data type:	UInt32
Default:	0.40	Change mode:	Read only

Range:
0.00 kW to 42949672.95 kW
Parameter description
Displays the rated power of the drive.

H01.14 **Maximum output power of the drive**

Comm. address:	2001-0Fh	Effective mode:	-
Min.:	0.00	Unit:	kW
Max.:	42949672.95	Data type:	UInt32
Default:	0.40	Change mode:	Read only

Range:
0.00 kW to 42949672.95 kW
Parameter description
Displays the maximum output power of the drive.

H01.16 **Rated output current of the drive**

Comm. address:	2001-11h	Effective mode:	-
Min.:	0.00	Unit:	A
Max.:	42949672.95	Data type:	UInt32
Default:	2.80	Change mode:	Read only

Range:
0.00 A to 42949672.95 A
Parameter description
Defines the rated output current of the drive.

H01.18 **Maximum output current of the drive**

Comm. address:	2001-13h	Effective mode:	-
Min.:	0.00	Unit:	A
Max.:	42949672.95	Data type:	UInt32
Default:	10.10	Change mode:	Read only

Range:
0.00 A to 42949672.95 A
Parameter description
Displays the maximum output current of the drive.

H01.40 **DC bus overvoltage protection threshold**

Comm. address:	2001-29h	Effective mode:	Real time
Min.:	0	Unit:	V
Max.:	2000	Data type:	UInt16
Default:	420	Change mode:	Real time

Range:

0 V to 2000 V

Parameter description

Displays DC bus overvoltage protection threshold.

H01.75 **Current loop scaling factor**

Comm. address:	2001-4Ch	Effective mode:	Real time
Min.:	0.00	Unit:	-
Max.:	655.35	Data type:	UInt16
Default:	1.00	Change mode:	Real time

Range:

0.00 to 655.35

Parameter description

Defines the current loop scaling factor.

H01.88 **Junction temperature parameter version 1**

Comm. address:	2001-59h	Effective mode:	-
Min.:	0.0	Unit:	-
Max.:	6553.5	Data type:	UInt16
Default:	0.0	Change mode:	Read only

Range:

0.0 to 6553.5

Parameter description

Displays the version 1 of the junction temperature parameter.

H01.89 **Junction temperature parameter version 2**

Comm. address:	2001-5Ah	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:

0 to 65535

Parameter description

Displays version 2 of the junction temperature parameter.

H01.90 **Motor attribute mask code**

Comm. address:	2001-5Bh	Effective mode:	Next power-on
Min. value:	0	Unit:	-

Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Parameter description
The setpoint 1 indicates that the bit function of H00.60 is being masked.

10.3 H02 Basic Control Parameters

H02.00 **Control mode selection**

Comm. address:	2002-01h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	9	Data type:	UInt16
Default:	9	Change mode:	At stop

Range:
0: Speed control mode
1: Position control mode
2: Torque control mode
7: Process segment mode
9: EtherCAT mode
Parameter description
0: Speed control mode
1: Position control mode
2: Torque control mode
7: Process segment mode
9: EtherCAT mode

H02.01 **Absolute system selection**

Comm. address:	2002-02h	Effective mode:	Next power-on
Min.:	0	Unit:	-
Max.:	4	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0: Incremental mode
1: Absolute position linear mode
2: Absolute position rotation mode
3: Absolute position linear mode (without encoder overflow alarm)
4: Absolute position single-turn mode
Parameter description

Defines the absolute encoder system mode.
0: Incremental mode
1: Absolute position linear mode
2: Absolute position rotation mode
3: Absolute position linear mode (without encoder overflow alarm)
4: Absolute position single-turn mode

H02.02 **Rotation direction selection**

Comm. address:	2002-03h	Effective mode:	Next power-on
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0: Counterclockwise (CCW) as forward direction
1: Clockwise (CW) as forward direction
Parameter description
Defines the forward direction of the motor when viewed from the motor shaft side.
0: Counterclockwise (CCW) as forward direction
1: Clockwise (CW) as forward direction

H02.03 **Output pulse phase**

Comm. address:	2002-04h	Effective mode:	Next power-on
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0: Phase A leads phase B
1: Phase A lags behind phase B
Parameter description
Defines the relation between phase A and phase B on the condition that the motor direction of rotation remains unchanged when pulse output is enabled.
0: Phase A leads phase B
1: Phase A lags behind phase B

H02.05 **Stop mode at S-ON OFF**

Comm. address:	2002-06h	Effective mode:	At stop
Min.:	-4	Unit:	-
Max.:	2	Data type:	Int16
Default:	0	Change mode:	Real time

Range:

-4: Ramp to stop as defined by 6085h, keeping dynamic braking state
-3: Stop at zero speed, keeping dynamic braking state
-2: Ramp to stop as defined by 6084h/609Ah (HM), keeping dynamic braking state
-1: Dynamic braking stop, keeping dynamic braking state
0: Coast to stop, keeping de-energized state
1: Ramp to stop as defined by 6084h/609Ah (HM), keeping de-energized state
2: Dynamic braking stop, keeping de-energized state

Parameter description

Defines the deceleration mode of the motor for stopping rotating upon S-ON OFF and the motor status after stop.

-4: Ramp to stop as defined by 6085h, keeping dynamic braking state
-3: Stop at zero speed, keeping dynamic braking state
-2: Ramp to stop as defined by 6084h/609Ah (HM), keeping dynamic braking state
-1: Dynamic braking stop, keeping dynamic braking state
0: Coast to stop, keeping de-energized state
1: Ramp to stop as defined by 6084h/609Ah (HM), keeping de-energized state
2: Dynamic braking stop, keeping dynamic braking state

Note: After the brake is enabled, H02.05 will be set to "-4: Ramp to stop as defined by 6085h, keeping dynamic braking state".

H02.06 **Stop mode at No. 2 fault**

Comm. address:	2002-07h	Effective mode:	At stop
Min.:	-5	Unit:	-
Max.:	4	Data type:	Int16
Default:	2	Change mode:	Real time

Range:

-5: Stop at zero speed, keeping dynamic braking state
-4: Stop at emergency stop torque, keeping dynamic braking state
-3: Ramp to stop as defined by 6085h, keeping dynamic braking state
-2: Ramp to stop as defined by 6084h/ 609Ah (HM), keeping dynamic braking state
-1: Dynamic braking stop, keeping dynamic braking state
0: Coast to stop, keeping de-energized state
1: Ramp to stop as defined by 6084h/ 609Ah (HM), keeping de-energized state
2: Ramp to stop as defined by 6085h, keeping de-energized state
3: Stop at emergency stop torque, keeping de-energized state
4: Dynamic braking stop, keeping de-energized state

Parameter description

Defines the deceleration mode of the servo motor for stopping rotating and the servo motor status when a No. 2 fault occurs.

-5: Stop at zero speed, keeping dynamic braking state
-4: Stop at emergency stop torque, keeping dynamic braking state
-3: Ramp to stop as defined by 6085h, keeping dynamic braking state
-2: Ramp to stop as defined by 6084h/609Ah (HM), keeping dynamic braking state

-1: Dynamic braking stop, keeping dynamic braking state
0: Coast to stop, keeping de-energized state
1: Ramp to stop as defined by 6084h/609Ah (HM), keeping de-energized state
2: Ramp to stop as defined by 6085h, keeping de-energized state
3: Stop at emergency stop torque, keeping de-energized state
4: Dynamic braking stop, keeping the de-energized state
Note: After the brake is enabled, H02.06 will be set to "-3: Ramp to stop as defined by 6085h, keeping dynamic braking state".

H02.07 **Stop mode at overtravel**

Comm. address:	2002-08h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	7	Data type:	UInt16
Default:	1	Change mode:	At stop

Range:
0: Coast to stop, keeping de-energized state
1: Stop at zero speed, keeping position lock state
2: Stop at zero speed, keeping de-energized state
3: Ramp to stop as defined by 6085h, keeping de-energized state
4: Ramp to stop as defined by 6085h, keeping position lock state
5: Dynamic braking stop, keeping de-energized state
6: Dynamic braking stop, keeping dynamic braking state
7: Not responding to overtravel
Parameter description
Defines the deceleration mode of the servo motor for stopping rotating and the servo motor status when overtravel occurs.
0: Coast to stop, keeping de-energized state
1: Stop at zero speed, keeping position lock state
2: Stop at zero speed, keeping de-energized state
3: Stop based on the ramp defined by 6085h, keeping de-energized state
4: Stop based on the ramp defined by 6085h keeping position lock state 5: Dynamic braking stop, keeping de-energized state
6: Dynamic braking stop, keeping dynamic braking state
7: Not responding to overtravel
Note: Set H02.07 to 7. After hitting the limit signal, some PLC can stop sending position references even if the drive does not respond, so the drive may stop.
Note: After the brake function is enabled, H02.07 will be forcibly set to “4: Ramp to stop as defined by 6085h, keeping position lock state” .

H02.08 **Stop mode at No. 1 fault**

Comm. address:	2002-09h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	2	Data type:	UInt16
Default:	2	Change mode:	At stop

Range:

0: Coast to stop, keeping de-energized state

1: Dynamic braking stop, keeping de-energized state

2: Dynamic braking stop, keeping dynamic braking state

Parameter description

Defines the deceleration mode of the servo motor for stopping rotating and the servo motor status when a No. 1 fault occurs.

0: Coast to stop, keeping de-energized state

1: Dynamic braking stop, keeping de-energized state

2: Dynamic braking stop, keeping dynamic braking state

Note: After the brake is enabled, H02.08 will be set to 2 (Dynamic braking stop, keeping dynamic braking state) forcibly.

H02.09 Delay from brake output ON to command received

Comm. address:	2002-0Ah	Effective mode:	At stop
Min.:	0	Unit:	ms
Max.:	500	Data type:	UInt16
Default:	250	Change mode:	Real time

Range:

0 ms to 500 ms

Parameter description

Defines the delay from the moment the brake output signal is ON to the moment the servo drive starts to receive commands after power-on.

H02.10 Delay from brake output OFF to motor de-energized

Comm. address:	2002-0Bh	Effective mode:	Real time
Min.:	50	Unit:	ms
Max.:	1000	Data type:	UInt16
Default:	150	Change mode:	Real time

Range:

50 ms to 1000 ms

Parameter description

Defines the delay from the moment brake output is OFF to the moment when the motor at standstill enters the de-energized status.

H02.11 Motor speed threshold at brake output OFF in rotation state

Comm. address:	2002-0Ch	Effective mode:	Real time
Min.:	20	Unit:	[mm/s]/[rpm]
Max.:	3000	Data type:	UInt16
Default:	30	Change mode:	Real time

Range:

20 [mm/s]/[rpm] to 3000 [mm/s]/[rpm]

Parameter description

Defines the motor speed threshold when brake (BK) output is OFF in the rotating state.

H02.12 **Delay from S-ON OFF to brake output OFF in rotation state**

Comm. address:	2002-0Dh	Effective mode:	Real time
Min.:	1	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	500	Change mode:	Real time

Range:

1 ms to 65535 ms

Parameter description

Defines the delay time from BK OFF to S-ON OFF when the motor is in the rotating state.

H02.15 **LED alarm display**

Comm. address:	2002-10h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Output alarm information immediately

1: Not output alarm information

Parameter description

Defines whether to switch the keypad to the fault display mode when a No. 3 fault occurs.

0: Output alarm information immediately

1: Not output alarm information

H02.16 **Brake switch**

Comm. address:	2002-11h	Effective mode:	At stop
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0: OFF

1: ON

Parameter description

Turns on or off the brake function.

0: OFF

1: ON

When bit0 of parameter H00.60 is set to 1 (Motor supports brake), H00.98 ≥ A502, and the drive model supports the built-in brake, parameter H02.16 will be automatically set to 1. In this case, you can set H02.16 to enable or disable the brake.

If any of the preceding three conditions is not met, H02.16 is forcibly set to 0.

H02.17 **Stop mode upon main circuit power failure**

Comm. address:	2002-12h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	3	Data type:	UInt16

Default:	2	Change mode:	Real time

Range:

0: Keep current action

1: Stop upon fault as defined by H02.06

2: Stop at S-ON OFF as defined by H02.05

3: Stop quickly as defined by H02.18

Parameter description

Defines the stop mode of the motor for stopping rotating upon main circuit power failure.

0: Keep current action

1: Stop upon fault as defined by H02.06

2: Stop at S-ON OFF as defined by H02.05

3: Stop quickly as defined by H02.18

H02.18 Quick stop mode

Comm. address:	2002-13h	Effective mode:	At stop
Min.:	0	Unit:	-
Max.:	7	Data type:	UInt16
Default:	2	Change mode:	Real time

Range:

0: Coast to stop, keeping de-energized state

1: Ramp to stop as defined by 6084h/609Ah (HM), keeping de-energized state

2: Ramp to stop as defined by 6085h, keeping de-energized state

3: Stop at emergency stop torque, keeping de-energized state

5: Ramp to stop as defined by 6084h/609Ah (HM), keeping position lock state

6: Ramp to stop as defined by 6085h, keeping position lock state

7: Stop at emergency stop torque, keeping position lock state

Parameter description

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

0: Coast to stop, keeping de-energized state

1: Ramp to stop as defined by 6084h/609Ah (HM), keeping de-energized state

2: Ramp to stop as defined by 6085h, keeping de-energized state

3: Stop at emergency stop torque, keeping de-energized state

5: Ramp to stop as defined by 6084h/609Ah (HM), keeping position lock state

6: Ramp to stop as defined by 6085h, keeping position lock state

7: Stop at emergency stop torque, keeping position lock state

Note: If the setpoint of H02.18 is lower than 4 after the brake is enabled, 605Ah will be set to 2 forcibly.

H02.21 Permissible minimum resistance of braking resistor

Comm. address:	2002-16h	Effective mode:	-
Min.:	1	Unit:	Ω
Max.:	1000	Data type:	UInt16
Default:	40	Change mode:	Read only

Range:
1 Ω to 1000 Ω
Parameter description
The permissible minimum resistance of the braking resistor is only related to the servo drive model.

H02.22 **Power of built-in braking resistor**

Comm. address:	2002-17h	Effective mode:	-
Min.:	0	Unit:	W
Max.:	65535	Data type:	UInt16
Default:	50	Change mode:	Read only

Range:
0 W to 65535 W
Parameter description
The power of the built-in braking resistor is only related to the drive model, which cannot be changed.

H02.23 **Resistance of built-in braking resistor**

Comm. address:	2002-18h	Effective mode:	-
Min.:	0	Unit:	Ω
Max.:	65535	Data type:	UInt16
Default:	50	Change mode:	Read only

Range:
0 Ω to 65535 Ω
Parameter description
The resistance of the built-in braking resistor is only related to the drive model, which cannot be changed.

H02.24 **Resistor heat dissipation coefficient**

Comm. address:	2002-19h	Effective mode:	Real time
Min.:	10	Unit:	%
Max.:	100	Data type:	UInt16
Default:	30	Change mode:	Real time

Range:
10% to 100%
Parameter description
Defines the heat dissipation coefficient of the braking resistor, which is applicable to both external and built-in braking resistors.
Set this parameter properly according to actual heat dissipation conditions of the resistor.
Recommendations:
Generally, the value of H02.24 cannot exceed 30% for natural cooling.
The setpoint of H02.24 cannot exceed 50% for forced air cooling.

H02.25 **Braking resistor type**

Comm. address:	2002-1Ah	Effective mode:	Real time

Min.:	0	Unit:	-
Max.:	3	Data type:	UInt16
Default:	3	Change mode:	Real time

Range:

0: Built-in

1: External, natural cooling

2: External, fan cooling

3: No resistor needed

Parameter description

Defines the resistor type and the mode for absorbing and releasing the braking energy.

0: Built-in

1: External, natural cooling

2: External, fan cooling

3: No resistor needed

H02.26 **Power of external braking resistor**

Comm. address:	2002-1Bh	Effective mode:	Real time
Min.:	1	Unit:	W
Max.:	65535	Data type:	UInt16
Default:	40	Change mode:	Real time

Range:

1 to 65535

Parameter description

Defines the power of external braking resistor.

H02.27 **Resistance of external braking resistor**

Comm. address:	2002-1Ch	Effective mode:	Real time
Min.:	15	Unit:	Ω
Max.:	1000	Data type:	UInt16
Default:	50	Change mode:	Real time

Range:

15 Ω to 1000 Ω

Parameter description

Defines the resistance of the external braking resistor.

H02.28 **Parameter initialization**

Comm. address:	2002-1Dh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	2	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: Parameters in group H02 and above initialized

1: Parameters in group H00, H02 and above initialized

2: All parameters initialized (default values used for model-related parameters)

Parameter description

Used to set the option for restoring default settings.

0: Parameters in group H02 and above initialized

1: Parameters in group H00, H02 and above initialized

2: All parameters initialized (default values used for model-related parameters)

H02.30 **User password**

Comm. address:	2002-1Fh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0 to 65535

Parameter description

Defines the user password.

H02.31 **System parameter initialization**

Comm. address:	2002-20h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	2	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: No operation

1: Restore default settings

2: Clear fault records

Parameter description

Used to restore default values or clear fault records.

0: No operation

1: Restore default settings

2: Clear fault records

H02.32 **Selection of parameters in group H0b**

Comm. address:	2002-21h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	99	Data type:	UInt16
Default:	50	Change mode:	Real time

Range:

0 to 99

Parameter description

Defines the offset of the parameter to be displayed on the operating panel.

For example, the setpoint 0 indicates the value of H0b.00 (Motor speed actual value) is displayed on the keypad.

The setpoint 1 indicates the value of H0b.01 is displayed on the operating panel.

H02.35 **Operating panel data refresh frequency**

Comm. address:	2002-24h	Effective mode:	Real time
Min.:	0	Unit:	Hz
Max.:	20	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:
0 Hz to 20 Hz
Parameter description
Defines the keypad data refresh frequency.

H02.38 **Overload time of external resistor**

Comm. address:	2002-27h	Effective mode:	Next power-on
Min.:	0	Unit:	s
Max.:	200	Data type:	UInt16
Default:	40	Change mode:	Real time

Range:
0s to 200s
Parameter description
Defines the overload time threshold of the external braking resistor.

H02.41 **Manufacturer password**

Comm. address:	2002-2Ah	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:
0 to 65535
Parameter description
Enter the manufacturer password to enable the manufacturer protection parameters.

H02.47 **Delay time from power cable disconnection to brake OFF**

Comm. address:	2002-30h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	1000	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:
0 ms to 1000 ms
Parameter description
Defines the delay time from power cable disconnection to brake OFF.

10.4 H03 Terminal Input Parameters

H03.02 **DI1 function selection**

Comm. address:	2003-03h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	59	Data type:	UInt16
Default value:	14	Change mode:	Real time

Range:

0: No assignment
1: Servo ON
2: Alarm reset signal
5: Multi-reference direction
6: Multi-reference switchover CMD1
7: Multi-reference switchover CMD2
8: Multi-reference switchover CMD3
9: Multi-reference switchover CMD4
14: Positive limit switch
15: Negative limit switch
16: Positive external torque limit
17: Negative external torque limit
18: Forward jog
19: Reverse jog
24: Electronic gear ratio selection
28: Multi-position reference selection
31: Home switch
34: Emergency stop
36: Internal speed limit
38: Probe 1
39: Probe 2
40: Enable multi-speed
46: Enable process segment
47: Process segment reference switchover 1
48: Process segment reference switchover 2
49: Process segment reference switchover 3
50: Process segment reference switchover 4
51: Event-triggered process segment 1
52: Event-triggered process segment 2
53: Event-triggered process segment 3
54: Event-triggered process segment 4
55: Pause process segment
56: Gantry torque alignment
57: Enable gantry DI alignment
58: Clear gantry DI alignment
59: Enable gantry synchronization

Parameter Description

Defines the function of DI1.

H03.03 **DI1 logic selection**

Comm. address:	2003-04h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Normally open

1: Closed

Parameter Description

Defines the level logic of DI1 when the function assigned to DI1 is active.

H03.04 **DI2 function selection**

Comm. address:	2003-05h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	59	Data type:	UInt16
Default value:	15	Change mode:	Real time

Range:

0: No assignment
1: Servo ON
2: Alarm reset signal
5: Multi-reference direction
6: Multi-reference switchover CMD1
7: Multi-reference switchover CMD2
8: Multi-reference switchover CMD3
9: Multi-reference switchover CMD4
14: Positive limit switch
15: Negative limit switch
16: Positive external torque limit
17: Negative external torque limit
18: Forward jog
19: Reverse jog
24: Electronic gear ratio selection
28: Multi-position reference selection
31: Home switch
34: Emergency stop
36: Internal speed limit
38: Probe 1
39: Probe 2
40: Enable multi-speed
46: Enable process segment
47: Process segment reference switchover 1
48: Process segment reference switchover 2
49: Process segment reference switchover 3
50: Process segment reference switchover 4
51: Event-triggered process segment 1
52: Event-triggered process segment 2
53: Event-triggered process segment 3
54: Event-triggered process segment 4
55: Pause process segment
56: Gantry torque alignment
57: Enable gantry DI alignment
58: Clear gantry DI alignment
59: Enable gantry synchronization

Parameter Description

Defines the function of DI2.

H03.05 **DI2 logic selection**

Comm. address:	2003-06h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Normally open

1: Closed

Parameter Description

Defines the level logic of DI2 when the function assigned to DI2 is active.

H03.06 **DI3 function selection**

Comm. address:	2003-07h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	59	Data type:	UInt16
Default value:	31	Change mode:	Real time

Range:

0: No assignment
1: Servo ON
2: Alarm reset signal
5: Multi-reference direction
6: Multi-reference switchover CMD1
7: Multi-reference switchover CMD2
8: Multi-reference switchover CMD3
9: Multi-reference switchover CMD4
14: Positive limit switch
15: Negative limit switch
16: Positive external torque limit
17: Negative external torque limit
18: Forward jog
19: Reverse jog
24: Electronic gear ratio selection
28: Multi-position reference selection
31: Home switch
34: Emergency stop
36: Internal speed limit
38: Probe 1
39: Probe 2
40: Enable multi-speed
46: Enable process segment
47: Process segment reference switchover 1
48: Process segment reference switchover 2
49: Process segment reference switchover 3
50: Process segment reference switchover 4
51: Event-triggered process segment 1
52: Event-triggered process segment 2
53: Event-triggered process segment 3
54: Event-triggered process segment 4
55: Pause process segment
56: Gantry torque alignment
57: Enable gantry DI alignment
58: Clear gantry DI alignment
59: Enable gantry synchronization

Parameter Description

Defines the function of DI3.

H03.07 **DI3 logic selection**

Comm. address:	2003-08h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Normally open

1: Closed

Parameter Description

Defines the level logic of DI3 when the function assigned to DI3 is active.

H03.08 **DI4 function selection**

Comm. address:	2003-09h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	59	Data type:	UInt16
Default value:	34	Change mode:	Real time

Range:

0: No assignment
1: Servo ON
2: Alarm reset signal
5: Multi-reference direction
6: Multi-reference switchover CMD1
7: Multi-reference switchover CMD2
8: Multi-reference switchover CMD3
9: Multi-reference switchover CMD4
14: Positive limit switch
15: Negative limit switch
16: Positive external torque limit
17: Negative external torque limit
18: Forward jog
19: Reverse jog
24: Electronic gear ratio selection
28: Multi-position reference selection
31: Home switch
34: Emergency stop
36: Internal speed limit
38: Probe 1
39: Probe 2
40: Enable multi-speed
46: Enable process segment
47: Process segment reference switchover 1
48: Process segment reference switchover 2
49: Process segment reference switchover 3
50: Process segment reference switchover 4
51: Event-triggered process segment 1
52: Event-triggered process segment 2
53: Event-triggered process segment 3
54: Event-triggered process segment 4
55: Pause process segment
56: Gantry torque alignment
57: Enable gantry DI alignment
58: Clear gantry DI alignment
59: Enable gantry synchronization

Parameter Description

Defines the function of DI4.

H03.09 **DI4 logic selection**

Comm. address:	2003-0Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Normally open

1: Closed

Parameter Description

Defines the level logic of DI4 when the function assigned to DI4 is active.

H03.10 **DI5 function selection**

Comm. address:	2003-0Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	59	Data type:	UInt16
Default value:	38	Change mode:	Real time

Range:

0: No assignment
1: Servo ON
2: Alarm reset signal
5: Multi-reference direction
6: Multi-reference switchover CMD1
7: Multi-reference switchover CMD2
8: Multi-reference switchover CMD3
9: Multi-reference switchover CMD4
14: Positive limit switch
15: Negative limit switch
16: Positive external torque limit
17: Negative external torque limit
18: Forward jog
19: Reverse jog
24: Electronic gear ratio selection
28: Multi-position reference selection
31: Home switch
34: Emergency stop
36: Internal speed limit
38: Probe 1
39: Probe 2
40: Enable multi-speed
46: Enable process segment
47: Process segment reference switchover 1
48: Process segment reference switchover 2
49: Process segment reference switchover 3
50: Process segment reference switchover 4
51: Event-triggered process segment 1
52: Event-triggered process segment 2
53: Event-triggered process segment 3
54: Event-triggered process segment 4
55: Pause process segment
56: Gantry torque alignment
57: Enable gantry DI alignment
58: Clear gantry DI alignment
59: Enable gantry synchronization

Parameter Description

Defines the function of DI5. The touch probe function is supported only by DI5 (high-speed DI).

H03.11 **DI5 logic selection**

Comm. address:	2003-0Ch	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Normally open

1: Closed

Parameter Description

Defines the level logic of DI5 when the function assigned to DI5 is active.

H03.50 **Voltage-type AI1 offset**

Comm. address:	2003-33h	Effective mode:	Real time
Min. value:	-5000	Unit:	mV
Max. value:	5000	Data type:	Int16
Default value:	0	Change mode:	Real time

Range:

-5000 mV to 5000 mV

Parameter Description

Defines the actual AI1 input voltage when the drive sampling voltage is 0 after zero drift correction.

H03.51 **Voltage-type AI1 input filter time constant**

Comm. address:	2003-34h	Effective mode:	Real time
Min. value:	0.00	Unit:	ms
Max. value:	655.35	Data type:	UInt16
Default value:	2.00	Change mode:	Real time

Range:

0.00 ms to 655.35 ms

Parameter Description

Defines the filter time constant of voltage signal input from AI1.

Set this parameter properly to avoid motor reference fluctuation caused by unstable analog voltage input and reduce motor misoperation caused by interference signals.

The filter function cannot eliminate or suppress zero drift or dead zone.

H03.53 **Voltage-type AI1 dead zone**

Comm. address:	2003-36h	Effective mode:	Real time
Min. value:	0.0	Unit:	mV
Max. value:	1000.0	Data type:	UInt16
Default value:	10.0	Change mode:	Real time

Range:

0.0 mV to 1000.0 mV

Parameter Description

Defines the AI1 input voltage range when the drive sampling voltage is 0.

H03.54 **Voltage-type AI1 zero drift**

Comm. address:	2003-37h	Effective mode:	Real time
Min. value:	-500.0	Unit:	mV
Max. value:	500.0	Data type:	Int16
Default value:	0.0	Change mode:	Real time

Range:
-500.0 mV to 500.0 mV
Parameter Description
Zero drift refers to the value of the drive o sampling voltage relative to GND upon zero AI voltage.
Set H0d.10 (Automatic adjustment of analog channels) to 1 to perform automatic adjustment on AI2 zero drift. The AI2 zero drift after adjustment is saved to H03.54.

H03.55 Voltage-type AI2 offset

Comm. address:	2003-38h	Effective mode:	Real time
Min. value:	-5000	Unit:	mV
Max. value:	5000	Data type:	Int16
Default value:	0	Change mode:	Real time

Range:
-5000 mV to 5000 mV
Parameter Description
Defines the actual AI2 input voltage when the drive sampling voltage is 0 after zero drift correction.

H03.56 Voltage-type AI2 input filter time constant

Comm. address:	2003-39h	Effective mode:	Real time
Min. value:	0.00	Unit:	ms
Max. value:	655.35	Data type:	UInt16
Default value:	2.00	Change mode:	Real time

Range:
0.00 ms to 655.35 ms
Parameter Description
Defines the filter time constant of voltage signal input from AI2.
Set this parameter properly to avoid motor reference fluctuation caused by unstable analog voltage input and reduce motor misoperation caused by interference signals.
The filter function cannot eliminate or suppress zero drift or dead zone.

H03.58 Voltage-type AI2 dead zone

Comm. address:	2003-3Bh	Effective mode:	Real time
Min. value:	0.0	Unit:	mV
Max. value:	1000.0	Data type:	UInt16
Default value:	10.0	Change mode:	Real time

Range:
0.0 mV to 1000.0 mV
Parameter Description
Defines the AI2 input voltage range when the drive sampling voltage is 0.

H03.59 Voltage-type AI2 zero drift

Comm. address:	2003-3Ch	Effective mode:	Real time
Min. value:	-500.0	Unit:	mV

Max. value:	500.0	Data type:	Int16
Default value:	0.0	Change mode:	Real time

Range:
-500.0 mV to 500.0 mV
Parameter Description
Zero drift refers to the value of the drive o sampling voltage relative to GND upon zero AI voltage.
Set H0d.10 (Automatic adjustment of analog channels) to 2 (AI2 adjustment) to perform automatic adjustment of AI2 zero drift. The adjusted AI2 zero drift will be saved in H03.59.

H03.60 **DI1 filter time**

Comm. address:	2003-3Dh	Effective mode:	Real time
Min. value:	0.00	Unit:	ms
Max. value:	500.00	Data type:	UInt16
Default value:	3.00	Change mode:	Real time

Range:
0.00 ms to 500.00 ms
Parameter Description
Defines the filter time of DI1. The DI function is active only after the effective level is kept within the time defined by H03.60.

H03.61 **DI2 fitter time**

Comm. address:	2003-3Eh	Effective mode:	Real time
Min. value:	0.00	Unit:	ms
Max. value:	500.00	Data type:	UInt16
Default value:	3.00	Change mode:	Real time

Range:
0.00 ms to 500.00 ms
Parameter Description
Defines the filter time of DI2. The DI function is active only after the effective level is kept within the time defined by H03.61.

H03.62 **DI3 filter time**

Comm. address:	2003-3Fh	Effective mode:	Real time
Min. value:	0.00	Unit:	ms
Max. value:	500.00	Data type:	UInt16
Default value:	3.00	Change mode:	Real time

Range:
0.00 ms to 500.00 ms
Parameter Description
Defines the filter time of DI3. The DI function is active only after the effective level is kept within the time defined by H03.62.

H03.63 **DI4 fitter time**

Comm. address:	2003-40h	Effective mode:	Real time
Min. value:	0.00	Unit:	ms
Max. value:	500.00	Data type:	UInt16
Default value:	3.00	Change mode:	Real time

Range:
0.00 ms to 500.00 ms
Parameter Description
Defines the filter time of DI4. The DI function is active only after the effective level is kept within the time defined by H03.63.

H03.64 **DI5 filter time**

Comm. address:	2003-41h	Effective mode:	Real time
Min. value:	0.00	Unit:	ms
Max. value:	500.00	Data type:	UInt16
Default value:	3.00	Change mode:	Real time

Range:
0.00 ms to 500.00 ms
Parameter Description
Defines the filter time of DI5. The DI function is active only after the effective level is kept within the time defined by H03.64.

H03.80 **Speed corresponding to 10 V**

Comm. address:	2003-51h	Effective mode:	Real time
Min. value:	0	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	UInt16
Default value:	3000	Change mode:	At stop

Range:
0[mm/s]/[rpm] to 10000[mm/s]/[rpm]
Parameter Description
Defines the motor speed when the sampling voltage is 10 V.
Speed reference value = Sampling voltage/10 x H03.80

H03.81 **Torque corresponding to 10 V**

Comm. address:	2003-52h	Effective mode:	Real time
Min. value:	0.00	Unit:	Multiplier
Max. value:	8.00	Data type:	UInt16
Default value:	1.00	Change mode:	At stop

Range:
0.00 to 8.00
Parameter Description
Defines the motor torque corresponding to a sampling voltage of 10 V.
Torque reference value = Sampling voltage/10 x H03.81

10.5 H04 Terminal Output Parameters

H04.00 **DO1 function selection**

Comm. address:	2004-01h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	33	Data type:	UInt16
Default value:	1	Change mode:	Real time

Range:

0: No assignment

1: Servo ready

2: Motor rotation signal

5: Positioning completed

6: Proximity

9: Braking

10: Alarm

11: Fault

22: Internal command completed

24: Internal motion completed

25: Comparison DO

26: Closed loop state

27: Left limit

28: Right limit

31: Communication-forced DO

32: EDM output

33: Gantry alignment

Parameter Description

Defines the function of DO1.

H04.01 **DO1 logic selection**

Comm. address:	2004-02h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Normally open

1: Closed

Parameter Description

Defines the level logic of DO1 when the function assigned to DO1 is active.

H04.02 **DO2 function selection**

Comm. address:	2004-03h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	33	Data type:	UInt16
Default value:	11	Change mode:	Real time

Range:

0: No assignment

1: Servo ready

2: Motor rotation signal

5: Positioning completed

6: Proximity

9: Braking

10: Alarm

11: Fault

22: Internal command completed

24: Internal motion completed

25: Comparison DO

26: Closed loop state

27: Left limit

28: Right limit

31: Communication-forced DO

32: EDM output

33: Gantry alignment

Parameter Description

Defines the function of DO2.

H04.03 **DO2 logic selection**

Comm. address:	2004-04h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Normally open

1: Closed

Parameter Description

Defines the level logic of DO2 when the function assigned to DO2 is active.

H04.22 **DO source**

Comm. address:	2004-17h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

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

bit2 to bit15: N/A

Parameter description

Defines whether the logic of a physical DO terminal is defined by the actual state of the drive or by communication.

H04.23 **EtherCAT-forced DO logic in non-OP status**

Comm. address:	2004-18h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

bit 0: DO1

0: Status unchanged

1: No output

bit 1: DO2

0: Status unchanged

1: No output

bit2 to bit15: N/A

Parameter description

Defines the DO state upon EtherCAT communication failure.

H04.24 **DO brake selection**

Comm. address:	2004-19h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0: Disable

1: Enable

Parameter Description

0: Brake control by DO is not enabled. The motor brake can be controlled only by the built-in brake, even if the DO brake function is configured.

1: Brake control by DO is enabled. Configure the DO brake function.

Note: The functional safety model does not support this function.

H04.50 **AO1 signal selection**

Comm. address:	2004-33h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	10	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0: Motor speed (1 V/1000 [mm/s]/[rpm])
1: Speed reference (1 V/1000 [mm/s]/[rpm])
2: Torque reference (1 V/100 × rated torque)
3: Position deviation (0.5 mV/1 reference unit)
4: Position deviation (0.5 mV/1 encoder unit)
5: Position reference speed (1 V/1000 [mm/s]/[rpm])
6: Positioning completed
8: AI1 voltage
9: AI2 voltage
10: H31.05

Parameter description

Defines the signal source of AO1.

H04.51 **AO1 offset voltage**

Comm. address:	2004-34h	Effective mode:	Real time
Min. value:	-10000	Unit:	mV
Max. value:	10000	Data type:	Int16
Default value:	0	Change mode:	Real time

Range:

-10000 mV to 10000 mV

Parameter Description

Defines the actual AO1 output voltage after offset when theoretical output voltage is 0 V.

H04.52 **AO1 multiplying factor**

Comm. address:	2004-35h	Effective mode:	Real time
Min. value:	-99.99	Unit:	-
Max. value:	99.99	Data type:	Int16
Default value:	1.00	Change mode:	Real time

Range:

-99.99 to 99.99

Parameter Description

Defines the actual AO1 output voltage after amplification when theoretical output voltage is 1 V.

10.6 H05 Position Control Parameters

H05.00 **Main position reference source**

Comm. address:	2005-01h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	2	Data type:	UInt16
Default:	2	Change mode:	Real time

Range:

2: Multi-position reference

Parameter description

Defines the position reference source in position control mode.

H05.02 **Pulses per revolution**

Comm. address:	2005-03h	Effective mode:	Next power-on
Min.:	0	Unit:	[P/N-N]/[P/Rev]
Max.:	4294967295	Data type:	UInt32
Default:	0	Change mode:	At stop

Range:

0 to 4294967295

Parameter description

Defines the number of pulses required per revolution of the motor.

H05.04 **First-order low-pass filter time constant**

Comm. address:	2005-05h	Effective mode:	Real time
Min.:	0.0	Unit:	ms
Max.:	6553.5	Data type:	UInt16
Default:	0.0	Change mode:	At stop

Range:

0.0 ms to 6553.5 ms

Parameter description

Defines the first-order low pass filter time constant of position references.

H05.06 **Moving average filter time constant 1**

Comm. address:	2005-07h	Effective mode:	Real time
Min.:	0.0	Unit:	ms
Max.:	128.0	Data type:	UInt16
Default:	0.0	Change mode:	At stop

Range:

0.0 ms to 128.0 ms

Parameter description

Defines the moving average filter time constant for the first group of position references.

H05.07 **Electronic gear ratio 1 (numerator)**

Comm. address:	2005-08h	Effective mode:	Real time
Min.:	1	Unit:	-
Max.:	1073741824	Data type:	UInt32
Default:	1	Change mode:	Real time

Range:

1 to 1073741824

Parameter description

Defines the numerator of electronic gear ratio 1 for encoder unit conversion to user unit.

H05.09 **Electronic gear ratio 1 (denominator)**

Comm. address:	2005-0Ah	Effective mode:	Real time
Min.:	1	Unit:	-
Max.:	1073741824	Data type:	UInt32
Default:	1	Change mode:	Real time

Range:

1 to 1073741824

Parameter description

Defines the denominator of electronic gear ratio 1 for encoder unit conversion to user unit.

H05.11 **Electronic gear ratio 2 (numerator)**

Comm. address:	2005-0Ch	Effective mode:	Real time
Min.:	1	Unit:	-
Max.:	1073741824	Data type:	UInt32
Default:	1	Change mode:	Real time

Range:

1 to 1073741824

Parameter description

Defines the numerator of electronic gear ratio 2 for encoder unit conversion to user unit.

H05.13 **Electronic gear ratio 2 (denominator)**

Comm. address:	2005-0Eh	Effective mode:	Real time
Min.:	1	Unit:	-
Max.:	1073741824	Data type:	UInt32
Default:	1	Change mode:	Real time

Range:

1 to 1073741824

Parameter description

Defines the denominator of electronic gear ratio 2 for encoder unit conversion to user unit.

H05.17 **Number of encoder frequency-division pulses**

Comm. address:	2005-12h	Effective mode:	Next power-on
Min.:	0	Unit:	[P/N-N]/[P/Rev]
Max.:	4194303	Data type:	UInt32
Default:	2500	Change mode:	At stop

Range:

0 to 4194303

Parameter description

Defines the number of pulses output by PAO or PBO per revolution.
Pulse output resolution = H05.17 x 4

H05.19 **Speed feedforward control**

Comm. address:	2005-14h	Effective mode:	Real time

Min.:	0	Unit:	-
Max.:	3	Data type:	UInt16
Default:	1	Change mode:	At stop

Range:

0: No speed feedforward

1: Internal speed feedforward

2: H05.72

3: Zero phase

Parameter description

Defines the source of the speed loop feedforward signal.

0: No speed feedforward

1: Internal speed feedforward

2: External speed feedforward (H05.72)

3: Zero phase

Note: When setting external speed feedforward, the feedforward source is set through H05.72.

H05.20 **Condition for positioning completion signal output**

Comm. address:	2005-15h	Effective mode	Real time
Min.:	0	Unit:	-
Max.:	10	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Absolute value of position deviation is lower than the value of H05.21
1: Absolute position deviation lower than the setpoint of H05.21 and the filtered position reference being 0
2: Absolute position deviation kept lower than H05.21 and unfiltered position reference being 0
3: Absolute position deviation kept lower than H05.21 and unfiltered position reference being 0 If the positioning hold time keeps within the time defined by H05.60 and the position reference is 0, the positioning completion signal will be outputted. After the positioning hold time defined by H05.60 elapses, whether the positioning completion signal is outputted depends on the unfiltered position reference and absolute value of position deviation.
4: Absolute position deviation lower than the setpoint of H05.21 and the filtered position reference being 0 If the positioning hold time keeps within the time defined by H05.60 and the position reference is 0, the positioning completion signal will be outputted. After the positioning hold time defined by H05.60 elapses, whether the positioning completion signal is outputted depends on the filtered position reference and absolute value of position deviation.
5: The positioning completion signal ON is outputted only when the unfiltered position reference is 0, the zero speed signal is ON, and the absolute value of position deviation is lower than H05.21.
6: The positioning completion signal is outputted only when the absolute position deviation is lower than H05.21, with zero speed signal ON and filtered position reference being 0.
7: Positioning completion judged after the delay defined by H05.60 elapses, with unfiltered position reference being 0; position completion signal outputted when absolute position deviation being lower than H05.21 and unfiltered position reference being 0 The positioning completion signal ON is outputted when the non-filtered position reference is 0 and the absolute position deviation is lower than H05.21.
8: Positioning completion is judged after the delay defined by H05.60 elapses and the filtered position reference is 0. The positioning completion signal ON is outputted when the filtered position reference is 0 and the absolute position deviation is lower than H05.21.
9: Positioning completion is judged after the delay defined by H05.60 elapses and the unfiltered position reference is 0, with absolute position deviation lower than H05.21. The positioning completion signal ON is outputted when the unfiltered position reference is 0 and the absolute position deviation is lower than H05.21.
10: Positioning completion is judged after the delay defined by H05.60 elapses and the filtered position reference is 0, with absolute position deviation lower than H05.21. The positioning completion signal ON is outputted when the filtered position reference is 0 and the absolute position deviation is lower than H05.21.

Parameter description

Defines the condition for outputting positioning completion/proximity signal. In the position control mode, if the absolute value of the position deviation during operation is within the setpoint of H05.21, the drive outputs the positioning completion/proximity signal. You can set the condition for outputting the positioning completion/proximity signal in H05.20.
0: Absolute value of position deviation is lower than the value of H05.21
1: Absolute position deviation lower than the setpoint of H05.21 and the filtered position reference being 0
2: Absolute position deviation kept lower than H05.21 and unfiltered position reference being 0
3: Absolute position deviation kept lower than H05.21 and unfiltered position reference being 0 If the positioning hold time keeps within the time defined by H05.60 and the position reference is 0, the positioning completion signal will be outputted. After the positioning hold time defined by H05.60 elapses, whether the positioning completion signal is outputted depends on the unfiltered position reference and absolute value of position deviation.
4: Absolute position deviation lower than the setpoint of H05.21 and the filtered position reference being 0 If the positioning hold time keeps within the time defined by H05.60 and the position reference is 0, the positioning completion signal will be outputted. After the positioning hold time defined by H05.60 elapses, whether the positioning completion signal is outputted depends on the filtered position reference and absolute value of position deviation.
5: The positioning completion signal ON is outputted only when the unfiltered position reference is 0, the zero speed signal is ON, and the absolute value of position deviation is lower than H05.21.
6: The positioning completion signal is outputted only when the absolute position deviation is lower than H05.21, with zero speed signal ON and filtered position reference being 0.
7: Positioning completion judged after the delay defined by H05.60 elapses, with unfiltered position reference being 0; position completion signal outputted when absolute position deviation being lower than H05.21 and unfiltered position reference being 0 The positioning completion signal ON is outputted when the non-filtered position reference is 0 and the absolute position deviation is lower than H05.21.
8: Positioning completion is judged after the delay defined by H05.60 elapses and the filtered position reference is 0. The positioning completion signal ON is outputted when the filtered position reference is 0 and the absolute position deviation is lower than H05.21.
9: Positioning completion is judged after the delay defined by H05.60 elapses and the unfiltered position reference is 0, with absolute position deviation lower than H05.21. The positioning completion signal ON is outputted when the unfiltered position reference is 0 and the absolute position deviation is lower than H05.21.
10: Positioning completion is judged after the delay defined by H05.60 elapses and the filtered position reference is 0, with absolute position deviation lower than H05.21. The positioning completion signal ON is outputted when the filtered position reference is 0 and the absolute position deviation is lower than H05.21.
Note: This parameter is active only when H02.00 is not set to 9.

H05.21 **Threshold of positioning completion**

Comm. address:	2005-16h	Effective mode:	Real time
Min.:	1	Unit:	Encoder unit
Max.:	65535	Data type:	UInt16

Default:	46976	Change mode:	Real time

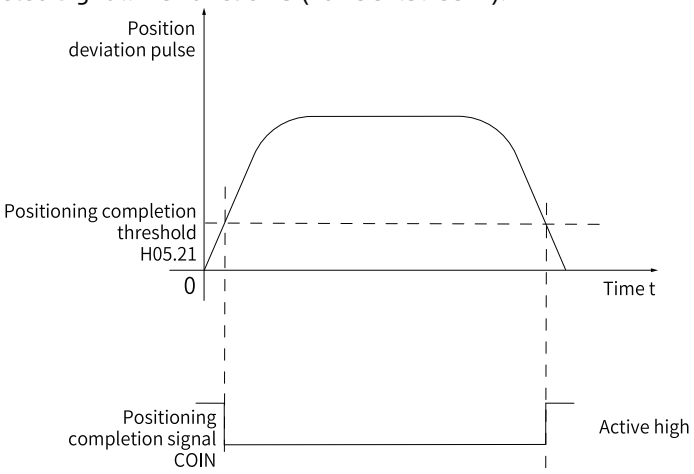
Range:

1 to 65535

Parameter description

Defines the threshold of the absolute value of position deviation when the drive outputs the positioning completion signal.

Positioning completed signal: DO function 5 (FunOUT.5: COIN).



Note: This parameter is active only when H02.00 is not set to 9.

H05.22 Proximity threshold

Comm. address:	2005-17h	Effective mode:	Real time
Min.:	1	Unit:	Encoder unit
Max.:	65535	Data type:	UInt16
Default:	65535	Change mode:	Real time

Range:

1 to 65535

Parameter description

Defines the threshold of the absolute value of position deviation when the drive outputs the proximity signal.

Note: This parameter is active only when H02.00 is not set to 9.

H05.30 Homing enable selection

Comm. address:	2005-1Fh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	6	Data type:	UInt16
Default:	0	Change mode:	Real time:

Range:

0: Disabled

6: Current position as the home

Parameter description

Defines the homing mode and the trigger signal source.
0: Disable
6: Current position as the home
Note: When H05.30 is set to 6, the position feedback is H05.36 regardless of the setting of H05.40.

H05.35 Home search time limit

Comm. address:	2005-24h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	10000	Change mode:	Real time

Range:
0 to 65535
Parameter description
Defines the maximum homing time. The unit is set by H05.66.

H05.36 Mechanical home offset

Comm. address:	2005-25h	Effective mode:	Real time
Min.:	-2147483648	Unit:	Reference unit
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:
-2147483648 to +2147483647
Parameter description
Defines the absolute position of the motor after homing.

H05.38 Frequency-division output source

Comm. address:	2005-27h	Effective mode:	Next power-on
Min.:	0	Unit:	-
Max.:	4	Data type:	UInt16
Default:	0	Change mode:	Real time:

Range:
0: Encoder frequency-division output
2: Frequency-division output inhibited
3: Secondary encoder frequency-division output
4: H31.01
Parameter description
Defines the output source of the pulse output terminal.
0: Encoder frequency-division output
2: Frequency-division output inhibited
3: Secondary encoder frequency-division output
4: H31.01

H05.39 Electronic gear ratio switchover condition

Comm. address:	2005-28h	Effective mode:	Real time

Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: Switchover after position reference is kept 0 for 2.5 ms

1: Switched in real time

Parameter description

Defines the condition for switching the electronic gear ratio. After the fully closed-loop function is enabled and H0F.00 is set to 2, the setpoint is forcibly set to 0.

When this parameter is set to 0 and H0F.00 is set to 2, the electronic gear ratio is switched when the position reference is 0 and positioning has been completed for 2.5 ms. When H0F.00 is not set to 2, the electronic gear ratio is switched when the position reference keeps at 0 for 2.5 ms.

H05.40 **Mechanical home offset and action upon overtravel**

Comm. address:	2005-29h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	3	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: H05.36 as the coordinate after homing, reverse homing applied after homing triggered again on overtravel

1: H05.36 as the relative offset after homing, reverse homing applied after homing triggered again on overtravel

2: H05.36 as the coordinate after homing, reverse homing auto-applied on overtravel

3: H05.36 as the relative offset after homing, reverse homing auto-applied on overtravel

Parameter description

Defines the offset relation between the mechanical home and mechanical zero point upon homing, as well as the action upon overtravel during homing.

0: H05.36 as the coordinate after homing, reverse homing applied after homing triggered again on overtravel

1: H05.36 as the relative offset after homing, reverse homing applied after homing triggered again on overtravel

2: H05.36 as the coordinate after homing, reverse homing auto-applied on overtravel

3: H05.36 as the relative offset after homing, reverse homing auto-applied on overtravel

H05.41 **Z pulse output polarity selection**

Comm. address:	2005-2Ah	Effective mode:	Next power-on
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x1	Change mode:	At stop

Value range:

Bit 0: Frequency-division Z output polarity

0: Positive (high level upon active Z pulse)

1: Negative (low level upon active Z pulse)

Bit 1: output polarity

0: Positive (high level upon active Z pulse)

1: Negative (low level upon active Z pulse)

bit2: Inner loop probe Z signal source

0: Motor Z signal

1: Frequency-division output Z signal

bit3 to bit15: N/A

Parameter description

Defines the output level when phase Z of the pulse output terminal is active.

bit0: Frequency-division Z output polarity

0: Positive (high level upon valid Z pulse)

1: Negative (low level upon valid Z pulse)

bit1: OCZ output polarity

0: Positive (high level upon valid Z pulse)

1: Negative (low level upon valid Z pulse)

bit2: Inner loop probe Z signal source

0: Motor Z signal

1: Frequency-division output Z signal

bit3 to bit15: N/A

H05.44 Numerator of frequency-division output reduction ratio

Comm. address:	2005-2Dh	Effective mode:	Real time
Min.:	1	Unit:	-
Max.:	16383	Data type:	UInt16
Default:	1	Change mode:	At stop

Range:

1 to 16383

Parameter description

Defines the numerator of frequency-division output reduction ratio.

H05.45 Denominator of frequency-division output reduction ratio

Comm. address:	2005-2Eh	Effective mode:	Real time
Min.:	1	Unit:	-
Max.:	8191	Data type:	UInt16
Default:	1	Change mode:	At stop

Range:

1 to 8191

Parameter description

Defines the denominator of frequency-division output reduction ratio.

H05.46 DI selection of multi-turn frequency-division Z starting point

Comm. address:	2005-2Fh	Effective mode:	Next power-on

Min.:	0	Unit:	-
Max.:	5	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: No operation

1: DI1

2: DI2

3: DI3

4: DI4

5: DI5

Parameter description

Sets the start point for frequency-division output. It is only effective when the frequency division ratio is greater than 1.

0: No operation

1: DI1

2: DI2

3: DI3

4: DI4

5: DI5

H05.47 Frequency-division Z pulse width

Comm. address:	2005-30h	Effective mode:	Real time
Min.:	0	Unit:	μs
Max.:	400	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0 μs to 400 μs

Parameter description

Defines the minimum output width (us) of the frequency division output PZ. When the pulse signal is used as master encoder and fully closed-loop encoder, the setpoint 0 indicates the original Z signal will be outputted. Other setpoints indicate the frequency-division Z signal will be outputted.

H05.48 Frequency-division output dead zone threshold

Comm. address:	2005-31h	Effective mode:	Real time
Min.:	0	Unit:	Encoder unit
Max.:	255	Data type:	UInt16
Default:	0	Change mode:	Real time:

Range:

0 to 255

Parameter description

Defines the dead zone threshold of frequency-division output to prevent frequency-division output caused by encoder jitter.

Note: When this function is enabled, the frequency-division output pulses may be not continuous at low speed and constant speed. Set this parameter properly.

H05.50 **Mechanical gear ratio in absolute position rotation mode (numerator)**

Comm. address:	2005-33h	Effective mode:	Real time
Min.:	1	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	1	Change mode:	At stop

Range:
1 to 65535
Parameter description
Defines the numerator of transmission ratio between the mechanical rotary load and the motor in the absolute position rotation mode.

H05.51 **Mechanical gear ratio in absolute position rotation mode (denominator)**

Comm. address:	2005-34h	Effective mode:	Real time
Min.:	1	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	1	Change mode:	At stop

Range:
1 to 65535
Parameter description
Defines the denominator of transmission ratio between the mechanical rotary load and the motor in the absolute position rotation mode.

H05.52 **Pulses per revolution of the load in absolute position rotation mode (low 32 bits)**

Comm. address:	2005-35h	Effective mode:	Real time
Min.:	0	Unit:	Encoder unit
Max.:	4294967295	Data type:	UInt32
Default:	0	Change mode:	At stop

Range:
0 to 4294967295
Parameter description
Defines the number of pulses per revolution of the rotary load in the absolute position rotation mode (low 32 bits).

H05.54 **Pulses per revolution of the load in absolute position rotation mode (high 32 bits)**

Comm. address:	2005-37h	Effective mode:	Real time
Min.:	0	Unit:	Encoder unit
Max.:	4294967295	Data type:	UInt32
Default:	0	Change mode:	At stop

Range:
0 to 4294967295
Parameter description
Defines the number of pulses per revolution of the rotary load in the absolute position rotation mode (high 32 bits).

H05.58 **Torque threshold in limit-triggered homing**

Comm. address:	2005-3Bh	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	400.0	Data type:	UInt16
Default:	100.0	Change mode:	Real time

Range:

0.0% to 400.0%

Parameter description

Defines the maximum positive/negative torque limit in limit-triggered homing.

H05.59 **Positioning window time**

Comm. address:	2005-3Ch	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	30000	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0 ms to 30000 ms

Parameter description

The positioning completion signal is activated only when the duration during which the positioning deviation keeps lower than the positioning completion threshold exceeds the set window time.

H05.60 **Hold time of positioning completion**

Comm. address:	2005-3Dh	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	30000	Data type:	UInt16
Default:	0	Change mode:	Real time:

Range:

0 ms to 30000 ms

Parameter description

Defines the hold time of an active positioning completion signal.

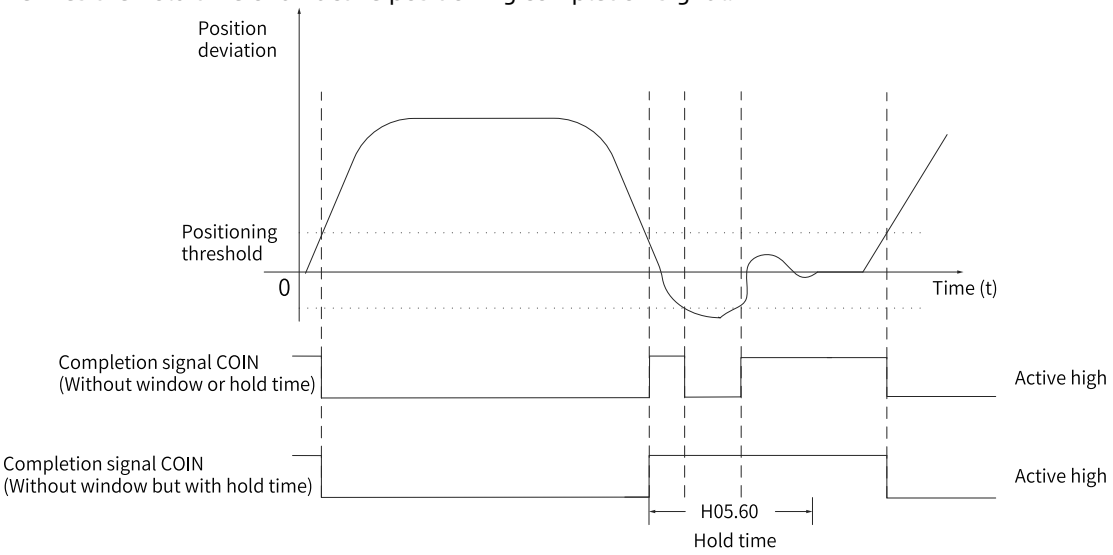


Figure 10-1 Schematic diagram for the window time (H05.59) and hold time (H05.60) of positioning completion signal

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

H05.66 **Homing time unit**

Comm. address:	2005-43h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	2	Data type:	UInt16
Default:	2	Change mode:	At stop

Range:

0: 1 ms

1: 10 ms

2: 100 ms

Parameter description

Defines the homing time unit.

0: 1 ms

1: 10 ms

2: 100 ms

Note: The actual timeout is H05.35 x H05.66 in ms.

H05.67 **Offset between zero point and single-turn absolute position**

Comm. address:	2005-44h	Effective mode:	Real time
Min.:	-2147483648	Unit:	Encoder unit
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	At stop

Range:

-2147483648 to +2147483647

Parameter description

Displays or defines the offset position relative to the home in absolute single-turn mode (H02.01 = 4).

H05.71 **Motor Z signal width**

Comm. address:	2005-48h	Effective mode:	Real time
Min.:	1	Unit:	ms
Max.:	100	Data type:	UInt16
Default:	4	Change mode:	Real time

Range:

1 ms to 100 ms

Parameter description

Defines the pulse width output upon active motor Z signal.

H05.72 **External speed feedforward source selection**

Comm. address:	2005-49h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	2	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: 60B1

1: AI1

2: AI2

Parameter description

Defines the external speed feedforward source.

0: 60B1

1: AI1

2: AI2

H05.73 **Homing completion threshold**

Comm. address:	2005-50h	Effective mode:	Next power-on
Min. value:	0.0	Unit:	-
Max. value:	6553.5	Data type:	UInt16
Default value:	1.0	Change mode:	At stop

Value range:

0.0 to 6553.5

Parameter description

Defines the position deviation condition that must be met when homing is done.

10.7 H06 Speed Control Parameters

H06.00 **Source of main speed reference A**

Comm. address:	2006-01h	Effective mode:	Real time

Min.:	0	Unit:	-
Max.:	2	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: H06.03

1: AI1

2: AI2

Parameter description

Defines the source of main speed reference A.

0: H06.03

1: AI1

2: AI2

H06.01 **Source of auxiliary speed reference B**

Comm. address:	2006-02h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	5	Data type:	UInt16
Default:	1	Change mode:	At stop

Range:

0: H06.03

1: AI1

2: AI2

5: Multi-speed reference

Parameter description

Defines the source of auxiliary speed reference B.

0: H06.03

1: AI1

2: AI2

5: Multi-speed reference

H06.02 **Speed reference source**

Comm. address:	2006-03h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	4	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

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

Parameter description

Defines the source of speed references.
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

H06.03 **Speed reference set through keypad**

Comm. address:	2006-04h	Effective mode:	Real time
Min.:	-10000	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	Int16
Default:	200	Change mode:	Real time

Range:
-10000 [mm/s]/[rpm] to +10000 [mm/s]/[rpm]
Parameter description
Defines the speed reference value set through the keypad.

H06.04 **DI-based jog speed reference**

Comm. address:	2006-05h	Effective mode:	Real time
Min.:	0	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	UInt16
Default:	150	Change mode:	Real time

Range:
0 [mm/s]/[rpm] to 10000 [mm/s]/[rpm]
Parameter description
Defines the DI-based jog speed reference.

H06.05 **Acceleration ramp time of speed reference**

Comm. address:	2006-06h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:
0 to 65535
Parameter description
Defines acceleration ramp time of speed reference.
H06.05 defines the time for the speed reference to change from 0 [mm/s]/[rpm] to 1000 [mm/s]/[rpm].
The formula for calculating the actual acceleration and deceleration time is as follows:
Actual acceleration time (t) = (Speed reference/1000) x Acceleration ramp time of speed reference

H06.06 **Deceleration ramp time of speed reference**

Comm. address:	2006-07h	Effective mode:	Real time
Min.:	0	Unit:	ms

Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:
0 to 65535
Parameter description
Defines the deceleration ramp time of speed reference.
H06.06 defines the time for the speed reference to change from 1000 [mm/s]/[rpm] to 0 [mm/s]/[rpm].
The formula for calculating the actual acceleration and deceleration time is as follows:
Actual deceleration time (t) = (Speed reference/1000) x Deceleration ramp time of speed reference

H06.07 **Maximum speed limit**

Comm. address:	2006-08h	Effective mode:	Real time
Min.:	0	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	UInt16
Default:	7000	Change mode:	Real time

Range:
0 [mm/s]/[rpm] to 10000 [mm/s]/[rpm]
Parameter description
Defines the maximum speed limit.

H06.08 **Forward speed threshold**

Comm. address:	2006-09h	Effective mode:	Real time
Min.:	0	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	UInt16
Default:	7000	Change mode:	Real time

Range:
0 [mm/s]/[rpm] to 10000 [mm/s]/[rpm]
Parameter description
Defines the positive speed threshold.

H06.09 **Reverse speed threshold**

Comm. address:	2006-0Ah	Effective mode:	Real time
Min.:	0	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	UInt16
Default:	7000	Change mode:	Real time

Range:
0 [mm/s]/[rpm] to 10000 [mm/s]/[rpm]
Parameter description
Defines the negative speed threshold.

H06.10 **Deceleration unit in emergency stop**

Comm. address:	2006-0Bh	Effective mode:	Real time

Min.:	0	Unit:	-
Max.:	2	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: x 1

1: x 10

2: x 100

Parameter description

Used to set the deceleration unit in emergency stop.

0: x 1

1: x 10

2: x 100

H06.11 Torque feedforward control

Comm. address:	2006-0Ch	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	3	Data type:	UInt16
Default:	1	Change mode:	Real time

Range:

0: No torque feedforward

1: Internal torque feedforward

2: 60B2h as external torque feedforward

3: Torque feedforward in Stune mode 5

Parameter description

Defines the source for torque feedforward control.

0: No torque feedforward

1: Internal torque feedforward

3: Torque feedforward of STune mode 5

H06.12 Acceleration/Deceleration ramp time of speed JOG

Comm. address:	2006-0Dh	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:

0 to 65535

Parameter description

Defines the acceleration/deceleration ramp time of speed JOG.

It indicates the time for the speed reference to accelerate from 0 rpm to 1000 rpm or decelerate from 1000 rpm to 0 rpm.

The formula for calculating the actual acceleration and deceleration time is as follows.

Actual acceleration/deceleration time t = Speed reference/1000 x Acceleration ramp time of speed reference

H06.13 Speed feedforward smoothing filter

Comm. address:	2006-0Eh	Effective mode:	Real time

Min.:	0	Unit:	μs
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:
0 μs to 65535 μs
Parameter description
Defines the speed feedforward smoothing filter time.

H06.15 Zero clamp speed threshold

Comm. address:	2006-10h	Effective mode:	Real time
Min.:	0	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:
0 [mm/s]/[rpm] to 10000 [mm/s]/[rpm]
Parameter description
Defines the zero clamp speed threshold.

H06.16 Threshold of TGON (motor rotation) signal

Comm. address:	2006-11h	Effective mode:	Real time
Min.:	0	Unit:	[mm/s]/[rpm]
Max.:	1000	Data type:	UInt16
Default:	20	Change mode:	Real time

Range:
0 [mm/s]/[rpm] to 1000 [mm/s]/[rpm]
Parameter description
Defines the threshold of motor rotation signal.

H06.17 Threshold of speed matching signal

Comm. address:	2006-12h	Effective mode:	Real time
Min.:	0	Unit:	[mm/s]/[rpm]
Max.:	100	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:
0 [mm/s]/[rpm] to 100 [mm/s]/[rpm]
Parameter description
Defines the speed threshold of speed matching signal.

H06.18 Threshold of speed reach signal

Comm. address:	2006-13h	Effective mode:	Real time
Min.:	20	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	UInt16
Default:	1000	Change mode:	Real time

Range:

20 [mm/s]/[rpm] to 10000 [mm/s]/[rpm]

Parameter description

Defines the speed threshold of speed reach signal.

H06.19 Threshold of zero speed output signal

Comm. address:	2006-14h	Effective mode:	Real time
Min.:	1	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:

1 [mm/s]/[rpm] to 10000 [mm/s]/[rpm]

Parameter description

Defines the speed threshold of zero speed output signal.

H06.50 Speed S-curve enable switch

Comm. address:	2006-33h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	1	Change mode:	At stop

Range:

0: Disable

1: Enable

Parameter description

0: Accelerate/Decelerate at fixed acceleration rate

1: Accelerate/Decelerate based on the S-curve

H06.51 Increasing acceleration 1 of speed S-curve acceleration segment

Comm. address:	2006-34h	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	50.0	Change mode:	At stop

Range:

0.0% to 100.0%

Parameter description

8 groups of S curve smoothing parameters can be set for each speed reference.

Increasing acceleration time at acceleration segment: The percentage of motor increasing acceleration time in the selected acceleration time.

H06.52 Decreasing acceleration 1 of speed S-curve acceleration segment

Comm. address:	2006-35h	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	50.0	Change mode:	At stop

Range:
0.0% to 100.0%
Parameter description
8 groups of S curve smoothing parameters can be set for each speed reference.
Decreasing acceleration time at acceleration segment: The percentage of motor decreasing acceleration time in the selected acceleration time.

H06.53 **Increasing deceleration 1 of speed S-curve deceleration segment**

Comm. address:	2006-36h	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	50.0	Change mode:	At stop

Range:
0.0% to 100.0%
Parameter description
8 groups of S curve smoothing parameters can be set for each speed reference.
Increasing deceleration time at deceleration segment: Indicates the ratio of the motor increasing deceleration time to the deceleration time selected.

H06.54 **Decreasing deceleration 1 of speed S-curve deceleration segment**

Comm. address:	2006-37h	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	50.0	Change mode:	At stop

Range:
0.0% to 100.0%
Parameter description
8 groups of S curve smoothing parameters can be set for each speed reference.
Decreasing acceleration time at deceleration segment: The percentage of motor decreasing deceleration time in the selected deceleration time.

H06.55 **Increasing acceleration 2 of speed S-curve acceleration segment**

Comm. address:	2006-38h	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	50.0	Change mode:	At stop

Range:
0.0% to 100.0%
Parameter description
8 groups of S curve smoothing parameters can be set for each speed reference.
Increasing acceleration time at acceleration segment: The percentage of motor increasing acceleration time in the selected acceleration time.

H06.56 **Decreasing acceleration 2 of speed S-curve acceleration segment**

Comm. address:	2006-39h	Effective mode:	Real time

Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	50.0	Change mode:	At stop

Range:
0.0% to 100.0%
Parameter description
8 groups of S curve smoothing parameters can be set for each speed reference.
Decreasing acceleration time at acceleration segment: The percentage of motor decreasing acceleration time in the selected acceleration time.

H06.57 **Increasing deceleration 2 of speed S-curve deceleration segment**

Comm. address:	2006-3Ah	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	50.0	Change mode:	At stop

Range:
0.0% to 100.0%
Parameter description
8 groups of S curve smoothing parameters can be set for each speed reference.
Increasing deceleration time at deceleration segment: Indicates the ratio of the motor increasing deceleration time to the deceleration time selected.

H06.58 **Decreasing deceleration 2 of speed S-curve deceleration segment**

Comm. address:	2006-3Bh	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	50.0	Change mode:	At stop

Range:
0.0% to 100.0%
Parameter description
8 groups of S curve smoothing parameters can be set for each speed reference.
Decreasing acceleration time at deceleration segment: The percentage of motor decreasing deceleration time in the selected deceleration time.

H06.59 **Increasing acceleration 3 of speed S-curve acceleration segment**

Comm. address:	2006-3Ch	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	50.0	Change mode:	At stop

Range:
0.0% to 100.0%
Parameter description
8 groups of S curve smoothing parameters can be set for each speed reference.
Increasing acceleration time at acceleration segment: The percentage of motor increasing acceleration time in the selected acceleration time.

H06.60 **Decreasing acceleration 3 of speed S-curve acceleration segment**

Comm. address:	2006-3Dh	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	50.0	Change mode:	At stop

Range:

0.0% to 100.0%

Parameter description

8 groups of S curve smoothing parameters can be set for each speed reference.

Decreasing acceleration time at acceleration segment: The percentage of motor decreasing acceleration time in the selected acceleration time.

H06.61 **Increasing deceleration 3 of speed S-curve deceleration segment**

Comm. address:	2006-3Eh	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	50.0	Change mode:	At stop

Range:

0.0% to 100.0%

Parameter description

8 groups of S curve smoothing parameters can be set for each speed reference.

Increasing deceleration time at deceleration segment: Indicates the ratio of the motor increasing deceleration time to the deceleration time selected.

H06.62 **Decreasing deceleration 3 of speed S-curve deceleration segment**

Comm. address:	2006-3Fh	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	50.0	Change mode:	At stop

Range:

0.0% to 100.0%

Parameter description

8 groups of S curve smoothing parameters can be set for each speed reference.

Decreasing acceleration time at deceleration segment: The percentage of motor decreasing deceleration time in the selected deceleration time.

H06.63 **Increasing acceleration 4 of speed S-curve acceleration segment**

Comm. address:	2006-40h	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	50.0	Change mode:	At stop

Range:

0.0% to 100.0%

Parameter description

8 groups of S curve smoothing parameters can be set for each speed reference.
Increasing acceleration time at acceleration segment: The percentage of motor increasing acceleration time in the selected acceleration time.

H06.64 Decreasing acceleration 4 of speed S-curve acceleration segment

Comm. address:	2006-41h	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	50.0	Change mode:	At stop

Range:
0.0% to 100.0%
Parameter description
8 groups of S curve smoothing parameters can be set for each speed reference.
Decreasing acceleration time at acceleration segment: The percentage of motor decreasing acceleration time in the selected acceleration time.

H06.65 Increasing deceleration 4 of speed S-curve deceleration segment

Comm. address:	2006-42h	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	50.0	Change mode:	At stop

Range:
0.0% to 100.0%
Parameter description
8 groups of S curve smoothing parameters can be set for each speed reference.
Increasing deceleration time at deceleration segment: Indicates the ratio of the motor increasing deceleration time to the deceleration time selected.

H06.66 Decreasing deceleration 4 of speed S-curve deceleration segment

Comm. address:	2006-43h	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	50.0	Change mode:	At stop

Range:
0.0% to 100.0%
Parameter description
8 groups of S curve smoothing parameters can be set for each speed reference.
Decreasing acceleration time at deceleration segment: The percentage of motor decreasing deceleration time in the selected deceleration time.

H06.67 Increasing acceleration 5 of speed S-curve acceleration segment

Comm. address:	2006-44h	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	50.0	Change mode:	At stop

Range:
0.0% to 100.0%
Parameter description
8 groups of S curve smoothing parameters can be set for each speed reference.
Increasing acceleration time at acceleration segment: The percentage of motor increasing acceleration time in the selected acceleration time.

H06.68 **Decreasing acceleration 5 of speed S-curve acceleration segment**

Comm. address:	2006-45h	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	50.0	Change mode:	At stop

Range:
0.0% to 100.0%
Parameter description
8 groups of S curve smoothing parameters can be set for each speed reference.
Decreasing acceleration time at acceleration segment: The percentage of motor decreasing acceleration time in the selected acceleration time.

H06.69 **Increasing deceleration 5 of speed S-curve deceleration segment**

Comm. address:	2006-46h	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	50.0	Change mode:	At stop

Range:
0.0% to 100.0%
Parameter description
8 groups of S curve smoothing parameters can be set for each speed reference.
Increasing deceleration time at deceleration segment: Indicates the ratio of the motor increasing deceleration time to the deceleration time selected.

H06.70 **Decreasing deceleration 5 of speed S-curve deceleration segment**

Comm. address:	2006-47h	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	50.0	Change mode:	At stop

Range:
0.0% to 100.0%
Parameter description
8 groups of S curve smoothing parameters can be set for each speed reference.
Decreasing acceleration time at deceleration segment: The percentage of motor decreasing deceleration time in the selected deceleration time.

H06.71 **Increasing acceleration 6 of speed S-curve acceleration segment**

Comm. address:	2006-48h	Effective mode:	Real time

Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	50.0	Change mode:	At stop

Range:
0.0% to 100.0%
Parameter description
8 groups of S curve smoothing parameters can be set for each speed reference.
Increasing acceleration time at acceleration segment: The percentage of motor increasing acceleration time in the selected acceleration time.

H06.72 **Decreasing acceleration 6 of speed S-curve acceleration segment**

Comm. address:	2006-49h	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	50.0	Change mode:	At stop

Range:
0.0% to 100.0%
Parameter description
8 groups of S curve smoothing parameters can be set for each speed reference.
Decreasing acceleration time at acceleration segment: The percentage of motor decreasing acceleration time in the selected acceleration time.

H06.73 **Increasing deceleration 6 of speed S-curve deceleration segment**

Comm. address:	2006-4Ah	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	50.0	Change mode:	At stop

Range:
0.0% to 100.0%
Parameter description
8 groups of S curve smoothing parameters can be set for each speed reference.
Increasing deceleration time at deceleration segment: Indicates the ratio of the motor increasing deceleration time to the deceleration time selected.

H06.74 **Decreasing deceleration 6 of speed S-curve deceleration segment**

Comm. address:	2006-4Bh	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	50.0	Change mode:	At stop

Range:
0.0% to 100.0%
Parameter description
8 groups of S curve smoothing parameters can be set for each speed reference.
Decreasing acceleration time at deceleration segment: The percentage of motor decreasing deceleration time in the selected deceleration time.

H06.75 **Increasing acceleration 7 of speed S-curve acceleration segment**

Comm. address:	2006-4Ch	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	50.0	Change mode:	At stop

Range:

0.0% to 100.0%

Parameter description

8 groups of S curve smoothing parameters can be set for each speed reference.

Increasing acceleration time at acceleration segment: The percentage of motor increasing acceleration time in the selected acceleration time.

H06.76 **Decreasing acceleration 7 of speed S-curve acceleration segment**

Comm. address:	2006-4Dh	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	50.0	Change mode:	At stop

Range:

0.0% to 100.0%

Parameter description

8 groups of S curve smoothing parameters can be set for each speed reference.

Decreasing acceleration time at acceleration segment: The percentage of motor decreasing acceleration time in the selected acceleration time.

H06.77 **Increasing deceleration 7 of speed S-curve deceleration segment**

Comm. address:	2006-4Eh	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	50.0	Change mode:	At stop

Range:

0.0% to 100.0%

Parameter description

8 groups of S curve smoothing parameters can be set for each speed reference.

Increasing deceleration time at deceleration segment: Indicates the ratio of the motor increasing deceleration time to the deceleration time selected.

H06.78 **Decreasing deceleration 7 of speed S-curve deceleration segment**

Comm. address:	2006-4Fh	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	50.0	Change mode:	At stop

Range:

0.0% to 100.0%

Parameter description

8 groups of S curve smoothing parameters can be set for each speed reference.
Decreasing acceleration time at deceleration segment: The percentage of motor decreasing deceleration time in the selected deceleration time.

H06.79 **Increasing acceleration 8 of speed S-curve acceleration segment**

Comm. address:	2006-50h	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	50.0	Change mode:	At stop

Range:
0.0% to 100.0%
Parameter description
8 groups of S curve smoothing parameters can be set for each speed reference.
Increasing acceleration time at acceleration segment: The percentage of motor increasing acceleration time in the selected acceleration time.

H06.80 **Decreasing acceleration 8 of speed S-curve acceleration segment**

Comm. address:	2006-51h	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	50.0	Change mode:	At stop

Range:
0.0% to 100.0%
Parameter description
8 groups of S curve smoothing parameters can be set for each speed reference.
Decreasing acceleration time at acceleration segment: The percentage of motor decreasing acceleration time in the selected acceleration time.

H06.81 **Increasing deceleration 8 of speed S-curve deceleration segment**

Comm. address:	2006-52h	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	50.0	Change mode:	At stop

Range:
0.0% to 100.0%
Parameter description
8 groups of S curve smoothing parameters can be set for each speed reference.
Increasing deceleration time at deceleration segment: Indicates the ratio of the motor increasing deceleration time to the deceleration time selected.

H06.82 **Decreasing deceleration 8 of speed S-curve deceleration segment**

Comm. address:	2006-53h	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	50.0	Change mode:	At stop

Range:
0.0% to 100.0%
Parameter description
8 groups of S curve smoothing parameters can be set for each speed reference.
Decreasing acceleration time at deceleration segment: The percentage of motor decreasing deceleration time in the selected deceleration time.

10.8 H07 Torque Control Parameters

H07.00 **Source of main torque reference A**

Comm. address:	2007-01h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	2	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0: H07.03
1: AI1
2: AI2
Parameter description
Defines the source of main torque reference A.
0: H07.03
1: AI1
2: AI2

H07.01 **Source of auxiliary torque reference B**

Comm. address:	2007-02h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	2	Data type:	UInt16
Default:	1	Change mode:	At stop

Range:
0: H07.03
1: AI1
2: AI2
Parameter description
Defines the source of auxiliary torque references.
0: H07.03
1: AI1
2: AI2

H07.02 **Torque reference source**

Comm. address:	2007-03h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	4	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: Source of main torque reference A

1: Source of auxiliary torque reference B

2: Source of A+B

3: Switched between A and B

4: Communication

Parameter description

Used to select torque reference.

0: Source of main torque reference A

1: Source of auxiliary torque reference B

2: Source of A+B

3: Switched between A and B

4: Communication

H07.03 Torque reference set through keypad

Comm. address:	2007-04h	Effective mode:	Real time
Min.:	-400.0	Unit:	%
Max.:	400.0	Data type:	Int16
Default:	0.0	Change mode:	Real time

Range:

-400.0% to +400.0%

Parameter description

Defines the torque reference.

H07.05 Torque reference filter time constant 1

Comm. address:	2007-06h	Effective mode:	Real time
Min.:	0.00	Unit:	ms
Max.:	30.00	Data type:	UInt16
Default:	0.50	Change mode:	Real time

Range:

0.00 ms to 30.00 ms

Parameter description

Defines the torque reference filter time constant 1.

H07.06 Torque reference filter time constant 2

Comm. address:	2007-07h	Effective mode:	Real time
Min.:	0.00	Unit:	ms
Max.:	30.00	Data type:	UInt16
Default:	0.27	Change mode:	Real time

Range:

0.00 ms to 30.00 ms

Parameter description

Defines the torque reference filter time constant 2.

H07.07 **Torque limit source**

Comm. address:	2007-08h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	4	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Positive/Negative internal torque limit

1: Internal or external limit as defined by DI

2: T_LMT

3: T_LMT or external limit as defined by DI (FunIN.16 or FunIN.17)

4: T_LMT or internal limit (FunIN.16 or FunIN.17) as defined by DI

Parameter description

Defines the torque limit source.

0: Positive/Negative internal torque limit

1: Internal or external limit as defined by DI

2: T_LMT

3: T_LMT or external limit as defined by DI (FunIN.16 or FunIN.17)

4: T_LMT or internal limit (FunIN.16 or FunIN.17) as defined by DI

H07.08 **T-LMT selection**

Comm. address:	2007-09h	Effective mode:	Real time
Min.:	1	Unit:	-
Max.:	2	Data type:	UInt16
Default:	1	Change mode:	Real time

Range:

1: AI1

2: AI2

Parameter description

Used to select AI as the torque limit.

1: AI1

2: AI2

H07.09 **Positive internal torque limit**

Comm. address:	2007-0Ah	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	400.0	Data type:	UInt16
Default:	350.0	Change mode:	Real time

Range:

0.0% to 400.0%

Parameter description

Defines the positive internal torque limit.

H07.10 **Negative internal torque limit**

Comm. address:	2007-0Bh	Effective mode:	Real time

Min.:	0.0	Unit:	%
Max.:	400.0	Data type:	UInt16
Default:	350.0	Change mode:	Real time

Range:
0.0% to 400.0%
Parameter description
Defines the negative internal torque limit.

H07.11 Positive external torque limit

Comm. address:	2007-0Ch	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	400.0	Data type:	UInt16
Default:	350.0	Change mode:	Real time

Range:
0.0% to 400.0%
Parameter description
Defines positive external torque limit.

H07.12 Negative external torque limit

Comm. address:	2007-0Dh	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	400.0	Data type:	UInt16
Default:	350.0	Change mode:	Real time

Range:
0.0% to 400.0%
Parameter description
Defines negative external torque limit.

H07.15 Emergency-stop torque

Comm. address:	2007-10h	Effective mode:	At stop
Min.:	0.0	Unit:	%
Max.:	400.0	Data type:	UInt16
Default:	100.0	Change mode:	Real time

Range:
0.0% to 400.0%
Parameter description
Defines the torque upon emergency stop.

H07.17 Speed limit source

Comm. address:	2007-12h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	2	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Internal speed limit

1: V-LMT

2: H07.19 or H07.20 as defined by DI

Parameter description

Speed limit source

0: Internal speed limit

1: V-LMT

2: H07.19 or H07.20 as defined by DI

Note: This parameter is active only when H02.00 is not set to 9.

H07.18 **V-LMT selection**

Comm. address:	2007-13h	Effective mode:	Real time
Min.:	1	Unit:	-
Max.:	2	Data type:	UInt16
Default:	1	Change mode:	Real time

Range:

1: AI1

2: AI2

Parameter description

Used to select AI as the speed limit.

1: AI1

2: AI2

H07.19 **Positive speed limit/Speed limit 1 in torque control**

Comm. address:	2007-14h	Effective mode:	Real time
Min.:	0	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	UInt16
Default:	3000	Change mode:	Real time

Range:

0 [mm/s]/[rpm] to 10000 [mm/s]/[rpm]

Parameter description

Defines the positive speed limit/speed limit 1 in torque control.

H07.20 **Negative speed limit/Speed limit 2 in torque control**

Comm. address:	2007-15h	Effective mode:	Real time
Min.:	0	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	UInt16
Default:	3000	Change mode:	Real time

Range:

0 [mm/s]/[rpm] to 10000 [mm/s]/[rpm]

Parameter description

Defines the negative speed limit/speed limit 2 in torque control.

H07.21 **Reference value for torque reach**

Comm. address:	2007-16h	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	400.0	Data type:	UInt16
Default:	0.0	Change mode:	Real time

Range:

0.0% to 400.0%

Parameter description

Defines the reference value for torque reach.

H07.22 **Threshold of valid torque reach**

Comm. address:	2007-17h	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	400.0	Data type:	UInt16
Default:	20.0	Change mode:	Real time

Range:

0.0% to 400.0%

Parameter description

Defines the threshold of valid torque reach.

H07.23 **Threshold of invalid torque reach**

Comm. address:	2007-18h	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	400.0	Data type:	UInt16
Default:	10.0	Change mode:	Real time

Range:

0.0% to 400.0%

Parameter description

Defines the threshold of invalid torque reach.

H07.24 **Field weakening depth**

Comm. address:	2007-19h	Effective mode:	Real time
Min.:	60	Unit:	%
Max.:	115	Data type:	UInt16
Default:	115	Change mode:	Real time

Range:

60% to 115%

Parameter description

Defines the field weakening depth.

H07.25 **Max. permissible demagnetizing current**

Comm. address:	2007-1Ah	Effective mode:	Real time
Min.:	0	Unit:	%

Max.:	300	Data type:	UInt16
Default:	100	Change mode:	Real time

Range:

0% to 300%

Parameter description

Defines the maximum permissible demagnetization current.

H07.26 Field weakening selection

Comm. address:	2007-1Bh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: Disable

1: Enable

Parameter description

Flux weakening selection

0: Disable

1: Enable

H07.27 Field weakening gain

Comm. address:	2007-1Ch	Effective mode:	Real time
Min.:	0.001	Unit:	kHz
Max.:	1.000	Data type:	UInt16
Default:	0.030	Change mode:	Real time

Range:

0.001 kHz to 1.000 kHz

Parameter description

Defines the field weakening gain.

H07.28 Speed of field weakening point

Comm. address:	2007-1Dh	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:

0 to 65535

Parameter description

Defines the speed of field weakening point.

H07.35 Torque non-standard function selection

Comm. address:	2007-24h	Effective mode:	Next power-on
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16

Default value:	0	Change mode:	At stop

Value range:
bit0: Enable motor output correction
bit1: Enable shield compensation data
bit2 to bit15: N/A
Parameter description
Torque non-standard feature switch
bit0: Enable motor torque output calibration
bit1: Enable compensation data shielding
bit2 to bit15: N/A

H07.36 **Time constant of low-pass filter 2**

Comm. address:	2007-25h	Effective mode:	Real time
Min.:	0.00	Unit:	ms
Max.:	10.00	Data type:	UInt16
Default:	0.00	Change mode:	Real time

Range:
0.00 ms to 10.00 ms
Parameter description
Defines the time constant of low-pass filter 2.

H07.37 **Torque reference filter selection**

Comm. address:	2007-26h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0: First-order filter
1: Second-order filter
Parameter description
Torque reference filter selection
0: First-order filter
1: Second-order filter
Note: When second-order filter is selected, the filter structure is biquad filter for ROT motors, and the filter parameters are set through H07.38. For DDR/DDL motors, the filter structure is biquad low-pass filter, and the filter parameters are set through H07.42.

H07.38 **Biquad filter attenuation ratio**

Comm. address:	2007-27h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	50	Data type:	UInt16
Default:	16	Change mode:	Real time

Range:
0 to 50

Parameter description
Defines the attenuation ratio of biquad filter.

H07.40 **Speed limit window in torque control mode**

Comm. address:	2007-29h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	300	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:
0 ms to 300 ms
Parameter description
Defines the speed limit time window in the torque control mode.

H07.42 **Damping coefficient of biquad low-pass filter**

Comm. address:	2007-2Bh	Effective mode:	Real time
Min.:	0.001	Unit:	-
Max.:	10.000	Data type:	UInt16
Default:	1.000	Change mode:	Real time

Range:
0.001 to 10.000
Parameter description
Defines the damping coefficient of biquad low-pass filter.

10.9 H08 Gain Parameters

H08.00 **Speed loop gain**

Comm. address:	2008-01h	Effective mode:	Real time
Min.:	0.0	Unit:	Hz
Max.:	2000.0	Data type:	UInt16
Default:	40.0	Change mode:	Real time:

Range:
0.0 Hz to 2000.0 Hz
Parameter description
Defines the responsiveness of the speed loop. The higher the setpoint, the faster the speed loop response is. Note that an excessively high setpoint may cause vibration.
In the position control mode, the position loop gain must be increased together with the speed loop gain.

H08.01 **Speed loop integral time constant**

Comm. address:	2008-02h	Effective mode:	Real time
Min.:	0.15	Unit:	ms
Max.:	512.00	Data type:	UInt16
Default:	19.89	Change mode:	Real time:

Range:

0.15 ms to 512.00 ms

Parameter description

Defines the integral time constant of the speed loop.

The lower the setpoint, the better the integral action, and the quicker will the deviation value be close to 0.

Note:

There is no integral action when H08.01 is set to 512.00.

H08.02 **Position loop gain**

Comm. address:	2008-03h	Effective mode:	Real time
Min.:	0.0	Unit:	Hz
Max.:	2000.0	Data type:	UInt16
Default:	64.0	Change mode:	Real time

Range:

0.0 Hz to 2000.0 Hz

Parameter description

Defines the proportional gain of the position loop.

This parameter 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 gain set include H08.00 (Speed loop gain), H08.01 (Speed loop integral time constant), H08.02, and H07.05 (Filter time constant of torque reference).

H08.03 **2nd speed loop gain**

Comm. address:	2008-04h	Effective mode:	Real time
Min.:	0.1	Unit:	Hz
Max.:	2000.0	Data type:	UInt16
Default:	75.0	Change mode:	Real time

Range:

0.1 Hz to 2000.0 Hz

Parameter description

Defines the 2nd speed loop gain.

H08.04 **2nd speed loop integral time constant**

Comm. address:	2008-05h	Effective mode:	Real time
Min.:	0.15	Unit:	ms
Max.:	512.00	Data type:	UInt16
Default:	10.61	Change mode:	Real time

Range:

0.15 ms to 512.00 ms

Parameter description

Defines the 2nd speed loop integral time constant.

H08.05 **2nd position loop gain**

Comm. address:	2008-06h	Effective mode:	Real time

Min.:	0.1	Unit:	Hz
Max.:	2000.0	Data type:	UInt16
Default:	120.0	Change mode:	Real time

Range:

0.1 Hz to 2000.0 Hz

Parameter description

Defines the second gain set of the position loop and speed loop. The 2nd gain set include H08.03 (Speed loop gain), H08.04 (Speed loop integral time constant), H08.05, and H07.06 (Torque reference filter time constant 2).

H08.08 **2nd gain mode setting**

Comm. address:	2008-09h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	1	Change mode:	Real time

Range:

0: Fixed to the 1st gain set, switched between P and PI as defined by bit26 of external 60FEh

1: Switched between the 1st and 2nd gain sets as defined by H08.09

Parameter description

Defines the mode for switching to the 2nd gain set.

0: Fixed to the 1st gain set, switched between P and PI as defined by bit26 of external 60FEh

1: Switched between the 1st and 2nd gain sets as defined by H08.09

H08.09 **Gain switchover condition**

Comm. address:	2008-0Ah	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	10	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Fixed to the 1st gain set (PS)

1: Switched as defined by bit26 of 60FEh

2: Torque reference too large (PS)

3: Speed reference too large (PS)

4: Speed reference change rate too large (PS)

5: Speed reference low/high speed threshold (PS)

6: Position deviation too large (P)

7: Position reference available (P)

8: Positioning unfinished (P)

9: Actual speed (P)

10: Position reference + Actual speed (P)

Parameter description

Defines the gain switchover condition.
0: Fixed to the 1st gain set (PS)
1: Switched as defined by bit26 of 60FEh
2: Torque reference too large (PS)
3: Speed reference too large (PS)
4: Speed reference change rate too large (PS)
5: Speed reference low/high speed threshold (PS)
6: Position deviation too large (P)
7: Position reference available (P)
8: Positioning unfinished (P)
9: Actual speed (P)
10: Position reference + Actual speed (P)

H08.10 **Gain switchover delay**

Comm. address:	2008-0Bh	Effective mode:	Real time
Min.:	0.0	Unit:	ms
Max.:	1000.0	Data type:	UInt16
Default:	5.0	Change mode:	Real time

Range:
0.0 ms to 1000.0 ms
Parameter description
Defines the delay when the drive switches from the 2nd gain set to the 1st gain set.

H08.11 **Gain switchover level**

Comm. address:	2008-0Ch	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	20000	Data type:	UInt16
Default:	50	Change mode:	Real time

Range:
0 to 20000
Parameter description
Defines the gain switchover level.
Gain switchover is affected by both the level and the dead time, as defined by H08.09. The unit of gain switchover level varies with the switchover condition.

H08.12 **Gain switchover hysteresis**

Comm. address:	2008-0Dh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	20000	Data type:	UInt16
Default:	30	Change mode:	Real time

Range:
0 to 20000
Parameter description
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 to a value equal to or higher than H08.12. If H08.11 is set to a value lower than H08.12, the drive will set H08.11 to the same value as H08.12 forcibly.

H08.13 Position gain switchover time

Comm. address:	2008-0Eh	Effective mode:	Real time
Min.:	0.0	Unit:	ms
Max.:	1000.0	Data type:	UInt16
Default:	3.0	Change mode:	Real time

Range:
0.0 ms to 1000.0 ms
Parameter description
In position control, if H08.05 (2nd position loop gain) is higher than H08.02 (Position loop gain), set the time for switching from H08.02 to H08.05.
This parameter can be used to reduce the impact caused by an increase in the position loop gain.

H08.15 Load moment of inertia ratio

Comm. address:	2008-10h	Effective mode:	Real time
Min.:	0.00	Unit:	-
Max.:	120.00	Data type:	UInt16
Default:	1.00	Change mode:	Real time

Range:
0.00 to 120.00
Parameter description
Defines the mechanical load inertia ratio relative to the motor moment of inertia.

When H08.15 is set to 0, it indicates the motor carries no load; if it is set to 1.00, it indicates the mechanical load inertia is the same as the motor moment of inertia.

H08.17 Zero phase delay

Comm. address:	2008-12h	Effective mode:	Real time
Min.:	0.0	Unit:	ms
Max.:	4.0	Data type:	UInt16
Default:	0.0	Change mode:	Real time

Range:
0.0 ms to 4.0 ms
Parameter description
Defines the zero phase delay.

H08.18 Speed feedforward filter time constant

Comm. address:	2008-13h	Effective mode:	Real time
Min.:	0.00	Unit:	ms

Max.:	64.00	Data type:	UInt16
Default:	0.50	Change mode:	Real time

Range:
0.00 ms to 64.00 ms
Parameter description
Defines the speed feedforward filter time constant.

H08.19 Speed feedforward gain

Comm. address:	2008-14h	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	0.0	Change mode:	Real time

Range:
0.0% to 100.0%
Parameter description
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 first, and then increase the value of H08.19 gradually from 0 to a certain value at which speed feedforward achieves the desired effect.
Adjust H08.18 and H08.19 repeatedly until a balanced performance is achieved.
Note:
For how to enable the speed feedforward function and select the speed feedforward signal, see H05.19 (Speed feedforward control).

H08.20 Torque feedforward filter time constant

Comm. address:	2008-15h	Effective mode:	Real time
Min.:	0.00	Unit:	ms
Max.:	64.00	Data type:	UInt16
Default:	0.50	Change mode:	Real time

Range:
0.00 ms to 64.00 ms
Parameter description
Defines the torque feedforward filter time constant.

H08.21 Torque feedforward gain

Comm. address:	2008-16h	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	300.0	Data type:	UInt16
Default:	0.0	Change mode:	Real time

Range:
0.0% to 300.0%
Parameter description

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 until a balanced performance is achieved.
Note:
For how to enable the torque feedforward function and select the torque feedforward signal, see H06.11 (Torque feedforward control).

H08.22 **Speed feedback filtering option**

Comm. address:	2008-17h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	4	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0: Inhibited
1: 2 times
2: 4 times
3: 8 times
4: 16 times
Parameter description
Defines the moving average filtering times for speed feedback.
0: Disable
1: 2 times
2: 4 times
3: 8 times
4: 16 times
Note: The higher the number of filtering times, the lower the speed feedback fluctuation, but the longer the feedback delay can be.

H08.23 **Cutoff frequency of speed feedback low-pass filter**

Comm. address:	2008-18h	Effective mode:	Real time
Min.:	100	Unit:	Hz
Max.:	8000	Data type:	UInt16
Default:	8000	Change mode:	Real time:

Range:
100 Hz to 8000 Hz
Parameter description
Defines the cutoff frequency for first-order low-pass filtering on the speed feedback.
Note:

The lower the setpoint, the weaker the speed feedback fluctuation, and the longer the feedback delay will be.
Setting this parameter to 8000 Hz negates the filtering effect.

H08.24 **PDFF control coefficient**

Comm. address:	2008-19h	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	200.0	Data type:	UInt16
Default:	100.0	Change mode:	Real time

Range:
0.0% to 200.0%
Parameter description
Defines the control mode of the speed loop.
When this parameter is set to 100.0, the speed loop adopts PI control (default) with quick dynamic response.
When this parameter is set to 0.0, speed loop integral action is enhanced, which filters out low-frequency interference but also slows down the dynamic response.
H08.24 can be used to keep a good responsiveness of the speed loop, with the anti-interference capacity in low-frequency bands improved and the speed feedback overshoot unaffected.

H08.25 **Speed measurement method**

Comm. address:	2008-1Ah	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0: M-method
1: MT-method
Parameter description
Speed measurement method
0: M-method
1: MT-method
Note: It is active only with setpoint 1 and a pulse encoder.

H08.27 **Speed observer cutoff frequency**

Comm. address:	2008-1Ch	Effective mode:	Real time
Min.:	50	Unit:	Hz
Max.:	600	Data type:	UInt16
Default:	170	Change mode:	Real time

Range:
50 Hz to 600 Hz
Parameter description
Defines the cutoff frequency of the speed observer. Note that an excessively high setpoint may incur resonance. Decrease the setpoint properly in case of excessive speed feedback noise.

H08.28 **Speed observer inertia correction coefficient**

Comm. address:	2008-1Dh	Effective mode:	Real time
Min.:	1	Unit:	%
Max.:	1600	Data type:	UInt16
Default:	100	Change mode:	Real time

Range:
1% to 1600%
Parameter description
Defines the speed observer inertia correction coefficient. If H08.15 is set based on the actual inertia, there is no need to adjust this parameter.

H08.29 **Speed observer filter time**

Comm. address:	2008-1Eh	Effective mode:	Real time
Min.:	0.00	Unit:	ms
Max.:	10.00	Data type:	UInt16
Default:	0.80	Change mode:	Real time

Range:
0.00 ms to 10.00 ms
Parameter description
Defines the speed observer filter time. It is recommended to set this parameter to a value equal to the sum of H07.05 plus 0.2 ms.

H08.31 **Disturbance cutoff frequency**

Comm. address:	2008-20h	Effective mode:	Real time
Min.:	1	Unit:	Hz
Max.:	4000	Data type:	UInt16
Default:	600	Change mode:	Real time

Range:
1 Hz to 4000 Hz
Parameter description
Defines the cutoff frequency of the disturbance observer. Increasing the setpoint improves the response of the disturbance observer and the compensation effect. Note that an excessively high setpoint may incur resonance.

H08.32 **Disturbance compensation gain**

Comm. address:	2008-21h	Effective mode:	Real time
Min.:	0	Unit:	%
Max.:	100	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:
0% to 100%
Parameter description
Defines the compensation gain of the disturbance observer. The setpoint 100% indicates full compensation.

H08.33 **Disturbance observer inertia correction coefficient**

Comm. address:	2008-22h	Effective mode:	Real time
Min.:	1	Unit:	%
Max.:	1600	Data type:	UInt16
Default:	100	Change mode:	Real time

Range:

1% to 1600%

Parameter description

Defines the inertia correction factor of the disturbance observer. If H08.15 is set based on the actual inertia, there is no need to adjust this parameter.

H08.37 **Phase modulation for medium-frequency jitter suppression 2**

Comm. address:	2008-26h	Effective mode:	Real time
Min.:	-90	Unit:	°
Max.:	90	Data type:	Int16
Default:	0	Change mode:	Real time

Range:

-90.0° to +90°

Parameter description

Defines the compensation phase of medium-frequency jitter suppression 2.

H08.38 **Medium-frequency suppression 2 frequency**

Comm. address:	2008-27h	Effective mode:	Real time
Min.:	0	Unit:	Hz
Max.:	1000	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0 Hz to 1000 Hz

Parameter description

Set this parameter based on actual resonance frequency. The valid suppression frequency range for medium-frequency jitter suppression 2 is 100 Hz to 1000 Hz.

H08.39 **Compensation gain of medium-frequency jitter suppression 2**

Comm. address:	2008-28h	Effective mode:	Real time
Min.:	0	Unit:	%
Max.:	300	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0% to 300%

Parameter description

Defines the compensation gain for medium-frequency jitter suppression 2. Set this parameter to 40%...55% in general cases. Setting this parameter to 0 negates the effect of medium-frequency jitter suppression 2.

H08.40 **Speed observer enable**

Comm. address:	2008-29h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Disable

1: Enable

Parameter description

Used to set the bit for enabling the speed observer.

0: Disable

1: Enable

H08.42 **Model control selection**

Comm. address:	2008-2Bh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	4	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Disable

1: Enable

2: Reserved

3: New model tracking

4: Model tracking B

Parameter description

Used to enable model tracking control.

H08.43 **Model gain**

Comm. address:	2008-2Ch	Effective mode:	Real time
Min.:	0.1	Unit:	-
Max.:	2000.0	Data type:	UInt16
Default:	40.0	Change mode:	Real time

Range:

0.1 to 2000.0

Parameter description

Defines the single inertia model gain. The higher the gain, the faster the position response. Note that an excessively high setpoint may incur excessive overshoot.

H08.46 **Feedforward value**

Comm. address:	2008-2Fh	Effective mode:	Real time
Min.:	0.0	Unit:	-
Max.:	102.4	Data type:	UInt16
Default:	95.0	Change mode:	Real time

Range:

0.0 to 102.4

Parameter description

Defines the speed feedforward gain for single inertia model control. If overshoot occurs, reduce the setpoint properly.

H08.48 Model torque feedforward positive compensation coefficient

Comm. address:	2008-31h	Effective mode:	Real time
Min.:	0.0	Unit:	-
Max.:	204.8	Data type:	UInt16
Default:	102.4	Change mode:	Real time

Range:

0.0 to 204.8

Parameter description

Defines the speed feedforward gain for single inertia model control. If overshoot occurs, reduce the setpoint properly.

H08.49 Model torque feedforward negative compensation coefficient

Comm. address:	2008-32h	Effective mode:	Real time
Min.:	0.0	Unit:	-
Max.:	204.8	Data type:	UInt16
Default:	102.4	Change mode:	Real time

Range:

0.0 to 204.8

Parameter description

Defines the speed feedforward gain for single inertia model control. If overshoot occurs, reduce the setpoint properly.

H08.53 Medium- and low-frequency jitter suppression frequency 3

Comm. address:	2008-36h	Effective mode:	Real time
Min.:	0.0	Unit:	Hz
Max.:	300.0	Data type:	UInt16
Default:	0.0	Change mode:	Real time

Range:

0.0 Hz to 300.0 Hz

Parameter description

Set this parameter based on actual resonance frequency. The resonance suppression range is 100 Hz to 300 Hz.

H08.54 Medium- and low-frequency jitter suppression compensation 3

Comm. address:	2008-37h	Effective mode:	Real time
Min.:	0	Unit:	%
Max.:	200	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0% to 200%

Parameter description

Defines the compensation gain for medium- and low-frequency suppression compensation 3. The setpoint 200% indicates full compensation.

H08.56 Medium- and low-frequency jitter suppression phase modulation 3

Comm. address:	2008-39h	Effective mode:	Real time
Min.:	0	Unit:	%
Max.:	600	Data type:	UInt16
Default:	100	Change mode:	Real time

Range:

0% to 600%

Parameter description

Adjust this parameter based on the actual compensation effect.

H08.59 Medium- and low-frequency jitter suppression frequency 4

Comm. address:	2008-3Ch	Effective mode:	Real time
Min.:	0.0	Unit:	Hz
Max.:	300.0	Data type:	UInt16
Default:	0.0	Change mode:	Real time

Range:

0.0 Hz to 300.0 Hz

Parameter description

Set this parameter based on actual resonance frequency. The resonance suppression range is 100 Hz to 300 Hz.

H08.60 Medium- and low-frequency jitter suppression compensation 4

Comm. address:	2008-3Dh	Effective mode:	Real time
Min.:	0	Unit:	%
Max.:	200	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0% to 200%

Parameter description

Defines the compensation gain for medium- and low-frequency suppression compensation 4. The setpoint 200% indicates full compensation.

H08.61 Medium- and low-frequency jitter suppression phase modulation 4

Comm. address:	2008-3Eh	Effective mode:	Real time
Min.:	0	Unit:	%
Max.:	600	Data type:	UInt16
Default:	100	Change mode:	Real time

Range:

0% to 600%

Parameter description

Adjust this parameter based on the actual compensation effect.

H08.62 Position loop integral time constant

Comm. address:	2008-3Fh	Effective mode:	Real time
Min.:	0.15	Unit:	-
Max.:	512.00	Data type:	UInt16
Default:	512.00	Change mode:	Real time

Range:

0.15 to 512.00

Parameter description

Defines the position loop integral time constant.

H08.63 2nd position loop integral time constant

Comm. address:	2008-40h	Effective mode:	Real time
Min.:	0.15	Unit:	-
Max.:	512.00	Data type:	UInt16
Default:	512.00	Change mode:	Real time

Range:

0.15 to 512.00

Parameter description

Defines the 2nd position loop integral time constant.

H08.64 Speed observer feedback source

Comm. address:	2008-41h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Speed outputted by the observer

1: Speed observed by the observer

Parameter description

Defines the speed observer feedback source.

0: Speed outputted by the observer

1: Speed observed by the observer

H08.65 Zero deviation control selection

Comm. address:	2008-42h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Disable

1: Enable

Parameter description

Used to enable/disable zero deviation control.

0: Disable

1: Enable

H08.66 **Zero deviation control position average filter**

Comm. address:	2008-43h	Effective mode:	Real time
Min.:	0.0	Unit:	ms
Max.:	320.0	Data type:	UInt16
Default:	5.0	Change mode:	At stop

Range:

0.0 ms to 320.0 ms

Parameter description

Defines the average filter time of zero deviation control position. It is recommended to increase the setpoint in case of large noise caused by low command resolution.

H08.68 **Speed feedforward of zero deviation control**

Comm. address:	2008-45h	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	100.0	Change mode:	Real time

Range:

0.0% to 100.0%

Parameter description

Defines the speed feedforward of zero deviation control.

H08.69 **Torque feedforward of zero deviation control**

Comm. address:	2008-46h	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	100.0	Change mode:	Real time

Range:

0.0% to 100.0%

Parameter description

Defines the torque feedforward of zero deviation control.

H08.90 **Encoder pitch fluctuation suppression device**

Comm. address:	2008-5Bh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	6	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Disabled

1: 1st group activated only-adaptive mode

2: 1st group activated only-hysteresis mode

3: Two groups activated-adaptive mode

4: Two groups activated-hysteresis mode

Parameter description

Used to enable the encoder pitch fluctuation suppression function.

0: Disabled

1: 1st group activated only-adaptive mode This mode is used to suppress or eliminate the control loop torque fluctuation caused by encoder pitch fluctuation, which can help alleviate speed fluctuation and operation noise.

2: 1st group activated only-hysteresis mode This mode is used in applications featuring long travel distance and slow speed changes (such as digital printing industry).

3: Two groups activated-adaptive mode Note that the number of suppressors used depend on the magnitude of torque fluctuation caused by encoder pitch fluctuation.

4. Two groups activated-hysteresis mode Note that the hysteresis mode is only applicable to applications requiring reciprocating movement. The adaptive mode is applicable to applications with slow speed changes.

10.10 H09 Auto-tuning Parameters

H09.00 **Auto-tuning mode**

Comm. address:	2009-01h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	9	Data type:	UInt16
Default:	4	Change mode:	Real time

Range:

0: Disabled, manual gain tuning required

1: Enabled, gain parameters generated automatically based on the stiffness level

2: Positioning mode, gain parameters generated automatically based on the stiffness level

3: Interpolation mode+Inertia auto-tuning

4: Normal mode+Inertia auto-tuning

5: STune mode 5

6: Quick positioning mode+Inertia auto-tuning

8: New model tracking mode+Inertia auto-tuning

9: Model tracking B+Inertia auto-tuning+Friction compensation

Parameter description

Defines different gain tuning modes. Related gain parameters can be set manually or automatically according to the stiffness level.
0: Disabled, manual gain tuning required
1: Enabled, gain parameters generated automatically based on the stiffness level
2: Positioning mode, gain parameters generated automatically based on the stiffness level
3: Interpolation mode+Inertia auto-tuning
4: Normal mode+Inertia auto-tuning
5: STune mode 5
6: Quick positioning mode+Inertia auto-tuning
8: New model tracking mode+Inertia auto-tuning
9: Model tracking B+Inertia auto-tuning+Friction compensation

H09.01 **Stiffness level selection**

Comm. address:	2009-02h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	41	Data type:	UInt16
Default:	15	Change mode:	Real time

Range:
0 to 41
Parameter description
Defines the stiffness level of the servo system. The higher the stiffness level, the stronger the gains and the quicker the response will be. But an excessively high stiffness level will cause vibration.
The setpoint 0 indicates the weakest stiffness and 41 indicates the strongest stiffness.

H09.02 **Adaptive notch mode**

Comm. address:	2009-03h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	4	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:
0: Adaptive notch no longer updated
1: One adaptive notch activated (3rd notch)
2: Two adaptive notches activated (3rd and 4th notches)
3: Resonance point tested only (displayed in H09.24)
4: Adaptive notch cleared, values of 3rd and 4th notches restored to default
Parameter description
Defines the operation mode of the adaptive notch.
0: Adaptive notch no longer updated
1: One adaptive notch activated (3rd notch)
2: Two adaptive notches activated (3rd and 4th notches)
3: Resonance point tested only (displayed in H09.24)
4: Adaptive notch cleared, values of 3rd and 4th notches restored to default

H09.03 **Online inertia auto-tuning mode**

Comm. address:	2009-04h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	3	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Disabled

1: Enabled, changing slowly

2: Enabled, changing normally

3: Enabled, changing quickly

Parameter description

Defines whether to enable online inertia auto-tuning and the inertia ratio update speed during online inertia auto-tuning.

0: Disabled

1: Enabled, changing slowly

2: Enabled, changing normally

3: Enabled, changing quickly

H09.05 **Offline inertia auto-tuning mode**

Comm. address:	2009-06h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: Bi-directional

1: Unidirectional

Parameter description

Defines the offline inertia auto-tuning mode. The offline inertia auto-tuning function can be enabled through H0d.02.

0: Bi-directional

1: Unidirectional

H09.06 **Maximum speed of inertia auto-tuning**

Comm. address:	2009-07h	Effective mode:	Real time
Min.:	100	Unit:	[mm/s]/[rpm]
Max.:	1000	Data type:	UInt16
Default:	500	Change mode:	At stop

Range:

100 [mm/s]/[rpm] to 1000 [mm/s]/[rpm]

Parameter description

Defines the maximum permissible motor speed reference in offline inertia auto-tuning. During inertia auto-tuning, the higher the speed, the more accurate the auto-tuned values can be. Use the default value in general applications.

H09.07 **Time constant for accelerating to max. speed during inertia auto-tuning**

Comm. address:	2009-08h	Effective mode:	Real time
Min.:	10	Unit:	ms
Max.:	5000	Data type:	UInt16
Default:	125	Change mode:	At stop

Range:
10 ms to 5000 ms
Parameter description
Defines the time for the motor to accelerate from 0 [mm/s]/[rpm] to the maximum speed of inertia auto-tuning (H09.06) during offline inertia auto-tuning.

H09.08 **Interval time after an individual inertia auto-tuning**

Comm. address:	2009-09h	Effective mode:	Real time
Min.:	50	Unit:	ms
Max.:	10000	Data type:	UInt16
Default:	800	Change mode:	At stop

Range:
50 ms to 10000 ms
Parameter description
Defines the interval time between two consecutive speed references when H09.05 (Offline inertia auto-tuning mode) is set to 1 (Positive/Negative triangular wave mode).

H09.09 **Motor movement distance per inertia auto-tuning**

Comm. address:	2009-0Ah	Effective mode:	Real time
Min.:	0.00	Unit:	[mm]/[Rev]
Max.:	100.00	Data type:	UInt16
Default:	1.00	Change mode:	Real time

Range:
0.00 [mm]/[Rev] to 100.00 [mm]/[Rev]
Parameter description
Defines the distance rotated by the motor 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 or H09.07 properly until the motor travel distance fulfills the requirement.

H09.11 **Vibration threshold**

Comm. address:	2009-0Ch	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	5.0	Change mode:	Real time

Range:
0.0% to 100.0%

Parameter description
Defines the alarm threshold for current feedback oscillation.

H09.12 **Frequency of the 1st notch**

Comm. address:	2009-0Dh	Effective mode:	Real time
Min.:	50	Unit:	Hz
Max.:	8000	Data type:	UInt16
Default:	8000	Change mode:	Real time

Range:
50 Hz to 8000 Hz
Parameter description
Defines the center frequency of the notch, which is the mechanical resonance frequency.
In the torque control mode, setting the notch frequency to 8000 Hz deactivates the notch function.

H09.13 **Width level of the 1st notch**

Comm. address:	2009-0Eh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	20	Data type:	UInt16
Default:	2	Change mode:	Real time

Range:
0 to 20
Parameter description
Defines the width level of the notch. Use the default setpoint in general cases.
Width level is the ratio of the notch width to the notch center frequency.

H09.14 **Depth level of the 1st notch**

Comm. address:	2009-0Fh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	99	Data type:	UInt16
Default:	0	Change mode:	Real time:

Range:
0 to 99
Parameter description
Defines the depth level of the notch.
The depth level of the notch is the ratio between the input to the output at the notch center frequency.
The higher the setpoint, the lower the notch depth and the weaker the mechanical resonance suppression will be. Note that an excessively high setpoint may cause system instability.

H09.15 **Frequency of the 2nd notch**

Comm. address:	2009-10h	Effective mode:	Real time
Min.:	50	Unit:	Hz
Max.:	8000	Data type:	UInt16

Default:	8000	Change mode:	Real time

Range:
50 Hz to 8000 Hz
Parameter description
Defines the frequency of the 2nd notch.

H09.16 **Width level of the 2nd notch**

Comm. address:	2009-11h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	20	Data type:	UInt16
Default:	2	Change mode:	Real time

Range:
0 to 20
Parameter description
Defines the width level of the 2nd notch.

H09.17 **Depth level of the 2nd notch**

Comm. address:	2009-12h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	99	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:
0 to 99
Parameter description
Defines the depth level of the 2nd notch.

H09.18 **Frequency of the 3rd notch**

Comm. address:	2009-13h	Effective mode:	Real time
Min.:	50	Unit:	Hz
Max.:	8000	Data type:	UInt16
Default:	8000	Change mode:	Real time

Range:
50 Hz to 8000 Hz
Parameter description
Defines the frequency of the 3rd notch.

H09.19 **Width level of the 3rd notch**

Comm. address:	2009-14h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	20	Data type:	UInt16
Default:	2	Change mode:	Real time

Range:
0 to 20

Parameter description
Defines the width level of the 3rd notch.

H09.20 **Depth level of the 3rd notch**

Comm. address:	2009-15h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	99	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:
0 to 99
Parameter description
Defines the depth level of the 3rd notch.

H09.21 **Frequency of the 4th notch**

Comm. address:	2009-16h	Effective mode:	Real time
Min.:	50	Unit:	Hz
Max.:	8000	Data type:	UInt16
Default:	8000	Change mode:	Real time

Range:
50 Hz to 8000 Hz
Parameter description
Defines the frequency of the 4th notch.

H09.22 **Width level of the 4th notch**

Comm. address:	2009-17h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	20	Data type:	UInt16
Default:	2	Change mode:	Real time

Range:
0 to 20
Parameter description
Defines the width level of the 4th notch.

H09.23 **Depth level of the 4th notch**

Comm. address:	2009-18h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	99	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:
0 to 99
Parameter description
Defines the depth level of the 4th notch.

H09.24 **Auto-tuned resonance frequency**

Comm. address:	2009-19h	Effective mode:	-
Min.:	0	Unit:	Hz
Max.:	5000	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0 Hz to 5000 Hz
Parameter description
When H09.02 (Adaptive notch mode) is set to 3, the current mechanical resonance frequency is displayed.

H09.27 **ITune mode**

Comm. address:	0x091B	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	20	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
-
Parameter description
-

H09.28 **Minimum inertia ratio of ITune**

Comm. address:	0x091C	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	80.0	Data type:	UInt16
Default value:	0.0	Change mode:	Real time

Value range:
-
Parameter description
-

H09.29 **Maximum inertia ratio of ITune**

Comm. address:	0x091D	Effective mode:	Real time
Min. value:	0.1	Unit:	%
Max. value:	120.0	Data type:	UInt16
Default value:	30.0	Change mode:	Real time

Value range:
-
Parameter description
-

H09.32 **Gravity compensation value**

Comm. address:	2009-21h	Effective mode:	Real time

Min.:	-100.0	Unit:	%
Max.:	100.0	Data type:	Int16
Default:	0.0	Change mode:	Real time

Range:
-100.0% to +100.0%
Parameter description
Defines the gravity compensation value. Setting this parameter properly in vertical axis applications can reduce the falling amplitude upon start.

H09.33 **Positive friction compensation value**

Comm. address:	2009-22h	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	100.0	Data type:	UInt16
Default:	0.0	Change mode:	Real time

Range:
0.0% to +100.0%
Parameter description
Defines the positive friction compensation value.

H09.34 **Negative friction compensation value**

Comm. address:	2009-23h	Effective mode:	Real time
Min.:	-100.0	Unit:	%
Max.:	0.0	Data type:	Int16
Default:	0.0	Change mode:	Real time

Range:
-100.0% to 0.0%
Parameter description
Defines the negative friction compensation value.

H09.35 **Friction compensation speed**

Comm. address:	2009-24h	Effective mode:	Real time
Min.:	0.0	Unit:	-
Max.:	20.0	Data type:	UInt16
Default:	2.0	Change mode:	Real time

Range:
0.0 to 20.0
Parameter description
Defines the friction compensation speed.

H09.36 **Friction compensation speed**

Comm. address:	2009-25h	Effective mode:	Real time
Min.:	0x0	Unit:	-
Max.:	0x13	Data type:	UInt16
Default:	0x0	Change mode:	Real time

Range:

0: Slow mode+Speed reference

1: Slow mode+Model speed

2: Slow mode+Speed feedback

3: Slow mode+Observe speed

16: Quick mode +Speed reference

17: Quick mode +Model speed

18: Quick mode +Speed feedback

19: Quick mode+Observe speed

Parameter description

Friction compensation speed selection:

0: Slow mode+Speed reference

1: Slow mode+Model speed

2: Slow mode+Speed feedback

3: Slow mode+Observe speed

16: Quick mode +Speed reference

17: Quick mode +Model speed

18: Quick mode +Speed feedback

19: Quick mode+Observe speed

H09.37 **Vibration monitoring time**

Comm. address:	2009-26h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	300	Change mode:	Real time

Range:

0 to 65535

Parameter description

The resonance detection suppression function is turned off automatically after the time defined by this parameter elapses. To suppress the resonance suppression function, set this parameter to 0.

H09.38 **Frequency of low-frequency resonance suppression 1 at the mechanical end**

Comm. address:	2009-27h	Effective mode:	Real time
Min.:	1.0	Unit:	Hz
Max.:	100.0	Data type:	UInt16
Default:	100.0	Change mode:	At stop

Range:

1.0 Hz to 100.0 Hz

Parameter description

Set this parameter based on the actual jitter frequency.

H09.39 **Low-frequency resonance suppression 1 at the mechanical end**

Comm. address:	2009-28h	Effective mode:	Real time
Min.:	0	Unit:	-

Max.:	3	Data type:	UInt16
Default:	2	Change mode:	At stop

Range:
0 to 3
Parameter description
Used to set different low-frequency resonance suppression type. Type 1 features the shortest delay.

H09.41 Frequency of the 5th notch

Comm. address:	2009-2Ah	Effective mode:	Real time
Min.:	50	Unit:	Hz
Max.:	8000	Data type:	UInt16
Default:	8000	Change mode:	Real time

Range:
50 Hz to 8000 Hz
Parameter description
Defines the frequency of the 5th notch.

H09.42 Width level of the 5th notch

Comm. address:	2009-2Bh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	20	Data type:	UInt16
Default:	2	Change mode:	Real time

Range:
0 to 20
Parameter description
Defines the width level of the 5th notch.

H09.43 Depth level of the 5th notch

Comm. address:	2009-2Ch	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	99	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:
0 to 99
Parameter description
Defines the depth level of the 5th notch.

H09.44 Frequency of low-frequency resonance suppression 2 at the mechanical end

Comm. address:	2009-2Dh	Effective mode:	Real time
Min.:	0.0	Unit:	Hz
Max.:	200.0	Data type:	UInt16
Default:	0.0	Change mode:	At stop

Range:

0.0 Hz to 200.0 Hz

Parameter description

Set this parameter based on the actual jitter frequency.

H09.45 **Response of low-frequency resonance suppression 2 at the mechanical end**

Comm. address:	2009-2Eh	Effective mode:	Real time
Min.:	0.01	Unit:	-
Max.:	10.00	Data type:	UInt16
Default:	1.00	Change mode:	At stop

Range:

0.01 to 10.00

Parameter description

Use the default setpoint in general cases. Increasing this setpoint can reduce the delay time.

H09.47 **Width of low-frequency resonance suppression 2 at the mechanical end**

Comm. address:	2009-30h	Effective mode:	Real time
Min.:	0.00	Unit:	-
Max.:	2.00	Data type:	UInt16
Default:	1.00	Change mode:	At stop

Range:

0.00 to 2.00

Parameter description

Use the default setpoint in general cases. Increasing this setpoint can increase the delay time.

H09.49 **Frequency of low-frequency resonance suppression 3 at the mechanical end**

Comm. address:	2009-32h	Effective mode:	Real time
Min.:	0.0	Unit:	Hz
Max.:	200.0	Data type:	UInt16
Default:	0.0	Change mode:	At stop

Range:

0.0 Hz to 200.0 Hz

Parameter description

Defines the frequency of low-frequency resonance suppression 3 at mechanical load end.

H09.50 **Response of low-frequency resonance suppression 3 at the mechanical end**

Comm. address:	2009-33h	Effective mode:	Real time
Min.:	0.01	Unit:	-
Max.:	10.00	Data type:	UInt16
Default:	1.00	Change mode:	At stop

Range:

0.01 to 10.00

Parameter description

Defines the response of low-frequency resonance suppression 3 at mechanical end.

H09.52 **Width of low-frequency resonance suppression 3 at the mechanical end**

Comm. address:	2009-35h	Effective mode:	Real time
Min.:	0.00	Unit:	-
Max.:	2.00	Data type:	UInt16
Default:	1.00	Change mode:	At stop

Range:

0.00 to 2.00

Parameter description

Defines the width of low-frequency resonance suppression 3 at mechanical load end.

H09.54 **Resonance detection torque threshold**

Comm. address:	2009-37h	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	300.0	Data type:	UInt16
Default:	50.0	Change mode:	Real time

Range:

0.0% to 300.0%

Parameter description

If the torque fluctuation exceeds the setpoint, an error will be reported. Setting this parameter to 0 hides the resonance detection function.

H09.56 **Maximum overshoot allowed by ETune**

Comm. address:	2009-39h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	2936	Change mode:	Real time

Range:

0 to 65535

Parameter description

Defines the maximum overshoot value allowed during ETune adjustment.

H09.57 **STune resonance suppression switchover frequency**

Comm. address:	2009-3Ah	Effective mode:	Real time
Min.:	0	Unit:	Hz
Max.:	4000	Data type:	UInt16
Default:	650	Change mode:	Real time

Range:

0 Hz to 4000 Hz

Parameter description

If the resonance frequency is lower than the setpoint, use medium-frequency resonance suppression 2 to suppress resonance. Otherwise, use the notch to suppress resonance. When H09.57 exceeds the frequency upper limit (1000 Hz) of medium frequency suppression 2, the medium frequency suppression is inactive.

H09.58 **STune resonance suppression reset selection**

Comm. address:	2009-3Bh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	2	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Disable

1: Enable

Parameter description

Used to reset STune resonance suppression to clear parameters related to resonance suppression, medium-frequency resonance suppression 2 and notches 3 and 4.

0: Disable

1: Enable

H09.62 **STune stop delay judgment**

Comm. address:	2009-3Fh	Effective mode:	Real time
Min.:	0.00	Unit:	ms
Max.:	50.00	Data type:	UInt16
Default:	1.00	Change mode:	Real time

Range:

0.00 ms to 50.00 ms

Parameter description

Defines the judgment time for STune stop delay.

H09.63 **STune quick convergence speed**

Comm. address:	2009-40h	Effective mode:	Real time
Min.:	0.00	Unit:	-
Max.:	50.00	Data type:	UInt16
Default:	1.00	Change mode:	Real time

Range:

0.00 to 50.00

Parameter description

Defines the quick convergence speed of STune.

H09.71 **Starting frequency**

Comm. address:	2009-48h	Effective mode:	Real time
Min.:	0	Unit:	Hz
Max.:	8000	Data type:	UInt16
Default:	15	Change mode:	Real time

Range:

0 Hz to 8000 Hz

Parameter description

Defines the start frequency for frequency sweeping in high-performance tuning.

H09.72 **Stop frequency**

Comm. address:	2009-49h	Effective mode:	Real time
Min.:	0	Unit:	Hz
Max.:	8000	Data type:	UInt16
Default:	8000	Change mode:	Real time

Range:

0 Hz to 8000 Hz

Parameter description

Defines the stop frequency for frequency sweeping in high-performance tuning.

H09.73 **Frequency subdivision**

Comm. address:	2009-4Ah	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	500	Data type:	UInt16
Default:	50	Change mode:	Real time

Range:

0 to 500

Parameter description

Defines the frequency resolution of high-performance tuning in the low frequency range (starting frequency to starting frequency 2). The higher the setpoint, the lower the resolution can be.

H09.74 **Excitation amplitude**

Comm. address:	2009-4Bh	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	400.0	Data type:	UInt16
Default:	15.0	Change mode:	Real time

Range:

0.0% to 400.0%

Parameter description

Defines the excitation amplitude of the sweeping frequency in high-performance tuning.

H09.75 **Starting frequency 2**

Comm. address:	2009-4Ch	Effective mode:	Real time
Min.:	0	Unit:	Hz
Max.:	8000	Data type:	UInt16
Default:	500	Change mode:	Real time

Range:

0 Hz to 8000 Hz

Parameter description

Defines the starting frequency in medium- and high-frequency range during high-performance tuning.

H09.76 **Frequency subdivision 2**

Comm. address:	2009-4Dh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1000	Data type:	UInt16
Default:	500	Change mode:	Real time

Range:

0 to 1000

Parameter description

Defines the frequency resolution of high-performance tuning at low frequency range (start frequency 2 to stop frequency). The higher the set value, the lower the resolution is.

H09.77 **Biquad filter mode**

Comm. address:	2009-4Eh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	6	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Disable

1: First-order low-pass

2: Second-order low-pass

3: Notch

4: Lead-lag

5: User-defined

Parameter description

Used to select biquad filter mode.

0: Disable

1: First-order low-pass

2: Second-order low-pass

3: Notch

4: Lead-lag

5: User-defined

H09.78 **Biquad filter numerator frequency**

Comm. address:	2009-4Fh	Effective mode:	Real time
Min.:	0	Unit:	Hz
Max.:	16000	Data type:	UInt16
Default:	8000	Change mode:	Real time

Range:

0 Hz to 16000 Hz

Parameter description

Defines the biquad filter numerator frequency.

H09.79 **Damping coefficient of biquad filter numerator**

Comm. address:	2009-50h	Effective mode:	Real time

Min.:	0.001	Unit:	-
Max.:	10.000	Data type:	UInt16
Default:	1.000	Change mode:	Real time

Range:
0.001 to 10.000
Parameter description
Defines the damping coefficient of biquad filter numerator.

H09.80 Biquad filter denominator frequency

Comm. address:	2009-51h	Effective mode:	Real time
Min.:	0	Unit:	Hz
Max.:	16000	Data type:	UInt16
Default:	8000	Change mode:	Real time

Range:
0 Hz to 16000 Hz
Parameter description
Defines the biquad filter denominator frequency.

H09.81 Damping coefficient of biquad filter denominator

Comm. address:	2009-52h	Effective mode:	Real time
Min.:	0.001	Unit:	-
Max.:	10.000	Data type:	UInt16
Default:	1.000	Change mode:	Real time

Range:
0.001 to 10.000
Parameter description
Defines the damping coefficient of biquad filter denominator.

H09.82 Vibration frequency 1

Comm. address:	2009-53h	Effective mode:	Real time
Min.:	0.0	Unit:	Hz
Max.:	300.0	Data type:	UInt16
Default:	0.0	Change mode:	Real time

Range:
0.0 Hz to 300.0 Hz
Parameter description
Defines the vibration frequency 1.

H09.83 Resonance frequency 1

Comm. address:	2009-54h	Effective mode:	Real time
Min.:	0.0	Unit:	Hz
Max.:	300.0	Data type:	UInt16
Default:	0.0	Change mode:	Real time

Range:
0.0 Hz to 300.0 Hz
Parameter description
Defines the resonance frequency 1.

H09.84 **Vibration damping 1**

Comm. address:	2009-55h	Effective mode:	Real time
Min.:	0.00	Unit:	-
Max.:	0.50	Data type:	UInt16
Default:	0.05	Change mode:	Real time

Range:
0.00 to 0.50
Parameter description
Defines the vibration damping 1.

H09.85 **Resonance damping 1**

Comm. address:	2009-56h	Effective mode:	Real time
Min.:	0.00	Unit:	-
Max.:	0.50	Data type:	UInt16
Default:	0.05	Change mode:	Real time

Range:
0.00 to 0.50
Parameter description
Defines resonance damping 1.

H09.86 **Vibration frequency 2**

Comm. address:	2009-57h	Effective mode:	Real time
Min.:	0.0	Unit:	Hz
Max.:	300.0	Data type:	UInt16
Default:	0.0	Change mode:	Real time

Range:
0.0 Hz to 300.0 Hz
Parameter description
Defines the vibration frequency 2.

H09.87 **Resonance frequency 2**

Comm. address:	2009-58h	Effective mode:	Real time
Min.:	0.0	Unit:	Hz
Max.:	300.0	Data type:	UInt16
Default:	0.0	Change mode:	Real time

Range:
0.0 Hz to 300.0 Hz
Parameter description
Defines the resonance frequency 2.

H09.88 **Vibration damping 2**

Comm. address:	2009-59h	Effective mode:	Real time
Min.:	0.00	Unit:	-
Max.:	0.50	Data type:	UInt16
Default:	0.05	Change mode:	Real time

Range:

0.00 to 0.50

Parameter description

Defines the vibration damping 2.

H09.89 **Resonance damping 2**

Comm. address:	2009-5Ah	Effective mode:	Real time
Min.:	0.00	Unit:	-
Max.:	0.50	Data type:	UInt16
Default:	0.05	Change mode:	Real time

Range:

0.00 to 0.50

Parameter description

Defines resonance damping 2.

H09.92 **Model friction compensation**

Comm. address:	2009-5Dh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	1	Change mode:	Real time

Range:

0: Disable

1: Enable

Parameter description

Used to enable model friction compensation.

H09.93 **Model friction compensation coefficient**

Hex:	2009-5Eh	Effective mode:	Real time
Min.:	0.00	Unit:	%1000rpm
Max.:	50.00	Data type:	UInt16
Default:	0.00	Change mode:	Real time

Range:

0.00 to 50.00

Parameter description

Defines the model friction compensation coefficient.

H09.94 **Stune model tracking gain proportional coefficient**

Comm. address:	2009-5Fh	Effective mode:	Real time

Min.:	0.00	Unit:	-
Max.:	30.00	Data type:	UInt16
Default:	2.00	Change mode:	Real time

Range:
0.00 to 30.00
Parameter description
Used to adjust the model gain (H08.43). Only Stune8 is available.

H09.95 **Jitter suppression auto-tuning at mechanical end**

Comm. address:	2009-60h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	2	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:
0: Disable
1: Enable
2: Clear resonance suppression parameters
Parameter description
-

H09.98 **Auto-tuning of advanced vibration suppression**

Comm. address:	2009-63h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	2	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:
0: Disabled
1: Auto-tuning of fast vibration suppression
2: Auto-tuning of slow vibration suppression
Parameter description
0: Disabled
1: Auto-tuning of fast vibration suppression
2: Auto-tuning of slow vibration suppression

10.11 H0A Fault and Protection Parameters

H0A.00 **Power input phase loss protection**

Comm. address:	200A-01h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0: Enable

1: Disable

Parameter description

Inovance provides servo drives of single-phase 200 V, three-phase 200 V, and three-phase 400 V. When the input voltage significantly fluctuates or phase loss occurs, the servo drive flexibly selects the protection mode based on the setting of H0A.00.

0: Enable

1: Disable

H0A.01 Absolute position limit

Comm. address:	200A-02h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	2	Data type:	UInt16
Default:	0	Change mode:	Real time:

Range:

0: Disabled

1: Enabled

2: Enabled after homing

Parameter description

Used to set the activation condition for enabling the software position limit function and the software limit.

0: Disabled

1: Enabled

2: Enabled after homing

H0A.04 Motor overload protection gain

Comm. address:	200A-05h	Effective mode:	Real time
Min.:	50	Unit:	-
Max.:	300	Data type:	UInt16
Default:	100	Change mode:	Real time

Range:

50 to 300

Parameter description

Determines the motor overload duration before E620.0 is reported when H32.70 is set to 0. Change the setpoint of 200A-05h to advance or delay the time when overload protection is triggered based on the motor heating condition. The setpoint 50% indicates the overload duration is cut by half; 150% indicates the overload duration is increased by 50%.

Set this parameter based on the actual heating condition of the motor.

H0A.08 Overspeed fault threshold

Comm. address:	200A-09h	Effective mode:	Real time
Min.:	0	Unit:	[mm/s]/[rpm]
Max.:	20000	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0 [mm/s]/[rpm] to 20000 [mm/s]/[rpm]

Parameter description

Defines the overspeed fault threshold of the motor.

H0A.10 **Threshold of excessive local position deviation**

Comm. address:	200A-0Bh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	4294967295	Data type:	UInt32
Default:	219895614	Change mode:	Real time:

Range:

0 to 4294967295

Parameter description

Defines the threshold for excessive position deviation in the position control mode, with the unit defined by H0A.17.

When the position deviation exceeds this threshold, the drive reports EB00.0 (Excessive position deviation).

H0A.12 **Runaway protection**

Comm. address:	200A-0Dh	Effective mode:	At stop
Min.:	0	Unit:	-
Max.:	2	Data type:	UInt16
Default:	1	Change mode:	At stop

Range:

0: Disable

1: Enable runaway protection scheme 1

2: Enable runaway protection scheme 2

Parameter description

Defines whether to enable runaway protection.

0: Mask E234 when the motor drives a vertical axis or is driven by the load.

1: Enable runway protection scheme 1

2: Enable runway protection scheme 2

H0A.13 **Angle auto-tuning mode**

Comm. address:	200A-0Eh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	10	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: Angle auto-tuning through pre-positioning

1: Angle auto-tuning through inching

2: Angle auto-tuning through voltage injection

6: Angle auto-tuning through static Hall

8: Angle auto-tuning through closed-loop pre-positioning

9: Angle auto-tuning through position lock

Parameter description

Motor angle auto-tuning mode
0: Angle auto-tuning through pre-positioning
1: Angle auto-tuning through inching
2: Angle auto-tuning through voltage injection
6: Angle auto-tuning through static Hall
8: Angle auto-tuning through closed-loop pre-positioning
9: Angle auto-tuning through position lock
Limits on the use of method 2:
1. The setpoint 2 is only applicable to motors with iron core. ROT and DDR can be used, and DDL is not recommended.
2. If other auto-tuning methods fail, perform the following test before using angle auto-tuning through voltage injection. Specifically, with continuous power-on and no software reset, perform angle auto-tuning through voltage injection at five different positions. Record each auto-tuning result (H00.28). Angle auto-tuning through voltage injection can be used only if the maximum deviation of the auto-tuning results is within 5400.

H0A.17 **Reference pulse selection**

Comm. address:	200A-12h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	1	Change mode:	At stop

Range:
0: Pulse unit
1: Reference unit
Parameter description
Used to set the unit for determining the threshold of excessive position deviation, positioning completion, and positioning proximity.
0: Pulse unit
1: Reference unit

H0A.18 **IGBT overtemperature threshold**

Comm. address:	200A-13h	Effective mode:	Real time
Min.:	120	Unit:	℃
Max.:	175	Data type:	UInt16
Default:	140	Change mode:	Real time

Range:
120 to 175
Parameter description
Defines the threshold for reporting E640.0 and E640.1.

H0A.19 **Filter time constant of touch probe 1**

Comm. address:	200A-14h	Effective mode:	Real time
Min.:	0.00	Unit:	μs
Max.:	6.30	Data type:	UInt16
Default:	2.00	Change mode:	Real time

Range:
0.00 to 6.30
Parameter description
Defines the filter time of touch probe 1.

H0A.20 **Filter time constant of touch probe 2**

Comm. address:	200A-15h	Effective mode:	Real time
Min.:	0.00	Unit:	μs
Max.:	6.30	Data type:	UInt16
Default:	2.00	Change mode:	Real time

Range:
0.00 to 6.30
Parameter description
Defines the filter time of touch probe 2.

H0A.21 **STO function display selection**

Comm. address:	200A-16h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	7	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
bit0: Show E150.0 fault
bit1: Inverting 60FD
bit2: Mask E150.5 fault
bit3 to bit15: N/A
Parameter description
STO function selection switch
bit0: STO display selection 0: The keypad displays "sto_" after the STO function is triggered. In this case, no fault is reported and no output is generated from the corresponding DO terminal. 1: The keypad displays "E150.0" after the STO function is triggered. In this case, the dive reports the fault and the corresponding DO terminal outputs the fault signal.
bit1: Displays selection of bit27 and bit25 of 60FDh 0: After STO is triggered, bit27 and bit28 of 60FDh = 1. 1: After STO is triggered, bit27 and bit28 of 60FDh = 0.
bit2: E150.5 fault hiding selection 0: Not hide E150.5; 1: Hide E150.5
bit3 to bit15: N/A

H0A.23 **TZ signal filter time**

Comm. address:	200A-18h	Effective mode:	Next power-on
Min.:	0	Unit:	25 ns
Max.:	31	Data type:	UInt16
Default:	15	Change mode:	At stop

Range:

Setting range: 0 to 31

Actual value range: 0 ns to 775 ns

Note: Actual value = Reference value x Unit

Parameter description

Defines the TZ signal filter time.

H0A.25 **Speed display DO low-pass filter time**

Comm. address:	200A-1Ah	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	5000	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0 ms to 5000 ms

Parameter description

Defines the low-pass filter time constant of the speed information for speed feedback and position references.

H0A.26 **Motor overload detection**

Comm. address:	200A-1Bh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Show motor overload alarm (E909.0) and fault (E620.0)

1: Mask motor overload alarm (E909.0) and fault (E620.0)

Parameter description

Defines whether to enable motor overload detection.

0: Show motor overload alarm (E909.0) and fault (E620.0)

1: Mask motor overload alarm (E909.0) and fault (E620.0)

H0A.27 **Average filter time for speed display DO**

Comm. address:	200A-1Ch	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	100	Data type:	UInt16
Default:	50	Change mode:	At stop

Range:

0 ms to 100 ms

Parameter description

Defines the the average filter time constant of the speed information for speed feedback and position references.

H0A.28 **ABZ encoder pulse signal filter time**

Comm. address:	200A-1Dh	Effective mode:	Next power-on
Min.:	0	Unit:	25 ns

Max.:	255	Data type:	UInt16
Default:	2	Change mode:	At stop

Range:

Setting range: 0 to 255

Actual value range: 0 ns to 6375 ns

Note: Actual value = Reference value x Unit

Parameter description

Defines the pulse signal filter time of the ABZ encoder that used as the primary encoder.

H0A.29 **Fully closed-loop encoder (ABZ) filter time**

Comm. address:	200A-1Eh	Effective mode:	Next power-on
Min.:	0	Unit:	25 ns
Max.:	65535	Data type:	UInt16
Default:	4111	Change mode:	At stop

Range:

bit0 to bit7: Fully closed-loop encoder (ABZ) pulse signal filter time

bit8 to bit15: Fully closed-loop encoder (ABZ) open circuit fault filter time

Parameter description

bit0 to bit7: Pulse signal filter time of the encoder in fully closed-loop mode (ABZ)

bit8 to bit15: Encoder (ABZ) open circuit fault filter time in fully closed-loop mode

H0A.32 **Time threshold for overtemperature protection upon motor stall**

Comm. address:	200A-21h	Effective mode:	Real time
Min.:	10	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	200	Change mode:	Real time

Range:

10 ms to 65535 ms

Parameter description

Defines the overtemperature duration before E630.0 (Motor stall) is detected by the drive. H0A.32 can be used to adjust the sensitivity of motor stall overtemperature detection.

H0A.33 **Motor stall overtemperature protection**

Comm. address:	200A-22h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	1	Change mode:	Real time

Range:

0: Disabled

1: Enabled

Parameter description

Defines whether to enable the detection for E630.0 (Motor stall overtemperature protection).

0: Disabled

1: Enabled

H0A.36 **Encoder multi-turn overflow fault selection**

Comm. address:	200A-25h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Not mask

1: Mask

Parameter description

When H02.01 is set to 1 and the multi-turn overflow fault need not be detected, set H0A.36 to 1 to mask this fault.

0: Not mask

1: Mask

H0A.37 **ABZ encoder open-circuit detection filter time**

Comm. address:	200A-26h	Effective mode:	Next power-on
Min.:	0	Unit:	25 ns
Max.:	255	Data type:	UInt16
Default:	200	Change mode:	At stop

Range:

Setting range: 0 to 255

Actual value range: 0 ns to 6375 ns

Note: Actual value = Reference value x Unit

Parameter description

Defines the open circuit detection filter time when the ABZ encoder is used as the primary encoder.

H0A.40 **Compensation function selection**

Comm. address:	200A-29h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x1F	Data type:	UInt16
Default value:	0x6	Change mode:	At stop

Value range:

bit0: Overtravel compensation

0: Enable

1: Disable

bit1: Touch probe rising edge compensation

0: Disable

1: Enable

bit2: Touch probe falling edge compensation

0: Disable

1: Enable

bit3: Touch probe solution

0: New solution

1: Old solution (same as SV660N)

bit4: Touch probe 2 independent compensation

0: Disable

1: Enable

bit5 to bit15: N/A

Parameter description

Selects overtravel and probe compensation functions.

bit0: Overtravel compensation

0: Compensation enabled

1: Compensation inhibited

bit1: Touch probe rising edge compensation

0: Not compensated

1: Compensated

bit2: Touch probe falling edge compensation

0: Not compensated

1: Compensated

bit3: Touch probe logic

0: Probe edge trigger coupled with DI logic

1: Probe edge trigger not coupled with DI logic

bit4: Touch probe 2 function selection

0: Disable

1: Enable

bit5 to bit15: N/A

H0A.41 **Positive position of software position limit**

Comm. address:	200A-2Ah	Effective mode:	Real time
Min.:	-2147483648	Unit:	Encoder unit
Max.:	2147483647	Data type:	Int32
Default:	2147483647	Change mode:	At stop

Range:

-2147483648 to +2147483647

Parameter description

When the absolute position counter (H0b.07) is higher than H0A.41, the drive reports E950.0 (Forward overtravel) and stops accordingly.

H0A.43 **Negative position of software position limit**

Comm. address:	200A-2Ch	Effective mode:	Real time
Min.:	-2147483648	Unit:	Encoder unit
Max.:	2147483647	Data type:	Int32
Default:	-2147483648	Change mode:	At stop

Range:

-2147483648 to +2147483647

Parameter description

When the absolute position counter (H0b.07) is lower than H0A.43, the drive reports E952.0 (Reverse overtravel) and stops accordingly.

H0A.49 **Braking resistor overtemperature threshold**

Hex:	200A-32h	Effective mode:	Real time
Min.:	100	Unit:	℃
Max.:	175	Data type:	UInt16
Default:	140	Change mode:	Real time

Range:

100 to 175

Parameter description

Defines the temperature threshold for braking resistor overload.

H0A.50 **Encoder communication fault tolerance threshold**

Comm. address:	200A-33h	Effective mode:	Next power-on
Min.:	0	Unit:	-
Max.:	31	Data type:	UInt16
Default:	31	Change mode:	Real time

Range:

0 to 31

Parameter description

When the number of communication failures between the encoder and the drive exceeds the number defined by H0A.50, the communication between the encoder and the drive fails.

H0A.51 **Phase loss detection filtering count**

Comm. address:	200A-34h	Effective mode:	Real time
Min.:	3	Unit:	55
Max.:	36	Data type:	UInt16
Default:	20	Change mode:	Real time

Range:

Setting range: 3 to 36

Actual value range: 165 ms to 1980 ms

Note: Actual value = Reference value x Unit

Parameter description

Phase loss fault is reported when phase loss keeps active for a period longer than H0A.51.

H0A.52 **Encoder temperature protection threshold**

Comm. address:	200A-35h	Effective mode:	Real time
Min.:	0	Unit:	℃
Max.:	175	Data type:	UInt16
Default:	120	Change mode:	Real time

Range:

0 to 175

Parameter description

Defines the temperature threshold for encoder overtemperature protection.

H0A.53 **Probe DI ON compensation time**

Comm. address:	200A-36h	Effective mode:	Real time
Min.:	-3000	Unit:	25 ns
Max.:	3000	Data type:	Int16
Default:	200	Change mode:	Real time

Range:

Setting range: -3000 to +3000

Actual value range: -75000 ns to +75000 ns

Note: Actual value = Reference value x Unit

Parameter description

Used to compensate for the action time when the touch probe is switched on.

H0A.54 **Probe DI OFF compensation time**

Comm. address:	200A-37h	Effective mode:	Real time
Min.:	-3000	Unit:	25 ns
Max.:	3000	Data type:	Int16
Default:	1512	Change mode:	Real time

Range:

Setting range: -3000 to +3000

Actual value range: -75000 ns to +75000 ns

Note: Actual value = Reference value x Unit

Parameter description

Used to compensate for the action time when the touch probe is switched off.

H0A.55 **Runaway current threshold**

Comm. address:	200A-38h	Effective mode:	Real time
Min.:	100.0	Unit:	%
Max.:	400.0	Data type:	UInt16
Default:	200.0	Change mode:	Real time

Range:

100.0% to 400.0%

Parameter description

Defines the current threshold for runaway protection detection.

H0A.56 **Fault reset delay**

Comm. address:	200A-39h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	60000	Data type:	UInt16
Default:	10000	Change mode:	Real time

Range:

0 ms to 60000 ms

Parameter description

Defines the fault reset delay.

H0A.57 **Runaway speed threshold**

Comm. address:	200A-3Ah	Effective mode:	Real time
Min.:	1	Unit:	[mm/s]/[rpm]
Max.:	1000	Data type:	UInt16
Default:	50	Change mode:	Real time

Range:

1 [mm/s]/[rpm] to 1000 [mm/s]/[rpm]

Parameter description

Defines the overspeed threshold for runaway protection detection.

H0A.58 **Runaway speed filter time**

Comm. address:	200A-3Bh	Effective mode:	Next power-on
Min.:	0.1	Unit:	ms
Max.:	100.0	Data type:	UInt16
Default:	2.0	Change mode:	Real time

Range:

0.1 ms to 100.0 ms

Parameter description

Defines the speed feedback filter time for runaway protection detection.

H0A.59 **Runaway protection detection time**

Comm. address:	200A-3Ch	Effective mode:	Real time
Min.:	10	Unit:	ms
Max.:	1000	Data type:	UInt16
Default:	30	Change mode:	Real time

Range:

10 ms to 1000 ms

Parameter description

The runaway fault is reported when the runaway state keeps active for a period longer than H0A.59.

H0A.60 **Black box function mode**

Comm. address:	200A-3Dh	Effective mode:	Real time

Min.:	0	Unit:	-
Max.:	3	Data type:	UInt16
Default:	1	Change mode:	Real time

Range:

0: Disable

1: Any fault

2: Designated fault

3: Triggered based on designated condition

Parameter description

Defines the condition for triggering black box sampling.

0: Disable

1: Any fault

2: Designated fault

3: Triggered based on designated condition

H0A.61 **Designated fault code**

Comm. address:	200A-3Eh	Effective mode:	Real time
Min.:	0.0	Unit:	-
Max.:	6553.5	Data type:	UInt16
Default:	0.0	Change mode:	Real time

Range:

0.0 to 6553.5

Parameter description

Defines the fault code for triggering the black box function.

H0A.62 **Trigger source**

Comm. address:	200A-3Fh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	27	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0 to 27

Parameter description

Defines the fault code for triggering the black box function through designated channel.

H0A.63 **Trigger level**

Comm. address:	200A-40h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Defines the trigger level for triggering the black box function through designated channel.

H0A.65 **Trigger level**

Comm. address:	200A-42h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	3	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Rising edge

1: Equal

2: Falling edge

3: Edge-triggered

Parameter description

Defines the trigger mode for triggering the black box function through H0A.63.

0: Rising edge

1: Equal

2: Falling edge

3: Edge-triggered

H0A.66 **Trigger position**

Comm. address:	200A-43h	Effective mode:	Real time
Min.:	0	Unit:	%
Max.:	100	Data type:	UInt16
Default:	75	Change mode:	Real time

Range:

0% to 100%

Parameter description

Defines the pre-trigger position for triggering black box sampling.

H0A.67 **Sampling frequency**

Comm. address:	200A-44h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	2	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Current loop

1: Position loop

2: Main cycle

Parameter description

Defines the frequency sampling mode during black box sampling.

0: Current loop

1: Position loop

2: Main cycle

H0A.70 **Overspeed threshold 2**

Comm. address:	200A-47h	Effective mode:	Real time

Min.:	0	Unit:	[mm/s]/[rpm]
Max.:	20000	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0 [mm/s]/[rpm] to 20000 [mm/s]/[rpm]

Parameter description

Defines the speed threshold for reporting E500.2 (Position feedback pulse overspeed).

H0A.71 **Internal function switchover switch**

Comm. address:	200A-48h	Effective mode:	Next power-on
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	4098	Change mode:	Real time

Range:

0 to 65535

Parameter description

bit0:

0: New overload curve

1: Old overload curve

bit1:

0: Enable discharging switch upon power failure

1: Mask discharging switch upon power failure

bit2:

0: Forced stop

1: No forced stop

bit3:

0: New feature used for multi-speed DI mode

1: Old feature used for multi-speed DI mode

bit4:

0: Mask the alarm indicating that the power rating of the drive is too low to drive the motor

1: Show the alarm indicating that the power rating of the drive is too low to drive the motor

bit5:

0: Parameter read/write inhibition not enabled

1: Parameter read/write inhibition enabled

bit6:

0: Show alarm 108.4

1: Mask alarm 108.4

bit7: CSV command interpolation mode

0: Sync interrupt interpolation 1

: IRQ interrupt interpolation

bit8:

0: 16-bit data type used for the rated motor current, inertia, and back EMF coefficient

1: 32-bit data type is used for the rated motor current, inertia, and back potential coefficient

bit9:

0: Enable the open circuit detection function

1: Disable the open circuit detection function

bit10:

0: Torque limit source switched automatically according to H02.00

1: Set through H07.09 and H07.10

bit11:
0: Ultra-accurate speed feedback switch turned off

1: Ultra-accurate speed feedback switch turned on

bit12:
0: Homing completion flag bit not saved upon power failure

1: Homing completion flag bit saved upon power failure

bit13:
STO status word rollback switch
0: Switch on disable

1: Fault

bit14:
0: Enable the encoder adaptive function switch

1: Disable the encoder adaptive function switch

bit15:
0: Interrupt positioning determined by current motor running direction

1: Interrupt positioning determined by parameter

H0A.72 **Maximum stop time in ramp-to-stop**

Comm. address:	200A-49h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	10000	Change mode:	At stop

Range:
0 ms to 65535 ms
Parameter description
Defines the time for the motor to decelerate from the maximum speed to 0 [mm/s]/[rpm] during ramp-to-stop.

H0A.73 **STO 24 V disconnection filter time**

Comm. address:	200A-4Ah	Effective mode:	Real time
Min.:	1	Unit:	ms
Max.:	5	Data type:	UInt16
Default:	1	Change mode:	Real time

Range:
1 ms to 5 ms
Parameter description
Defines the delay from the moment when 24 V is disconnected to the moment when the STO state applies.

H0A.74 **Filter time for two inconsistent STO channels**

Comm. address:	200A-4Bh	Effective mode:	Real time
Min.:	1	Unit:	ms
Max.:	1000	Data type:	UInt16
Default:	100	Change mode:	Real time

Range:
1 ms to 1000 ms
Parameter description
Defines the delay from the moment the inconsistent 24V is input to the drive through two channels to the moment when the STO state applies.

H0A.75 **Servo OFF delay after STO triggered**

Comm. address:	200A-4Ch	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	25	Data type:	UInt16
Default:	20	Change mode:	Real time

Range:
0 ms to 25 ms
Parameter description
Defines the delay from the moment the STO state is triggered to the moment the S-ON signal is switched off.

H0A.81 **Voltage drop protection enable**

Comm. address:	200 A-52h	Effective mode:	Next power-on
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0: No operation
1: Host controller executes torque limit
2: Servo executes torque limit
Parameter description
Defines whether to enable voltage drop protection:
0: Not detected
1: Host controller executes torque limit
2: Servo executes torque limit

H0A.82 **Voltage drop torque limit**

Comm. address:	200 A-53h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	Real time

Value range:
0.0 to 100.0
Parameter description
Defines the voltage drop torque limit.

H0A.83 **Torque limit cancellation time**

Comm. address:	200 A-54h	Effective mode:	Real time

Min. value:	0	Unit:	ms
Max. value:	1000	Data type:	UInt16
Default value:	100	Change mode:	Real time

Value range:
0 to 1000
Parameter description
Defines the torque limit deactivation time.

H0A.84 **Hold time of instantaneous power failure**

Comm. address:	200 A-55h	Effective mode:	Real time
Min. value:	20	Unit:	ms
Max. value:	50000	Data type:	UInt16
Default value:	1000	Change mode:	Real time

Value range:
20 to 50000
Parameter description
Defines the instantaneous power failure hold time.

H0A.85 **Open circuit detection torque reference**

Comm. address:	200A-56h	Effective mode:	Real time
Min. value:	4.0	Unit:	%
Max. value:	400.0	Data type:	UInt16
Default value:	5.0	Change mode:	At stop

Value range:
4.0 to 400.0
Parameter description
Defines the open circuit detection torque reference.

H0A.86 **Open circuit detection filter time**

Comm. address:	200A-57h	Effective mode:	Real time
Min. value:	5	Unit:	ms
Max. value:	1000	Data type:	UInt16
Default value:	30	Change mode:	At stop

Value range:
5 to 1000
Parameter description
Defines the open circuit detection filter time.

H0A.87 **Hall status fault filtering count**

Comm. address:	200A-58h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1000	Data type:	UInt16
Default:	1	Change mode:	Real time

Range:
0 to 1000
Parameter description
Defines the Hall state monitoring filter count. If the Hall state is detected to be 0 or 7 continuously and exceeds the value defined by H0A.57, A34.0 (Hall state error) can be reported.

H0A.88 **Alarm selection**

Comm. address:	200A-59h	Effective mode:	Next power-on
Min.:	0	Unit:	-
Max.:	3	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 3
Parameter description
bit0: Defines whether to enable original BiSS-C data alarm function, which is only applicable to the encoder that adopts BiSS-C protocol.
bit1: Mask the undervoltage alarm (E971.0) for voltage drop protection

H0A.89 **Correct state of BiSS-C data**

Comm. address:	200A-5Ah	Effective mode:	Next power-on
Min. value:	0	Unit:	-
Max. value:	31	Data type:	UInt16
Default value:	3	Change mode:	At stop

Value range:
0 to 31
Parameter description
Defines the status bit state during normal operation of BiSS-C.

H0A.90 **Speed display low-pass filter time**

Comm. address:	200A-5Bh	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	100	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 ms to 100 ms
Parameter description
Defines the low-pass filter time constant for displayed speed values.

H0A.91 **Moving average filter time for displayed torque values**

Comm. address:	200A-5Ch	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	100	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0 ms to 100 ms

Parameter description

Defines the moving average filter time constant for displayed torque values.

H0A.92 **Moving average filter time for displayed position values**

Comm. address:	200A-5Dh	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	100	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0 ms to 100 ms

Parameter description

Defines the moving average filter time constant for displayed position values.

H0A.93 **Low-pass filter time for displayed voltage values**

Comm. address:	200A-5Eh	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	250	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0 ms to 250 ms

Parameter description

Defines the low-pass filter time constant for displayed voltage values.

H0A.94 **Low-pass filter time for displayed thermal values**

Comm. address:	200A-5Fh	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	250	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0 ms to 250 ms

Parameter description

Defines the low-pass filter time constant for displayed thermal values.

10.12 H0b Monitoring Parameters

H0b.00 **Actual motor speed**

Comm. address:	200b-01h	Effective mode:	-
Min.:	-32767	Unit:	[mm/s]/[rpm]
Max.:	32767	Data type:	Int16
Default:	0	Change mode:	Read only

Range:

-32767 [mm/s]/[rpm] to +32767 [mm/s]/[rpm]

Parameter description

Indicates the actual motor speed after round-off, which is accurate to 1 (mm/s)/RPM.
You can set in H0A.25 the filter time constant for H0b.00.

H0b.01 Speed reference

Comm. address:	200b-02h	Effective mode:	-
Min.:	-32767	Unit:	[mm/s]/[rpm]
Max.:	32767	Data type:	Int16
Default:	0	Change mode:	Read only

Range:

-32767 [mm/s]/[rpm] to +32767 [mm/s]/[rpm]

Parameter description

Indicates the present speed reference (accurate to 1 [mm/s]/[rpm]) of the drive in the position and speed control modes.

H0b.02 Internal torque reference

Comm. address:	200b-03h	Effective mode:	-
Min.:	-3276.7	Unit:	%
Max.:	3276.7	Data type:	Int16
Default:	0.0	Change mode:	Read only

Range:

-3276.7% to +3276.7%

Parameter description

Displays the current torque reference in unit of 0.1%. The value 100.0% corresponds to the rated motor torque.

H0b.03 Input (DI) signal monitoring

Comm. address:	200b-04h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:

0 to 65535

Parameter description

Displays the level status of five DI terminals without filtering.
Upper LED segments ON: high level (indicated by "1"); Lower LED segments ON: low level (indicated by "0")

H0b.05 Output (DO) signal monitoring

Comm. address:	200b-06h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0 to 65535
Parameter description
Displays the level status of 2 DO terminals without filtering.
Upper LED segments ON: high level (indicated by "1"); Lower LED segments ON: low level (indicated by "0")

H0b.07 **Absolute position counter**

Comm. address:	200b-08h	Effective mode:	-
Min.:	-2147483648	Unit:	Reference unit
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Read only

Range:
-2147483648 to +2147483647
Parameter description
Displays current absolute position of the motor in reference unit.
This parameter is a 32-bit integer, which is displayed as a decimal on the keypad.

H0b.09 **Mechanical angle**

Comm. address:	200b-0Ah	Effective mode:	-
Min.:	0.0	Unit:	°
Max.:	360.0	Data type:	UInt16
Default:	0.0	Change mode:	Read only

Range:
0.0 to 360.0
Parameter description
Displays present mechanical angle in encoder unit of the motor. The setpoint 0 indicates the mechanical angle is 0°.
Actual mechanical angle = 360° x H0b.09/(Maximum value of H0b.09 + 1)

Maximum value of H0b.09 for an absolute encoder is 65535.

H0b.10 **Electrical angle**

Comm. address:	200b-0Bh	Effective mode:	-
Min.:	0.0	Unit:	°
Max.:	360.0	Data type:	UInt16
Default:	0.0	Change mode:	Read only

Range:
0.0 to 360.0
Parameter description
Displays present electrical angle of the motor, with an accuracy of 0.1°.
The electrical angle variation range is ±360.0° during rotation. If the motor has four pairs of poles, each revolution generates four rounds of angle change from 0° to 359°. Similarly, if the motor has five pairs of poles, each revolution generates five rounds of angle change from 0° to 359°.

H0b.12 **Average load ratio**

Comm. address:	200b-0Dh	Effective mode:	-
Min.:	0.0	Unit:	%
Max.:	800.0	Data type:	UInt16
Default:	0.0	Change mode:	Read only

Range:

0.0% to 800.0%

Parameter description

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.

H0b.15 **Position following error (encoder unit)**

Comm. address:	200b-10h	Effective mode:	-
Min.:	-2147483648	Unit:	Encoder unit
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Read only

Range:

-2147483648 to +2147483647

Parameter description

Displays the position deviation value after being divided/multiplied by the electronic gear ratio in the position control mode.

This parameter is a 32-bit integer, which is displayed as a decimal on the keypad.

Note:

H0b.15 can be clear when the condition defined in H05.16 (Clear action) is met.

H0b.17 **Feedback pulse counter**

Comm. address:	200b-12h	Effective mode:	-
Min.:	-2147483648	Unit:	Encoder unit
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Read only

Range:

-2147483648 to +2147483647

Parameter description

Displays the number of position pulses fed back by the encoder in any control mode.

This parameter is a 32-bit integer, which is displayed as a decimal on the keypad.

H0b.19 **Total power-on time**

Comm. address:	200b-14h	Effective mode:	-
Min.:	0.0	Unit:	s
Max.:	429496729.5	Data type:	UInt32
Default:	0.0	Change mode:	Read only

Range:

0.0s to 429496729.5s

Parameter description

Displays the total operating time of the drive.
This parameter is a 32-bit integer, which is displayed as a decimal on the keypad.
Note:
If the servo drive is switched on and off repeatedly within a short period of time, a deviation within 1h may be present in the total power-on time record.

H0b.21 Displayed AI1 voltage

Comm. address:	200b-16h	Effective mode:	-
Min.:	-327.67	Unit:	V
Max.:	327.67	Data type:	Int16
Default:	0.00	Change mode:	Read only

Range:
-327.67 V to +327.67 V
Parameter description
Displays the actual sampling voltage of channel 1.

H0b.22 Displayed AI2 voltage

Comm. address:	200b-17h	Effective mode:	-
Min.:	-327.67	Unit:	V
Max.:	327.67	Data type:	Int16
Default:	0.00	Change mode:	Read only

Range:
-327.67 V to +327.67 V
Parameter description
Displays the actual sampling voltage of channel 2.

H0b.24 Effective value of phase current

Comm. address:	200b-19h	Effective mode:	-
Min.:	0.0	Unit:	A
Max.:	6553.5	Data type:	UInt16
Default:	0.0	Change mode:	Read only

Range:
0.0 A to 6553.5 A
Parameter description
Displays the effective value of the phase current of the motor in unit of 0.1 A.

H0b.25 Angle obtained upon voltage injection auto-tuning

Comm. address:	200b-1Ah	Effective mode:	-
Min.:	0.0	Unit:	°
Max.:	360.0	Data type:	UInt16
Default:	0.0	Change mode:	Read only

Range:
0.0 to 360.0

Parameter description

Displays the angle obtained upon auto-tuning through voltage injection.

H0b.26 Bus voltage

Comm. address:	200b-1Bh	Effective mode:	-
Min.:	0.0	Unit:	V
Max.:	6553.5	Data type:	UInt16
Default:	0.0	Change mode:	Read only

Range:

0.0 V to 6553.5 V

Parameter description

Displays the DC bus voltage of the main circuit input voltage after rectification, with an accuracy of 0.01 V.

H0b.27 Module temperature

Comm. address:	200b-1Ch	Effective mode:	-
Min.:	-20	Unit:	℃
Max.:	200	Data type:	Int16
Default:	0	Change mode:	Read only

Range:

-20℃ to 200℃

Parameter description

Displays the temperature of the module inside the drive, which can be used as a reference for estimating the actual temperature of the drive.

H0b.28 Absolute encoder fault information sent by FPGA

Comm. address:	200b-1Dh	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFF

Parameter description

Displays the absolute encoder fault information sent by FPGA.

H0b.29 Axis status information sent by FPGA

Comm. address:	200b-1Eh	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFF

Parameter description

Displays the axis status information sent by FPGA.

H0b.30 **Axis fault information sent by FPGA**

Comm. address:	200b-1Fh	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFF

Parameter description

Displays the axis fault information sent by FPGA.

H0b.31 **Encoder fault information**

Comm. address:	200b-20h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFF

Parameter description

Displays the internal fault information of the encoder.

H0b.33 **Fault log**

Comm. address:	200b-22h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	19	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Present fault
1: Last fault
2: 2nd to last fault
3: 3rd to last fault
4: 4th to last fault
5: 5th to last fault 6: 6th to last fault
7: 7th to last fault
8: 8th to last fault
9: 9th to last fault
10: 10th to last fault
11: 11th to last fault
12: 12th to last fault
13: 13th to last fault
14: 14th to last fault
15: 15th to last fault
16: 16th to last fault
17: 17th to last fault
18: 18th to last fault
19: 19th to last fault

Parameter description

Used to view the latest 20 faults of the drive.

0: Present fault
1: Last fault
2: 2nd to last fault
3: 3rd to last fault
4: 4th to last fault
5: 5th to last fault 6: 6th to last fault
7: 7th to last fault
8: 8th to last fault
9: 9th to last fault
10: 10th to last fault
11: 11th to last fault
12: 12th to last fault
13: 13th to last fault
14: 14th to last fault
15: 15th to last fault
16: 16th to last fault
17: 17th to last fault
18: 18th to last fault
19: 19th to last fault

H0b.34 **Fault code of the selected fault**

Comm. address:	200b-23h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFF
Parameter description
Displays the fault code of the selected fault.

H0b.35 Timestamp of the selected fault

Comm. address:	200b-24h	Effective mode:	-
Min.:	0.0	Unit:	s
Max.:	429496729.5	Data type:	UInt32
Default:	0.0	Change mode:	Read only

Range:
0.0s to 429496729.5s
Parameter description
Displays the time stamp of the selected fault.

H0b.37 Motor speed upon occurrence of the selected fault

Comm. address:	200b-26h	Effective mode:	-
Min.:	-32767	Unit:	[mm/s]/[rpm]
Max.:	32767	Data type:	Int16
Default:	0	Change mode:	Read only

Range:
-32767 [mm/s]/[rpm] to +32767 [mm/s]/[rpm]
Parameter description
Displays the motor speed upon occurrence of the selected fault.

H0b.38 Motor phase U current upon occurrence of the selected fault

Comm. address:	200b-27h	Effective mode:	-
Min.:	-3276.7	Unit:	A
Max.:	3276.7	Data type:	Int16
Default:	0.0	Change mode:	Read only

Range:
-3276.7 A to +3276.7 A
Parameter description
Displays the motor phase U current upon occurrence of the selected fault.

H0b.39 Motor phase V current upon occurrence of the selected fault

Comm. address:	200b-28h	Effective mode:	-
Min.:	-3276.7	Unit:	A
Max.:	3276.7	Data type:	Int16
Default:	0.0	Change mode:	Read only

Range:
-3276.7 A to +3276.7 A
Parameter description
Displays the motor phase V current upon occurrence of the selected fault.

H0b.40 **Bus voltage upon occurrence of the selected fault**

Comm. address:	200b-29h	Effective mode:	-
Min.:	0.0	Unit:	V
Max.:	6553.5	Data type:	UInt16
Default:	0.0	Change mode:	Read only

Range:

0.0 V to 6553.5 V

Parameter description

Displays the bus voltage upon occurrence of the selected fault.

H0b.41 **Input terminal state upon the selected fault**

Comm. address:	200b-2Ah	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:

0 to 65535

Parameter description

Displays the input terminal state upon the selected fault.

H0b.43 **Output terminal status upon the selected fault**

Comm. address:	200b-2Ch	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:

0 to 65535

Parameter description

Displays the output terminal status upon occurrence of the selected fault.

H0b.45 **Internal fault code**

Comm. address:	200b-2Eh	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFF

Parameter description

Displays the internal fault code.

H0b.46 **Absolute encoder fault information sent by FPGA upon occurrence of the selected fault**

Comm. address:	200b-2Fh	Effective mode:	-
Min.:	0x0	Unit:	-

Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFF
Parameter description
Displays the absolute encoder fault information sent by FPGA upon occurrence of the selected fault.

H0b.47 System status information sent by FPGA upon occurrence of the selected fault

Comm. address:	200b-30h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFF
Parameter description
Displays the system status information sent by FPGA upon occurrence of the selected fault.

H0b.48 System fault information sent by FPGA upon occurrence of the selected fault

Comm. address:	200b-31h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFF
Parameter description
Displays the system fault information sent by FPGA upon occurrence of the selected fault.

H0b.49 Encoder fault information upon occurrence of the selected fault

Comm. address:	200b-32h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFF
Parameter description
Displays the encoder fault information upon occurrence of the selected fault.

H0b.51 Internal fault code upon occurrence of the selected fault

Comm. address:	200b-34h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFF
Parameter description
Displays the internal fault code upon occurrence of the selected fault.

H0b.52 FPGA timeout fault standard bit upon the selected fault

Comm. address:	200b-35h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFF
Parameter description
Displays the FPGA timeout fault standard bit upon occurrence of the selected fault.

H0b.53 Position following error (reference unit)

Comm. address:	200b-36h	Effective mode:	-
Min.:	-2147483648	Unit:	Reference unit
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Read only

Range:
-2147483648 to +2147483647
Parameter description
Displays the position deviation value which has not been divided or multiplied by the electronic gear ratio in the position control mode.
Position deviation (in reference unit) is the value obtained after encoder position deviation calculation. The precision is compromised during division.
This parameter is a 32-bit integer, which is displayed as a decimal on the keypad.

H0b.55 Actual motor speed 2

Comm. address:	200b-38h	Effective mode:	-
Min.:	-214748364.8	Unit:	[mm/s]/[rpm]
Max.:	214748364.7	Data type:	Int32
Default:	0.0	Change mode:	Read only

Range:
-214748364.8 [mm/s]/[rpm] to +214748364.7 [mm/s]/[rpm]
Parameter description
Indicates the actual value of motor speed, which is accurate to 0.1 [mm/s]/[rpm].
This parameter is a 32-bit integer, which is displayed as a decimal on the keypad.
You can set the filter time constant for the speed feedback through H0A.25.

H0b.57 Control circuit bus voltage

Comm. address:	200b-3Ah	Effective mode:	-
Min.:	0.0	Unit:	V
Max.:	6553.5	Data type:	UInt16

Default:	0.0	Change mode:	Read only

Range:
0.0 V to 6553.5 V
Parameter description
Displays the bus voltage of the control circuit.

H0b.58 Mechanical absolute position (low 32 bits)

Comm. address:	200b-3Bh	Effective mode:	-
Min.:	0	Unit:	Encoder unit
Max.:	4294967295	Data type:	UInt32
Default:	0	Change mode:	Read only

Range:
0 to 4294967295
Parameter description
Displays the low 32-bit value (encoder unit) of the mechanical position feedback when the absolute encoder is used.

H0b.60 Mechanical absolute position (high 32 bits)

Comm. address:	200b-3Dh	Effective mode:	-
Min.:	-2147483648	Unit:	Encoder unit
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Read only

Range:
-2147483648 to +2147483647
Parameter description
Displays the high 32-bit value (encoder unit) of the mechanical position feedback when the absolute encoder is used.

H0b.63 NotRdy state

Comm. address:	200b-40h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	9	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0: Normal
1: Control circuit error
2: Main circuit input error
3: Bus undervoltage
4: Soft start failed
5: Encoder initialization not done
6: Short circuit to ground failed
7: Others
8: STO
9: Initialization of fully closed-loop encoder not done

Parameter description

Displays the reason for the NRD state.

0: Normal

1: Control circuit error

2: Main circuit input error

3: Bus undervoltage

4: Soft start failed

5: Encoder initialization not done

6: Short circuit to ground failed

7: Others

8: STO

9: Initialization of fully closed-loop encoder not done

H0b.66 Encoder temperature

Comm. address:	200b-43h	Effective mode:	-
Min.:	-32768	Unit:	℃
Max.:	32767	Data type:	Int16
Default:	0	Change mode:	Read only

Range:

-32768℃ to +32767℃

Parameter description

Indicates the encoder temperature.

H0b.67 Load rate of the braking resistor

Comm. address:	200b-44h	Effective mode:	-
Min.:	0.0	Unit:	%
Max.:	200.0	Data type:	UInt16
Default:	0.0	Change mode:	Read only

Range:

0.0% to 200.0%

Parameter description

Displays the load rate of the braking resistor.

H0b.70 Number of absolute encoder revolutions

Comm. address:	200b-47h	Effective mode:	-
Min.:	-32768	Unit:	Rev
Max.:	32767	Data type:	Int16
Default:	0	Change mode:	Read only

Range:

-32768 to +32767

Parameter description

Displays the number of revolutions of the absolute encoder.

H0b.71 **Position fed back by the absolute encoder within one turn**

Comm. address:	200b-48h	Effective mode:	-
Min.:	0	Unit:	Encoder unit
Max.:	2147483647	Data type:	UInt32
Default:	0	Change mode:	Read only

Range:

0 to 2147483647

Parameter description

Displays the single-turn position feedback of the absolute encoder.

H0b.74 **System fault information sent by FPGA**

Comm. address:	200b-4Bh	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFF

Parameter description

Displays the system fault information sent by FPGA.

H0b.77 **Encoder position (low 32 bits)**

Comm. address:	200b-4Eh	Effective mode:	-
Min.:	0	Unit:	Encoder unit
Max.:	4294967295	Data type:	UInt32
Default:	0	Change mode:	Read only

Range:

0 to 4294967295

Parameter description

Displays the low 32-bit data of the position feedback of the absolute encoder.

H0b.79 **Encoder position (high 32 bits)**

Comm. address:	200b-50h	Effective mode:	-
Min.:	-2147483648	Unit:	Encoder unit
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Read only

Range:

-2147483648 to +2147483647

Parameter description

Displays the high 32-bit data of the position feedback of the absolute encoder.

H0b.81 **Single-turn position of the rotary load (low 32 bits)**

Comm. address:	200b-52h	Effective mode:	-
Min.:	0	Unit:	Encoder unit

Max.:	4294967295	Data type:	UInt32
Default:	0	Change mode:	Read only

Range:
0 to 4294967295
Parameter description
Displays the low 32-bit data of the position feedback of the rotary load when the absolute system works in the rotation mode.

H0b.83 Single-turn position of the rotary load (high 32 bits)

Comm. address:	200b-54h	Effective mode:	-
Min.:	-2147483648	Unit:	Encoder unit
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Read only

Range:
-2147483648 to +2147483647
Parameter description
Displays the high 32-bit data of the position feedback of the rotary load when the absolute system works in the rotation mode.

H0b.85 Single-turn position of the rotary load (reference unit)

Comm. address:	200b-56h	Effective mode:	-
Min.:	0	Unit:	Reference unit
Max.:	4294967295	Data type:	UInt32
Default:	0	Change mode:	Read only

Range:
0 to 4294967295
Parameter description
Displays the high 32-bit data of the position feedback of the rotary load when the absolute system works in the rotation mode.

H0b.87 IGBT junction temperature

Comm. address:	200b-58h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	200	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0 to 200
Parameter description
Displays the IGBT junction temperature.

H0b.90 Group No. of the abnormal parameter

Comm. address:	200b-5Bh	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16

Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFF
Parameter description
Displays the group No. of the abnormal parameter.

H0b.91 Offset within the group of the abnormal parameter

Comm. address:	200b-5Ch	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0 to 65535
Parameter description
Displays the offset within the group of the abnormal parameter.

H0b.92 Hall state check

Comm. address:	200b-5Dh	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0 to 65535
Parameter description
Displays the Hall state.

H0b.93 Closed loop state

Comm. address:	200b-5Eh	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0: Semi closed-loop
1: Fully closed-loop
Parameter description
Displays the closed loop state in position control mode.
0: Semi closed-loop
1: Fully closed-loop

H0b.94 Individual power-on time

Comm. address:	200b-5Fh	Effective mode:	-
Min.:	0.0	Unit:	s
Max.:	429496729.5	Data type:	UInt32

Default:	0.0	Change mode:	Read only

Range:
0.0s to 429496729.5s
Parameter description
Display the individual power-on time of the drive.

H0b.96 **Individual power-on time upon the selected fault**

Comm. address:	200b-61h	Effective mode:	-
Min.:	0.0	Unit:	s
Max.:	429496729.5	Data type:	UInt32
Default:	0.0	Change mode:	Read only

Range:
0.0s to 429496729.5s
Parameter description
Displays the individual power-on time upon occurrence of the selected fault.

H0b.98 **Dynamic braking resistor load rate**

Comm. address:	200b-63h	Effective mode:	-
Min.:	0.0	Unit:	%
Max.:	200.0	Data type:	UInt16
Default:	0.0	Change mode:	Read only

Range:
0.0% to 200.0%
Parameter description
Displays the load rate of dynamic braking resistor.

10.13 H0C Fault and Protection Parameters 2

H0C.53 **Probe DI ON compensation time 2**

Comm. address:	200C-36h	Effective mode:	Real time
Min.:	-3000	Unit:	25 ns
Max.:	3000	Data type:	Int16
Default:	200	Change mode:	Real time:

Range:
Setting range: -3000 to +3000

Actual value range: -75000 ns to +75000 ns

Note: Actual value = Reference value x Unit
Parameter description
Used to compensate for the action time when the touch probe 2 is switched on. (Active when bit4=1)

H0C.54 **Probe DI OFF compensation time 2**

Comm. address:	200C-37h	Effective mode:	Real time
Min.:	-3000	Unit:	25 ns
Max.:	3000	Data type:	Int16
Default:	1512	Change mode:	Real time:

Range:

Setting range: -3000 to +3000

Actual value range: -75000 ns to +75000 ns

Note: Actual value = Reference value x Unit

Parameter description

Used to compensate for the action time when the touch probe 2 is switched off. (Active when bit4 of H0A.40 is set to 1)

H0C.71 **Internal function switchover switch 2**

Comm. address:	200C-48h	Effective mode:	Next power-on
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	512	Change mode:	Real time

Range:

0 to 65535

Parameter description

bit9: Switch for masking FPGA encoder feedback overspeed threshold

H0C.72 **Internal function switchover switch 3**

Comm. address:	200C-49h	Effective mode:	Next power-on
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0 to 65535

Parameter description

bit6: Fault level switchover function switch

0: Supported

1: Not supported

bit10: Whether to upload E08.7 error frame alarm signal to the host controller

0: Upload

1: Not upload

H0C.73 **Internal function switch 4**

Comm. address:	200C-4Ah	Effective mode:	Next power-on
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 65535
Parameter description
bit1: Anti-voltage dip function, which automatically switches to the baud rate of 2 M at power-on, preventing E136 and E740 (Voltage dip) alarms.
0: ON
1: OFF
bit2: Overcurrent detection scheme switchover
0: New scheme 202/203
1: Old scheme 201
bit4: Whether E601.3 is enabled after E740.0 is reported and homing is completed in incremental mode
0: ON
1: OFF
bit11: bit5 to bit11 of 60FD display the safety DI status switch
0: Enable
1: Disable

H0C.80 **Fault level selection register**

Comm. address:	200C-51h	Effective mode:	Next power-on
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
bit0 to bit3: E234.0
0: Default
1: Level 1 non-resettable
2: Level 1 resettable
bit4 to bit7: EB00.0
0: Default
2: Level 1 resettable
4: Level 2 resettable
bit8 to bit11: EB00.1
0: Default
2: Level 1 resettable
4: Level 2 resettable
bit12 to bit15: E234.1
0: Default
1: Level 1 non-resettable
2: Level 1 resettable
Parameter description
bit0 to bit3: E234.0 supports escalation/deescalation of level 1 non-resettable and level 1 resettable faults
bit4 to bit7: EB00.0 supports the escalation/deescalation of level 1 resettable and level 2 resettable faults
bit8 to bit11: EB00.1 supports the escalation/deescalation of level 1 resettable and level 2 resettable faults
bit12 to bit15: E234.1 supports escalation/deescalation of level 1 non-resettable and level 1 resettable faults

10.14 H0d Auxiliary Function Parameters

H0d.00 **Software reset**

Comm. address:	200d-01h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: Not apply

1: Enable

Parameter description

0: Not apply

1: Enable

Programs in the drive are reset automatically (similar to the program reset upon power-on) after the software reset function is enabled, without the need for a power cycle.

H0d.01 **Fault reset**

Comm. address:	200d-02h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: Not apply

1: Enable

Parameter description

0: Not apply

1: Enable

When a No. 1 or No. 2 resettable fault occurs, you can enable the fault reset function in the non-operational state after rectifying the fault cause, stopping the keypad from displaying the fault and allowing the drive to enter the "rdy" state.

When a No. 3 alarm occurs, you can enable the fault reset function directly, regardless of the servo drive status.

H0d.02 **Inertia auto-tuning**

Comm. address:	200d-03h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0 to 65

Parameter description

Used to enable offline inertia auto-tuning through the keypad. In the parameter display mode, switch to H0d.02 and press the SET key to enable offline inertia auto-tuning.

H0d.04 **Read/Write in encoder ROM**

Comm. address:	200d-05h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	3	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: No operation

1: Write ROM

2: Read ROM

3: ROM failure

Parameter description

For Inovance encoders, parameters are activated at next power-on of the USB and control circuit after data are written to ROM. Ensure that the drive is powered on during parameter writing.

0: No operation

1: Write ROM

2: Read ROM

3: ROM failure

H0d.05 **Emergency stop**

Comm. address:	200d-06h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Not apply

1: Emergency stop

Parameter description

Enable the emergency stop through parameters.

0: Not apply

1: Enable

Note: The stop mode corresponding to H0D.05 is defined by H02_05 or 605C.

H0d.06 **Current loop auto-tuning test**

Comm. address:	200d-07h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	6	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: Not apply

1: Enable current loop auto-tuning

2: Enable current loop step test (static)

3: Enable current loop step test

Parameter description

0: Not apply

1: Enable current loop auto-tuning

2: Enable current loop step test (static)

3: Enable current loop step test

H0d.10 Auto-tuning of analog channel

Comm. address:	200d-0Bh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	2	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: Not apply

1: Adjust AI1

2: Adjust AI2

Parameter description

When automatic adjustment of the analog channel is enabled, the drive automatically corrects the zero drift voltage of the analog channel to improve signal detection accuracy.

0: Not apply

1: Adjust AI1

2: Adjust AI2

H0d.12 Phase U/V current balance calibration

Comm. address:	200d-0Dh	Effective mode:	Next power-on
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: Disable

1: Enable

Parameter description

Used to enable phase U/V current balance calibration.

0: Disable

1: Enable

H0d.17 Forced DI/DO switch

Comm. address:	200d-12h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

bit0: Forced DI switch

0: Disable

1: Enable

bit1: Forced DO switch

0: Disable

1: Enable

bit2 to bit15: N/A

Parameter description

Defines whether to enable forced DI/DO.

bit0: defines whether to enable forced DI.

0: Disable

1: Enable

bit1: Defines whether to enable forced DO

0: Disable

1: Enable

bit2 to bit15: N/A

H0d.18 Forced DI value

Comm. address:	200d-13h	Effective mode:	Real time
Min.:	0x0	Unit:	-
Max.:	0x1F	Data type:	UInt16
Default:	0x1F	Change mode:	Real time

Range:

0x0 to 0x1F

Parameter description

Defines whether the DI functions set in group H03 is active when forced DI is activated (H0d.17 = 1 or 3).

H0d.18 is displayed in hex on the keypad. In the converted binary value, bit(n) = 1 indicates that the DI is active high, and bit(n) = 0 indicates that the DI is active low.

H0d.19 Forced DO value

Comm. address:	200d-14h	Effective mode:	Real time
Min.:	0x0	Unit:	-
Max.:	0x3	Data type:	UInt16
Default:	0x0	Change mode:	Real time

Range:

0x0 to 0x3

Parameter description

Defines whether the DO functions assigned in group H04 are active when forced DO is active (H0d.17 = 2 or 3).

H0d.19 is displayed in hex on the keypad. In the converted binary value, bit(n) = 1 indicates that the DO function is active, and bit(n) = 0 indicates that the DO function is inactive.

H0d.20 Absolute encoder reset

Comm. address:	200d-15h	Effective mode:	Real time

Min.:	0	Unit:	-
Max.:	4	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: No operation

1: Reset fault

2: Reset fault and multi-turn data

3: Reset Inovance secondary encoder fault

4: Reset Inovance secondary encoder fault and multi-turn data

Parameter description

Set H0d.20 to determine whether to reset the encoder internal fault or encoder multi-turn data.

0: No operation

1: Reset fault

2: Reset fault and multi-turn data

3: Reset Inovance secondary encoder fault

4: Reset Inovance secondary encoder fault and multi-turn data

H0d.21 Read error status bit of Nikon and EnDat2.2 encoders

Comm. address:	200d-16h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: Not read

1: Read error status bit

Parameter description

Used to read the error status bit of Nikon encoder and ENDAT encoder.

0: Not read

1: Read error status bit

H0d.29 Motor parameter auto-tuning

Comm. address:	200d-1Eh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: No action

1: Enable

Parameter description

Resistor inductance auto-tuning

0: No action

1: Enable

10.15 H0E Communication Function Parameters

H0E.00 **Node address**

Comm. address:	200E-01h	Effective mode:	Real time
Min.:	1	Unit:	-
Max.:	127	Data type:	UInt16
Default:	1	Change mode:	At stop

Range:

1 to 127

Parameter description

Indicates the CAN slave node address. Ensure this parameter is consistent with the configuration of the host controller.

H0E.01 **Save data written through communication to EEPROM**

Comm. address:	200E-02h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	255	Data type:	UInt16
Default value:	4	Change mode:	Real time

Value range:

0: Not save

1: Save parameters

2: Save object dictionaries

3: Save parameters and object dictionaries

4: Save object dictionaries written before communication (OP)

255: Determined by H0E.03 and H0E.04

Parameter description

Defines whether to save parameters and object dictionaries written through the serial port or SDO communication.

0: Not save

1: Save parameters

2: Save object dictionaries

3: Save parameters and object dictionaries

4: Save object dictionaries written before communication (OP)

255: Determined by H0E.03 and H0E.04

H0E.03 **Save objects written through software tool (commissioning protocol) to EEPROM**

Comm. address:	200E-04h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	1	Change mode:	Real time

Range:

0: Not save

1: Save

Parameter description

Defines whether to save objects written through software (commissioning protocol) to EEPROM, including parameters and object dictionaries.
0: Not saved to EEPROM
1: Saved to EEPROM

H0E.04 **Save objects written through communication to EEPROM (excluding commissioning protocol)**

Comm. address:	200E-05h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:
0: Not save
1: Save
Parameter description
You can use this parameter to determine whether to save the data written through communication to EEPROM (excluding commissioning protocol) (CANOpen, CANLink, Ethernet COE, Modbus485). The data include the parameters and object dictionaries.
0: Not saved to EEPROM
1: Saved to EEPROM

H0E.07 **Object dictionary unit selection**

Comm. address:	200E-08h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0: Reference unit system (p/s, p/s²)
1: User unit system (0.01[mm/s]/[rpm], ms)
Parameter description
Servo unit system switching:
0: Use reference unit system. The unit for speed-type object dictionaries is p/s or p/s² for acceleration-type object dictionaries.
1: User unit system, 0.01 [mm/s]/[rpm] for speed type object dictionaries and ms (time taken for changing from 0 [mm/s]/[rpm] to 1000 [mm/s]/[rpm]) for acceleration type object dictionaries

H0E.20 **EtherCAT slave name**

Comm. address:	200E-15h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0 to 65535
Parameter description
Defines EtherCAT slave name.

H0E.21 **EtherCAT slave alias**

Comm. address:	200E-16h	Effective mode:	Next power-on
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0 to 65535

Parameter description

Defines EtherCAT slave alias.

H0E.22 **Number of sync loss events allowed by EtherCAT**

Comm. address:	200E-17h	Effective mode:	Real time
Min.:	1	Unit:	-
Max.:	20	Data type:	UInt16
Default:	8	Change mode:	Real time

Range:

1 to 20

Parameter description

Defines the number of sync loss errors allowed by EtherCAT.

H0E.24 **Sync loss count**

Comm. address:	200E-19h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:

0 to 65535

Parameter description

Defines the number of sync loss errors.

H0E.25 **Maximum number of error frames and invalid frames of EtherCAT port 0 per unit time**

Comm. address:	200E-1Ah	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFF

Parameter description

Defines the maximum error value and invalid frames of EtherCAT port 0 per unit time.

H0E.26 **Maximum number of error frames and invalid frames of EtherCAT port 1 per unit time**

Comm. address:	200E-1Bh	Effective mode:	-
Min.:	0x0	Unit:	-

Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFF

Parameter description

Defines the maximum error value and invalid frames of EtherCAT port 1 per unit time.

H0E.27 **Maximum count value of EtherCAT port transfer errors per unit time**

Comm. address:	200E-1Ch	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFF

Parameter description

Defines the maximum count value of EtherCAT port transfer errors per unit time.

H0E.28 **Maximum number of error frames processed by EtherCAT data frame processing unit per unit time**

Comm. address:	200E-1Dh	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFF

Parameter description

Defines the maximum EtherCAT data frame processing unit error per unit time.

H0E.29 **Maximum link loss count value of EtherCAT port 0 per unit time**

Comm. address:	200E-1Eh	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFF

Parameter description

Defines the maximum link loss value of EtherCAT port 0 per unit time.

H0E.31 **EtherCAT synchronization mode setting**

Comm. address:	200E-20h	Effective mode:	Next power-on
Min.:	0	Unit:	-
Max.:	3	Data type:	UInt16
Default:	2	Change mode:	At stop

Range:
0 to 3
Parameter description
Defines EtherCAT synchronization mode.

H0E.32 **EtherCAT synchronization error threshold**

Comm. address:	200E-21h	Effective mode:	Real time
Min.:	100	Unit:	ns
Max.:	8000	Data type:	UInt16
Default:	4000	Change mode:	At stop

Range:
100 ns to 8000 ns
Parameter description
Defines EtherCAT synchronization error threshold.

H0E.33 **EtherCAT state machine status and port connection status**

Comm. address:	200E-22h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFF
Parameter description
Defines EtherCAT state machine status and port connection status.

H0E.34 **Excessive CSP position command increment count**

Comm. address:	200E-23h	Effective mode:	Real time
Min.:	1	Unit:	-
Max.:	30	Data type:	UInt16
Default:	20	Change mode:	Real time

Range:
1 to 30
Parameter description
Defines the number of excessive CSP position reference increment events.

H0E.35 **AL fault code**

Comm. address:	200E-24h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFF
Parameter description
Displays the AL fault code.

H0E.36 **EtherCAT enhanced link selection**

Comm. address:	200E-25h	Effective mode:	Next power-on
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Disable

1: Enable

Parameter description

EtherCAT enhanced link selection

0: Disable

1: Enable

H0E.37 **EtherCAT XML reset selection**

Comm. address:	200E-26h	Effective mode:	Next power-on
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Disable

1: Enable

Parameter description

EtherCAT XML reset selection

0: Disable

1: Enable

H0E.73 **EtherCAT port control mode and status display**

Comm. address:	200E-4Ah	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFF

Parameter description

EtherCAT port control mode and status display

H0E.80 **Modbus baud rate**

Comm. address:	200E-51h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	9	Data type:	UInt16
Default:	9	Change mode:	Real time

Range:

0: 300 bps
1: 600 bps
2: 1200 bps
3: 2400 bps
4: 4800 bps
5: 9600 bps
6: 19200 bps
7: 38400 bps
8: 57600 bps
9: 115200 bps

Parameter description

Defines the communication rate between the servo drive and the host controller. The baud rate set in the servo drive must be the same as that in the host controller. Otherwise, communication will fail.

0: 300 bps
1: 600 bps
2: 1200 bps
3: 2400 bps
4: 4800 bps
5: 9600 bps
6: 19200 bps
7: 38400 bps
8: 57600 bps
9: 115200 bps

H0E.81 **Modbus data format**

Comm. address:	200E-52h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	3	Data type:	UInt16
Default:	3	Change mode:	Real time

Range:

0: No parity, 2 stop bits (N-2)
1: Even parity, 1 stop bit (E-1)
2: Odd parity, 1 stop bit (O-1)
3: No parity, 1 stop bit (N-1)

Parameter description

Defines the data check mode between the servo drive and the host controller during communication.

0: No parity, 2 stop bits
1: Even parity, 1 stop bit
2: Odd parity, 1 stop bit
3: No parity, 1 stop bit

The data format of the servo drive must be the same as that of the host controller. Otherwise, communication will fail.

H0E.82 **Modbus response delay**

Comm. address:	200E-53h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	20	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:
0 ms to 20 ms
Parameter description
Defines the delay from the moment when the slave receives a command to the moment when the slave returns a response.

H0E.83 **Modbus communication timeout**

Comm. address:	200E-54h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	600	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:
0 ms to 600 ms
Parameter description
Defines Modbus communication timeout.

H0E.84 **Modbus communication data sequence**

Comm. address:	200E-55h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	1	Change mode:	Real time

Range:
0: High bits before low bits
1: Low bits before high bits
Parameter description
Defines the 32-bit data transmission format of Modbus communication.
0: High 16 bits before low 16 bits
1: Low 16 bits before high 16 bits

H0E.90 **Communication version**

Comm. address:	200E-5Bh	Effective mode:	-
Min.:	0.00	Unit:	-
Max.:	655.35	Data type:	UInt16
Default:	0.00	Change mode:	Read only

Range:
0.00 to 655.35
Parameter description
Displays the communication version.

H0E.96 **XML version information**

Comm. address:	200E-61h	Effective mode:	-
Min.:	0.00	Unit:	-
Max.:	655.35	Data type:	UInt16
Default:	0.00	Change mode:	Read only

Range:

0.00 to 655.35

Parameter description

Displays XML version information.

10.16 H0F Fully Closed-loop Parameters

H0F.00 **Encoder feedback mode**

Comm. address:	200F-01h	Effective mode:	Next power-on
Min.:	0	Unit:	-
Max.:	2	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Internal encoder feedback

1: External encoder feedback

2: Inner/Outer loop switchover

Parameter description

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, with electronic gear ratio 1 used.)

2: Internal/External encoder feedback switched along with switchover of the electronic gear ratio (The DI assigned with FunIN.24 (GEAR_SEL, electronic gear ratio switchover) is used to switch between inner and outer position closed loops.)

Note:

When the DI function is inactive, the internal encoder feedback and electronic gear ratio 1 are used.

When the DI function is active, the external encoder feedback and electronic gear ratio 2 are used.

H0F.01 **Fully closed-loop encoder application mode**

Comm. address:	200F-02h	Effective mode:	Next power-on
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Standard operating direction

1: Reverse operating direction

Parameter description

Defines the feedback pulse counting direction of internal and external encoders when the motor rotates in the fully closed-loop mode.

0: Standard operating direction: The pulse feedback counter of the internal encoder (H0F.18) is in the same direction as that of the external encoder (H0F.20) during rotation of the motor.

1: Reverse operating direction: The pulse feedback counter of the internal encoder (H0F.18) is in the opposite direction as that of the external encoder (H0F.20) during rotation of the motor.

H0F.02 **Fully closed-loop encoder absolute value**

Comm. address:	200F-03h	Effective mode:	Next power-on
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: Incremental mode

1: Absolute linear mode

Parameter description

Defines the absolute value of the encoder in fully closed-loop mode.

0: Incremental mode

1: Absolute linear mode

H0F.03 **Fully closed-loop encoder feedback type**

Comm. address:	200F-04h	Effective mode:	Next power-on
Min.:	0	Unit:	-
Max.:	4	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: Quadrature pulse

1: Inovance

2: BiSS-C

3: EnDat2.2

4: SSI

Parameter description

Defines the feedback type of the encoder in fully closed-loop mode.

0: Quadrature pulse

1: Inovance

2: BiSS-C (linear type only)

3: EnDat 2.2 (linear type supported only)

4: SSI (linear type supported only)

H0F.04 **Number of fully closed-loop encoder pulses per revolution**

Comm. address:	200F-05h	Effective mode:	Next power-on
Min.:	1	Unit:	-
Max.:	2147483647	Data type:	UInt32
Default:	10000	Change mode:	At stop

Range:

1 to 2147483647

Parameter description

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

Defines the quantity relation between feedback pulses from the external encoder and those from the internal encoder.

Calculate the value of this parameter through analyzing mechanical parameters. When rigid connection is applied between the motor and the external encoder (grating scale), you can also set this parameter using the following method.

1. Manually rotate the motor and observe H0F.18 (Feedback pulse counter of internal encoder) at the same time. After ensuring that the motor rotates for one revolution (H0F.18 = Servo motor resolution), calculate the change value of H0F.20 (Feedback pulse counter of external encoder). The absolute value of the change value is the value of H0F.04.

2. If H0F.18 = X1, H0F.20 = Y1 before rotating the motor, and H0F-18 = X2, H0F.20 = Y2 after rotating the motor:

H0F.04 = Servo motor resolution x (Y2 - Y1)/(X2 - X1) The calculated result must be positive; if not, perform step 1 again.

For non-rigid connection, an error may exist in the calculation result.

Note:

Make sure that H0F.04 is set correctly. Failure to comply may result in EB02.0 (Excessive position deviation in fully closed-loop mode).

H0F.06 **Encoder interface in fully closed-loop mode**

Comm. address:	200F-07h	Effective mode:	Next power-on
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	1	Change mode:	At stop

Range:

0: CN2

1: CN7

Parameter description

Used to set the drive interface used by the encoder in fully closed-loop mode.

0: CN2

1: CN7

H0F.08 **Excessive deviation threshold in compound control mode**

Comm. address:	200F-09h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	2147483647	Data type:	UInt32
Default:	1000	Change mode:	Real time

Range:

0 to 2147483647

Parameter description

Defines the position deviation threshold at which the servo drive detects fault EB02.0, indicating that the position deviation is excessive.

When H0F.08 is set to 0, the servo drive does not detect EB02.0 and always clears the full closed-loop position deviation.

H0F.10 **Deviation clear in compound control**

Comm. address:	200F-0Bh	Effective mode:	Real time
Min.:	0	Unit:	Rev
Max.:	100	Data type:	UInt16
Default:	1	Change mode:	Real time

Range:
0 Rev to 100 Rev
Parameter description
Defines the number of revolutions (H0F.10) rotated by the motor per a clear of the fully closed-loop position deviation during operation. The number of revolutions is expressed by the internal encoder feedback pulses in H0F.18. The number of motor revolutions is not cleared when the drive is not in the operational state.

H0F.13 **Compound vibration suppression filter time**

Comm. address:	200F-0Eh	Effective mode:	Real time
Min. value:	0.0	Unit:	ms
Max. value:	6553.5	Data type:	UInt16
Default value:	0.0	Change mode:	At stop

Value range:
0.0 to 6553.5
Parameter description
Defines the time constant for compound vibration suppression in fully closed-loop control when external encoder feedback (H0F.00 = 1 or 2) is used.
Increase the setpoint gradually and check the response change.
When the stiffness of the transmission mechanism between fully closed loop and internal loop is insufficient, set the time constant properly to improve system stability. This is to generate the effect of internal loop temporarily and form a fully closed loop again after the system is stabilized. Ignore this parameter if the stiffness is sufficient.

If H0F.13 is set to 0, no EB02.1 alarms are detected.

H0F.16 **Pulse deviation display in compound control mode**

Comm. address:	200F-11h	Effective mode:	-
Min.:	-2147483648	Unit:	Encoder unit
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Read only

Range:
-2147483648 to +2147483647
Parameter description
Used to count and display the position deviation absolute value in fully closed loop control.
Pulse deviation in compound control = Absolute position feedback of external encoder - Absolute position feedback conversion value of internal encoder
Align the inner and outer loop feedback each time the deviation is cleared.

H0F.18 **Internal position pulse feedback display**

Comm. address:	200F-13h	Effective mode:	-
Min.:	-2147483648	Unit:	Encoder unit
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Read only

Range:

-2147483648 to +2147483647

Parameter description

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).

H0F.20 **Fully closed-loop encoder position pulse feedback display**

Comm. address:	200F-15h	Effective mode:	-
Min.:	-2147483648	Unit:	Encoder unit
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Read only

Range:

-2147483648 to +2147483647

Parameter description

Used to count and display the number of feedback pulses of the external encoder (after being divided or multiplied by electronic gear ratio, in external encoder unit).

H0F.22 **Quadrature pulse phase Z detection invalid in fully closed-loop mode**

Comm. address:	200F-17h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Detected

1: Not detected

Parameter description

Quadrature pulse phase Z detection in fully closed-loop mode

0: Detected

1: Not detected

H0F.23 **Absolute homing offset of BiSS-C/SSI/EDNAT2.2 encoder in fully closed-loop mode**

Comm. address:	200F-18h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

The homing offset is updated automatically after homing is done. Write this value manually only when the drive needs to be replaced. When the fully closed-loop encoder operates in the absolute linear mode, the initial position upon power-on = Original value of encoder position feedback + Homing offset - Absolute feedback offset

H0F.25 Source of touch probe Z signal in fully closed-loop mode

Comm. address:	200F-1Ah	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Motor Z signal

1: External feedback Z signal

Parameter description

Defines the source of touch probe Z signal in fully closed-loop mode.

0: Motor Z signal

1: External feedback Z signal

H0F.26 Absolute feedback offset of BiSS-C/SSI/EDNAT2.2 encoder in fully closed-loop mode

Comm. address:	200F-1Bh	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

When the fully closed-loop encoder operates in the absolute linear mode, the absolute feedback offset will be updated after homing is done. Write this value manually only when the drive needs to be replaced.

H0F.28 BiSS-C/SSI status word display value

Comm. address:	200F-1Dh	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:

0 to 65535

Parameter description

Displays the status word value of BiSS-C/SSI encoder

H0F.29 BiSS-C fully closed-loop encoder CRC check value bit inversion/SSI fully closed-loop encoder parity selection

Comm. address:	200F-1Eh	Effective mode:	Next power-on

Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	1	Change mode:	Real time

Value range:
0: Positive
1: Negative
Parameter description
BiSS-C:

0: CRC check value not inverted by bit

1: CRC check value inverted by bit

SSI:

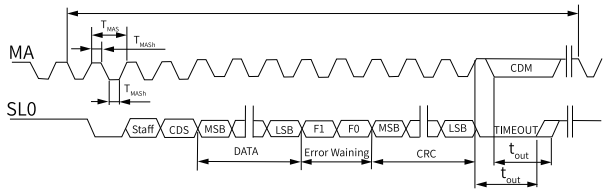
0: Even parity

1: Odd parity

H0F.30 **valid bits of BiSS-C/SSI/EDNAT2.2 encoder position feedback during communication in fully closed-loop mode**

Comm. address:	200F-1Fh	Effective mode:	Next power-on
Min.:	0	Unit:	-
Max.:	127	Data type:	UInt16
Default:	29	Change mode:	At stop

Range:
0 to 127
Parameter description
Defines the valid bits of BiSS-C/SSI/EDNAT2.2 encoder position feedback during communication in fully closed-loop mode.



- DATA: Position data, CRC: 6-digit CRC check code
- $100ns \leqslant T_{MAS} \leqslant 2t_{out} 25ns \leqslant T_{MASh} \leqslant t_{out} 25ns \leqslant T_{MASh} \leqslant t_{out}$
- t_{out}= 1.5 MA clock cycle
- MA: master clock output; SL0: slave data output
  Transmission speed up to 10 Mbps
- CDM: register communication master transmit bit;
  CDS: register communication slave return bit.
- Error Warning: Error bit and alarm bit index
  (F1 low level indicates an error, and F0 low level indicates an alarm)
- The input and output of the optical scale comply with the standard RS-422A interface.
  Differential line drive and line receiver are required.
- CRC generator polynomial: X6 + X1 + 1, initial value 0, check range "DATA", "Error Warning".
  In the figure, MA SL0 is not displayed.

H0F.30: DATA setting bit, valid bits of position feedback (See the user guide of the third-party BiSS-C encoder.)

H0F.31 **Valid bits of BiSS-C/SSI encoder communication status word during communication in fully closed-loop mode**

Comm. address:	200F-20h	Effective mode:	Next power-on
Min. value:	0	Unit:	-
Max. value:	31	Data type:	UInt16

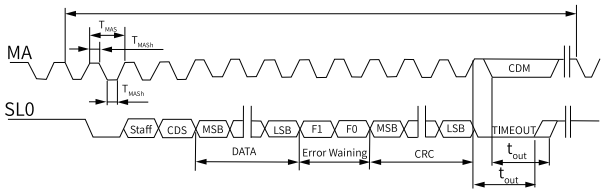
Default value:	2	Change mode:	At stop

Value range:

0 to 31

Parameter description

Defines the length of the status word configured based on the BiSS-C/SSI protocol.



- DATA: Position data, CRC: 6-digit CRC check code
- $100ns \leqslant T_{MAS} \leqslant 2t_{out}25ns \leqslant T_{MASh} \leqslant t_{out}25ns \leqslant T_{MASh} \leqslant t_{out}$
- t_{out}= 1.5 MA clock cycle
- MA: master clock output; SL0: slave data output
  Transmission speed up to 10 Mbps
- CDM: register communication master transmit bit;
  CDS: register communication slave return bit.
- Error Warning: Error bit and alarm bit index
  (F1 low level indicates an error, and F0 low level indicates an alarm)
- The input and output of the optical scale comply with the standard RS-422A interface.
  Differential line drive and line receiver are required.
- CRC generator polynomial: X6 + X1 + 1, initial value 0, check range "DATA", "Error Warning".

In the figure, MA SL0 is not displayed.

H0F.31: the error alarm setting bit, which defines the error and alarm bit index. Set the value of H0F.31 to the bit offset between DATA and CRC.

H0F.32 BiSS-C/SSI/ENDAT encoder communication frequency in fully closed-loop mode

Comm. address:	200F-21h	Effective mode:	Next power-on
Min.:	0	Unit:	kHz
Max.:	10000	Data type:	UInt16
Default:	2000	Change mode:	Real time

Range:

0 kHz to 10000 kHz

Parameter description

Defines BiSS-C/SSI/ENDAT encoder communication frequency in fully closed-loop mode.

H0F.33 SSI/EnDat2.2 encoder recovery time in fully closed-loop mode

Comm. address:	200F-22h	Effective mode:	Next power-on
Min. value:	0.000	Unit:	μs
Max. value:	40.000	Data type:	UInt16
Default value:	0.500	Change mode:	Real time

Value range:

0.000 to 40.000

Parameter description

Defines the time between the first falling edge and the first rising edge of the clock signal for EnDat2.2 and SSI encoders.

H0F.35 BiSS-C status word detection in fully closed-loop mode

Comm. address:	200F-24h	Effective mode:	Next power-on
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16

Default value:	0	Change mode:	At stop

Value range:

0: Disable

1: Enable

Parameter description

Enables detection on status bits of the BiSS-C protocol by FPGA software.

0: Disable

1: Enable

H0F.36 **BiSS-C status word error status in fully closed-loop mode**

Comm. address:	200F-25h	Effective mode:	Next power-on
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0: Positive

1: Negative

Parameter description

0: Positive

1: Negative

H0F.40 **Communication-type encoder fault information in fully closed-loop mode**

Comm. address:	200F-29h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:

0 to 65535

Parameter description

Displays the fault information of the communication-type encoder in fully closed-loop mode.

Table 10–1 Applicable Inovance encoder

Bit	Name
0	Fully closed-loop serial encoder communication timeout error (RX end [1])
1	Fully closed-loop serial encoder frame stop bit error (RX end)
2	Fully closed-loop serial encoder CRC error (RX end)[2]
3	Fully closed-loop serial encoder data field error (RX end)
4	Fully closed-loop serial encoder position counting error (TX end[1])
5	Fully closed-loop serial encoder overspeed (TX end)
6	Fully closed-loop serial encoder overtemperature (TX end)
7	Encoder single-turn resolution error in fully closed-loop mode (TX end)
8	Serial encoder multi-turn counting error in fully closed-loop mode (TX end)
9	Serial encoder battery alarm in fully closed-loop mode (TX end)
10	Serial encoder battery failure in fully closed-loop mode (TX end)
11 to 12	Undefined
13[3]	Serial encoder counting increment error in fully closed-loop mode (algorithm[1])

Bit	Name
14 to 15	Undefined
16 to 23	Serial encoder expansion data 1 in fully closed-loop mode
24 to 31	Serial encoder expansion data 2 in fully closed-loop mode

Table 10–2 Matching the EnDat encoder

Bit	Name
0	EnDat encoder communication timeout error (RX end)
1	EnDat level 1 fault (RX end)
2	EnDat encoder CRC error (RX end)[2]
3	EnDat level 2 fault (RX end)
4	EnDat fault information 1 (TX end)
5	EnDat fault information 2 (TX end)
6 to 8	Undefined
9	EnDat additional data 1 CRC error
10	EnDat additional data 2 CRC error
11 to 12	Undefined
13[3]	Serial encoder counting increment error in fully closed-loop mode (algorithm)
14	EnDat level 3 fault (RX end)
15	EnDat level 3 fault (RX end)
16 to 23	Serial encoder expansion data 1 in fully closed-loop mode
24 to 31	Serial encoder expansion data 2 in fully closed-loop mode

Table 10–3 Matching BiSS-C and SSI encoders

Bit	Name
0	Encoder communication timeout error in fully closed-loop mode (RX end)
1	Undefined
2	Serial encoder CRC error in fully closed-loop mode (RX end)[2]
3 to 10	Undefined
7	Encoder single-turn resolution error in fully closed-loop mode (TX end)
11 to 12	Undefined
13[3]	Serial encoder counting increment error in fully closed-loop mode (algorithm)
14 to 15	Undefined
16 to 23[4]	Serial encoder expansion data 1 in fully closed-loop mode
24 to 31[4]	Serial encoder expansion data 2 in fully closed-loop mode

Note

[1]: In the above table, the RX side refers to the drive and the TX side refers to the motor encoder. The algorithm refers to the type of the indirect error caused by a direct error on the RX or TX side.

[2]: When a BiSS-C encoder is used: 1-CRC error; 0-CRC is normal. When an SSI encoder is used: 1-Parity error; 0-Parity is normal.

[3]: When H0A.50 or more data transmission errors occur continuously, bit13 will be set to 1 and the drive must be stopped. For other error types, you can stop the drive as needed.

[4]: Full closed-loop serial encoder extended data 1/2 (when a BiSS-C encoder is used): This part is the status word of BiSS-C and SSI encoders.

H0F.41 **Inovance encoder version in fully closed-loop mode**

Comm. address: 200F-2Ah

Effective mode: -

Min.:	0.0	Unit:	-
Max.:	6553.5	Data type:	UInt16
Default:	0.0	Change mode:	Read only

Range:
0.0 to 6553.5
Parameter description
Displays Inovance encoder version in fully closed-loop mode.

H0F.42 **Inovance encoder resolution in fully closed-loop mode**

Comm. address:	200F-2Bh	Effective mode:	-
Min.:	0	Unit:	-
Max.:	4294967295	Data type:	UInt32
Default:	0	Change mode:	Read only

Range:
0 to 4294967295
Parameter description
Displays Inovance encoder resolution in fully closed-loop mode.

H0F.45 **Positioning completion/Position deviation threshold in fully closed-loop mode**

Comm. address:	200F-2Eh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0: Threshold scaled to outer loop unit
1: Same threshold used for inner and outer loops
Parameter description
0: Fully closed-loop positioning completion threshold 6067h/Excessive position deviation threshold 6065h (scaled to the outer loop unit)
1: Same threshold used for inner and outer loops

H0F.51 **SSI encoder check bit selection in fully closed-loop mode**

Comm. address:	200F-34h	Effective mode:	Next power-on
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	1	Change mode:	At stop

Range:
0: No check
1: Check applied
Parameter description
Used to set the SSI encoder check bit in fully closed-loop mode according to the encoder manual.
0: No check
1: Check applied

H0F.52 **SSI encoder position data code system in fully closed-loop mode**

Comm. address:	200F-35h	Effective mode:	Next power-on
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	1	Change mode:	At stop

Value range:

0: Binary

1: Gray code

Parameter description

Sets the SSI encoder code system in full closed-loop mode according to the encoder manual.

0: Binary

1: Gray code

H0F.53 **SSI encoder status word code system in fully closed-loop mode**

Comm. address:	200F-36h	Effective mode:	Next power-on
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	1	Change mode:	At stop

Range:

0: Binary

1: Gray code

Parameter description

Used to set the SSI encoder status word code system in fully closed-loop mode according to the encoder manual.

0: Binary

1: Gray code

H0F.54 **SSI encoder parity check in fully closed-loop mode**

Comm. address:	200F-37h	Effective mode:	Next power-on
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: Disable

1: Enable

Parameter description

Used to enable the SSI encoder parity check in fully closed-loop mode according to the encoder manual.

0: Disable

1: Enable

H0F.55 **Communication timeout error count of the encoder in fully closed-loop mode**

Comm. address:	200F-38h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16

Default:	0	Change mode:	Read only

Range:
0 to 65535
Parameter description
Defines the communication timeout error count of the encoder in fully closed-loop mode.

H0F.56 **Encoder CRC error count in fully closed-loop mode**

Comm. address:	200F-39h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0 to 65535
Parameter description
Defines the encoder CRC error count in fully closed-loop mode.

H0F.57 **Communication frame stop bit error count of the encoder in fully closed-loop mode**

Comm. address:	200F-3Ah	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

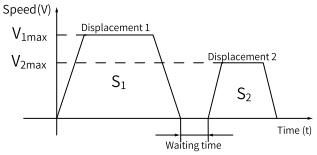
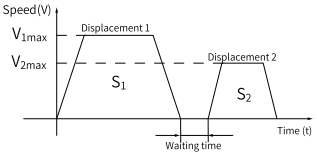
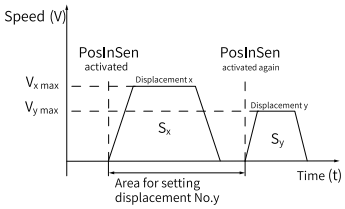
Range:
0 to 65535
Parameter description
Defines the communication frame stop bit error count of the encoder in fully closed-loop mode.

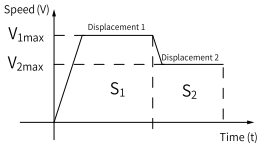
10.17 H11 Multi-position Parameters

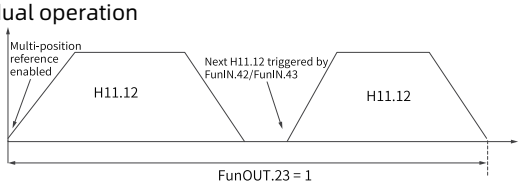
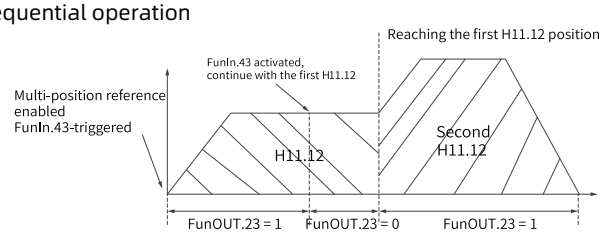
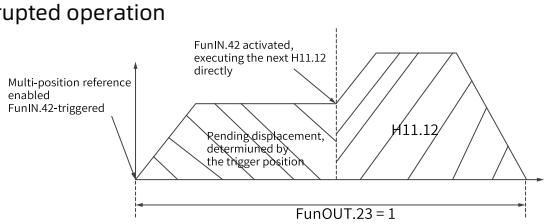
H11.00 **Multi-position operation mode**

Comm. address:	2011-01h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	5	Data type:	UInt16
Default:	1	Change mode:	At stop

Range:
0: Individual operation (number of displacements defined by H11.01)
1: Cyclic operation (number of displacement defined by H11.01)
2: DI-based operation (defined by DI)
3: Sequential operation
5: Axis-controlled continuous operation
Parameter description
Defines the multi-position operation mode when the main position reference source is multi-position references (H05.00 = 2) in the position control mode.

Value range	Operation mode	Remarks	Operation curve
0	Stop after operating for one cycle	The drive stops after one cycle of operation. The drive automatically switches to the next speed. You can set the interval time between displacements. The multi-position reference is level-triggered.	 V1max, V2max: maximum operating speeds in displacement 1 and displacement 2 S1, S2: displacement 1 and displacement 2
1	Cyclic operation	The starting displacement after the first cycle is displacement 1. The drive automatically switches to the next speed. You can set the interval time between displacements. The multi-position reference is level-triggered.	 V1max, V2max: maximum operating speeds in displacement 1 and displacement 2 S1, S2: displacement 1 and displacement 2
2	DI-based operation	The drive continues operating when the displacement No. is updated. The speed No. is determined by the DI logic. The interval time between displacements is determined by the command delay of the host controller. The multi-position reference is edge-triggered.	 Vxmax, Vymax: maximum operating speeds in displacement x and displacement y Sx, Sy: displacement x and displacement y

Value range	Operation mode	Remarks	Operation curve
3	Sequential operation	The drive stops after one cycle of operation. (H11.05 = 0 or H11.05 > H11.01) When H11.05 is higher than H11.01, the software forcibly sets H11.05 to 0. The starting displacement after the first cycle is defined by H11.05. The drive automatically switches to the next speed. There is no interval time between displacements. The multi-position reference is level-triggered.	 V1max, V2max: maximum operating speeds in displacement 1 and displacement 2 S1, S2: displacement 1 and displacement 2

Value range	Operation mode	Remarks	Operation curve
5	Axis-controlled continuous operation Used in conjunction with CANlink	The drives executes one displacement only. The individual operation mode, sequential operation mode, and interrupted operation mode are supported. The PoslnSen (multi-position reference enable) signal is level-triggered.	• Individual operation  • The PoslnSen (multi-position reference enable) signal is triggered only once (FunIN.43/42 triggered later). The drive stops after executing the distance defined by H11.12. • Sequential operation  • The PoslnSen (multi-position reference enable) signal is triggered only once. Write H11.12 again and activate FunIN.43 when the distance defined by the first H11.12 is still in progress.• After receiving the new distance (or speed), which is the second H11.12, the drive continues executing the first H11.12 until the distance defined by the first H11.12 is done. Then it starts to execute the second H11.12 directly. The travel distance therefore is the sum of the first H11.12 and the second H11.12. • Interrupted operation  • The PoslnSen (Multi-position reference enable) signal is triggered only once. Write H11.12 (such as 1000000) again and activate FunIN.42 when the first H11.12 (such as 9000000) is still in progress. After receiving the new distance (or speed), which is the second H11.12, the drive stops executing the first H11.12 and turns to executing the second H11.12.

To use the multi-position function, assign FunIN.28 (PosInSen, multi-position reference enable) to a DI first. See "Group H03: Terminal input parameters" for the setting mode.

The positioning completion (COIN) signal is activated each time upon completion of a displacement. To determine whether a certain displacement is done executing, use FunOUT.5 (COIN, positioning completed). See "Group H04: Terminal output parameters" for details.

Ensure the S-ON signal is active during operation of each displacement. Otherwise, the drive stops immediately as defined by H02.05 (Stop mode at S-ON OFF) and the positioning completion (COIN) signal is inactive. In modes other than DI-based operation, if the S-ON signal is active but multi-position is disabled during operation of a certain displacement, the drive abandons the unsent displacement reference and stops, with the positioning completion (COIN) signal being active. If the multi-position function is enabled again, the displacement to be executed is defined by H11.02.

H11.01 **Number of displacement references in multi-position mode**

Comm. address:	2011-02h	Effective mode:	Real time
Min.:	1	Unit:	-
Max.:	16	Data type:	UInt16
Default:	1	Change mode:	At stop

Range:

1 to 16

Parameter description

Defines the total number of displacement references in the multi-position mode. You can set different displacements, operating speeds, and acceleration/deceleration time for each displacement.

H11.00 ≠ 2: Displacements are switched automatically in a sequence from 1, 2...H11.01.

H11.00 is 2: Assign four DIs (Hardware DI or VDI) with DI functions 6 to 9 (FunIN.6: CMD1 to FunIN.9: CMD4) and control the DI logic through the host controller to switch between different speeds. The segment No. is a 4-bit binary value. bit0 to bit3 correspond to CMD1 to CMD4.

The speed No. is a 4-bit binary value. The relation between the speed No. and CMD1 to CMD4 is shown in the following table.

FunIN.9	FunIN.8	FunIN.7	FunIN.6	Segment No.
CMD4	CMD3	CMD2	CMD1	
0	0	0	0	1
0	0	0	1	2
...				
1	1	1	1	16

H11.02 **Starting displacement No. after pause**

Comm. address:	2011-03h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: Continue to execute the unexecuted displacements

1: Start from displacement 1

Parameter description

Defines the starting displacement No. when the multi-position operation recovers from a pause.

0: Continue to execute the unexecuted displacements: For example, if H11.01 is set to 16 and the drive pauses at displacement 2, after the drive recovers from the pause, it will start from displacement 3.

1: Start from displacement 1: For example, if H11.01 is set to 16 and the drive pauses at displacement 2, after the drive recovers from the pause, it will start from displacement 1.

The reasons for the pause are as follows:

1. The servo drive switches to another control mode or the interrupt positioning function is enabled during multi-position operation.
2. The internal multi-position enable signal (FunIN.28:PosInSen) changes from "active" to "inactive".

H11.03 **Waiting time unit**

Comm. address:	2011-04h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: ms

1: s

Parameter description

Defines the unit of acceleration/deceleration time and the interval time during multi-position operation.

The acceleration/deceleration time refers to the time for the motor to change from 0 [mm/s]/[rpm] to 1000 [mm/s]/[rpm] at a constant speed.

The waiting time refers to the time starting from the end of the last reference to the beginning of the next reference.

H11.04 **Displacement reference type**

Comm. address:	2011-05h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Relative displacement reference

1: Absolute displacement reference

Parameter description

Relative displacement: position increment of the target position relative to the current motor position

Absolute displacement: position increment of the target position relative to the motor home.

H11.05 **Starting displacement No. in sequential operation**

Comm. address:	2011-06h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	16	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0 to 16

Parameter description

Defines whether to perform cyclic operation and the starting displacement No. after the first cycle of operation in the sequential operation mode (H11.00 = 3).

0: The drive executes the displacements defined by H11.01 only once and then stops. The motor is in the locked state.

1–16: The drive operates cyclically, with the starting displacement No. defined by H11.05 after the first cycle of operation. The value of H11.05 should be lower than or equal to H11.01.

H11.09 **Deceleration upon axis control OFF**

Comm. address:	2011-0Ah	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	65535	Change mode:	Real time

Range:

0 ms to 65535 ms

Parameter description

Defines the deceleration rate upon axis control OFF.

H11.10 **Starting speed of displacement 1**

Comm. address:	2011-0Bh	Effective mode:	Real time
Min.:	0	Unit:	[mm/s]/[rpm]
Max.:	6000	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0 [mm/s]/[rpm] to 6000 [mm/s]/[rpm]

Parameter description

Defines the starting speed of displacement 1.

H11.11 **Stop speed of displacement 1**

Comm. address:	2011-0Ch	Effective mode:	Real time
Min.:	0	Unit:	[mm/s]/[rpm]
Max.:	6000	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0 [mm/s]/[rpm] to 6000 [mm/s]/[rpm]

Parameter description

Defines the stop speed of displacement 1.

H11.12 **Displacement 1**

Comm. address:	2011-0Dh	Effective mode:	Real time
Min.:	-1073741824	Unit:	Reference unit
Max.:	1073741824	Data type:	Int32
Default:	10000	Change mode:	Real time

Range:

-1073741824 to +1073741824

Parameter description

Defines displacement 1 (reference unit) in multi-position operation.

H11.14 **Maximum speed of displacement 1**

Comm. address:	2011-0Fh	Effective mode:	Real time
Min.:	1	Unit:	[mm/s]/[rpm]

Max.:	10000	Data type:	UInt16
Default:	200	Change mode:	Real time

Range:

1 [mm/s]/[rpm] to 10000 [mm/s]/[rpm]

Parameter description

Defines the maximum speed of displacement 1 in multi-position operation.

The maximum speed is the average operating speed when the motor is not in the acceleration/deceleration process. If H11.12 is set to a too low value, the actual motor speed will be lower than H11.14.

H11.15 Acceleration/Deceleration time in displacement 1

Comm. address:	2011-10h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:

0 to 65535

Parameter description

Defines the time for the motor to change from 0 [mm/s]/[rpm] 1000 rpm[mm/s]/[rpm] at a constant speed during displacement 1.

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

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

Note: The mechanical rigidity must be proper and the speed loop can follow the position reference.

H11.16 Interval time after displacement 1

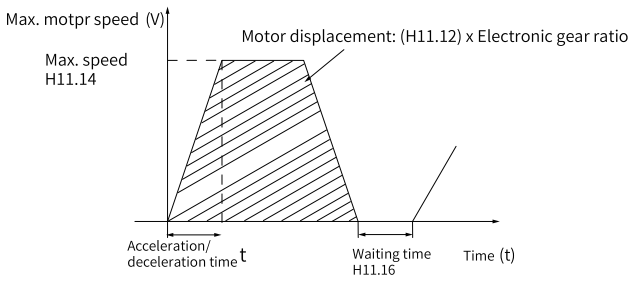
Comm. address:	2011-11h	Effective mode:	Real time
Min.:	0	Unit:	ms (s)
Max.:	10000	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:

0 ms(s) to 10000 ms(s)

Parameter description

Defines the interval time that starts from the end of displacement 1 to the beginning of the next displacement.



H11.17 **Displacement 2**

Comm. address:	2011-12h	Effective mode:	Real time
Min.:	-1073741824	Unit:	Reference unit
Max.:	1073741824	Data type:	Int32
Default:	10000	Change mode:	Real time

Range:

-1073741824 to +1073741824

Parameter description

Same as displacement 1

H11.19 **Maximum speed of displacement 2**

Comm. address:	2011-14h	Effective mode:	Real time
Min.:	1	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	UInt16
Default:	200	Change mode:	Real time

Range:

1 [mm/s]/[rpm] to 10000 [mm/s]/[rpm]

Parameter description

Same as the maximum speed of displacement 1

H11.20 **Acceleration/Deceleration time of displacement 2**

Comm. address:	2011-15h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:

0 ms to 65535 ms

Parameter description

Same as the acceleration/deceleration time of displacement 1

H11.21 **Interval time after displacement 2**

Comm. address:	2011-16h	Effective mode:	Real time
Min.:	0	Unit:	ms (s)
Max.:	10000	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:

0 ms(s) to 10000 ms(s)

Parameter description

Same as the interval time after displacement 1

H11.22 **Displacement 3**

Comm. address:	2011-17h	Effective mode:	Real time
Min.:	-1073741824	Unit:	Reference unit

Max.:	1073741824	Data type:	Int32
Default:	10000	Change mode:	Real time

Range:

-1073741824 to +1073741824

Parameter description

Same as displacement 1

H11.24 Maximum speed of displacement 3

Comm. address:	2011-19h	Effective mode:	Real time
Min.:	1	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	UInt16
Default:	200	Change mode:	Real time

Range:

1 [mm/s]/[rpm] to 10000 [mm/s]/[rpm]

Parameter description

Same as the maximum speed of displacement 1

H11.25 Acceleration/Deceleration time of displacement 3

Comm. address:	2011-1Ah	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:

0 ms to 65535 ms

Parameter description

Same as the acceleration/deceleration time of displacement 1

H11.26 Interval time after displacement 3

Comm. address:	2011-1Bh	Effective mode:	Real time
Min.:	0	Unit:	ms (s)
Max.:	10000	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:

0 ms(s) to 10000 ms(s)

Parameter description

Same as the interval time after displacement 1

H11.27 Displacement 4

Comm. address:	2011-1Ch	Effective mode:	Real time
Min.:	-1073741824	Unit:	Reference unit
Max.:	1073741824	Data type:	Int32
Default:	10000	Change mode:	Real time

Range:

-1073741824 to +1073741824

Parameter description

Same as displacement 1

H11.29 **Maximum speed of displacement 4**

Comm. address:	2011-1Eh	Effective mode:	Real time
Min.:	1	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	UInt16
Default:	200	Change mode:	Real time

Range:

1 [mm/s]/[rpm] to 10000 [mm/s]/[rpm]

Parameter description

Same as the maximum speed of displacement 1

H11.30 **Acceleration/Deceleration time of displacement 4**

Comm. address:	2011-1Fh	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:

0 ms to 65535 ms

Parameter description

Same as the acceleration/deceleration time of displacement 1

H11.31 **Interval time after displacement 4**

Comm. address:	2011-20h	Effective mode:	Real time
Min.:	0	Unit:	ms (s)
Max.:	10000	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:

0 ms(s) to 10000 ms(s)

Parameter description

Same as the interval time after displacement 1

H11.32 **Displacement 5**

Comm. address:	2011-21h	Effective mode:	Real time
Min.:	-1073741824	Unit:	Reference unit
Max.:	1073741824	Data type:	Int32
Default:	10000	Change mode:	Real time

Range:

-1073741824 to +1073741824

Parameter description

Same as displacement 1

H11.34 **Maximum speed of displacement 5**

Comm. address:	2011-23h	Effective mode:	Real time
Min.:	1	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	UInt16
Default:	200	Change mode:	Real time

Range:

1 [mm/s]/[rpm] to 10000 [mm/s]/[rpm]

Parameter description

Same as the maximum speed of displacement 1

H11.35 **Acceleration/Deceleration time of displacement 5**

Comm. address:	2011-24h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:

0 ms to 65535 ms

Parameter description

Same as the acceleration/deceleration time of displacement 1

H11.36 **Interval time after displacement 5**

Comm. address:	2011-25h	Effective mode:	Real time
Min.:	0	Unit:	ms (s)
Max.:	10000	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:

0 ms(s) to 10000 ms(s)

Parameter description

Same as the interval time after displacement 1

H11.37 **Displacement 6**

Comm. address:	2011-26h	Effective mode:	Real time
Min.:	-1073741824	Unit:	Reference unit
Max.:	1073741824	Data type:	Int32
Default:	10000	Change mode:	Real time

Range:

-1073741824 to +1073741824

Parameter description

Same as displacement 1

H11.39 **Maximum speed of displacement 6**

Comm. address:	2011-28h	Effective mode:	Real time
Min.:	1	Unit:	[mm/s]/[rpm]

Max.:	10000	Data type:	UInt16
Default:	200	Change mode:	Real time

Range:

1 [mm/s]/[rpm] to 10000 [mm/s]/[rpm]

Parameter description

Same as the maximum speed of displacement 1

H11.40 Acceleration/Deceleration time of displacement 6

Comm. address:	2011-29h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:

0 ms to 65535 ms

Parameter description

Same as the acceleration/deceleration time of displacement 1

H11.41 Interval time after displacement 6

Comm. address:	2011-2Ah	Effective mode:	Real time
Min.:	0	Unit:	ms (s)
Max.:	10000	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:

0 ms(s) to 10000 ms(s)

Parameter description

Same as the interval time after displacement 1

H11.42 Displacement 7

Comm. address:	2011-2Bh	Effective mode:	Real time
Min.:	-1073741824	Unit:	Reference unit
Max.:	1073741824	Data type:	Int32
Default:	10000	Change mode:	Real time

Range:

-1073741824 to +1073741824

Parameter description

Same as displacement 1

H11.44 Maximum speed of displacement 7

Comm. address:	2011-2Dh	Effective mode:	Real time
Min.:	1	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	UInt16
Default:	200	Change mode:	Real time

Range:

1 [mm/s]/[rpm] to 10000 [mm/s]/[rpm]

Parameter description

Same as the maximum speed of displacement 1

H11.45 **Acceleration/Deceleration time of displacement 7**

Comm. address:	2011-2Eh	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:

0 ms to 65535 ms

Parameter description

Same as the acceleration/deceleration time of displacement 1

H11.46 **Interval time after displacement 7**

Comm. address:	2011-2Fh	Effective mode:	Real time
Min.:	0	Unit:	ms (s)
Max.:	10000	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:

0 ms(s) to 10000 ms(s)

Parameter description

Same as the interval time after displacement 1

H11.47 **Displacement 8**

Comm. address:	2011-30h	Effective mode:	Real time
Min.:	-1073741824	Unit:	Reference unit
Max.:	1073741824	Data type:	Int32
Default:	10000	Change mode:	Real time

Range:

-1073741824 to +1073741824

Parameter description

Same as displacement 1

H11.49 **Maximum speed of displacement 8**

Comm. address:	2011-32h	Effective mode:	Real time
Min.:	1	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	UInt16
Default:	200	Change mode:	Real time

Range:

1 [mm/s]/[rpm] to 10000 [mm/s]/[rpm]

Parameter description

Same as the maximum speed of displacement 1

H11.50 **Acceleration/Deceleration time of displacement 8**

Comm. address:	2011-33h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:

0 ms to 65535 ms

Parameter description

Same as the acceleration/deceleration time of displacement 1

H11.51 **Interval time after displacement 8**

Comm. address:	2011-34h	Effective mode:	Real time
Min.:	0	Unit:	ms (s)
Max.:	10000	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:

0 ms(s) to 10000 ms(s)

Parameter description

Same as the interval time after displacement 1

H11.52 **Displacement 9**

Comm. address:	2011-35h	Effective mode:	Real time
Min.:	-1073741824	Unit:	Reference unit
Max.:	1073741824	Data type:	Int32
Default:	10000	Change mode:	Real time

Range:

-1073741824 to +1073741824

Parameter description

Same as displacement 1

H11.54 **Maximum speed of displacement 9**

Comm. address:	2011-37h	Effective mode:	Real time
Min.:	1	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	UInt16
Default:	200	Change mode:	Real time

Range:

1 [mm/s]/[rpm] to 10000 [mm/s]/[rpm]

Parameter description

Same as the maximum speed of displacement 1

H11.55 **Acceleration/Deceleration time of displacement 9**

Comm. address:	2011-38h	Effective mode:	Real time
Min.:	0	Unit:	ms

Max.:	65535	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:
0 ms to 65535 ms
Parameter description
Same as the acceleration/deceleration time of displacement 1

H11.56 Interval time after displacement 9

Comm. address:	2011-39h	Effective mode:	Real time
Min.:	0	Unit:	ms (s)
Max.:	10000	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:
0 ms(s) to 10000 ms(s)
Parameter description
Same as the interval time after displacement 1

H11.57 Displacement 10

Comm. address:	2011-3Ah	Effective mode:	Real time
Min.:	-1073741824	Unit:	Reference unit
Max.:	1073741824	Data type:	Int32
Default:	10000	Change mode:	Real time

Range:
-1073741824 to +1073741824
Parameter description
Same as displacement 1

H11.59 Maximum speed of displacement 10

Comm. address:	2011-3Ch	Effective mode:	Real time
Min.:	1	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	UInt16
Default:	200	Change mode:	Real time

Range:
1 [mm/s]/[rpm] to 10000 [mm/s]/[rpm]
Parameter description
Same as the maximum speed of displacement 1

H11.60 Acceleration/Deceleration time of displacement 10

Comm. address:	2011-3Dh	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:

0 ms to 65535 ms

Parameter description

Same as the acceleration/deceleration time of displacement 1

H11.61 Interval time after displacement 10

Comm. address:	2011-3Eh	Effective mode:	Real time
Min.:	0	Unit:	ms (s)
Max.:	10000	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:

0 ms(s) to 10000 ms(s)

Parameter description

Same as the interval time after displacement 1

H11.62 Displacement 11

Comm. address:	2011-3Fh	Effective mode:	Real time
Min.:	-1073741824	Unit:	Reference unit
Max.:	1073741824	Data type:	Int32
Default:	10000	Change mode:	Real time

Range:

-1073741824 to +1073741824

Parameter description

Same as displacement 1

H11.64 Maximum speed of displacement 11

Comm. address:	2011-41h	Effective mode:	Real time
Min.:	1	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	UInt16
Default:	200	Change mode:	Real time

Range:

1 [mm/s]/[rpm] to 10000 [mm/s]/[rpm]

Parameter description

Same as the maximum speed of displacement 1

H11.65 Acceleration/Deceleration time of displacement 11

Comm. address:	2011-42h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:

0 ms to 65535 ms

Parameter description

Same as the acceleration/deceleration time of displacement 1

H11.66 **Interval time after displacement 11**

Comm. address:	2011-43h	Effective mode:	Real time
Min.:	0	Unit:	ms (s)
Max.:	10000	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:

0 ms(s) to 10000 ms(s)

Parameter description

Same as the interval time after displacement 1

H11.67 **Displacement 12**

Comm. address:	2011-44h	Effective mode:	Real time
Min.:	-1073741824	Unit:	Reference unit
Max.:	1073741824	Data type:	Int32
Default:	10000	Change mode:	Real time

Range:

-1073741824 to +1073741824

Parameter description

Same as displacement 1

H11.69 **Maximum speed of displacement 12**

Comm. address:	2011-46h	Effective mode:	Real time
Min.:	1	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	UInt16
Default:	200	Change mode:	Real time

Range:

1 [mm/s]/[rpm] to 10000 [mm/s]/[rpm]

Parameter description

Same as the maximum speed of displacement 1

H11.70 **Acceleration/Deceleration time of displacement 12**

Comm. address:	2011-47h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:

0 ms to 65535 ms

Parameter description

Same as the acceleration/deceleration time of displacement 1

H11.71 **Interval time after displacement 12**

Comm. address:	2011-48h	Effective mode:	Real time
Min.:	0	Unit:	ms (s)

Max.:	10000	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:
0 ms(s) to 10000 ms(s)
Parameter description
Same as the interval time after displacement 1

H11.72 Displacement 13

Comm. address:	2011-49h	Effective mode:	Real time
Min.:	-1073741824	Unit:	Reference unit
Max.:	1073741824	Data type:	Int32
Default:	10000	Change mode:	Real time

Range:
-1073741824 to +1073741824
Parameter description
Same as displacement 1

H11.74 Maximum speed of displacement 13

Comm. address:	2011-4Bh	Effective mode:	Real time
Min.:	1	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	UInt16
Default:	200	Change mode:	Real time

Range:
1 [mm/s]/[rpm] to 10000 [mm/s]/[rpm]
Parameter description
Same as the maximum speed of displacement 1

H11.75 Acceleration/Deceleration time of displacement 13

Comm. address:	2011-4Ch	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:
0 ms to 65535 ms
Parameter description
Same as the acceleration/deceleration time of displacement 1

H11.76 Interval time after displacement 13

Comm. address:	2011-4Dh	Effective mode:	Real time
Min.:	0	Unit:	ms (s)
Max.:	10000	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:

0 ms(s) to 10000 ms(s)

Parameter description

Same as the interval time after displacement 1

H11.77 **Displacement 14**

Comm. address:	2011-4Eh	Effective mode:	Real time
Min.:	-1073741824	Unit:	Reference unit
Max.:	1073741824	Data type:	Int32
Default:	10000	Change mode:	Real time

Range:

-1073741824 to +1073741824

Parameter description

Same as displacement 1

H11.79 **Maximum speed of displacement 14**

Comm. address:	2011-50h	Effective mode:	Real time
Min.:	1	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	UInt16
Default:	200	Change mode:	Real time

Range:

1 [mm/s]/[rpm] to 10000 [mm/s]/[rpm]

Parameter description

Same as the maximum speed of displacement 1

H11.80 **Acceleration/Deceleration time of displacement 14**

Comm. address:	2011-51h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:

0 ms to 65535 ms

Parameter description

Same as the acceleration/deceleration time of displacement 1

H11.81 **Interval time after displacement 14**

Comm. address:	2011-52h	Effective mode:	Real time
Min.:	0	Unit:	ms (s)
Max.:	10000	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:

0 ms(s) to 10000 ms(s)

Parameter description

Same as the interval time after displacement 1

H11.82 **Displacement 15**

Comm. address:	2011-53h	Effective mode:	Real time
Min.:	-1073741824	Unit:	Reference unit
Max.:	1073741824	Data type:	Int32
Default:	10000	Change mode:	Real time

Range:

-1073741824 to +1073741824

Parameter description

Same as displacement 1

H11.84 **Maximum speed of displacement 15**

Comm. address:	2011-55h	Effective mode:	Real time
Min.:	1	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	UInt16
Default:	200	Change mode:	Real time

Range:

1 [mm/s]/[rpm] to 10000 [mm/s]/[rpm]

Parameter description

Same as the maximum speed of displacement 1

H11.85 **Acceleration/Deceleration time of displacement 15**

Comm. address:	2011-56h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:

0 ms to 65535 ms

Parameter description

Same as the acceleration/deceleration time of displacement 1

H11.86 **Interval time after displacement 15**

Comm. address:	2011-57h	Effective mode:	Real time
Min.:	0	Unit:	ms (s)
Max.:	10000	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:

0 ms(s) to 10000 ms(s)

Parameter description

Same as the interval time after displacement 1

H11.87 **Displacement 16**

Comm. address:	2011-58h	Effective mode:	Real time
Min.:	-1073741824	Unit:	Reference unit

Max.:	1073741824	Data type:	Int32
Default:	10000	Change mode:	Real time

Range:
-1073741824 to +1073741824
Parameter description
Same as displacement 1

H11.89 **Maximum speed of displacement 16**

Comm. address:	2011-5Ah	Effective mode:	Real time
Min.:	1	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	UInt16
Default:	200	Change mode:	Real time

Range:
1 [mm/s]/[rpm] to 10000 [mm/s]/[rpm]
Parameter description
Same as the maximum speed of displacement 1

H11.90 **Acceleration/Deceleration time of displacement 16**

Comm. address:	2011-5Bh	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:
0 ms to 65535 ms
Parameter description
Same as the acceleration/deceleration time of displacement 1

H11.91 **Interval time after displacement 16**

Comm. address:	2011-5Ch	Effective mode:	Real time
Min.:	0	Unit:	ms (s)
Max.:	10000	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:
0 ms(s) to 10000 ms(s)
Parameter description
Same as the interval time after displacement 1

10.18 H12 Multi-speed Parameters

H12.00 **Multi-speed operation mode**

Comm. address:	2012-01h	Effective mode:	Real time
Min.:	0	Unit:	-

Max.:	2	Data type:	UInt16
Default:	1	Change mode:	At stop

Range:

0: Individual operation (number of speeds selected in H12.01)

1: Cyclic operation (number of speeds selected in H12.01)

2: DI-based operation

Parameter description

Defines the multi-speed operation mode when the speed reference source is multi-speed reference (H06.01 = 5, H06.02 = 1/2/3) in the speed control mode.

0: Individual operation (stop after one cycle of operation), switched to the next speed automatically

1: Cyclic operation (start from speed 1 after each cycle of operation), with speed no. changed automatically. The cyclic operation state keeps active as long as the S-ON signal is active.

2. The drive can run continuously when it is enabled. The segment number is determined by DI terminal logic. The running time of each speed reference is only determined by the interval time of segment number switching. FunIN.5 (DlR-SEL) can be used to switch the direction of the speed reference.

The S-ON signal must be active during operation of each speed reference; otherwise, the drive will stop immediately as defined by H02.05 (Stop mode at S-ON off).

Speed arrival (FunOUT.19: V-Arr) signal is valid when a certain speed reference reaches the set value.

H12.01 **Number of speed references in multi-speed mode**

Comm. address:	2012-02h	Effective mode:	Real time
Min.:	1	Unit:	-
Max.:	16	Data type:	UInt16
Default:	16	Change mode:	At stop

Range:

1 to 16

Parameter description

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.

When H12.00 = 2: Assign four DIs (Hardware DI or VDI) with DI functions 6 to 9 (FunIN.6: CMD1 to FunIN.9: CMD4) and control the DI logic through the host controller to switch between different speeds. The segment No. is a 4-bit binary value. bit0 to bit3 correspond to CMD1 to CMD4.

H12.02 **Operating time unit**

Comm. address:	2012-03h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: s

1: min

Parameter description

Defines the time unit of multi-speed operation.

0: s

1: min

H12.03 **Acceleration time 1**

Comm. address:	2012-04h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:

0 ms to 65535 ms

Parameter description

Four groups of acceleration/deceleration time can be set for each speed reference.

Acceleration time: time for the motor to accelerate from 0 [mm/s]/[rpm] to 1000 [mm/s]/[rpm] at a constant speed

H12.04 **Deceleration time 1**

Comm. address:	2012-05h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:

0 ms to 65535 ms

Parameter description

Four groups of acceleration/deceleration time can be set for each speed reference.

Deceleration time: time for the motor to decelerate from 1000 [mm/s]/[rpm] to 0 [mm/s]/[rpm] at a constant speed

H12.05 **Acceleration time 2**

Comm. address:	2012-06h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	50	Change mode:	Real time

Range:

0 ms to 65535 ms

Parameter description

Four groups of acceleration/deceleration time can be set for each speed reference.

Acceleration time: time for the motor to accelerate from 0 [mm/s]/[rpm] to 1000 [mm/s]/[rpm] at a constant speed

H12.06 **Deceleration time 2**

Comm. address:	2012-07h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16

Default:	50	Change mode:	Real time

Range:
0 ms to 65535 ms
Parameter description
Four groups of acceleration/deceleration time can be set for each speed reference.
Deceleration time: time for the motor to decelerate from 1000 [mm/s]/[rpm] to 0 [mm/s]/[rpm] at a constant speed

H12.07 **Acceleration time 3**

Comm. address:	2012-08h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	100	Change mode:	Real time

Range:
0 ms to 65535 ms
Parameter description
Four groups of acceleration/deceleration time can be set for each speed reference.
Acceleration time: time for the motor to accelerate from 0 [mm/s]/[rpm] to 1000 [mm/s]/[rpm] at a constant speed

H12.08 **Deceleration time 3**

Comm. address:	2012-09h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	100	Change mode:	Real time

Range:
0 ms to 65535 ms
Parameter description
Four groups of acceleration/deceleration time can be set for each speed reference.
Deceleration time: time for the motor to decelerate from 1000 [mm/s]/[rpm] to 0 [mm/s]/[rpm] at a constant speed

H12.09 **Acceleration time 4**

Comm. address:	2012-0Ah	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	150	Change mode:	Real time

Range:
0 ms to 65535 ms
Parameter description
Four groups of acceleration/deceleration time can be set for each speed reference.
Acceleration time: time for the motor to accelerate from 0 [mm/s]/[rpm] to 1000 [mm/s]/[rpm] at a constant speed

H12.10 **Deceleration time 4**

Comm. address:	2012-0Bh	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	150	Change mode:	Real time

Range:

0 ms to 65535 ms

Parameter description

Four groups of acceleration/deceleration time can be set for each speed reference.

Deceleration time: time for the motor to decelerate from 1000 [mm/s]/[rpm] to 0 [mm/s]/[rpm] at a constant speed

H12.20 **Speed reference 1**

Comm. address:	2012-15h	Effective mode:	Real time
Min.:	-10000	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	Int16
Default:	0	Change mode:	Real time

Range:

-10000 [mm/s]/[rpm] to +10000 [mm/s]/[rpm]

Parameter description

Defines speed reference 1 in multi-speed operation mode.

H12.21 **Operating time of speed 1**

Comm. address:	2012-16h	Effective mode:	Real time
Min.:	0.0	Unit:	s (m)
Max.:	6553.5	Data type:	UInt16
Default:	5.0	Change mode:	Real time

Range:

0.0s(m) to 6553.5s(m)

Parameter description

Defines the operating time of speed 1.

The operating time is the sum of the speed variation time from previous speed reference to present speed reference plus the average operating time of present speed reference.

If the operating time is set to 0, the drive skips this speed reference automatically.

As long as H12.00 (Multi-speed operation mode) is set to 2 (DI-based operation) and the speed No. determined by the external DI does not change, the drive continues operating at the speed defined by this speed reference, without being affected by the reference operating time.

H12.22 **Acceleration/Deceleration and S-curve smoothing parameter time in speed 1**

Comm. address:	2012-17h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	256	Change mode:	Real time

Range:

bit0 to bit7: Acceleration/Deceleration time

0: Zero acceleration/deceleration time

1: Acceleration/Deceleration time 1

2: Acceleration/Deceleration time 2

3: Acceleration/Deceleration time 3

4: Acceleration/Deceleration time 4

bit8 to bit15: S-curve smoothing parameter

1: Smoothing parameter 1

2: Smoothing parameter 2

3: Smoothing parameter 3

4: Smoothing parameter 4

5: Smoothing parameter 5

6: Smoothing parameter 6

7: Smoothing parameter 7

8: Smoothing parameter 8

Parameter description

bit0 to bit7: Acceleration/Deceleration time

Defines the acceleration/deceleration time of speed 1.

0: Zero acceleration/deceleration time; Acceleration time: 0

Deceleration time: 0

1: Acceleration/Deceleration time 1; Acceleration time: H12.03

Deceleration time: H12.04

2: Acceleration/Deceleration time 2; Acceleration time: H12.05

Deceleration time: H12.06

3: Acceleration/Deceleration time 3; Acceleration time: H12.07

Deceleration time: H12.08

4: Acceleration/Deceleration time 4; Acceleration time: H12.09

Deceleration time: H12.10

bit8 to bit15: S-curve smoothing parameters

1: Smoothing parameter 1; Increasing acceleration time at acceleration segment: H06.51

Decreasing acceleration time at acceleration segment: H06.52

Decreasing deceleration time at deceleration segment: H06.53

Decreasing acceleration time at acceleration segment: H06.54

2: Smoothing parameter 2; Increasing acceleration time at acceleration segment: H06.55

Decreasing acceleration time at acceleration segment: H06.56

Decreasing deceleration time at deceleration segment: H06.57

Decreasing acceleration time at acceleration segment: H06.58

3: Smoothing parameter 3; Increasing acceleration time at acceleration segment: H06.59

Decreasing acceleration time at acceleration segment: H06.60

Decreasing deceleration time at deceleration segment: H06.61

Decreasing acceleration time at acceleration segment: H06.62

4: Smoothing parameter 4; Increasing acceleration time at acceleration segment: H06.63

Decreasing acceleration time at acceleration segment: H06.64

Decreasing deceleration time at deceleration segment: H06.65

Decreasing acceleration time at acceleration segment: H06.66

5: Smoothing parameter 5; Increasing acceleration time at acceleration segment: H06.67

Decreasing acceleration time at acceleration segment: H06.68

Decreasing deceleration time at deceleration segment: H06.69

Decreasing acceleration time at acceleration segment: H06.70

6: Smoothing parameter 6; Increasing acceleration time at acceleration segment: H06.71
Decreasing acceleration time at acceleration segment: H06.72
Decreasing deceleration time at deceleration segment: H06.73
Decreasing acceleration time at acceleration segment: H06.74
7: Smoothing parameter 7; Increasing acceleration time at acceleration segment: H06.75
Decreasing acceleration time at acceleration segment: H06.76
Decreasing deceleration time at deceleration segment: H06.77
Decreasing acceleration time at acceleration segment: H06.78
8: Smoothing parameter 8; Increasing acceleration time at acceleration segment: H06.79
Decreasing acceleration time at acceleration segment: H06.80
Decreasing deceleration time at deceleration segment: H06.81
Decreasing acceleration time at acceleration segment: H06.82

H12.23 **Multi-speed reference 2**

Comm. address:	2012-18h	Effective mode:	Real time
Min.:	-10000	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	Int16
Default:	100	Change mode:	Real time

Range:
-10000 [mm/s]/[rpm] to +10000 [mm/s]/[rpm]
Parameter description
Same as reference 1.

H12.24 **Operating time of speed 2**

Comm. address:	2012-19h	Effective mode:	Real time
Min.:	0.0	Unit:	s (m)
Max.:	6553.5	Data type:	UInt16
Default:	5.0	Change mode:	Real time

Range:
0.0s(m) to 6553.5s(m)
Parameter description
Same as the operating time of speed 1.

H12.25 **Acceleration/Deceleration and S-curve smoothing parameter time of speed 2**

Comm. address:	2012-1Ah	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	256	Change mode:	Real time

Range:

bit0 to bit7: Acceleration/Deceleration time

0: Zero acceleration/deceleration time

1: Acceleration/Deceleration time 1

2: Acceleration/Deceleration time 2

3: Acceleration/Deceleration time 3

4: Acceleration/Deceleration time 4

bit8 to bit15: S-curve smoothing parameter

1: Smoothing parameter 1

2: Smoothing parameter 2

3: Smoothing parameter 3

4: Smoothing parameter 4

5: Smoothing parameter 5

6: Smoothing parameter 6

7: Smoothing parameter 7

8: Smoothing parameter 8

Parameter description

Same as the acceleration/deceleration time of speed 1

H12.26 **Multi-speed reference 3**

Comm. address:	2012-1Bh	Effective mode:	Real time
Min.:	-10000	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	Int16
Default:	300	Change mode:	Real time

Range:

-10000 [mm/s]/[rpm] to +10000 [mm/s]/[rpm]

Parameter description

Same as reference 1.

H12.27 **Operating time of speed 3**

Comm. address:	2012-1Ch	Effective mode:	Real time
Min.:	0.0	Unit:	s (m)
Max.:	6553.5	Data type:	UInt16
Default:	5.0	Change mode:	Real time

Range:

0.0s(m) to 6553.5s(m)

Parameter description

Same as the operating time of speed 1.

H12.28 **Acceleration/Deceleration and S-curve smoothing parameter time of speed 3**

Comm. address:	2012-1Dh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	256	Change mode:	Real time

Range:

bit0 to bit7: Acceleration/Deceleration time

0: Zero acceleration/deceleration time

1: Acceleration/Deceleration time 1

2: Acceleration/Deceleration time 2

3: Acceleration/Deceleration time 3

4: Acceleration/Deceleration time 4

bit8 to bit15: S-curve smoothing parameter

1: Smoothing parameter 1

2: Smoothing parameter 2

3: Smoothing parameter 3

4: Smoothing parameter 4

5: Smoothing parameter 5

6: Smoothing parameter 6

7: Smoothing parameter 7

8: Smoothing parameter 8

Parameter description

Same as the acceleration/deceleration time of speed 1

H12.29 **Multi-speed reference 4**

Comm. address:	2012-1Eh	Effective mode:	Real time
Min.:	-10000	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	Int16
Default:	500	Change mode:	Real time

Range:

-10000 [mm/s]/[rpm] to +10000 [mm/s]/[rpm]

Parameter description

Same as reference 1.

H12.30 **Operating time of speed 4**

Comm. address:	2012-1Fh	Effective mode:	Real time
Min.:	0.0	Unit:	s (m)
Max.:	6553.5	Data type:	UInt16
Default:	5.0	Change mode:	Real time

Range:

0.0s(m) to 6553.5s(m)

Parameter description

Same as the operating time of speed 1.

H12.31 **Acceleration/Deceleration and S-curve smoothing parameter time of speed 4**

Comm. address:	2012-20h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	256	Change mode:	Real time

Range:

bit0 to bit7: Acceleration/Deceleration time

0: Zero acceleration/deceleration time

1: Acceleration/Deceleration time 1

2: Acceleration/Deceleration time 2

3: Acceleration/Deceleration time 3

4: Acceleration/Deceleration time 4

bit8 to bit15: S-curve smoothing parameter

1: Smoothing parameter 1

2: Smoothing parameter 2

3: Smoothing parameter 3

4: Smoothing parameter 4

5: Smoothing parameter 5

6: Smoothing parameter 6

7: Smoothing parameter 7

8: Smoothing parameter 8

Parameter description

Same as the acceleration/deceleration time of speed 1

H12.32 **Multi-speed reference 5**

Comm. address:	2012-21h	Effective mode:	Real time
Min.:	-10000	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	Int16
Default:	700	Change mode:	Real time

Range:

-10000 [mm/s]/[rpm] to +10000 [mm/s]/[rpm]

Parameter description

Same as reference 1.

H12.33 **Operating time of speed 5**

Comm. address:	2012-22h	Effective mode:	Real time
Min.:	0.0	Unit:	s (m)
Max.:	6553.5	Data type:	UInt16
Default:	5.0	Change mode:	Real time

Range:

0.0s(m) to 6553.5s(m)

Parameter description

Same as the operating time of speed 1.

H12.34 **Acceleration/Deceleration and S-curve smoothing parameter time of speed 5**

Comm. address:	2012-23h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	256	Change mode:	Real time

Range:

bit0 to bit7: Acceleration/Deceleration time

0: Zero acceleration/deceleration time

1: Acceleration/Deceleration time 1

2: Acceleration/Deceleration time 2

3: Acceleration/Deceleration time 3

4: Acceleration/Deceleration time 4

bit8 to bit15: S-curve smoothing parameter

1: Smoothing parameter 1

2: Smoothing parameter 2

3: Smoothing parameter 3

4: Smoothing parameter 4

5: Smoothing parameter 5

6: Smoothing parameter 6

7: Smoothing parameter 7

8: Smoothing parameter 8

Parameter description

Same as the acceleration/deceleration time of speed 1

H12.35 **Multi-speed reference 6**

Comm. address:	2012-24h	Effective mode:	Real time
Min.:	-10000	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	Int16
Default:	900	Change mode:	Real time

Range:

-10000 [mm/s]/[rpm] to +10000 [mm/s]/[rpm]

Parameter description

Same as reference 1.

H12.36 **Operating time of speed 6**

Comm. address:	2012-25h	Effective mode:	Real time
Min.:	0.0	Unit:	s (m)
Max.:	6553.5	Data type:	UInt16
Default:	5.0	Change mode:	Real time

Range:

0.0s(m) to 6553.5s(m)

Parameter description

Same as the operating time of speed 1.

H12.37 **Acceleration/Deceleration and S-curve smoothing parameter time of speed 6**

Comm. address:	2012-26h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	256	Change mode:	Real time

Range:

bit0 to bit7: Acceleration/Deceleration time

0: Zero acceleration/deceleration time

1: Acceleration/Deceleration time 1

2: Acceleration/Deceleration time 2

3: Acceleration/Deceleration time 3

4: Acceleration/Deceleration time 4

bit8 to bit15: S-curve smoothing parameter

1: Smoothing parameter 1

2: Smoothing parameter 2

3: Smoothing parameter 3

4: Smoothing parameter 4

5: Smoothing parameter 5

6: Smoothing parameter 6

7: Smoothing parameter 7

8: Smoothing parameter 8

Parameter description

Same as the acceleration/deceleration time of speed 1

H12.38 **Multi-speed reference 7**

Comm. address:	2012-27h	Effective mode:	Real time
Min.:	-10000	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	Int16
Default:	600	Change mode:	Real time

Range:

-10000 [mm/s]/[rpm] to +10000 [mm/s]/[rpm]

Parameter description

Same as reference 1.

H12.39 **Operating time of speed 7**

Comm. address:	2012-28h	Effective mode:	Real time
Min.:	0.0	Unit:	s (m)
Max.:	6553.5	Data type:	UInt16
Default:	5.0	Change mode:	Real time

Range:

0.0s(m) to 6553.5s(m)

Parameter description

Same as the operating time of speed 1.

H12.40 **Acceleration/Deceleration and S-curve smoothing parameter time of speed 7**

Comm. address:	2012-29h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	256	Change mode:	Real time

Range:

bit0 to bit7: Acceleration/Deceleration time

0: Zero acceleration/deceleration time

1: Acceleration/Deceleration time 1

2: Acceleration/Deceleration time 2

3: Acceleration/Deceleration time 3

4: Acceleration/Deceleration time 4

bit8 to bit15: S-curve smoothing parameter

1: Smoothing parameter 1

2: Smoothing parameter 2

3: Smoothing parameter 3

4: Smoothing parameter 4

5: Smoothing parameter 5

6: Smoothing parameter 6

7: Smoothing parameter 7

8: Smoothing parameter 8

Parameter description

Same as the acceleration/deceleration time of speed 1

H12.41 **Multi-speed reference 8**

Comm. address:	2012-2Ah	Effective mode:	Real time
Min.:	-10000	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	Int16
Default:	300	Change mode:	Real time

Range:

-10000 [mm/s]/[rpm] to +10000 [mm/s]/[rpm]

Parameter description

Same as reference 1.

H12.42 **Operating time of speed 8**

Comm. address:	2012-2Bh	Effective mode:	Real time
Min.:	0.0	Unit:	s (m)
Max.:	6553.5	Data type:	UInt16
Default:	5.0	Change mode:	Real time

Range:

0.0s(m) to 6553.5s(m)

Parameter description

Same as the operating time of speed 1.

H12.43 **Acceleration/Deceleration and S-curve smoothing parameter time of speed 8**

Comm. address:	2012-2Ch	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	256	Change mode:	Real time

Range:

bit0 to bit7: Acceleration/Deceleration time

0: Zero acceleration/deceleration time

1: Acceleration/Deceleration time 1

2: Acceleration/Deceleration time 2

3: Acceleration/Deceleration time 3

4: Acceleration/Deceleration time 4

bit8 to bit15: S-curve smoothing parameter

1: Smoothing parameter 1

2: Smoothing parameter 2

3: Smoothing parameter 3

4: Smoothing parameter 4

5: Smoothing parameter 5

6: Smoothing parameter 6

7: Smoothing parameter 7

8: Smoothing parameter 8

Parameter description

Same as the acceleration/deceleration time of speed 1

H12.44 **Multi-speed reference 9**

Comm. address:	2012-2Dh	Effective mode:	Real time
Min.:	-10000	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	Int16
Default:	100	Change mode:	Real time

Range:

-10000 [mm/s]/[rpm] to +10000 [mm/s]/[rpm]

Parameter description

Same as reference 1.

H12.45 **Operating time of speed 9**

Comm. address:	2012-2Eh	Effective mode:	Real time
Min.:	0.0	Unit:	s (m)
Max.:	6553.5	Data type:	UInt16
Default:	5.0	Change mode:	Real time

Range:

0.0s(m) to 6553.5s(m)

Parameter description

Same as the operating time of speed 1.

H12.46 **Acceleration/Deceleration and S-curve smoothing parameter time of speed 9**

Comm. address:	2012-2Fh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	256	Change mode:	Real time

Range:

bit0 to bit7: Acceleration/Deceleration time

0: Zero acceleration/deceleration time

1: Acceleration/Deceleration time 1

2: Acceleration/Deceleration time 2

3: Acceleration/Deceleration time 3

4: Acceleration/Deceleration time 4

bit8 to bit15: S-curve smoothing parameter

1: Smoothing parameter 1

2: Smoothing parameter 2

3: Smoothing parameter 3

4: Smoothing parameter 4

5: Smoothing parameter 5

6: Smoothing parameter 6

7: Smoothing parameter 7

8: Smoothing parameter 8

Parameter description

Same as the acceleration/deceleration time of speed 1

H12.47 **Multi-speed reference 10**

Comm. address:	2012-30h	Effective mode:	Real time
Min.:	-10000	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	Int16
Default:	-100	Change mode:	Real time

Range:

-10000 [mm/s]/[rpm] to +10000 [mm/s]/[rpm]

Parameter description

Same as reference 1.

H12.48 **Operating time of speed 10**

Comm. address:	2012-31h	Effective mode:	Real time
Min.:	0.0	Unit:	s (m)
Max.:	6553.5	Data type:	UInt16
Default:	5.0	Change mode:	Real time

Range:

0.0s(m) to 6553.5s(m)

Parameter description

Same as the operating time of speed 1.

H12.49 **Acceleration/Deceleration and S-curve smoothing parameter time of speed 10**

Comm. address:	2012-32h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	256	Change mode:	Real time

Range:

bit0 to bit7: Acceleration/Deceleration time

0: Zero acceleration/deceleration time

1: Acceleration/Deceleration time 1

2: Acceleration/Deceleration time 2

3: Acceleration/Deceleration time 3

4: Acceleration/Deceleration time 4

bit8 to bit15: S-curve smoothing parameter

1: Smoothing parameter 1

2: Smoothing parameter 2

3: Smoothing parameter 3

4: Smoothing parameter 4

5: Smoothing parameter 5

6: Smoothing parameter 6

7: Smoothing parameter 7

8: Smoothing parameter 8

Parameter description

Same as the acceleration/deceleration time of speed 1

H12.50 **Multi-speed reference 11**

Comm. address:	2012-33h	Effective mode:	Real time
Min.:	-10000	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	Int16
Default:	-300	Change mode:	Real time

Range:

-10000 [mm/s]/[rpm] to +10000 [mm/s]/[rpm]

Parameter description

Same as reference 1.

H12.51 **Operating time of speed 11**

Comm. address:	2012-34h	Effective mode:	Real time
Min.:	0.0	Unit:	s (m)
Max.:	6553.5	Data type:	UInt16
Default:	5.0	Change mode:	Real time

Range:

0.0s(m) to 6553.5s(m)

Parameter description

Same as the operating time of speed 1.

H12.52 **Acceleration/Deceleration and S-curve smoothing parameter time of speed 11**

Comm. address:	2012-35h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	256	Change mode:	Real time

Range:

bit0 to bit7: Acceleration/Deceleration time

0: Zero acceleration/deceleration time

1: Acceleration/Deceleration time 1

2: Acceleration/Deceleration time 2

3: Acceleration/Deceleration time 3

4: Acceleration/Deceleration time 4

bit8 to bit15: S-curve smoothing parameter

1: Smoothing parameter 1

2: Smoothing parameter 2

3: Smoothing parameter 3

4: Smoothing parameter 4

5: Smoothing parameter 5

6: Smoothing parameter 6

7: Smoothing parameter 7

8: Smoothing parameter 8

Parameter description

Same as the acceleration/deceleration time of speed 1

H12.53 **Multi-speed reference 12**

Comm. address:	2012-36h	Effective mode:	Real time
Min.:	-10000	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	Int16
Default:	-500	Change mode:	Real time

Range:

-10000 [mm/s]/[rpm] to +10000 [mm/s]/[rpm]

Parameter description

Same as reference 1.

H12.54 **Operating time of speed 12**

Comm. address:	2012-37h	Effective mode:	Real time
Min.:	0.0	Unit:	s (m)
Max.:	6553.5	Data type:	UInt16
Default:	5.0	Change mode:	Real time

Range:

0.0s(m) to 6553.5s(m)

Parameter description

Same as the operating time of speed 1.

H12.55 **Acceleration/Deceleration and S-curve smoothing parameter time of speed 12**

Comm. address:	2012-38h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	256	Change mode:	Real time

Range:

bit0 to bit7: Acceleration/Deceleration time

0: Zero acceleration/deceleration time

1: Acceleration/Deceleration time 1

2: Acceleration/Deceleration time 2

3: Acceleration/Deceleration time 3

4: Acceleration/Deceleration time 4

bit8 to bit15: S-curve smoothing parameter

1: Smoothing parameter 1

2: Smoothing parameter 2

3: Smoothing parameter 3

4: Smoothing parameter 4

5: Smoothing parameter 5

6: Smoothing parameter 6

7: Smoothing parameter 7

8: Smoothing parameter 8

Parameter description

Same as the acceleration/deceleration time of speed 1

H12.56 **Multi-speed reference 13**

Comm. address:	2012-39h	Effective mode:	Real time
Min.:	-10000	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	Int16
Default:	-700	Change mode:	Real time

Range:

-10000 [mm/s]/[rpm] to +10000 [mm/s]/[rpm]

Parameter description

Same as reference 1.

H12.57 **Operating time of speed 13**

Comm. address:	2012-3Ah	Effective mode:	Real time
Min.:	0.0	Unit:	s (m)
Max.:	6553.5	Data type:	UInt16
Default:	5.0	Change mode:	Real time

Range:

0.0s(m) to 6553.5s(m)

Parameter description

Same as the operating time of speed 1.

H12.58 **Acceleration/Deceleration and S-curve smoothing parameter time of speed 13**

Comm. address:	2012-3Bh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	256	Change mode:	Real time

Range:

bit0 to bit7: Acceleration/Deceleration time

0: Zero acceleration/deceleration time

1: Acceleration/Deceleration time 1

2: Acceleration/Deceleration time 2

3: Acceleration/Deceleration time 3

4: Acceleration/Deceleration time 4

bit8 to bit15: S-curve smoothing parameter

1: Smoothing parameter 1

2: Smoothing parameter 2

3: Smoothing parameter 3

4: Smoothing parameter 4

5: Smoothing parameter 5

6: Smoothing parameter 6

7: Smoothing parameter 7

8: Smoothing parameter 8

Parameter description

Same as the acceleration/deceleration time of speed 1

H12.59 **Multi-speed reference 14**

Comm. address:	2012-3Ch	Effective mode:	Real time
Min.:	-10000	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	Int16
Default:	-900	Change mode:	Real time

Range:

-10000 [mm/s]/[rpm] to +10000 [mm/s]/[rpm]

Parameter description

Same as reference 1.

H12.60 **Operating time of speed 14**

Comm. address:	2012-3Dh	Effective mode:	Real time
Min.:	0.0	Unit:	s (m)
Max.:	6553.5	Data type:	UInt16
Default:	5.0	Change mode:	Real time

Range:

0.0s(m) to 6553.5s(m)

Parameter description

Same as the operating time of speed 1.

H12.61 **Acceleration/Deceleration and S-curve smoothing parameter time of speed 14**

Comm. address:	2012-3Eh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	256	Change mode:	Real time

Range:

bit0 to bit7: Acceleration/Deceleration time

0: Zero acceleration/deceleration time

1: Acceleration/Deceleration time 1

2: Acceleration/Deceleration time 2

3: Acceleration/Deceleration time 3

4: Acceleration/Deceleration time 4

bit8 to bit15: S-curve smoothing parameter

1: Smoothing parameter 1

2: Smoothing parameter 2

3: Smoothing parameter 3

4: Smoothing parameter 4

5: Smoothing parameter 5

6: Smoothing parameter 6

7: Smoothing parameter 7

8: Smoothing parameter 8

Parameter description

Same as the acceleration/deceleration time of speed 1

H12.62 **Multi-speed reference 15**

Comm. address:	2012-3Fh	Effective mode:	Real time
Min.:	-10000	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	Int16
Default:	-600	Change mode:	Real time

Range:

-10000 [mm/s]/[rpm] to +10000 [mm/s]/[rpm]

Parameter description

Same as reference 1.

H12.63 **Operating time of speed 15**

Comm. address:	2012-40h	Effective mode:	Real time
Min.:	0.0	Unit:	s (m)
Max.:	6553.5	Data type:	UInt16
Default:	5.0	Change mode:	Real time

Range:

0.0s(m) to 6553.5s(m)

Parameter description

Same as the operating time of speed 1.

H12.64 **Acceleration/Deceleration and S-curve smoothing parameter time of speed 15**

Comm. address:	2012-41h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	256	Change mode:	Real time

Range:

bit0 to bit7: Acceleration/Deceleration time

0: Zero acceleration/deceleration time

1: Acceleration/Deceleration time 1

2: Acceleration/Deceleration time 2

3: Acceleration/Deceleration time 3

4: Acceleration/Deceleration time 4

bit8 to bit15: S-curve smoothing parameter

1: Smoothing parameter 1

2: Smoothing parameter 2

3: Smoothing parameter 3

4: Smoothing parameter 4

5: Smoothing parameter 5

6: Smoothing parameter 6

7: Smoothing parameter 7

8: Smoothing parameter 8

Parameter description

Same as the acceleration/deceleration time of speed 1

H12.65 **Multi-speed reference 16**

Comm. address:	2012-42h	Effective mode:	Real time
Min.:	-10000	Unit:	[mm/s]/[rpm]
Max.:	10000	Data type:	Int16
Default:	-300	Change mode:	Real time

Range:

-10000 [mm/s]/[rpm] to +10000 [mm/s]/[rpm]

Parameter description

Same as reference 1.

H12.66 **Operating time of speed 16**

Comm. address:	2012-43h	Effective mode:	Real time
Min.:	0.0	Unit:	s (m)
Max.:	6553.5	Data type:	UInt16
Default:	5.0	Change mode:	Real time

Range:

0.0s(m) to 6553.5s(m)

Parameter description

Same as the operating time of speed 1.

H12.67 **Acceleration/Deceleration and S-curve smoothing parameter time of speed 16**

Comm. address:	2012-44h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	256	Change mode:	Real time

Range:

bit0 to bit7: Acceleration/Deceleration time

0: Zero acceleration/deceleration time

1: Acceleration/Deceleration time 1

2: Acceleration/Deceleration time 2

3: Acceleration/Deceleration time 3

4: Acceleration/Deceleration time 4

bit8 to bit15: S-curve smoothing parameter

1: Smoothing parameter 1

2: Smoothing parameter 2

3: Smoothing parameter 3

4: Smoothing parameter 4

5: Smoothing parameter 5

6: Smoothing parameter 6

7: Smoothing parameter 7

8: Smoothing parameter 8

Parameter description

Same as the acceleration/deceleration time of speed 1

10.19 H14 Gantry Synchronization Parameters

H14.00 **Gantry communication status**

Comm. address:	2014-01h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:

0 to 1

Parameter Description

The gantry communication state is used to judge whether the two axes establish the communication state after the gantry function is enabled.

H14.01 **Gantry alignment status**

Comm. address:	2014-02h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:

0 to 1

Parameter Description

After the gantry is aligned, the gantry alignment state is outputted as "1".

H14.02 **Gantry function selection**

Comm. address:	2014-03h	Effective mode:	Real time

Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0: Disable

1: Gantry synchronization

Parameter Description

The gantry function selection switch.

0: Disable gantry synchronization

1: Enable gantry synchronization

H14.03 **Gantry axis attribute (master-slave)**

Comm. address:	2014-04h	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0: Slave axis

1: Master axis

Parameter Description

Selects the gantry axis attribute.

0: Slave axis

1: Master axis

H14.04 **Gantry mechanical attribute**

Comm. address:	2014-05h	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0: Rigid gantry solution 1 - Dual-axis position control

1: Flexible gantry solution 1 - Dual-axis position control

2: Rigid gantry solution 2 - Slave axis torque control on master axis position

3: Flexible gantry solution 2 - Slave axis torque control on master axis position

Parameter Description

The mechanical attribute of the gantry is related to the gantry mechanical structure, which are divided into rigid beam gantry and flexible beam gantry.

0: Rigid beam gantry (Axis stuck may occur upon excessive deviation between two axes)

1: Flexible beam gantry (Certain synchronous deviation between two axes is allowed)

2: Rigid beam gantry (Applicable in case of moderate positioning accuracy)

3: Flexible beam gantry (Certain synchronous deviation between two axes is allowed)

H14.07 **Gantry synchronization enable**

Comm. address:	2014-08h	Effective mode:	Real time
Min. value:	0	Unit:	-

Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Disable

1: Enable

2: Enabled by DI

Parameter Description

After gantry synchronization is enabled, H14.08 to H14.11 will be activated.

0: Disable

1: Enable

2: Enabled by DI

H14.08 **Gantry synchronization position loop proportional gain**

Comm. address:	2014-09h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	300.0	Data type:	UInt16
Default value:	0.0	Change mode:	Real time

Range:

0.0 to 300.0

Parameter Description

Defines the gantry synchronization position loop proportional gain, which is active only in the slave axis.

H14.09 **Gantry position loop integral time constant**

Comm. address:	2014-0Ah	Effective mode:	Real time
Min. value:	0.5	Unit:	ms
Max. value:	1000.0	Data type:	UInt16
Default value:	1000.0	Change mode:	Real time

Range:

0.5 to 1000.0

Parameter Description

Defines the gantry position loop integral time constant, which is active only in the slave axis.

H14.10 **Gantry synchronization speed loop proportional gain**

Comm. address:	2014-0Bh	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	300.0	Data type:	UInt16
Default value:	0.0	Change mode:	Real time

Range:

0.0 to 300.0

Parameter Description

Defines the gantry synchronization speed loop proportional gain, which is active only in the slave axis.

H14.11 **Gantry synchronization speed loop integral time constant**

Comm. address:	2014-0Ch	Effective mode:	Real time
Min. value:	0.5	Unit:	ms
Max. value:	1000.0	Data type:	UInt16
Default value:	1000.0	Change mode:	Real time

Range:

0.5 to 1000.0

Parameter Description

Defines the gantry synchronization speed loop integral time constant, which is active only in the slave axis.

H14.12 **Gantry synchronization speed limit**

Comm. address:	2014-0Dh	Effective mode:	Real time
Min. value:	0.0	Unit:	rpm
Max. value:	6000.0	Data type:	UInt16
Default value:	50.0	Change mode:	Real time

Range:

0.0 to 6000.0

Parameter Description

Defines the gantry synchronization compensation speed limit.

H14.13 **Gantry alignment speed**

Comm. address:	2014-0Eh	Effective mode:	Real time
Min. value:	0.0	Unit:	rpm
Max. value:	3000.0	Data type:	UInt16
Default value:	10.0	Change mode:	Real time

Range:

0.0 to 3000.0

Parameter Description

Defines the gantry alignment speed.

H14.14 **Acceleration/Deceleration time of gantry alignment**

Comm. address:	2014-0Fh	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	1000	Data type:	UInt16
Default value:	100	Change mode:	Real time

Range:

0 to 1000

Parameter Description

Defines the acceleration/deceleration time of gantry alignment.

H14.18 **Torque pre-alignment before gantry homing**

Comm. address:	2014-13h	Effective mode:	Real time

Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0: Disable

1: Enable

Parameter Description

Used to set whether to perform torque pre-alignment before gantry homing.

0: Disable

1: Enable

H14.20 Gantry aligned by default upon power-on

Comm. address:	2014-15h	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	1	Change mode:	At stop

Range:

0: No action

1: Aligned by default upon initial power-on of the two axes

Parameter Description

Defines whether to align the gantry by default upon power-on.

0: Disable default alignment

1: Aligned by default upon initial power-on of the two axes

H14.21 Gantry alignment mode

Comm. address:	2014-16h	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	-
Max. value:	4	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0: Gantry homing alignment

2: Gantry torque alignment

3: Gantry enable alignment

4: Gantry DI alignment

Parameter Description

Defines the dual-axis alignment mode of the gantry.

0: Gantry homing alignment

2: Gantry torque alignment

3: Gantry enable alignment

4: Gantry DI alignment

H14.25 Flexible gantry homing - Master/Slave home deviation value auto-tuning

Comm. address:	2014-1Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16

Default value:	0	Change mode:	Real time

Range:

0: Disable

1: Torque alignment auto-tuning

2: Position auto-tuning

Parameter Description

Used to set whether to perform deviation value auto-tuning on the master/slave axis home when H14.04 is set to 1.

0: Disable

1: Torque alignment auto-tuning

2: Position auto-tuning

H14.26 Gantry torque alignment enable

Comm. address:	2014-1Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Disable

1: Enable

2: Enabled by DI input

3: Enabled upon power-on

Parameter Description

Used to enable torque alignment in gantry alignment mode.

0: Disable

1: Enable

2: Enabled by DI input

3: Enabled upon power-on

H14.27 Gantry torque alignment torque

Comm. address:	2014-1Ch	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	300.0	Data type:	UInt16
Default value:	10.0	Change mode:	Real time

Range:

0.0 to 300.0

Parameter Description

Defines the torque in gantry torque alignment mode.

H14.28 Gantry torque alignment count

Comm. address:	2014-1Dh	Effective mode:	Real time
Min. value:	1	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	2	Change mode:	Real time

Range:
1 to 2
Parameter Description
Defines the number of alignments in gantry torque alignment mode.

H14.29 Gantry torque alignment speed

Comm. address:	2014-1Eh	Effective mode:	Real time
Min. value:	0.0	Unit:	rpm
Max. value:	3000.0	Data type:	UInt16
Default value:	10.0	Change mode:	Real time

Range:
0.0 to 3000.0
Parameter Description
Defines the speed in gantry torque alignment mode.

H14.30 Alarm time for gantry torque alignment timeout

Comm. address:	2014-1Fh	Effective mode:	Real time
Min. value:	1	Unit:	s
Max. value:	65535	Data type:	UInt16
Default value:	100	Change mode:	Real time

Range:
1 to 65535
Parameter Description
Defines the alarm time for gantry torque alignment timeout.

H14.31 Acceleration/Deceleration time of gantry torque alignment

Comm. address:	2014-20h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	1000	Data type:	UInt16
Default value:	100	Change mode:	Real time

Range:
0 to 1000
Parameter Description
Defines the acceleration/deceleration time of gantry torque alignment.

H14.32 Zero speed threshold of gantry torque alignment

Comm. address:	2014-21h	Effective mode:	Real time
Min. value:	0.0	Unit:	rpm
Max. value:	100.0	Data type:	UInt16
Default value:	2.0	Change mode:	Real time

Range:
0.0 to 100.0
Parameter Description
Defines the zero speed threshold in gantry torque alignment.

H14.33 **Mechanical limit judgement cycles of gantry torque alignment**

Comm. address:	2014-22h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	5	Change mode:	Real time

Range:

0 to 65535

Parameter Description

Defines the mechanical limit judgement cycles of gantry torque alignment.

H14.35 **Position deviation between two axes (in encoder unit)**

Comm. address:	2014-24h	Effective mode:	-
Min. value:	-2147483648	Unit:	Encoder unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Range:

-2147483648 to 2147483647

Parameter Description

Defines the position deviation between current axis and pairing axis (in encoder unit) in gantry mode is related to H0B.17 of the two axes.

H14.37 **Speed deviation between two axes**

Comm. address:	2014-26h	Effective mode:	-
Min. value:	-32767	Unit:	rpm
Max. value:	32767	Data type:	Int16
Default value:	0	Change mode:	Read-only

Range:

-32767 to 32767

Parameter Description

Defines the speed difference between current axis and pairing axis in gantry mode.

H14.38 **Defines the current axis torque reference.**

Comm. address:	2014-27h	Effective mode:	-
Min. value:	-3276.7	Unit:	%
Max. value:	3276.7	Data type:	Int16
Default value:	0.0	Change mode:	Read-only

Range:

-3276.7 to 3276.7

Parameter Description

Defines the current axis torque reference.

H14.39 **Defines the pairing axis torque reference.**

Comm. address:	2014-28h	Effective mode:	-

Min. value:	-3276.7	Unit:	%
Max. value:	3276.7	Data type:	Int16
Default value:	0.0	Change mode:	Read-only

Range:
-3276.7 to 3276.7
Parameter Description
Defines the pairing axis torque reference.

H14.40 **Current axis motor speed**

Comm. address:	2014-29h	Effective mode:	-
Min. value:	-32767	Unit:	rpm
Max. value:	32767	Data type:	Int16
Default value:	0	Change mode:	Read-only

Range:
-32767 to 32767
Parameter Description
Defines the current axis motor speed.

H14.41 **Pairing axis motor speed**

Comm. address:	2014-2Ah	Effective mode:	-
Min. value:	-32767	Unit:	rpm
Max. value:	32767	Data type:	Int16
Default value:	0	Change mode:	Read-only

Range:
-32767 to 32767
Parameter Description
Defines the pairing axis motor speed.

H14.44 **Time threshold for excessive gantry position deviation alarm**

Comm. address:	2014-2Dh	Effective mode:	Real time
Min. value:	0.5	Unit:	ms
Max. value:	1000.0	Data type:	UInt16
Default value:	3.0	Change mode:	Real time

Range:
0.5 to 1000.0
Parameter Description
Time threshold for excessive gantry position deviation alarm

H14.45 **Gantry position alarm threshold**

Comm. address:	2014-2Eh	Effective mode:	Real time
Min. value:	0	Unit:	Encoder unit
Max. value:	4294967295	Data type:	UInt32
Default value:	50000	Change mode:	At stop

Range:

0 to 4294967295

Parameter Description

Gantry position alarm threshold

H14.47 Excessive gantry position deviation alarm

Comm. address:	2014-30h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	1	Change mode:	Real time

Range:

0: Disable

1: Enable

Parameter Description

Defines whether to enable excessive gantry position deviation alarm.

0: Disable

1: Enable

H14.48 Time threshold for excessive gantry torque deviation alarm

Comm. address:	2014-31h	Effective mode:	Real time
Min. value:	0.5	Unit:	ms
Max. value:	1000.0	Data type:	UInt16
Default value:	3.0	Change mode:	Real time

Range:

0.5 to 1000.0

Parameter Description

Alarm time threshold for excessive gantry torque deviation.

H14.49 Alarm threshold for excessive gantry torque deviation

Comm. address:	2014-32h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	800.0	Data type:	UInt16
Default value:	300.0	Change mode:	At stop

Range:

0.0 to 800.0

Parameter Description

Alarm threshold for excessive gantry torque deviation.

H14.50 Excessive gantry torque deviation alarm

Comm. address:	2014-33h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Disable

1: Enable

Parameter Description

Used to enable or disable excessive gantry torque deviation alarm.

0: Disable

1: Enable

H14.51 **Gantry absolute encoder alignment**

Comm. address:	2014-34h	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Disable

1: Enable

Parameter Description

0: Disable

1: Enable

Note: Perform homing before using this function. Do not perform homing when this function is active.

H14.52 **Gantry mismatch**

Comm. address:	2014-35h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	1451	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Range:

0 to 1451

Parameter Description

This parameter will be displayed when parameters of the two gantry axes do not match.

H14.71 **Flexible gantry homing - Slave axis homing position aligned to home offset**

Comm. address:	2014-48h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No action

1: Enable

2: Enable solution 2: dual-axis homing

Parameter Description

Flexible gantry homing: Slave axis homing position aligned to home offset.

0: No action

1: Enable

2: Enable solution 2: dual-axis homing

10.20 H15 Machine Tool Parameters

H15.00 **Positive friction compensation torque**

Comm. address:	2015-01h	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	50.0	Data type:	UInt16
Default:	0.0	Change mode:	Real time

Range:
0.0% to 50.0%
Parameter description
-

H15.01 **Negative friction compensation torque**

Comm. address:	2015-02h	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	50.0	Data type:	UInt16
Default:	0.0	Change mode:	Real time

Range:
0.0% to 50.0%
Parameter description
-

H15.02 **Filter time constant of positive friction torque**

Comm. address:	2015-03h	Effective mode:	Real time
Min.:	0.10	Unit:	ms
Max.:	100.00	Data type:	UInt16
Default:	0.10	Change mode:	Real time

Range:
0.10 ms to 100.00 ms
Parameter description
-

H15.03 **Filter time constant of negative friction torque**

Comm. address:	2015-04h	Effective mode:	Real time
Min.:	0.10	Unit:	ms
Max.:	100.00	Data type:	UInt16
Default:	0.10	Change mode:	Real time

Range:
0.10 ms to 100.00 ms
Parameter description
-

H15.04 **Friction torque compensation speed reference source**

Comm. address:	2015-05h	Effective mode:	Real time

Min.:	0x0	Unit:	-
Max.:	0x4	Data type:	UInt16
Default:	0x2	Change mode:	Real time

Range:

0: Position reference

1: Model speed

2: Speed feedback

3: Observed speed

4: Speed reference

Parameter description

-

H15.05 **Friction torque compensation delay time**

Comm. address:	2015-06h	Effective mode:	Real time
Min.:	0.00	Unit:	ms
Max.:	300.00	Data type:	UInt16
Default:	0.00	Change mode:	Real time

Range:

0.00 ms to 300.00 ms

Parameter description

-

H15.06 **Speed threshold for valid friction torque compensation**

Comm. address:	2015-07h	Effective mode:	Real time
Min.:	0.0	Unit:	rpm
Max.:	20.0	Data type:	UInt16
Default:	0.1	Change mode:	Real time

Range:

0.0 rpm to 20.0 rpm

Parameter description

-

H15.15 **Backlash compensation enable**

Comm. address:	2015-10h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Inactive

1: Ramp

Parameter description

-

H15.16 **Backlash compensation speed signal source**

Comm. address:	2015-11h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	4	Data type:	UInt16
Default:	4	Change mode:	Real time

Range:

0: Position reference

1: Model speed

2: Speed feedback

3: Observed speed

4: Speed reference

Parameter description

-

H15.17 **Minimum speed threshold of backlash compensation**

Comm. address:	2015-12h	Effective mode:	Real time
Min.:	0.0	Unit:	rpm
Max.:	20.0	Data type:	UInt16
Default:	2.0	Change mode:	Real time

Range:

0.0 rpm to 20.0 rpm

Parameter description

-

H15.18 **Number of backlash compensation pulses**

Comm. address:	2015-13h	Effective mode:	Real time
Min.:	0	Unit:	p
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0 p to 65535 p

Parameter description

Note: The setting of H15.18 and H15.21 (H15.21, H15.23) must meet the requirements of H15.18/H15.21 (H15.23) > 16.

H15.19 **Backlash delay time**

Comm. address:	2015-14h	Effective mode:	Real time
Min.:	0.0	Unit:	ms
Max.:	300.0	Data type:	UInt16
Default:	0.0	Change mode:	Real time

Range:

0.0 ms to 300.0 ms

Parameter description

-

H15.21 **Forward backlash compensation time**

Comm. address:	2015-16h	Effective mode:	Real time
Min.:	0.1	Unit:	ms
Max.:	300.0	Data type:	UInt16
Default:	0.1	Change mode:	Real time

Range:

0.1 ms to 300.0 ms

Parameter description

Note: The setting of H15.18 and H15.21 (H15.21, H15.23) must meet the requirements of H15.18/H15.21 (H15.23) > 16.

H15.23 **Reverse backlash compensation time**

Comm. address:	2015-18h	Effective mode:	Real time
Min.:	0.1	Unit:	ms
Max.:	300.0	Data type:	UInt16
Default:	0.1	Change mode:	Real time

Range:

0.1 ms to 300.0 ms

Parameter description

Note: The setting of H15.18 and H15.21 (H15.21, H15.23) must meet the requirements of H15.18/H15.21 (H15.23) > 16.

H15.25 **Moving average filter time constant for backlash compensation**

Comm. address:	2015-1Ah	Effective mode:	Real time
Min.:	0.0	Unit:	ms
Max.:	50.0	Data type:	UInt16
Default:	0.0	Change mode:	At stop

Range:

0.0 ms to 50.0 ms

Parameter description

Defines the moving average filter time constant for backlash compensation.

10.21 H16 Variable Monitoring

H16.43 **Error frame pre-alarm function switch/threshold**

Comm. address:	2016-2Ch	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	255	Data type:	UInt8
Default:	4	Change mode:	At stop

Range:

0 to 255

Parameter description

Defines the pre-alarm function switch/threshold for the error frame.
0: Disable the error frame pre-alarm function.

1, 2, and 3...: Enable the error frame pre-alarm function and the pre-alarm threshold is the corresponding value (that is, when the number of error frames reaches this value, a pre-alarm is triggered).

H16.44 Error frame pre-alarm sampling time interval

Comm. address:	2016-2Dh	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	1000	Change mode:	Real time

Range:
0 ms to 65535 ms
Parameter description
Defines the error frame pre-alarm sampling time interval.

H16.46 Total duration of last link-down

Comm. address:	2016-2Fh	Effective mode:	-
Min.:	0	Unit:	ms
Max.:	4294967295	Data type:	UInt32
Default:	0	Change mode:	Read only

Range:
0 ms to 4294967295 ms
Parameter description
Records the total duration of last link-down.

H16.52 Port 0 error register upon switching from safeop state to op state

Comm. address:	2016-35h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFF
Parameter description
Records the invalid frames and maximum error value of EtherCAT port 0 upon switching from the safeop state to op state.

H16.53 Port 1 error register upon switching from safeop state to op state

Comm. address:	2016-36h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFF

Parameter description

Records the invalid frames and maximum error value of EtherCAT port 1 upon switching from the safeop state to op state.

H16.54 Transfer error frame register upon switching from safeop state to op state

Comm. address:	2016-37h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFF

Parameter description

Records the maximum transfer error frame of EtherCAT port upon switching from safeop state to op state.

H16.55 Processing unit error frame register upon switching from safeop state to op state

Comm. address:	2016-38h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFF	Data type:	UInt8
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFF

Parameter description

Records the maximum processing unit error of EtherCAT data frame upon switching from safeop state to op state.

H16.56 Link loss frame register upon switching from safeop state to op state

Comm. address:	2016-39h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFF

Parameter description

Records the maximum value of EtherCAT port 0 link loss frame upon switching from safeop state to op state.

H16.66 Fault record monitoring variable property

Comm. address:	2016-43h	Effective mode:	Real time
Min.:	0x0	Unit:	-
Max.:	0xFF	Data type:	UInt8
Default:	0x0	Change mode:	Real time

Range:

0x0 to 0xFF

Parameter description

bit0 to bit3: Correspond to data type of test variable 1. bit4 to bit7: Correspond to data type of test variable 2. bit8 to bit11: Correspond to data type of test variable 3. bit12 to bit15: Correspond to data type of test variable 4.

Relationship of data type setting: INT8 - 1; UINT8 - 2; INT16 - 3; UINT16 - 4; INT32 - 5; UINT32 - 6; Float32 - 7

H16.67 **Address of fault record variable 1**

Comm. address:	2016-44h	Effective mode:	Real time
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Real time

Range:

0x0 to 0xFFFFFFFF

Parameter description

Input the address of E08 fault record test variable 1.

H16.69 **Address of fault record variable 2**

Comm. address:	2016-46h	Effective mode:	Real time
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Real time

Range:

0x0 to 0xFFFFFFFF

Parameter description

Input the address of E08 fault record test variable 2.

10.22 H17 VDI/DO Parameters

H17.90 **Communication VDI selection**

Comm. address:	2017-5Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0: Disable

1: Enable

Parameter Description

To use the VDI function:

1. Set H17.90 to enable VDI.
2. Set the default level after power-on through H17.91.
3. Set the DI function of the VDI terminal through parameters in group H17.
4. Set VDI output through H31.00.

H17.91 **VDI default value after power-on**

Comm. address:	2017-5Ch	Effective mode:	Upon the next power-on
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

bit0: VDI1

bit1: VDI2

bit2: VDI3

bit3: VDI4

bit4: VDI5

bit5: VDI6

bit6: VDI7

bit7: VDI8

bit8: VDI9

bit9: VDI10

bit10: VDI11

bit11: VDI12

bit12: VDI13

bit13: VDI14

bit14: VDI15

bit15: VDI16

Parameter Description

Configures the initial value of VDI upon power-on.

bit0 corresponds to VDI1.

bit1 corresponds to VDI2.

...

bit15 corresponds to VDI16.

H17.00 **VDI1 function selection**

Comm. address:	2017-01h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	59	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment
1: Servo ON
2: Alarm reset signal
5: Multi-reference direction
6: Multi-reference switchover CMD1
7: Multi-reference switchover CMD2
8: Multi-reference switchover CMD3
9: Multi-reference switchover CMD4
14: Positive limit switch
15: Negative limit switch
16: Positive external torque limit
17: Negative external torque limit
18: Forward jog
19: Reverse jog
24: Electronic gear ratio selection
28: Multi-position reference selection
31: Home switch
34: Emergency stop
36: Internal speed limit
40: Enable multi-speed
46: Enable process segment
47: Process segment reference switchover 1
48: Process segment reference switchover 2
49: Process segment reference switchover 3
50: Process segment reference switchover 4
51: Event-triggered process segment 1
52: Event-triggered process segment 2
53: Event-triggered process segment 3
54: Event-triggered process segment 4
55: Pause process segment
56: Gantry torque alignment
57: Enable gantry DI alignment
58: Clear gantry DI alignment
59: Enable gantry synchronization

Parameter Description

Defines the DI function assigned to VDI1.

H17.01 **VDI1 logic level selection**

Comm. address:	2017-02h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Valid when the value 1 is written to VDI1
1: Valid when the value written to VDI1 changes from 0 to 1

Parameter Description
Defines the active level of VDI1.

H17.02 **VDI2 function selection**

Comm. address:	2017-03h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	59	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: No assignment
1: Servo ON
2: Alarm reset signal
5: Multi-reference direction
6: Multi-reference switchover CMD1
7: Multi-reference switchover CMD2
8: Multi-reference switchover CMD3
9: Multi-reference switchover CMD4
14: Positive limit switch
15: Negative limit switch
16: Positive external torque limit
17: Negative external torque limit
18: Forward jog
19: Reverse jog
24: Electronic gear ratio selection
28: Multi-position reference selection
31: Home switch
34: Emergency stop
36: Internal speed limit
40: Enable multi-speed
46: Enable process segment
47: Process segment reference switchover 1
48: Process segment reference switchover 2
49: Process segment reference switchover 3
50: Process segment reference switchover 4
51: Event-triggered process segment 1
52: Event-triggered process segment 2
53: Event-triggered process segment 3
54: Event-triggered process segment 4
55: Pause process segment
56: Gantry torque alignment
57: Enable gantry DI alignment
58: Clear gantry DI alignment
59: Enable gantry synchronization

Parameter Description
Defines the DI function assigned to VDI2.

H17.03 **VDI2 logic level selection**

Comm. address:	2017-04h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Valid when the value 1 is written to VDI2

1: Valid when the value written to VDI2 changes from 0 to 1

Parameter Description

Defines the active level for VDI2.

H17.04 **VDI3 function selection**

Comm. address:	2017-05h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	59	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment
1: Servo ON
2: Alarm reset signal
5: Multi-reference direction
6: Multi-reference switchover CMD1
7: Multi-reference switchover CMD2
8: Multi-reference switchover CMD3
9: Multi-reference switchover CMD4
14: Positive limit switch
15: Negative limit switch
16: Positive external torque limit
17: Negative external torque limit
18: Forward jog
19: Reverse jog
24: Electronic gear ratio selection
28: Multi-position reference selection
31: Home switch
34: Emergency stop
36: Internal speed limit
40: Enable multi-speed
46: Enable process segment
47: Process segment reference switchover 1
48: Process segment reference switchover 2
49: Process segment reference switchover 3
50: Process segment reference switchover 4
51: Event-triggered process segment 1
52: Event-triggered process segment 2
53: Event-triggered process segment 3
54: Event-triggered process segment 4
55: Pause process segment
56: Gantry torque alignment
57: Enable gantry DI alignment
58: Clear gantry DI alignment
59: Enable gantry synchronization

Parameter Description

Defines the DI function assigned to VDI3.

H17.05 **VDI3 logic selection**

Comm. address:	2017-06h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Valid when the value 1 is written to VDI3
1: Valid when the value written to VDI3 changes from 0 to 1

Parameter Description
Defines the active level for VDI3.

H17.06 **VDI4 function selection**

Comm. address:	2017-07h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	59	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: No assignment
1: Servo ON
2: Alarm reset signal
5: Multi-reference direction
6: Multi-reference switchover CMD1
7: Multi-reference switchover CMD2
8: Multi-reference switchover CMD3
9: Multi-reference switchover CMD4
14: Positive limit switch
15: Negative limit switch
16: Positive external torque limit
17: Negative external torque limit
18: Forward jog
19: Reverse jog
24: Electronic gear ratio selection
28: Multi-position reference selection
31: Home switch
34: Emergency stop
36: Internal speed limit
40: Enable multi-speed
46: Enable process segment
47: Process segment reference switchover 1
48: Process segment reference switchover 2
49: Process segment reference switchover 3
50: Process segment reference switchover 4
51: Event-triggered process segment 1
52: Event-triggered process segment 2
53: Event-triggered process segment 3
54: Event-triggered process segment 4
55: Pause process segment
56: Gantry torque alignment
57: Enable gantry DI alignment
58: Clear gantry DI alignment
59: Enable gantry synchronization

Parameter Description
Defines the DI function assigned to VDI4.

H17.07 **VDI4 logic selection**

Comm. address:	2017-08h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Valid when the value 1 is written to VDI4

1: Valid when the value written to VDI4 changes from 0 to 1

Parameter Description

Defines the active level for VDI4.

H17.08 **VDI5 function selection**

Comm. address:	2017-09h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	59	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment
1: Servo ON
2: Alarm reset signal
5: Multi-reference direction
6: Multi-reference switchover CMD1
7: Multi-reference switchover CMD2
8: Multi-reference switchover CMD3
9: Multi-reference switchover CMD4
14: Positive limit switch
15: Negative limit switch
16: Positive external torque limit
17: Negative external torque limit
18: Forward jog
19: Reverse jog
24: Electronic gear ratio selection
28: Multi-position reference selection
31: Home switch
34: Emergency stop
36: Internal speed limit
40: Enable multi-speed
46: Enable process segment
47: Process segment reference switchover 1
48: Process segment reference switchover 2
49: Process segment reference switchover 3
50: Process segment reference switchover 4
51: Event-triggered process segment 1
52: Event-triggered process segment 2
53: Event-triggered process segment 3
54: Event-triggered process segment 4
55: Pause process segment
56: Gantry torque alignment
57: Enable gantry DI alignment
58: Clear gantry DI alignment
59: Enable gantry synchronization

Parameter Description

Defines the DI function assigned to VDI5.

H17.09 **VDI5 logic level selection**

Comm. address:	2017-0Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Valid when the value 1 is written to VDI5
1: Valid when the value written to VDI5 changes from 0 to 1

Parameter Description
Defines the active level for VDI5.

H17.10 **VDI6 function selection**

Comm. address:	2017-0Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	59	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: No assignment
1: Servo ON
2: Alarm reset signal
5: Multi-reference direction
6: Multi-reference switchover CMD1
7: Multi-reference switchover CMD2
8: Multi-reference switchover CMD3
9: Multi-reference switchover CMD4
14: Positive limit switch
15: Negative limit switch
16: Positive external torque limit
17: Negative external torque limit
18: Forward jog
19: Reverse jog
24: Electronic gear ratio selection
28: Multi-position reference selection
31: Home switch
34: Emergency stop
36: Internal speed limit
40: Enable multi-speed
46: Enable process segment
47: Process segment reference switchover 1
48: Process segment reference switchover 2
49: Process segment reference switchover 3
50: Process segment reference switchover 4
51: Event-triggered process segment 1
52: Event-triggered process segment 2
53: Event-triggered process segment 3
54: Event-triggered process segment 4
55: Pause process segment
56: Gantry torque alignment
57: Enable gantry DI alignment
58: Clear gantry DI alignment
59: Enable gantry synchronization

Parameter Description
Defines the DI function assigned to VDI6.

H17.11 **VDI6 logic selection**

Comm. address:	2017-0Ch	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Valid when the value 1 is written to VDI6

1: Valid when the value written to VDI6 changes from 0 to 1

Parameter Description

Defines the active level for VDI6.

H17.12 **VDI7 function selection**

Comm. address:	2017-0Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	59	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment
1: Servo ON
2: Alarm reset signal
5: Multi-reference direction
6: Multi-reference switchover CMD1
7: Multi-reference switchover CMD2
8: Multi-reference switchover CMD3
9: Multi-reference switchover CMD4
14: Positive limit switch
15: Negative limit switch
16: Positive external torque limit
17: Negative external torque limit
18: Forward jog
19: Reverse jog
24: Electronic gear ratio selection
28: Multi-position reference selection
31: Home switch
34: Emergency stop
36: Internal speed limit
40: Enable multi-speed
46: Enable process segment
47: Process segment reference switchover 1
48: Process segment reference switchover 2
49: Process segment reference switchover 3
50: Process segment reference switchover 4
51: Event-triggered process segment 1
52: Event-triggered process segment 2
53: Event-triggered process segment 3
54: Event-triggered process segment 4
55: Pause process segment
56: Gantry torque alignment
57: Enable gantry DI alignment
58: Clear gantry DI alignment
59: Enable gantry synchronization

Parameter Description

Defines the DI function assigned to VDI7.

H17.13 VDI7 logic selection

Comm. address:	2017-0Eh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Valid when the value 1 is written to VDI7
1: Valid when the value written to VDI7 changes from 0 to 1

Parameter Description
Defines the active level for VDI7.

H17.14 **VDI8 function selection**

Comm. address:	2017-0Fh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	59	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: No assignment
1: Servo ON
2: Alarm reset signal
5: Multi-reference direction
6: Multi-reference switchover CMD1
7: Multi-reference switchover CMD2
8: Multi-reference switchover CMD3
9: Multi-reference switchover CMD4
14: Positive limit switch
15: Negative limit switch
16: Positive external torque limit
17: Negative external torque limit
18: Forward jog
19: Reverse jog
24: Electronic gear ratio selection
28: Multi-position reference selection
31: Home switch
34: Emergency stop
36: Internal speed limit
40: Enable multi-speed
46: Enable process segment
47: Process segment reference switchover 1
48: Process segment reference switchover 2
49: Process segment reference switchover 3
50: Process segment reference switchover 4
51: Event-triggered process segment 1
52: Event-triggered process segment 2
53: Event-triggered process segment 3
54: Event-triggered process segment 4
55: Pause process segment
56: Gantry torque alignment
57: Enable gantry DI alignment
58: Clear gantry DI alignment
59: Enable gantry synchronization

Parameter Description
Defines the DI function assigned to VDI8.

H17.15 **VDI8 logic selection**

Comm. address:	2017-10h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Valid when the value 1 is written to VDI8

1: Valid when the value written to VDI8 changes from 0 to 1

Parameter Description

Defines the active level for VDI8.

H17.16 **VDI9 function selection**

Comm. address:	2017-11h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	59	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment
1: Servo ON
2: Alarm reset signal
5: Multi-reference direction
6: Multi-reference switchover CMD1
7: Multi-reference switchover CMD2
8: Multi-reference switchover CMD3
9: Multi-reference switchover CMD4
14: Positive limit switch
15: Negative limit switch
16: Positive external torque limit
17: Negative external torque limit
18: Forward jog
19: Reverse jog
24: Electronic gear ratio selection
28: Multi-position reference selection
31: Home switch
34: Emergency stop
36: Internal speed limit
40: Enable multi-speed
46: Enable process segment
47: Process segment reference switchover 1
48: Process segment reference switchover 2
49: Process segment reference switchover 3
50: Process segment reference switchover 4
51: Event-triggered process segment 1
52: Event-triggered process segment 2
53: Event-triggered process segment 3
54: Event-triggered process segment 4
55: Pause process segment
56: Gantry torque alignment
57: Enable gantry DI alignment
58: Clear gantry DI alignment
59: Enable gantry synchronization

Parameter Description

Defines the DI function assigned to VDI9.

H17.17 **VDI9 logic selection**

Comm. address:	2017-12h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Valid when the value 1 is written to VDI9
1: Valid when the value written to VDI9 changes from 0 to 1

Parameter Description
Defines the active level for VDI9.

H17.18 **VDI10 function selection**

Comm. address:	2017-13h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	59	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: No assignment
1: Servo ON
2: Alarm reset signal
5: Multi-reference direction
6: Multi-reference switchover CMD1
7: Multi-reference switchover CMD2
8: Multi-reference switchover CMD3
9: Multi-reference switchover CMD4
14: Positive limit switch
15: Negative limit switch
16: Positive external torque limit
17: Negative external torque limit
18: Forward jog
19: Reverse jog
24: Electronic gear ratio selection
28: Multi-position reference selection
31: Home switch
34: Emergency stop
36: Internal speed limit
40: Enable multi-speed
46: Enable process segment
47: Process segment reference switchover 1
48: Process segment reference switchover 2
49: Process segment reference switchover 3
50: Process segment reference switchover 4
51: Event-triggered process segment 1
52: Event-triggered process segment 2
53: Event-triggered process segment 3
54: Event-triggered process segment 4
55: Pause process segment
56: Gantry torque alignment
57: Enable gantry DI alignment
58: Clear gantry DI alignment
59: Enable gantry synchronization

Parameter Description
Defines the DI function assigned to VDI10.

H17.19 **VDI10 logic selection**

Comm. address:	2017-14h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Valid when the value 1 is written to VDI10

1: Valid when the value written to VDI10 changes from 0 to 1

Parameter Description

Defines the active level for VDI10.

H17.20 **VDI11 function selection**

Comm. address:	2017-15h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	59	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment
1: Servo ON
2: Alarm reset signal
5: Multi-reference direction
6: Multi-reference switchover CMD1
7: Multi-reference switchover CMD2
8: Multi-reference switchover CMD3
9: Multi-reference switchover CMD4
14: Positive limit switch
15: Negative limit switch
16: Positive external torque limit
17: Negative external torque limit
18: Forward jog
19: Reverse jog
24: Electronic gear ratio selection
28: Multi-position reference selection
31: Home switch
34: Emergency stop
36: Internal speed limit
40: Enable multi-speed
46: Enable process segment
47: Process segment reference switchover 1
48: Process segment reference switchover 2
49: Process segment reference switchover 3
50: Process segment reference switchover 4
51: Event-triggered process segment 1
52: Event-triggered process segment 2
53: Event-triggered process segment 3
54: Event-triggered process segment 4
55: Pause process segment
56: Gantry torque alignment
57: Enable gantry DI alignment
58: Clear gantry DI alignment
59: Enable gantry synchronization

Parameter Description

Defines the DI function assigned to VDI11.

H17.21 **VDI11 logic selection**

Comm. address:	2017-16h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Valid when the value 1 is written to VDI11
1: Valid when the value written to VDI11 changes from 0 to 1

Parameter Description
Defines the active level for VDI11.

H17.22 **VDI12 function selection**

Comm. address:	2017-17h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	59	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: No assignment
1: Servo ON
2: Alarm reset signal
5: Multi-reference direction
6: Multi-reference switchover CMD1
7: Multi-reference switchover CMD2
8: Multi-reference switchover CMD3
9: Multi-reference switchover CMD4
14: Positive limit switch
15: Negative limit switch
16: Positive external torque limit
17: Negative external torque limit
18: Forward jog
19: Reverse jog
24: Electronic gear ratio selection
28: Multi-position reference selection
31: Home switch
34: Emergency stop
36: Internal speed limit
40: Enable multi-speed
46: Enable process segment
47: Process segment reference switchover 1
48: Process segment reference switchover 2
49: Process segment reference switchover 3
50: Process segment reference switchover 4
51: Event-triggered process segment 1
52: Event-triggered process segment 2
53: Event-triggered process segment 3
54: Event-triggered process segment 4
55: Pause process segment
56: Gantry torque alignment
57: Enable gantry DI alignment
58: Clear gantry DI alignment
59: Enable gantry synchronization

Parameter Description
Defines the DI function assigned to VDI12.

H17.23 **VDI12 logic selection**

Comm. address:	2017-18h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Valid when the value 1 is written to VDI12

1: Valid when the value written to VDI12 changes from 0 to 1

Parameter Description

Defines the active level for VDI12.

H17.24 **VDI13 function selection**

Comm. address:	2017-19h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	59	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment
1: Servo ON
2: Alarm reset signal
5: Multi-reference direction
6: Multi-reference switchover CMD1
7: Multi-reference switchover CMD2
8: Multi-reference switchover CMD3
9: Multi-reference switchover CMD4
14: Positive limit switch
15: Negative limit switch
16: Positive external torque limit
17: Negative external torque limit
18: Forward jog
19: Reverse jog
24: Electronic gear ratio selection
28: Multi-position reference selection
31: Home switch
34: Emergency stop
36: Internal speed limit
40: Enable multi-speed
46: Enable process segment
47: Process segment reference switchover 1
48: Process segment reference switchover 2
49: Process segment reference switchover 3
50: Process segment reference switchover 4
51: Event-triggered process segment 1
52: Event-triggered process segment 2
53: Event-triggered process segment 3
54: Event-triggered process segment 4
55: Pause process segment
56: Gantry torque alignment
57: Enable gantry DI alignment
58: Clear gantry DI alignment
59: Enable gantry synchronization

Parameter Description

Defines the DI function assigned to VDI13.

H17.25 **VDI13 logic selection**

Comm. address:	2017-1Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Valid when set to 1
1: Valid when the value written to VDI13 changes from 0 to 1

Parameter Description
Defines the active level for VDI13.

H17.26 **VDI14 function selection**

Comm. address:	2017-1Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	59	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: No assignment
1: Servo ON
2: Alarm reset signal
5: Multi-reference direction
6: Multi-reference switchover CMD1
7: Multi-reference switchover CMD2
8: Multi-reference switchover CMD3
9: Multi-reference switchover CMD4
14: Positive limit switch
15: Negative limit switch
16: Positive external torque limit
17: Negative external torque limit
18: Forward jog
19: Reverse jog
24: Electronic gear ratio selection
28: Multi-position reference selection
31: Home switch
34: Emergency stop
36: Internal speed limit
40: Enable multi-speed
46: Enable process segment
47: Process segment reference switchover 1
48: Process segment reference switchover 2
49: Process segment reference switchover 3
50: Process segment reference switchover 4
51: Event-triggered process segment 1
52: Event-triggered process segment 2
53: Event-triggered process segment 3
54: Event-triggered process segment 4
55: Pause process segment
56: Gantry torque alignment
57: Enable gantry DI alignment
58: Clear gantry DI alignment
59: Enable gantry synchronization

Parameter Description
Defines the DI function assigned to VDI14.

H17.27 **VDI14 logic selection**

Comm. address:	2017-1Ch	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Valid when the value 1 is written to VDI14

1: Valid when the value written to VDI14 changes from 0 to 1

Parameter Description

Defines the active level for VDI14.

H17.28 **VDI15 function selection**

Comm. address:	2017-1Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	59	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment
1: Servo ON
2: Alarm reset signal
5: Multi-reference direction
6: Multi-reference switchover CMD1
7: Multi-reference switchover CMD2
8: Multi-reference switchover CMD3
9: Multi-reference switchover CMD4
14: Positive limit switch
15: Negative limit switch
16: Positive external torque limit
17: Negative external torque limit
18: Forward jog
19: Reverse jog
24: Electronic gear ratio selection
28: Multi-position reference selection
31: Home switch
34: Emergency stop
36: Internal speed limit
40: Enable multi-speed
46: Enable process segment
47: Process segment reference switchover 1
48: Process segment reference switchover 2
49: Process segment reference switchover 3
50: Process segment reference switchover 4
51: Event-triggered process segment 1
52: Event-triggered process segment 2
53: Event-triggered process segment 3
54: Event-triggered process segment 4
55: Pause process segment
56: Gantry torque alignment
57: Enable gantry DI alignment
58: Clear gantry DI alignment
59: Enable gantry synchronization

Parameter Description

Defines the DI function assigned to VDI15.

H17.29 **VDI15 logic selection**

Comm. address:	2017-1Eh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Valid when the value 1 is written to VDI15
1: Valid when the value written to VDI15 changes from 0 to 1

Parameter Description
Defines the active level for VDI15.

H17.30 **VDI16 function selection**

Comm. address:	2017-1Fh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	59	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:
0: No assignment
1: Servo ON
2: Alarm reset signal
5: Multi-reference direction
6: Multi-reference switchover CMD1
7: Multi-reference switchover CMD2
8: Multi-reference switchover CMD3
9: Multi-reference switchover CMD4
14: Positive limit switch
15: Negative limit switch
16: Positive external torque limit
17: Negative external torque limit
18: Forward jog
19: Reverse jog
24: Electronic gear ratio selection
28: Multi-position reference selection
31: Home switch
34: Emergency stop
36: Internal speed limit
40: Enable multi-speed
46: Enable process segment
47: Process segment reference switchover 1
48: Process segment reference switchover 2
49: Process segment reference switchover 3
50: Process segment reference switchover 4
51: Event-triggered process segment 1
52: Event-triggered process segment 2
53: Event-triggered process segment 3
54: Event-triggered process segment 4
55: Pause process segment
56: Gantry torque alignment
57: Enable gantry DI alignment
58: Clear gantry DI alignment
59: Enable gantry synchronization

Parameter Description
Defines the DI function assigned to VDI16.

H17.31 **VDI16 logic level selection**

Comm. address:	2017-20h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Valid when the value 1 is written to VDI16

1: Valid when the value written to VDI16 changes from 0 to 1

Parameter Description

Defines the active level for VDI16.

H17.92 **Communication VDO selection**

Comm. address:	2017-5Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Range:

0: Disable

1: Enable

Parameter Description

To use the VDO function:

1. Enable VDO through H17.92.

2. Set the default level after power-on through H17.93.

3. Set the DO function of the VDO terminal through parameters in group H17.

4: Read the output level of the VDO from H17.32.

H17.93 **VDO default value after power-on**

Comm. address:	2017-5Eh	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	At stop

Range:

bit0: VDO1
bit1: VDO2
bit2: VDO3
bit3: VDO4
bit4: VDO5
bit5: VDO6
bit6: VDO7
bit7: VDO8
bit8: VDO9
bit9: VDO10
bit10: VDO11
bit11: VDO12
bit12: VDO13
bit13: VDO14
bit14: VDO15
bit15: VDO16

Parameter Description

Configures the initial value of VDO upon power-on.
bit0 corresponds to VDO1.
bit1 corresponds to VDO2.
...
bit15 corresponds to VDO16.

H17.32 VDO virtual level

Comm. address:	2017-21h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:

0x0 to 0xFFFF

Parameter Description

Displays the VDO virtual level.

H17.33 VDO1 function selection

Comm. address:	2017-22h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	33	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment
1: Servo ready
2: Motor rotation signal
5: Positioning completed
6: Proximity
9: Braking
10: Alarm
11: Fault
22: Internal command completed
24: Internal motion completed
26: Closed loop state
27: Left limit
28: Right limit
32: EDM output
33: Gantry alignment

Parameter Description

Defines the function of VDO1.

H17.34 **VDO1 logic selection**

Comm. address:	2017-23h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Output 1 when valid
1: Output 0 when valid

Parameter Description

Defines the active level of VDO1.

H17.35 **VDO2 function selection**

Comm. address:	2017-24h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	33	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment
1: Servo ready
2: Motor rotation signal
5: Positioning completed
6: Proximity
9: Braking
10: Alarm
11: Fault
22: Internal command completed
24: Internal motion completed
26: Closed loop state
27: Left limit
28: Right limit
32: EDM output
33: Gantry alignment

Parameter Description

Same as H17.33.

H17.36 **VDO2 logic selection**

Comm. address:	2017-25h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Output 1 when valid
1: Output 0 when valid

Parameter Description

Same as H17.34.

H17.37 **VDO3 function selection**

Comm. address:	2017-26h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	33	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment
1: Servo ready
2: Motor rotation signal
5: Positioning completed
6: Proximity
9: Braking
10: Alarm
11: Fault
22: Internal command completed
24: Internal motion completed
26: Closed loop state
27: Left limit
28: Right limit
32: EDM output
33: Gantry alignment

Parameter Description

Same as H17.33.

H17.38 VDO3 logic selection

Comm. address:	2017-27h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Output 1 when valid
1: Output 0 when valid

Parameter Description

Same as H17.34.

H17.39 VDO4 function selection

Comm. address:	2017-28h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	33	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment
1: Servo ready
2: Motor rotation signal
5: Positioning completed
6: Proximity
9: Braking
10: Alarm
11: Fault
22: Internal command completed
24: Internal motion completed
26: Closed loop state
27: Left limit
28: Right limit
32: EDM output
33: Gantry alignment

Parameter Description

Same as H17.33.

H17.40 **VDO4 logic selection**

Comm. address:	2017-29h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Output 1 when valid
1: Output 0 when valid

Parameter Description

Same as H17.34.

H17.41 **VDO5 function selection**

Comm. address:	2017-2Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	33	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment
1: Servo ready
2: Motor rotation signal
5: Positioning completed
6: Proximity
9: Braking
10: Alarm
11: Fault
22: Internal command completed
24: Internal motion completed
26: Closed loop state
27: Left limit
28: Right limit
32: EDM output
33: Gantry alignment

Parameter Description

Same as H17.33.

H17.42 VDO5 logic selection

Comm. address:	2017-2Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Output 1 when valid
1: Output 0 when valid

Parameter Description

Same as H17.34.

H17.43 VDO6 function selection

Comm. address:	2017-2Ch	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	33	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment
1: Servo ready
2: Motor rotation signal
5: Positioning completed
6: Proximity
9: Braking
10: Alarm
11: Fault
22: Internal command completed
24: Internal motion completed
26: Closed loop state
27: Left limit
28: Right limit
32: EDM output
33: Gantry alignment

Parameter Description

Same as H17.33.

H17.44 **VDO6 logic selection**

Comm. address:	2017-2Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Output 1 when valid
1: Output 0 when valid

Parameter Description

Same as H17.34.

H17.45 **VDO7 function selection**

Comm. address:	2017-2Eh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	33	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment
1: Servo ready
2: Motor rotation signal
5: Positioning completed
6: Proximity
9: Braking
10: Alarm
11: Fault
22: Internal command completed
24: Internal motion completed
26: Closed loop state
27: Left limit
28: Right limit
32: EDM output
33: Gantry alignment

Parameter Description

Same as H17.33.

H17.46 **VDO7 logic selection**

Comm. address:	2017-2Fh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Output 1 when valid
1: Output 0 when valid

Parameter Description

Same as H17.34.

H17.47 **VDO8 function selection**

Comm. address:	2017-30h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	33	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment
1: Servo ready
2: Motor rotation signal
5: Positioning completed
6: Proximity
9: Braking
10: Alarm
11: Fault
22: Internal command completed
24: Internal motion completed
26: Closed loop state
27: Left limit
28: Right limit
32: EDM output
33: Gantry alignment

Parameter Description

Same as H17.33.

H17.48 **VDO8 logic selection**

Comm. address:	2017-31h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Output 1 when valid
1: Output 0 when valid

Parameter Description

Same as H17.34.

H17.49 **VDO9 function selection**

Comm. address:	2017-32h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	33	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment
1: Servo ready
2: Motor rotation signal
5: Positioning completed
6: Proximity
9: Braking
10: Alarm
11: Fault
22: Internal command completed
24: Internal motion completed
26: Closed loop state
27: Left limit
28: Right limit
32: EDM output
33: Gantry alignment

Parameter Description

Same as H17.33.

H17.50 **VDO9 logic selection**

Comm. address:	2017-33h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Output 1 when valid
1: Output 0 when valid

Parameter Description

Same as H17.34.

H17.51 **VDO10 function selection**

Comm. address:	2017-34h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	33	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment
1: Servo ready
2: Motor rotation signal
5: Positioning completed
6: Proximity
9: Braking
10: Alarm
11: Fault
22: Internal command completed
24: Internal motion completed
26: Closed loop state
27: Left limit
28: Right limit
32: EDM output
33: Gantry alignment

Parameter Description

Same as H17.33.

H17.52 VDO10 logic selection

Comm. address:	2017-35h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Output 1 when valid
1: Output 0 when valid

Parameter Description

Same as H17.34.

H17.53 VDO11 function selection

Comm. address:	2017-36h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	33	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment
1: Servo ready
2: Motor rotation signal
5: Positioning completed
6: Proximity
9: Braking
10: Alarm
11: Fault
22: Internal command completed
24: Internal motion completed
26: Closed loop state
27: Left limit
28: Right limit
32: EDM output
33: Gantry alignment

Parameter Description

Same as H17.33.

H17.54 **VDO11 logic selection**

Comm. address:	2017-37h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Output 1 when valid
1: Output 0 when valid

Parameter Description

Same as H17.34.

H17.55 **VDO12 function selection**

Comm. address:	2017-38h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	33	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment
1: Servo ready
2: Motor rotation signal
5: Positioning completed
6: Proximity
9: Braking
10: Alarm
11: Fault
22: Internal command completed
24: Internal motion completed
26: Closed loop state
27: Left limit
28: Right limit
32: EDM output
33: Gantry alignment

Parameter Description

Same as H17.33.

H17.56 **VDO12 logic selection**

Comm. address:	2017-39h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Output 1 when valid
1: Output 0 when valid

Parameter Description

Same as H17.34.

H17.57 **VDO13 function selection**

Comm. address:	2017-3Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	33	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment
1: Servo ready
2: Motor rotation signal
5: Positioning completed
6: Proximity
9: Braking
10: Alarm
11: Fault
22: Internal command completed
24: Internal motion completed
26: Closed loop state
27: Left limit
28: Right limit
32: EDM output
33: Gantry alignment

Parameter Description

Same as H17.33.

H17.58 VDO13 logic selection

Comm. address:	2017-3Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Output 1 when valid
1: Output 0 when valid

Parameter Description

Same as H17.34.

H17.59 VDO14 function selection

Comm. address:	2017-3Ch	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	33	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment
1: Servo ready
2: Motor rotation signal
5: Positioning completed
6: Proximity
9: Braking
10: Alarm
11: Fault
22: Internal command completed
24: Internal motion completed
26: Closed loop state
27: Left limit
28: Right limit
32: EDM output
33: Gantry alignment

Parameter Description

Same as H17.33.

H17.60 **VDO14 logic selection**

Comm. address:	2017-3Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Output 1 when valid
1: Output 0 when valid

Parameter Description

Same as H17.34.

H17.61 **VDO15 function selection**

Comm. address:	2017-3Eh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	33	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment
1: Servo ready
2: Motor rotation signal
5: Positioning completed
6: Proximity
9: Braking
10: Alarm
11: Fault
22: Internal command completed
24: Internal motion completed
26: Closed loop state
27: Left limit
28: Right limit
32: EDM output
33: Gantry alignment

Parameter Description

Same as H17.33.

H17.62 **VDO15 logic selection**

Comm. address:	2017-3Fh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Output 1 when valid
1: Output 0 when valid

Parameter Description

Same as H17.34.

H17.63 **VDO16 function selection**

Comm. address:	2017-40h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	33	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: No assignment
1: Servo ready
2: Motor rotation signal
5: Positioning completed
6: Proximity
9: Braking
10: Alarm
11: Fault
22: Internal command completed
24: Internal motion completed
26: Closed loop state
27: Left limit
28: Right limit
32: EDM output
33: Gantry alignment

Parameter Description

Same as H17.33.

H17.64 **VDO16 logic selection**

Comm. address:	2017-41h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Range:

0: Output 1 when valid
1: Output 0 when valid

Parameter Description

Same as H17.34.

10.23 H18 Position Comparison Output Parameters

H18.00 **Position comparison output selection**

Comm. address:	2018-01h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Disable
1: Enable (rising edge-triggered)

Parameter description

0: Disable
1: Enable (rising edge-triggered)

H18.01 **Position comparison output feedback source**

Comm. address:	2018-02h	Effective mode:	Next power-on
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Motor encoder feedback

1: Fully closed-loop position feedback

Parameter description

Used to select position comparison output feedback source.

0: Motor encoder feedback

1: Fully closed-loop position feedback

H18.02 **Position comparison resolution**

Comm. address:	2018-03h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	7	Data type:	UInt16
Default:	1	Change mode:	Real time

Range:

0: 24-bit

1: 23-bit

2: 22-bit

3: 21-bit

4: 20-bit

5: 19-bit

6: 18-bit

7: 17-bit

Parameter description

Defines the position comparison resolution.

0: 24-bit

1: 23-bit

2: 22-bit

3: 21-bit

4: 20-bit

5: 19-bit

6: 18-bit

7: 17-bit

H18.03 **Position comparison mode**

Comm. address:	2018-04h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	2	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Individual comparison mode

1: Cyclic comparison mode

2: Fixed cyclic comparison mode

Parameter description

Defines the position comparison mode.

0: Individual comparison mode

1: Cyclic comparison mode

2: Fixed cyclic comparison mode

H18.04 **Current position as zero**

Comm. address:	2018-05h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Disable

1: Enable (rising edge-triggered)

Parameter description

Used to set the current position as the zero point.

H18.05 **Position comparison output width**

Comm. address:	2018-06h	Effective mode:	Real time
Min.:	0.1	Unit:	ms
Max.:	204.7	Data type:	UInt16
Default:	0.1	Change mode:	Real time

Range:

0.1 ms to 204.7 ms

Parameter description

Defines the effective pulse width of the DO when the comparison point is reached.

H18.06 **Position comparison output ABZ port polarity**

Comm. address:	2018-07h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

bit0: OCZ output logic

0: Positive, output high level upon active logic

1: Negative, output low level upon active logic

bit1: Z port output logic

0: Positive, output high level upon active logic

1: Negative, output low level upon active logic

bit2: A/B output logic

0: Positive, output high level upon active logic

1: Negative, output low level upon active logic

bit3 to bit15: N/A

Parameter description

0: Positive (output high level upon active logic) 1: Negative (output high level upon active logic)

bit0: OCZ output logic
bit1: Z output logic
bit2: A/B output logic

bit3 to bit15: N/A

H18.07 **Starting point of position comparison**

Comm. address:	2018-08h	Effective mode:	Real time
Min.:	1	Unit:	-
Max.:	40	Data type:	UInt16
Default:	1	Change mode:	Real time

Range:

1 to 40

Parameter description

Defines the starting point of position comparison.

H18.08 **Ending point of position comparison**

Comm. address:	2018-09h	Effective mode:	Real time
Min.:	1	Unit:	-
Max.:	40	Data type:	UInt16
Default:	1	Change mode:	Real time

Range:

1 to 40

Parameter description

Defines the ending point of position comparison.

H18.09 **Current state of position comparison**

Comm. address:	2018-0Ah	Effective mode:	-
Min.:	0	Unit:	-
Max.:	1024	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:

0 to 1024

Parameter description
Displays current state of position comparison.

H18.10 **Real-time position of position comparison**

Comm. address:	2018-0Bh	Effective mode:	-
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Read only

Range:
-2147483648 to +2147483647
Parameter description
Displays the real-time position of position comparison.

H18.12 **Zero offset of position comparison**

Comm. address:	2018-0Dh	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:
-2147483648 to +2147483647
Parameter description
Defines the zero offset of position comparison.

H18.14 **Position comparison output delay compensation**

Comm. address:	2018-0Fh	Effective mode:	Next power-on
Min.:	-12.00	Unit:	μs
Max.:	12.00	Data type:	Int16
Default:	0.00	Change mode:	Real time

Range:
-12.00 μs to +12.00 μs
Parameter description
Used to compensate the delay caused by hardware signal output.

H18.15 **Number of fixed mode cycles**

Comm. address:	2018-10h	Effective mode:	Real time
Min.:	1	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	1	Change mode:	Real time

Range:
1 to 65535
Parameter description
Defines the number of fixed mode cycles.

H18.16 **ABZ output function setting**

Comm. address:	2018-11h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

bit 0: OCZ output function

0: Frequency-division output

1: Position comparison

bit 1: Z port output function

0: Frequency-division output

1: Position comparison

bit 2: A/B port output function

0: Frequency-division output

1: Position comparison

bit3 to bit15: N/A

Parameter description

Sets the ABZ output function.

bit0: OCZ output setting. 0: Frequency-division output; 1: Position comparison

bit1: Z output setting. 0: Frequency-division output; 1: Position comparison

bit2: A/B output setting. 0: Frequency-division output; 1: Position comparison

bit3 to bit15: N/A

H18.17 **Number of completed fixed modes**

Comm. address:	2018-12h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:

0 to 65535

Parameter description

Displays the number of completed fixed modes.

10.24 H19 Target Position Parameters

H19.00 **Target value of position comparison 1**

Comm. address:	2019-01h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Defines the target value of position comparison 1.

H19.02 **Attribute value of position comparison 1**

Comm. address:	2019-03h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

bit 0: Output DO active signal if current position changes from "less than" to "more than" the comparison point

bit 1: Output DO active signal if current position changes from "more than" to "less than" the comparison point

bit 2: N/A

bit 3: N/A

bit 4 N/A

bit 5: N/A

bit 6: N/A

bit 7: DO1 output

bit 8: DO2 output

bit 9: N/A

bit 10: N/A

bit 11: N/A

bit 12: Frequency-division A output

bit 13: Frequency-division B output

bit 14: Frequency-division Z output

bit 15: Frequency-division OCZ output

Parameter description

Defines the attribute setting of position comparison point 1.

bit0: 1: Current position changing from "less than" to "more than" the comparison point enabled; 0: Disable

bit1: 1: Current position changing from "more than" to "less than" the comparison point enabled; 0: Disable

bit2 to bit6: N/A.

bit7: 1: Enable DO1 output; 0: Disable

bit8: 1: Enable DO2 output; 0: Disable

bit9 to bit11:N/A

bit12: 1: Enable frequency-division A output; 0: Disable

bit13: 1: Enable frequency-division B output; 0: Disable

bit14: 1: Enable frequency-division C output; 0: Disable

bit15: 1: Enable Frequency-division OCZ output; 0: Disable

H19.03 **Target value of position comparison 2**

Comm. address:	2019-04h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32

Default:	0	Change mode:	Real time

Range:
-2147483648 to +2147483647
Parameter description
Same as H19.00

H19.05 **Attribute value of position comparison 2**

Comm. address:	2019-06h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:
bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output
Parameter description
Same as H19.02.

H19.06 **Target value of position comparison 3**

Comm. address:	2019-07h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:
-2147483648 to +2147483647
Parameter description
Same as H19.00

H19.08 **Attribute value of position comparison 3**

Comm. address:	2019-09h	Effective mode:	Real time
Min.:	0	Unit:	-

Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point

bit1: Current position changes from "more than" to "less than" the comparison point

bit2: N/A

bit3: N/A

bit4: N/A

bit5: N/A

bit6: N/A

bit7: DO1 output

bit8: DO2 output

bit9: N/A

bit10: N/A

bit11: N/A

bit12: Frequency-division A output

bit13: Frequency-division B output

bit14: Frequency-division Z output

bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.09 Target value of position comparison 4

Comm. address:	2019-0Ah	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.11 Attribute value of position comparison 4

Comm. address:	2019-0Ch	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.12 Target value of position comparison 5

Comm. address:	2019-0Dh	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.14 Attribute value of position comparison 5

Comm. address:	2019-0Fh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.15 Target value of position comparison 6

Comm. address:	2019-10h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.17 Attribute value of position comparison 6

Comm. address:	2019-12h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.18 **Target value of position comparison 7**

Comm. address:	2019-13h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.20 **Attribute value of position comparison 7**

Comm. address:	2019-15h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.21 Target value of position comparison 8

Comm. address:	2019-16h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.23 Attribute value of position comparison 8

Comm. address:	2019-18h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.24 Target value of position comparison 9

Comm. address:	2019-19h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.26 Attribute value of position comparison 9

Comm. address:	2019-1Bh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.27 Target value of position comparison 10

Comm. address:	2019-1Ch	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.29 Attribute value of position comparison 10

Comm. address:	2019-1Eh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.30 Target value of position comparison 11

Comm. address:	2019-1Fh	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.32 Attribute value of position comparison 11

Comm. address:	2019-21h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.33 Target value of position comparison 12

Comm. address:	2019-22h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.35 Attribute value of position comparison 12

Comm. address:	2019-24h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.36 Target value of position comparison 13

Comm. address:	2019-25h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.38 Attribute value of position comparison 13

Comm. address:	2019-27h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.39 Target value of position comparison 14

Comm. address:	2019-28h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.41 Attribute value of position comparison 14

Comm. address:	2019-2Ah	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.42 Target value of position comparison 15

Comm. address:	2019-2Bh	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.44 Attribute value of position comparison 15

Comm. address:	2019-2Dh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.45 Target value of position comparison 16

Comm. address:	2019-2Eh	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.47 Attribute value of position comparison 16

Comm. address:	2019-30h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.48 **Target value of position comparison 17**

Comm. address:	2019-31h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.50 **Attribute value of position comparison 17**

Comm. address:	2019-33h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.51 Target value of position comparison 18

Comm. address:	2019-34h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.53 Attribute value of position comparison 18

Comm. address:	2019-36h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.54 Target value of position comparison 19

Comm. address:	2019-37h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.56 Attribute value of position comparison 19

Comm. address:	2019-39h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.57 Target value of position comparison 20

Comm. address:	2019-3Ah	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.59 Attribute value of position comparison 20

Comm. address:	2019-3Ch	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.60 Target value of position comparison 21

Comm. address:	2019-3Dh	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.62 Attribute value of position comparison 21

Comm. address:	2019-3Fh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.63 Target value of position comparison 22

Comm. address:	2019-40h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.65 Attribute value of position comparison 22

Comm. address:	2019-42h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.66 Target value of position comparison 23

Comm. address:	2019-43h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.68 Attribute value of position comparison 23

Comm. address:	2019-45h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.69 Target value of position comparison 24

Comm. address:	2019-46h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.71 Attribute value of position comparison 24

Comm. address:	2019-48h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.72 **Target value of position comparison 25**

Comm. address:	2019-49h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.74 **Attribute value of position comparison 25**

Comm. address:	2019-4Bh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.75 Target value of position comparison 26

Comm. address:	2019-4Ch	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.77 Attribute value of position comparison 26

Comm. address:	2019-4Eh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.78 **Target value of position comparison 27**

Comm. address:	2019-4Fh	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.80 **Attribute value of position comparison 27**

Comm. address:	2019-51h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.81 Target value of position comparison 28

Comm. address:	2019-52h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.83 Attribute value of position comparison 28

Comm. address:	2019-54h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.84 **Target value of position comparison 29**

Comm. address:	2019-55h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.86 **Attribute value of position comparison 29**

Comm. address:	2019-57h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.87 **Target value of position comparison 30**

Comm. address:	2019-58h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.89 **Attribute value of position comparison 30**

Comm. address:	2019-5Ah	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.90 Target value of position comparison 31

Comm. address:	2019-5Bh	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.92 Attribute value of position comparison 31

Comm. address:	2019-5Dh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.93 Target value of position comparison 32

Comm. address:	2019-5Eh	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.95 Attribute value of position comparison 32

Comm. address:	2019-60h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.96 **Target value of position comparison 33**

Comm. address:	2019-61h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.98 **Attribute value of position comparison 33**

Comm. address:	2019-63h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.99 **Target value of position comparison 34**

Comm. address:	2019-64h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.101 **Attribute value of position comparison 34**

Comm. address:	2019-66h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.102 **Target value of position comparison 35**

Comm. address:	2019-67h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.104 **Attribute value of position comparison 35**

Comm. address:	2019-69h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.105 **Target value of position comparison 36**

Comm. address:	2019-6Ah	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.107 **Attribute value of position comparison 36**

Comm. address:	2019-6Ch	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.108 Target value of position comparison 37

Comm. address:	2019-6Dh	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.110 Attribute value of position comparison 37

Comm. address:	2019-6Fh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.111 **Target value of position comparison 38**

Comm. address:	2019-70h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.113 **Attribute value of position comparison 38**

Comm. address:	2019-72h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.114 Target value of position comparison 39

Comm. address:	2019-73h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.116 Attribute value of position comparison 39

Comm. address:	2019-75h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

H19.117 Target value of position comparison 40

Comm. address:	2019-76h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Same as H19.00

H19.119 Attribute value of position comparison 40

Comm. address:	2019-78h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

bit0: Current position changes from "less than" to "more than" the comparison point
bit1: Current position changes from "more than" to "less than" the comparison point
bit2: N/A
bit3: N/A
bit4: N/A
bit5: N/A
bit6: N/A
bit7: DO1 output
bit8: DO2 output
bit9: N/A
bit10: N/A
bit11: N/A
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Parameter description

Same as H19.02.

10.25 H1E Oscilloscope Variables

H1E.61 **Black box sampling state**

Comm. address:	201E-3Eh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0 to 65535

Parameter description

-

H1E.69 **Black box sampling frequency**

Comm. address:	201E-46h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:

0 to 65535

Parameter description

-

H1E.80 **Black box function mode**

Comm. address:	201E-51h	Effective mode:	-

Min.:	0	Unit:	-
Max.:	3	Data type:	UInt16
Default:	1	Change mode:	Read only

Range:

0: Disable

1: Any fault

2: Designated fault

3: Triggered based on designated condition

Parameter description

Defines the condition for triggering black box sampling.

H1E.81 **Designated fault code**

Comm. address:	201E-52h	Effective mode:	-
Min.:	0.0	Unit:	-
Max.:	6553.5	Data type:	UInt16
Default:	0.0	Change mode:	Read only

Range:

0.0 to 6553.5

Parameter description

Defines the fault code for triggering the black box function.

H1E.82 **Trigger source**

Comm. address:	201E-53h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	22	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:

0 to 22

Parameter description

Defines the fault code for triggering the black box function through designated channel.

H1E.83 **Trigger level**

Comm. address:	201E-54h	Effective mode:	-
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Read only

Range:

-2147483648 to +2147483647

Parameter description

Defines the trigger level for triggering the black box function through designated channel.

H1E.85 **Trigger level**

Comm. address:	201E-56h	Effective mode:	-
Min.:	0	Unit:	-

Max.:	3	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:

0: Rising edge

1: Equal

2: Falling edge

3: Edge-triggered

Parameter description

Defines the trigger mode for triggering the black box function through H0A.63.

H1E.86 **Trigger position**

Comm. address:	201E-57h	Effective mode:	-
Min.:	0	Unit:	%
Max.:	100	Data type:	UInt16
Default:	75	Change mode:	Read only

Range:

0% to 100%

Parameter description

Defines the pre-trigger position for triggering black box sampling.

H1E.87 **Sampling frequency**

Comm. address:	201E-58h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	2	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:

0: Current loop

1: Position loop

2: Main cycle

Parameter description

Defines the frequency sampling mode during black box sampling.

H1E.88 **Offset calculation triggered by black box**

Comm. address:	201E-59h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:

0 to 65535

Parameter description

Defines the waveform offset when the black box is triggered.

H1E.89 **Black box pre-triggering**

Comm. address:	201E-5Ah	Effective mode:	-

Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0 to 65535
Parameter description
Defines the pre-triggering point of the black box.

H1E.90 **Servo operation time**

Comm. address:	201E-5Bh	Effective mode:	-
Min.:	0.0	Unit:	-
Max.:	429496729.5	Data type:	UInt32
Default:	0.0	Change mode:	Read only

Range:
0.0 to 429496729.5
Parameter description
Defines the servo operation time.

H1E.92 **Selected black box record**

Comm. address:	201E-5Dh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	20	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:
0 to 20
Parameter description
Indicates the fault record mapped to black box information.

H1E.93 **Fault record mapped to black box information**

Comm. address:	201E-5Eh	Effective mode:	-
Min.:	0	Unit:	-
Max.:	20	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0 to 20
Parameter description
Indicates the selected black box record.

H1E.94 **Read black box records**

Comm. address:	201E-5Fh	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0 to 65535
Parameter description
Used to read black box records.

10.26 H1F Software Tool Parameters

H1F.90 **DI function state 1 read through communication**

Comm. address:	201F-5Bh	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0 to 65535
Parameter description
bit0 corresponds to DI function 1.
bit1 corresponds to DI function 2.
bit2 corresponds to DI function 3.
…
By analogy

H1F.91 **DI function state 2 read through communication**

Comm. address:	201F-5Ch	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0 to 65535
Parameter description
bit0 corresponds to DI function 17.
bit1 corresponds to DI function 18.
bit2 corresponds to DI function 19.
…
By analogy

H1F.92 **DI function state 3 read through communication**

Comm. address:	201F-5Dh	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0 to 65535
Parameter description
bit0 corresponds to DI function 33.
bit1 corresponds to DI function 34.

bit2 corresponds to DI function 35.
…
By analogy

H1F.93 **DI function state 4 read through communication**

Comm. address:	201F-5Eh	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0 to 65535
Parameter description
bit0 corresponds to DI function 49.
bit1 corresponds to DI function 50.
bit2 corresponds to DI function 51.
…
By analogy

H1F.94 **DO function status 1 read through communication**

Comm. address:	201F-5Fh	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0 to 65535
Parameter description
bit0 corresponds to DO function 1.
bit1 corresponds to DO function 2.
bit2 corresponds to DO function 3.
…
By analogy

H1F.95 **DO function status 2 read through communication**

Comm. address:	201F-60h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0 to 65535
Parameter description
bit0 corresponds to DO function 17.
bit1 corresponds to DO function 18.
bit2 corresponds to DO function 19.
…
By analogy

10.27 H21 Current Loop Gain Switchover Parameters

H21.00 **Current loop gain switchover**

Comm. address:	2021-01h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Not apply

1: Enable

Parameter description

Used to enable or disable current loop gain switchover.

0: Not apply

1: Enabled

10.28 H22 Process Segment Parameters

H22.00 **Process segment command trigger**

Comm. address:	2022-01h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1000	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0 to 1000

Parameter description

Used to trigger the process segment. The process segment can be triggered through the keypad or communication.

The homing function is triggered when 0 is written to H22.00.

Process segments 1 to 15 are triggered when 1 to 15 are written to H22.00.

The process segment pauses when 1000 is written to H22.00.

E126.0 (Process segment number error) will be reported when 16 to 999 are written to H22.00.

H22.01 **Process segment triggered by the event rising edge**

Comm. address:	2022-02h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0 to 65535

Parameter description

DI: ProceEvTri (OFF to ON, rising edge-triggered).
bit0 to bit3: The motor does not act when the value is 0 and the rising edge of DI: ProceEvTri1 is triggered. When the value is 1 to 15, process segments 1 to 15 will be executed when the rising edge of DI: ProceEvTri1 is triggered.
bit4 to bit7: The motor does not act when the value is 0 and the rising edge of DI: ProceEvTri2 is triggered. When the value is 1 to 15, process segments 1 to 15 will be executed when the rising edge of DI: ProceEvTri2 is triggered.
bit8 to bit11: The motor does not act when the value is 0 and the rising edge of DI: ProceEvTri3 is triggered. When the value is 1 to 15, process segments 1 to 15 will be executed when the rising edge of DI: ProceEvTri3 is triggered.
bit12 to bit15: The motor does not act when the value is 0 and the rising edge of DI: ProceEvTri4 is triggered. When the value is 1 to 15, process segments 1 to 15 will be executed when the rising edge of DI: ProceEvTri4 is triggered.

H22.02 **Process segment triggered by the event falling edge**

Comm. address:	2022-03h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 65535
Parameter description
DI: ProceEvTri (ON to OFF, falling edge-triggered).
bit0 to bit3: The motor does not act when the value is 0 and the falling edge of DI: ProceEvTri1 is triggered. When the value is 1 to 15, process segments 1 to 15 will be executed when the falling edge of DI: ProceEvTri1 is triggered.
bit4 to bit7: The motor does not act when the value is 0 and the falling edge of DI: ProceEvTri2 is triggered. When the value is 1 to 15, process segments 1 to 15 will be executed when the falling edge of DI: ProceEvTri2 is triggered.
bit8 to bit11: The motor does not act when the value is 0 and the falling edge of DI: ProceEvTri3 is triggered. When the value is 1 to 15, process segments 1 to 15 will be executed when the falling edge of DI: ProceEvTri3 is triggered.
bit12 to bit15: The motor does not act when the value is 0 and the falling edge of DI: ProceEvTri4 is triggered. When the value is 1 to 15, process segments 1 to 15 will be executed when the falling edge of DI: ProceEvTri4 is triggered.

H22.03 **Acceleration/Deceleration time upon process segment pause**

Comm. address:	2022-04h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	7	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Acceleration/Deceleration time
1: Acceleration/Deceleration time 1
2: Acceleration/Deceleration time 2
3: Acceleration/Deceleration time 3
4: Acceleration/Deceleration time 4
5: Acceleration/Deceleration time 5
6: Acceleration/Deceleration time 6
7: Acceleration/Deceleration time 7

Parameter description

When the process segment is paused, the motor ramps to stop based on the deceleration time defined by H22.03. Setpoints 0 to 7 correspond to parameters H22.35 to H22.42.

H22.04 Positive software position limit

Comm. address:	2022-05h	Effective mode:	Real time
Min.:	-2147483648	Unit:	Reference unit
Max.:	2147483647	Data type:	Int32
Default:	2147483647	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

E956.0 can occur when the motor operates forwardly with position reference exceeding the setpoint of H22.04 during positioning in the process segment mode.

H22.06 Negative software position limit

Comm. address:	2022-07h	Effective mode:	Real time
Min.:	-2147483648	Unit:	Reference unit
Max.:	2147483647	Data type:	Int32
Default:	-2147483648	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

E958.0 can occur when the motor operates reversely with position reference exceeding the setpoint of H22.06 during positioning in the process segment mode.

H22.08 Process segment number

Comm. address:	2022-09h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:

0 to 65535

Parameter description

Indicates the process segment number in progress in the process segment mode.

H22.09 **Process segment function switch**

Comm. address:	2022-0Ah	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0 to 65535

Parameter description

bit0:

0: Keep interrupt positioning state

1: Exit interrupt positioning state when triggering process segment

H22.10 **Process segment state**

Comm. address:	2022-0Bh	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:

0 to 65535

Parameter description

Used for process segment state feedback.

The process segment number will be read back when commands in the positioning mode are not done executing.

The process segment number + 10000 will be read back when commands in the positioning mode are done executing.

The process segment number + 20000 will be read back when commands in the positioning mode are done executing and positioning has been completed.

H22.19 **Target speed**

Comm. address:	2022-14h	Effective mode:	Real time
Min.:	0.1	Unit:	[mm/s]/[rpm]
Max.:	6000.0	Data type:	UInt16
Default:	50.0	Change mode:	Real time

Range:

0.1 [mm/s]/[rpm] to 6000.0 [mm/s]/[rpm]

Parameter description

Eight groups of target speed are available for each process segment command.

Target speed refers to the constant operating speed when the motor is not in the acceleration/deceleration process. If the displacement is too small in the positioning mode, the actual motor speed will be lower than the setpoint of H22.19.

H22.20 **Target speed 1**

Comm. address:	2022-15h	Effective mode:	Real time
Min.:	0.1	Unit:	[mm/s]/[rpm]
Max.:	6000.0	Data type:	UInt16

Default:	200.0	Change mode:	Real time

Range:
0.1 [mm/s]/[rpm] to 6000.0 [mm/s]/[rpm]
Parameter description
See H22.19.

H22.21 Target speed 2

Comm. address:	2022-16h	Effective mode:	Real time
Min.:	0.1	Unit:	[mm/s]/[rpm]
Max.:	6000.0	Data type:	UInt16
Default:	500.0	Change mode:	Real time

Range:
0.1 [mm/s]/[rpm] to 6000.0 [mm/s]/[rpm]
Parameter description
See H22.19.

H22.22 Target speed 3

Comm. address:	2022-17h	Effective mode:	Real time
Min.:	0.1	Unit:	[mm/s]/[rpm]
Max.:	6000.0	Data type:	UInt16
Default:	1000.0	Change mode:	Real time

Range:
0.1 [mm/s]/[rpm] to 6000.0 [mm/s]/[rpm]
Parameter description
See H22.19.

H22.23 Target speed 4

Comm. address:	2022-18h	Effective mode:	Real time
Min.:	0.1	Unit:	[mm/s]/[rpm]
Max.:	6000.0	Data type:	UInt16
Default:	1500.0	Change mode:	Real time

Range:
0.1 [mm/s]/[rpm] to 6000.0 [mm/s]/[rpm]
Parameter description
See H22.19.

H22.24 Target speed 5

Comm. address:	2022-19h	Effective mode:	Real time
Min.:	0.1	Unit:	[mm/s]/[rpm]
Max.:	6000.0	Data type:	UInt16
Default:	2000.0	Change mode:	Real time

Range:
0.1 [mm/s]/[rpm] to 6000.0 [mm/s]/[rpm]

Parameter description
See H22.19.

H22.25 **Target speed 6**

Comm. address:	2022-1Ah	Effective mode:	Real time
Min.:	0.1	Unit:	[mm/s]/[rpm]
Max.:	6000.0	Data type:	UInt16
Default:	2500.0	Change mode:	Real time

Range:
0.1 [mm/s]/[rpm] to 6000.0 [mm/s]/[rpm]
Parameter description
See H22.19.

H22.26 **Target speed 7**

Comm. address:	2022-1Bh	Effective mode:	Real time
Min.:	0.1	Unit:	[mm/s]/[rpm]
Max.:	6000.0	Data type:	UInt16
Default:	3000.0	Change mode:	Real time

Range:
0.1 [mm/s]/[rpm] to 6000.0 [mm/s]/[rpm]
Parameter description
See H22.19.

H22.35 **Acceleration/deceleration time**

Comm. address:	2022-24h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	50	Change mode:	Real time

Range:
0 ms to 65535 ms
Parameter description
Eight groups of acceleration/deceleration time are available for each process segment command.
Acceleration/Deceleration time refers to the time for the motor to change from 0 [mm/s]/[rpm] to 1000 [mm/s]/[rpm] at a constant speed.

H22.36 **Acceleration/Deceleration time 1**

Comm. address:	2022-25h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	200	Change mode:	Real time

Range:
0 ms to 65535 ms

Parameter description
Same as H22.35.

H22.37 Acceleration/Deceleration time 2

Comm. address:	2022-26h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	500	Change mode:	Real time

Range:
0 ms to 65535 ms
Parameter description
Same as H22.35.

H22.38 Acceleration/Deceleration time 3

Comm. address:	2022-27h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	1000	Change mode:	Real time

Range:
0 ms to 65535 ms
Parameter description
Same as H22.35.

H22.39 Acceleration/Deceleration time 4

Comm. address:	2022-28h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	1500	Change mode:	Real time

Range:
0 ms to 65535 ms
Parameter description
Same as H22.35.

H22.40 Acceleration/Deceleration time 5

Comm. address:	2022-29h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	2000	Change mode:	Real time

Range:
0 ms to 65535 ms
Parameter description
Same as H22.35.

H22.41 **Acceleration/Deceleration time 6**

Comm. address:	2022-2Ah	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	2500	Change mode:	Real time

Range:
0 ms to 65535 ms
Parameter description
Same as H22.35.

H22.42 **Acceleration/Deceleration time 7**

Comm. address:	2022-2Bh	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	3000	Change mode:	Real time

Range:
0 ms to 65535 ms
Parameter description
Same as H22.35.

H22.51 **Delay after completion of the process segment**

Comm. address:	2022-34h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:
0 to 65535
Parameter description
Eight groups of delay time are available for each process segment command.
The delay time refers to the delay that starts from the end of current command to the operation of the next command in the process segment.

H22.52 **Delay time 1 after completion of the process segment**

Comm. address:	2022-35h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	50	Change mode:	Real time

Range:
0 ms to 65535 ms
Parameter description
See H22.51.

H22.53 **Delay time 2 after completion of the process segment**

Comm. address:	2022-36h	Effective mode:	Real time

Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	200	Change mode:	Real time

Range:
0 ms to 65535 ms
Parameter description
See H22.51.

H22.54 **Delay time 3 after completion of the process segment**

Comm. address:	2022-37h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	500	Change mode:	Real time

Range:
0 ms to 65535 ms
Parameter description
See H22.51.

H22.55 **Delay time 4 after completion of the process segment**

Comm. address:	2022-38h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	1000	Change mode:	Real time

Range:
0 ms to 65535 ms
Parameter description
See H22.51.

H22.56 **Delay time 5 after completion of the process segment**

Comm. address:	2022-39h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	1500	Change mode:	Real time

Range:
0 ms to 65535 ms
Parameter description
See H22.51.

H22.57 **Delay time 6 after completion of the process segment**

Comm. address:	2022-3Ah	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	2000	Change mode:	Real time

Range:
0 ms to 65535 ms
Parameter description
See H22.51.

H22.58 **Delay time 7 after completion of the process segment**

Comm. address:	2022-3Bh	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	3000	Change mode:	Real time

Range:
0 ms to 65535 ms
Parameter description
See H22.51.

H22.70 **Homing mode of process segment**

Comm. address:	2022-47h	Effective mode:	Real time
Min. value:	-32768	Unit:	-
Max. value:	32767	Data type:	Int16
Default value:	-2	Change mode:	Real time

Range:
-32767 to 32768
Parameter Description
Defines the default motor direction of rotation, deceleration point, and home during homing.
When H22.70 is set to a value from -2 to 35, 402 homing is used (6098h = -2...35). See section "Homing Function" in SV680N-INT Series Servo Drive Function Guide for details.
When H22.70 is set to a value lower than or equal to -200, local homing is used (H22.70 = -200 + H05.31). See section "Homing Function" in SV680N-INT Series Servo Drive Function Guide for details.

H22.71 **Speed of high-speed search for home switch signal**

Comm. address:	2022-48h	Effective mode:	Real time
Min.:	0	Unit:	[mm/s]/[rpm]
Max.:	3000	Data type:	UInt16
Default:	100	Change mode:	Real time

Range:
0 [mm/s]/[rpm] to 3000 [mm/s]/[rpm]
Parameter description
Defines the motor speed for searching for the deceleration point signal during homing.

H22.72 **Speed of low-speed search for home switch signal**

Comm. address:	2022-49h	Effective mode:	Real time
Min.:	0	Unit:	[mm/s]/[rpm]
Max.:	1000	Data type:	UInt16

Default:	10	Change mode:	Real time

Range:
0 [mm/s]/[rpm] to 1000 [mm/s]/[rpm]
Parameter description
Defines the motor speed for searching for the home signal during homing.

H22.73 Acceleration/Deceleration time during homing

Comm. address:	2022-4Ah	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	1000	Data type:	UInt16
Default:	1000	Change mode:	Real time

Range:
0 ms to 1000 ms
Parameter description
Defines the time for the motor to accelerate from 0 [mm/s]/[rpm] to 1000 [mm/s]/[rpm] at a constant speed during homing.

H22.74 Home search time limit

Comm. address:	2022-4Bh	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	10000	Change mode:	Real time

Range:
0 ms to 65535 ms
Parameter description
Defines the maximum homing time.

H22.75 Mechanical home offset

Comm. address:	2022-4Ch	Effective mode:	Real time
Min.:	-2147483648	Unit:	Reference unit
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:
-2147483648 to +2147483647
Parameter description
Defines the absolute position of the motor after homing.

H22.79 Relative/Absolute homing

Comm. address:	2022-50h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0 to 65535

Parameter description

Defines the offset relation between the mechanical home and mechanical zero point upon homing, as well as the action upon overtravel during homing.
When H22.79 is set to 0, the value of H05.40 is 2.
When H22.79 is set to 1, the value of H05.40 is 3.

H22.83 Jump count threshold

Comm. address:	2022-54h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65534	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0 to 65534

Parameter description

Eight groups of process segment jump count are available for each process segment command.
Jump count threshold: Two jumpable process segments are available for the jump reference.
When the accumulative number of jumps executed by the jump reference is lower than the jump count threshold, process segment A applies. Otherwise, process segment B applies. For details, see section process segment mode in the user guide.

H22.84 Jump count threshold 1

Comm. address:	2022-55h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65534	Data type:	UInt16
Default:	20	Change mode:	Real time

Range:

0 to 65534

Parameter description

Same as H22.83

H22.85 Jump count threshold 2

Comm. address:	2022-56h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65534	Data type:	UInt16
Default:	40	Change mode:	Real time

Range:

0 to 65534

Parameter description

Same as H22.83

H22.86 Jump count threshold 3

Comm. address:	2022-57h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65534	Data type:	UInt16

Default:	80	Change mode:	Real time

Range:
0 to 65534
Parameter description
Same as H22.83

H22.87 Jump count threshold 4

Comm. address:	2022-58h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65534	Data type:	UInt16
Default:	160	Change mode:	Real time

Range:
0 to 65534
Parameter description
Same as H22.83

H22.88 Jump count threshold 5

Comm. address:	2022-59h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65534	Data type:	UInt16
Default:	320	Change mode:	Real time

Range:
0 to 65534
Parameter description
Same as H22.83

H22.89 Jump count threshold 6

Comm. address:	2022-5Ah	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65534	Data type:	UInt16
Default:	640	Change mode:	Real time

Range:
0 to 65534
Parameter description
Same as H22.83

H22.90 Jump count threshold 7

Comm. address:	2022-5Bh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65534	Data type:	UInt16
Default:	1280	Change mode:	Real time

Range:
0 to 65534

Parameter description
See H22.83.

10.29 H23 Process Segment Parameters

H23.00 **Definition of homing**

Comm. address:	2023-01h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	Real time

Value range:
0 to 4294967295
Parameter description
See section "Homing Mode" in "Process Segment Mode" in the user guide for details.

H23.02 **Homing data**

Comm. address:	2023-03h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:
-2147483648 to +2147483647
Parameter description
The homing data is not used.

H23.04 **Definition of process segment 1**

Comm. address:	2023-05h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	Real time

Value range:
0 to 4294967295
Parameter description
bit0 to bit3: Mode, which is the operation mode of the process segment.
Mode = 1: The fixed speed mode applies. Mode = 2: The positioning mode applies, which stops after positioning is done. Mode = 3: The next segment is executed automatically after positioning is done. Mode = 7: The jump mode applies, which is used to jump to the designated process segment. Mode = 8: The parameter-write mode applies, which allows you to write specific parameters.
See section "Process Segment Operation Mode" in SV680N-INT Series Servo Drive User Guide for details.

H23.06 **Data of process segment 1**

Comm. address:	2023-07h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Value range:
-2147483648 to +2147483647
Parameter description
Different modes selected in process segment 1 correspond to different process segment data. See section "Process Segment Operation Mode" in SV680N-INT Series Servo Drive User Guide for details.

H23.08 **Definition of process segment 2**

Comm. address:	2023-09h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	4294967295	Data type:	UInt32
Default:	0	Change mode:	Real time

Range:
0 to 4294967295
Parameter description
See definition of process segment 1.

H23.10 **Data of process segment 2**

Comm. address:	2023-0Bh	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:
-2147483648 to +2147483647
Parameter description
See that of process segment 1.

H23.12 **Definition of process segment 3**

Comm. address:	2023-0Dh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	4294967295	Data type:	UInt32
Default:	0	Change mode:	Real time

Range:
0 to 4294967295
Parameter description
See definition of process segment 1.

H23.14 **Data of process segment 3**

Comm. address:	2023-0Fh	Effective mode:	Real time

Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:
-2147483648 to +2147483647
Parameter description
See that of process segment 1.

H23.16 **Definition of process segment 4**

Comm. address:	2023-11h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	4294967295	Data type:	UInt32
Default:	0	Change mode:	Real time

Range:
0 to 4294967295
Parameter description
See definition of process segment 1.

H23.18 **Data of process segment 4**

Comm. address:	2023-13h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:
-2147483648 to +2147483647
Parameter description
See that of process segment 1.

H23.20 **Definition of process segment 5**

Comm. address:	2023-15h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	4294967295	Data type:	UInt32
Default:	0	Change mode:	Real time

Range:
0 to 4294967295
Parameter description
See definition of process segment 1.

H23.22 **Data of process segment 5**

Comm. address:	2023-17h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:
-2147483648 to +2147483647
Parameter description
See that of process segment 1.

H23.24 **Definition of process segment 6**

Comm. address:	2023-19h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	4294967295	Data type:	UInt32
Default:	0	Change mode:	Real time

Range:
0 to 4294967295
Parameter description
See definition of process segment 1.

H23.26 **Data of process segment 6**

Comm. address:	2023-1Bh	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:
-2147483648 to +2147483647
Parameter description
See that of process segment 1.

H23.28 **Definition of process segment 7**

Comm. address:	2023-1Dh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	4294967295	Data type:	UInt32
Default:	0	Change mode:	Real time

Range:
0 to 4294967295
Parameter description
See definition of process segment 1.

H23.30 **Data of process segment 7**

Comm. address:	2023-1Fh	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:
-2147483648 to +2147483647
Parameter description
See that of process segment 1.

H23.32s **Definition of process segment 8**

Comm. address:	2023-21h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	4294967295	Data type:	UInt32
Default:	0	Change mode:	Real time

Range:
0 to 4294967295
Parameter description
See definition of process segment 1.

H23.34 **Data of process segment 8**

Comm. address:	2023-23h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:
-2147483648 to +2147483647
Parameter description
See that of process segment 1.

H23.36 **Definition of process segment 9**

Comm. address:	2023-25h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	4294967295	Data type:	UInt32
Default:	0	Change mode:	Real time

Range:
0 to 4294967295
Parameter description
See definition of process segment 1.

H23.38 **Data of process segment 9**

Comm. address:	2023-27h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:
-2147483648 to +2147483647
Parameter description
See that of process segment 1.

H23.40 **Definition of process segment 10**

Comm. address:	2023-29h	Effective mode:	Real time
Min.:	0	Unit:	-

Max.:	4294967295	Data type:	UInt32
Default:	0	Change mode:	Real time

Range:
0 to 4294967295
Parameter description
See definition of process segment 1.

H23.42 **Data of process segment 10**

Comm. address:	2023-2Bh	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:
-2147483648 to +2147483647
Parameter description
See that of process segment 1.

H23.44 **Definition of process segment 11**

Comm. address:	2023-2Dh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	4294967295	Data type:	UInt32
Default:	0	Change mode:	Real time

Range:
0 to 4294967295
Parameter description
See definition of process segment 1.

H23.46 **Data of process segment 11**

Comm. address:	2023-2Fh	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:
-2147483648 to +2147483647
Parameter description
See that of process segment 1.

H23.48 **Definition of process segment 12**

Comm. address:	2023-31h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	4294967295	Data type:	UInt32
Default:	0	Change mode:	Real time

Range:

0 to 4294967295

Parameter description

See definition of process segment 1.

H23.50 **Data of process segment 12**

Comm. address:	2023-33h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

See that of process segment 1.

H23.52 **Definition of process segment 13**

Comm. address:	2023-35h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	4294967295	Data type:	UInt32
Default:	0	Change mode:	Real time

Range:

0 to 4294967295

Parameter description

See definition of process segment 1.

H23.54 **Data of process segment 13**

Comm. address:	2023-37h	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

See that of process segment 1.

H23.56 **Definition of process segment 14**

Comm. address:	2023-39h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	4294967295	Data type:	UInt32
Default:	0	Change mode:	Real time

Range:

0 to 4294967295

Parameter description

See definition of process segment 1.

H23.58 **Data of process segment 14**

Comm. address:	2023-3Bh	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:
-2147483648 to +2147483647
Parameter description
See that of process segment 1.

H23.60 **Definition of process segment 15**

Comm. address:	2023-3Dh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	4294967295	Data type:	UInt32
Default:	0	Change mode:	Real time

Range:
0 to 4294967295
Parameter description
See definition of process segment 1.

H23.62 **Data of process segment 15**

Comm. address:	2023-3Fh	Effective mode:	Real time
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:
-2147483648 to +2147483647
Parameter description
See that of process segment 1.

10.30 H30 Variables Read Through Communication

H30.00 **Servo state read through communication**

Comm. address:	2030-01h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0 to 65535
Parameter description
Displays the current operating state of the servo for interaction with the background.

H30.01 **DO function status 1 read through communication**

Comm. address:	2030-02h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:

0 to 65535

Parameter description

bit0 corresponds to DO function 1.
bit1 corresponds to DO function 2.
bit2 corresponds to DO function 3.
…
By analogy

H30.02 **DO function status 2 read through communication**

Comm. address:	2030-03h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:

0 to 65535

Parameter description

bit0 corresponds to DO function 17.
bit1 corresponds to DO function 18.
bit2 corresponds to DO function 19.
…
By analogy

H30.12 **Cumulative count value of primary encoder communication timeout upon the selected fault**

Comm. address:	2030-0Dh	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:

0 to 65535

Parameter description

Displays the number of communication timeout events of the primary encoder upon the selected fault.

H30.13 **Cumulative count of CRC or frame stop errors during communication of primary encoder upon selected fault**

Comm. address:	2030-0Eh	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0 to 65535
Parameter description
Displays the cumulative count of CRC or frame stop errors during communication of primary encoder upon selected fault.

H30.14 **Rising edge count of primary encoder communication timeout error upon the selected fault**

Comm. address:	2030-0Fh	Effective mode:	-
Min.:	0	Unit:	-
Max.:	255	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0 to 255
Parameter description
Displays the rising edge count of primary encoder communication timeout error upon occurrence of the selected fault.

H30.15 **5 V voltage monitoring value of the drive upon the selected fault**

Comm. address:	2030-10h	Effective mode:	-
Min.:	0.00	Unit:	V
Max.:	655.35	Data type:	UInt16
Default:	0.00	Change mode:	Read only

Range:
0.00 V to 655.35 V
Parameter description
Displays the internal 5 V voltage of the drive upon the selected fault.

H30.16 **Cumulative count of communication timeout of primary encoder**

Comm. address:	2030-11h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0 to 65535
Parameter description
Defines the cumulative count of communication timeout of primary encoder upon power-on.

H30.17 **Cumulative count of CRC or frame stop errors during communication of primary encoder**

Comm. address:	2030-12h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0 to 65535

Parameter description

Defines the cumulative count of CRC or frame stop errors during communication of primary encoder.

H30.18 Maximum value of consecutive timeout error during communication of primary encoder

Comm. address:	2030-13h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:

0 to 65535

Parameter description

Defines the maximum value of timeout error during communication of primary encoder.

H30.28 Rising edge count of primary encoder communication timeout error

Comm. address:	2030-1Dh	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:

0 to 65535

Parameter description

Defines the rising edge count of primary encoder communication timeout error.

H30.29 5 V voltage monitoring value of the drive

Comm. address:	2030-1Eh	Effective mode:	-
Min.:	0.00	Unit:	V
Max.:	655.35	Data type:	UInt16
Default:	0.00	Change mode:	Read only

Range:

0.00 V to 655.35 V

Parameter description

Defines the internal 5 V voltage of the drive.

H30.30 Error frame pre-alarm count

Comm. address:	2030-1Fh	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:

0 to 65535

Parameter description

Displays the number of pre-alarms (E08.7).

H30.31 **E08 fault log**

Comm. address:	2030-20h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	19	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0: Present E08 fault

1: Last E08 fault

2: 2nd to last E08 fault

3: 3rd to last E08 fault

4: 4th to last E08 fault

5: 5th to last E08 fault 6: 6th to last E08 fault

7: 7th to last E08 fault

8: 8th to last E08 fault

9: 9th to last E08 fault

10: 10th to last E08 fault

11: 11th to last E08 fault

12: 12th to last E08 fault

13: 13th to last E08 fault

14: 14th to last E08 fault

15: 15th to last E08 fault

16: 16th to last E08 fault

17: 17th to last E08 fault

18: 18th to last E08 fault

19: 19th to last E08 fault

Parameter description

Used to select from the latest twenty E08 faults of the drive.

0: Present fault

1: Last fault

2: 2nd to last fault

3: 3rd to last fault

4: 4th to last fault

5: 5th to last fault 6: 6th to last fault

7: 7th to last fault

8: 8th to last fault

9: 9th to last fault

10: 10th to last fault

11: 11th to last fault

12: 12th to last fault

13: 13th to last fault

14: 14th to last fault

15: 15th to last fault

16: 16th to last fault

17: 17th to last fault

18: 18th to last fault

19: 19th to last fault

H30.32 **E08 fault code of the fault selected by H30.31**

Comm. address:	2030-21h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFF

Parameter description

Displays the E08 fault code of the fault selected by H30.31.

H30.33 **Time stamp of the selected E08 fault**

Comm. address:	2030-22h	Effective mode:	-
Min.:	0.0	Unit:	s
Max.:	429496729.5	Data type:	UInt32
Default:	0.0	Change mode:	Read only

Range:

0.0s to 429496729.5s

Parameter description

Displays the time stamp of the selected E08 fault.

H30.35 **Port 0 error register when switching from safeop to op state upon the selected E08 fault**

Comm. address:	2030-24h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFF

Parameter description

Displays the error register of port 0 for the selected E08 fault upon switching from safeop state to op state.

H30.36 **Port 1 error register when switching from safeop to op state upon the selected E08 fault**

Comm. address:	2030-25h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFF

Parameter description

Displays the error register of port 1 for the selected E08 fault upon switching from safeop state to op state.

H30.37 **Transfer error register when switching from safeop to op state upon the selected E08 fault**

Comm. address:	2030-26h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFF
Parameter description
Displays transfer error register when switching from safeop to op state upon the selected E08 fault.

H30.38 **Processing unit error register when switching from safeop to op state upon selected E08 fault**

Comm. address:	2030-27h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFF	Data type:	UInt8
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFF
Parameter description
Displays the processing unit error register when switching from safeop to op state upon selected E08 fault.

H30.39 **Connection loss register when switching from safeop to op state upon the selected E08 fault**

Comm. address:	2030-28h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFF
Parameter description
Displays connection loss register when switching from safeop to op state upon the selected E08 fault.

H30.40 **Port 0 error register upon the selected E08 fault**

Comm. address:	2030-29h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFF
Parameter description
Displays the error register of port 0 upon occurrence of the selected E08 fault.

H30.41 **Port 1 error register upon the selected E08 fault**

Comm. address:	2030-2Ah	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFF

Parameter description

Displays the error register of port 1 upon occurrence of the selected E08 fault.

H30.42 **Transfer error register upon occurrence of the selected E08 fault**

Comm. address:	2030-2Bh	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFF

Parameter description

Displays the transfer error register upon occurrence of the selected E08 fault

H30.43 **Processing unit error register upon the selected E08 fault**

Comm. address:	2030-2Ch	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFF	Data type:	UInt8
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFF

Parameter description

Displays the processing unit error register upon occurrence of the selected E08 fault.

H30.44 **Connection loss register upon occurrence of the selected E08 fault**

Comm. address:	2030-2Dh	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFF

Parameter description

Displays the connection loss register upon occurrence of the selected E08 fault.

H30.45 **Synchronization signal cycle upon occurrence of the selected E08 fault.**

Comm. address:	2030-2Eh	Effective mode:	-
Min.:	-2147483648	Unit:	-

Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Read only

Range:
-2147483648 to +2147483647
Parameter description
Displays the synchronization signal cycle upon occurrence of the selected E08 fault.

H30.47 **Phase difference between the synchronization signal and IRQ signal upon occurrence of the selected E08 fault**

Comm. address:	2030-30h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	4294967295	Data type:	UInt32
Default:	0	Change mode:	Read only

Range:
0 to 4294967295
Parameter description
Displays the phase difference between the synchronization signal and IRQ signal upon occurrence of the selected E08 fault.

H30.49 **Fault record variable 1 upon occurrence of the selected E08 fault.**

Comm. address:	2030-32h	Effective mode:	-
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Read only

Range:
-2147483648 to +2147483647
Parameter description
Displays the fault record variable 1 upon occurrence of the selected E08 fault.

H30.51 **Fault record variable 2 upon occurrence of the selected E08 fault.**

Comm. address:	2030-34h	Effective mode:	-
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Read only

Range:
-2147483648 to +2147483647
Parameter description
Displays the fault record variable 2 upon occurrence of the selected E08 fault.

H30.53 **Read/Write ESC/PHY register switch**

Comm. address:	2030-36h	Effective mode:	Real time
Min.:	0x0	Unit:	-
Max.:	0x101	Data type:	UInt16
Default:	0x0	Change mode:	Real time

Range:
0x0 to 0x101
Parameter description
Used as the register function switch for reading/writing ESC/PHY.
Low 8 bits: 0 - Reading/Writing of ESC register not enabled; 1 - Reading/Writing of ESC register enabled
High 8 bits: 0 - Reading/Writing of PHY register not enabled; 1 - Reading/Writing of PHY register enabled

H30.54 **Read/Write property of ESC register**

Comm. address:	2030-37h	Effective mode:	Real time
Min.:	0x0	Unit:	-
Max.:	0x4	Data type:	UInt8
Default:	0x0	Change mode:	Real time

Range:
0x0 to 0x4
Parameter description
Used to set the read/write property of the ESC register.
0 - Invalid; 1 - Read; 4 - Write

H30.55 **ESC register address**

Comm. address:	2030-38h	Effective mode:	Real time
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Real time

Range:
0x0 to 0xFFFF
Parameter description
Used to set the ESC register address.

H30.56 **ESC register data**

Comm. address:	2030-39h	Effective mode:	Real time
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Real time

Range:
0x0 to 0xFFFF
Parameter description
Used to set/display the ESC register data.

H30.57 **Read/Write property of PHY register**

Comm. address:	2030-3Ah	Effective mode:	Real time
Min.:	0x0	Unit:	-
Max.:	0x4101	Data type:	UInt16
Default:	0x0	Change mode:	Real time

Range:
0x0 to 0x4101
Parameter description
The high 8 bits are used to read and write operations.
The high 4 bits (bit12 to bit115) indicate the register type (1 - Standard register; 4 - Extended register).
The low 4 bits (bit8 to bit11) indicate read-write attribute (0 - Invalid; 1 - Read).
- The low 8 bits are for the PHY address (bit0 to bit7).
PHY address: 0 - IN port; 1 - OUT port

H30.58 **PHY register address**

Comm. address:	2030-3Bh	Effective mode:	Real time
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Real time

Range:
0x0 to 0xFFFF
Parameter description
Used to set the PHY register address.

H30.59 **PHY register data**

Comm. address:	2030-3Ch	Effective mode:	Real time
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Real time

Range:
0x0 to 0xFFFF
Parameter description
Displays the corresponding PHY register value.

H30.60 **PHY - MII reception error enable**

Comm. address:	2030-3Dh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:
0: Disable MII-ERR monitoring function
1: Enable MII-ERR monitoring function
Parameter description
0: Disable MII-ERR monitoring function
1: Enable MII-ERR monitoring function

H30.61 **Read PHY address for MII reception error**

Comm. address:	2030-3Eh	Effective mode:	Real time
Min.:	0	Unit:	-

Max.:	1	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:
0: IN port
1: OUT port
Parameter description
Used to set the PHY address.
0: IN port
1: OUT port

H30.62 **MII reception error, 64 <= length <= 1518**

Comm. address:	2030-3Fh	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0 to 65535
Parameter description
MII interface data frame reception error, data frame length: 64 ≤ length ≤ 1518

H30.63 **MII reception error, length > 1518**

Comm. address:	2030-40h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0 to 65535
Parameter description
Data frame reception error of MII interface, data frame length: ≤ 1518

H30.64 **MII reception error, length < 64**

Comm. address:	2030-41h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0 to 65535
Parameter description
Data frame reception error of MII interface, data frame length: length < 64

H30.65 **SFD error**

Comm. address:	2030-42h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16

Default:	0	Change mode:	Read only

Range:
0 to 65535
Parameter description
Defines the data frame SFD error.

H30.66 **Total number of frames received by MII**

Comm. address:	2030-43h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0 to 65535
Parameter description
Defines the total number of data frames received by the MII interface.

10.31 H31 References Set Through Communication

H31.00 **VDI virtual level set through communication**

Comm. address:	2031-01h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:
0 to 65535
Parameter description
When H17.90 is set to 1, the VDI state is defined by H31.00.
The VDI logic is determined by H17.91 (Default VDI virtual level value upon power-on) upon initial power-on. Then, H31.00 is determined by the VDI logic.
"bit(n) = 1" of H31.00 indicates the logic of VDI (n+1) is "1". "bit(n)=0" indicates the logic of VDI (n +1) is "0".

H31.01 **Frequency-division output frequency set through communication**

Comm. address:	2031-02h	Effective mode:	Real time
Min.:	0	Unit:	Hz
Max.:	16000000	Data type:	UInt32
Default:	0	Change mode:	Real time

Range:
0 Hz to 16000000 Hz
Parameter description
When H05.38 is set to 4, H31.01 defines the frequency (after frequency quadrupled) of the frequency-division output port.

H31.04 **DO status set through communication**

Comm. address:	2031-05h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0 to 65535

Parameter description

Defines the DO output status.

H31.05 **AO status set through communication**

Comm. address:	2031-06h	Effective mode:	Real time
Min.:	-10000	Unit:	mV
Max.:	10000	Data type:	Int16
Default:	0	Change mode:	Real time

Range:

-10000 mV to +10000 mV

Parameter description

Set H04.50 to 10 to define AO through H31.05 (in mV).

H31.09 **Speed reference set through communication**

Comm. address:	2031-0Ah	Effective mode:	Real time
Min.:	-9999.000	Unit:	[mm/s]/[rpm]
Max.:	9999.000	Data type:	Int32
Default:	0.000	Change mode:	Real time

Range:

-9999.000 [mm/s]/[rpm] to +9999.000 [mm/s]/[rpm]

Parameter description

Set H06.02 to 4 to define the speed reference in the speed control mode (unit: 0.001 [mm/s]/[rpm]).

H31.11 **Torque reference set through communication**

Comm. address:	2031-0Ch	Effective mode:	Real time
Min.:	-100.000	Unit:	%
Max.:	100.000	Data type:	Int32
Default:	0.000	Change mode:	Real time

Range:

-100.000% to +100.000%

Parameter description

Set H07.02 to 4 to define the torque reference in the torque control mode through this parameter (unit: 0.001%). The setpoint 100.000% corresponds to the rated torque of the motor.

10.32 H32 Direct Drive Parameters

H32.00 **Encoder interpolater mismatch alarm (E124)**

Comm. address:	2032-01h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	1	Change mode:	At stop

Range:

0: Disable

1: Enable

Parameter description

The T2 interpolator matches the HipeFace encoder. The power-on check switch is turned on by default.

0: Disable

1: Enable

H32.01 **Encoder interface switchover switch**

Comm. address:	2032-02h	Effective mode:	Next power-on
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: Default encoder interface

1: Switching the encoder interface

Parameter description

Used to switch the encoder interface.

0: Default encoder interface

1: Switching the encoder interface

H32.02 **Angle auto-tuning upon power-on**

Comm. address:	2032-03h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: Disabled

1: Enabled

Parameter description

Angle auto-tuning starts after the drive switches to the rdy state and the time defined by H32.41 elapses.

0: Disabled

1: Enabled

H32.03 **Angle auto-tuning switch controlled by control word**

Comm. address:	2032-04h	Effective mode:	Real time

Min.:	0	Unit:	-
Max.:	2	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: Disable

1: Control word 6

2: Control word 7

Parameter description

Used to enable the angle auto-tuning switchover switch through the control word.

0: Disable

1: Control word 6

2: Control word 7

H32.04 **Angle auto-tuning state display**

Comm. address:	2032-05h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

bit0: bit7 of 6041

bit1: E602.9

bit2 to bit15: N/A

Parameter description

When angle auto-tuning is not performed on the incremental encoder, the related alarm or status bit is generated based on the setting.

bit0: bit7 of 6041h

bit1: E602.9

bit2 to bit15: N/A

H32.05 **Pre-positioning retract selection**

Comm. address:	2032-06h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: Disabled

1: Enabled

Parameter description

Used to retract by a certain distance after auto-tuning through pre-positioning is done.

0: Disabled

1: Enabled

H32.06 **Position feedback processing**

Comm. address:	2032-07h	Effective mode:	Real time
Min.:	0	Unit:	-

Max.:	1	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: Disabled

1: Enabled

Parameter description

Used to align the position feedback to the position before angle auto-tuning for incremental encoders..

0: Disabled

1: Enabled

H32.07 **Incremental homing mode**

Comm. address:	2032-08h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	9	Data type:	UInt16
Default:	1	Change mode:	At stop

Range:

0: Z signal short-circuited

1: Short-circuited only at the first time

Parameter description

Defines the Z signal selection upon homing for an incremental communication encoder.

0: Z signal short-circuited

1: Short-circuited only at the first time

Note: The width of the Z signal is set according to H32.08.

H32.08 **Homing signal width**

Comm. address:	2032-09h	Effective mode:	Real time
Min.:	100	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	800	Change mode:	At stop

Range:

100 to 65535

Parameter description

The setpoint is active after the position is latched by Z signal.

H32.10 **Maximum reference current in angle auto-tuning through inching**

Comm. address:	2032-0Bh	Effective mode:	At stop
Min.:	10.0	Unit:	%
Max.:	300.0	Data type:	UInt16
Default:	100.0	Change mode:	At stop

Range:

10.0% to 300.0%

Parameter description

Defines the maximum reference current during auto-tuning.

H32.13 **Motor action threshold (ROT/DDR) in angle auto-tuning through inching**

Comm. address:	2032-0Eh	Effective mode:	At stop
Min.:	0.001	Unit:	deg
Max.:	20.000	Data type:	UInt16
Default:	0.200	Change mode:	At stop

Range:

0.001 deg to 20.000 deg

Parameter description

Defines the threshold for determining motor action during auto-tuning.

The default value applies to most of applications. When a specific action amplitude is required, change the default value properly. Note that the lower the setpoint, the smaller the motor action during auto-tuning. An excessively low value can lead to large auto-tuning error.

H32.14 **Motor standstill threshold (ROT/DDR) in angle auto-tuning through inching**

Comm. address:	2032-0Fh	Effective mode:	At stop
Min.:	0.1	Unit:	[mm/s]/[rpm]
Max.:	100.0	Data type:	UInt16
Default:	1.0	Change mode:	At stop

Range:

0.1 [mm/s]/[rpm] to 100.0 [mm/s]/[rpm]

Parameter description

Defines the threshold for determining whether the motor is at a standstill during auto-tuning.

The default value applies to most of applications.

H32.15 **Motor action threshold (DDL) in angle auto-tuning through inching**

Comm. address:	2032-10h	Effective mode:	At stop
Min.:	0.001	Unit:	mm
Max.:	20.000	Data type:	UInt16
Default:	0.200	Change mode:	At stop

Range:

0.001 mm to 20.000 mm

Parameter description

Defines the threshold for determining motor action during auto-tuning.

The default value applies to most of applications. When a specific action amplitude is required, change the default value properly. Note that the lower the setpoint, the smaller the motor action during auto-tuning. An excessively low value can lead to large auto-tuning error.

H32.16 **Motor standstill threshold (DDL) in angle auto-tuning through inching**

Comm. address:	2032-11h	Effective mode:	At stop
Min.:	0.1	Unit:	mm/s
Max.:	100.0	Data type:	UInt16
Default:	1.0	Change mode:	At stop

Range:

0.1 mm/s to 100.0 mm/s

Parameter description

Defines the threshold for determining whether the motor is at a standstill during auto-tuning. The default value applies to most of applications.

H32.18 Motor standstill time threshold in angle auto-tuning through inching

Comm. address:	2032-13h	Effective mode:	At stop
Min.:	0.1	Unit:	s
Max.:	10.0	Data type:	UInt16
Default:	1.0	Change mode:	At stop

Range:

0.1s to 10.0s

Parameter description

Defines the time threshold for determining whether the motor is at a standstill during auto-tuning. The default value applies to most of applications.

H32.20 Max. reference current in angle auto-tuning through pre-positioning (closed-loop)

Comm. address:	2032-15h	Effective mode:	At stop
Min.:	10.0	Unit:	%
Max.:	300.0	Data type:	UInt16
Default:	100.0	Change mode:	At stop

Range:

10.0% to 300.0%

Parameter description

Defines the maximum reference current during auto-tuning.

H32.22 Electrical angle reference in angle auto-tuning through pre-positioning (closed-loop)

Comm. address:	2032-17h	Effective mode:	At stop
Min.:	0.0	Unit:	deg
Max.:	360.0	Data type:	UInt16
Default:	0.0	Change mode:	At stop

Range:

0.0 deg to 360.0 deg

Parameter description

Defines the electrical angle during auto-tuning through pre-positioning.

H32.23 Electrical angle reference change range in angle auto-tuning through pre-positioning (closed-loop)

Comm. address:	2032-18h	Effective mode:	At stop
Min.:	10.0	Unit:	deg
Max.:	170.0	Data type:	UInt16
Default:	90.0	Change mode:	At stop

Range:

10.0 deg to 170.0 deg

Parameter description
Defines the electrical angle change range during auto-tuning.

H32.24 Motor stop threshold (ROT/DDR) in angle auto-tuning through pre-positioning (closed-loop)

Comm. address:	2032-19h	Effective mode:	At stop
Min.:	0.1	Unit:	[mm/s]/[rpm]
Max.:	100.0	Data type:	UInt16
Default:	1.0	Change mode:	At stop

Range:
0.1 [mm/s]/[rpm] to 100.0 [mm/s]/[rpm]
Parameter description
Defines the threshold for determining whether the motor is at a standstill during auto-tuning. The default value applies to most of applications.

H32.25 Motor stop threshold (DDL) in angle auto-tuning through pre-positioning (closed-loop)

Comm. address:	2032-1Ah	Effective mode:	At stop
Min.:	0.1	Unit:	mm/s
Max.:	100.0	Data type:	UInt16
Default:	1.0	Change mode:	At stop

Range:
0.1 mm/s to 100.0 mm/s
Parameter description
Defines the threshold for determining whether the motor is at a standstill during auto-tuning. The default value applies to most of applications.

H32.26 Damping in angle auto-tuning through pre-positioning (closed-loop)

Comm. address:	2032-1Bh	Effective mode:	At stop
Min.:	0.00	Unit:	[N/(m/s)]/[N·m/rpm]
Max.:	655.35	Data type:	UInt16
Default:	0.00	Change mode:	At stop

Range:
0.00 [N/(m/s)]/[N·m/rpm] to 655.35 [N/(m/s)]/[N·m/rpm]
Parameter description
Defines the damping coefficient during auto-tuning. A proper coefficient ensures a smooth and impact-free operation process.
1. The setpoint is related to the load characteristics. The higher the load, the higher the coefficient.
2. Violent impact may be present during auto-tuning in case of an excessively low setpoint, which is normal. The motor action may be delayed in case of an excessively high setpoint, which is also normal unless a timeout alarm is reported.

H32.29 Motor standstill threshold in angle auto-tuning through pre-positioning (closed-loop)

Comm. address:	2032-1Eh	Effective mode:	At stop
Min.:	0.1	Unit:	s
Max.:	10.0	Data type:	UInt16

Default:	0.5	Change mode:	At stop

Range:
0.1s to 10.0s
Parameter description
Defines the time for determining whether the motor is at a standstill during auto-tuning. The default value applies to most of applications.

H32.30 Maximum current reference in angle auto-tuning through position lock

Comm. address:	2032-1Fh	Effective mode:	At stop
Min.:	10.0	Unit:	%
Max.:	300.0	Data type:	UInt16
Default:	100.0	Change mode:	At stop

Range:
10.0% to 300.0%
Parameter description
Defines the maximum current reference during auto-tuning.

H32.33 Motor action threshold (ROT/DDR) in angle auto-tuning through position lock

Comm. address:	2032-22h	Effective mode:	At stop
Min.:	0.001	Unit:	deg
Max.:	20.000	Data type:	UInt16
Default:	0.200	Change mode:	At stop

Range:
0.001 deg to 20.000 deg
Parameter description
Defines the threshold for determining motor action during auto-tuning.
The default value applies to most of applications. When a specific action amplitude is required, change the default value properly. Note that the lower the setpoint, the smaller the motor action during auto-tuning. An excessively low value can lead to large auto-tuning error.

H32.34 Motor standstill threshold (ROT/DDR) in angle auto-tuning through position lock

Comm. address:	2032-23h	Effective mode:	At stop
Min.:	0.1	Unit:	[mm/s]/[rpm]
Max.:	100.0	Data type:	UInt16
Default:	1.0	Change mode:	At stop

Range:
0.1 [mm/s]/[rpm] to 100.0 [mm/s]/[rpm]
Parameter description
Defines the threshold for determining whether the motor is at a standstill during auto-tuning.
The default value applies to most of applications.

H32.35 Motor action threshold (DDL) in angle auto-tuning through position lock

Comm. address:	2032-24h	Effective mode:	At stop
Min.:	0.001	Unit:	mm

Max.:	20.000	Data type:	UInt16
Default:	0.200	Change mode:	At stop

Range:
0.001 mm to 20.000 mm
Parameter description
Defines the threshold for determining motor action during auto-tuning.
The default value applies to most of applications. When a specific action amplitude is required, change the default value properly. Note that the lower the setpoint, the smaller the motor action during auto-tuning. An excessively low value can lead to large auto-tuning error.

H32.36 Motor standstill threshold (DDL) in angle auto-tuning through position lock

Comm. address:	2032-25h	Effective mode:	At stop
Min.:	0.1	Unit:	mm/s
Max.:	100.0	Data type:	UInt16
Default:	1.0	Change mode:	At stop

Range:
0.1 mm/s to 100.0 mm/s
Parameter description
Defines the threshold for determining whether the motor is at a standstill during auto-tuning.
The default value applies to most of applications.

H32.37 Angle gain in angle auto-tuning through position lock

Comm. address:	2032-26h	Effective mode:	At stop
Min.:	0	Unit:	deg/(p/s)
Max.:	10000	Data type:	UInt16
Default:	1000	Change mode:	At stop

Range:
0 deg/(p/s) to 10000 deg/(p/s)
Parameter description
Defines the angle gain during auto-tuning. A proper setpoint improves the auto-tuning angle accuracy. The default value applies to most of applications.

H32.38 Inertia ratio in angle auto-tuning through position lock

Comm. address:	2032-27h	Effective mode:	At stop
Min.:	0.00	Unit:	-
Max.:	120.00	Data type:	UInt16
Default:	0.00	Change mode:	At stop

Range:
0.00 to 120.00
Parameter description
Defines the inertia ratio gain used during auto-tuning. A proper setpoint ensures a smooth and jitter-free auto-tuning process and reduces the auto-tuning action range.

1. The setting of this coefficient is generally related to the load characteristics. Set this coefficient based on the actual inertia ratio.
2. An excessively low setpoint can lead to a large movement value during auto-tuning, which is normal. An excessively high setpoint can lead to oscillation caused by gain mismatch.

H32.39 Gain level in angle auto-tuning through position lock

Comm. address:	2032-28h	Effective mode:	At stop
Min.:	4	Unit:	level
Max.:	31	Data type:	UInt16
Default:	12	Change mode:	At stop

Range:

4 to 31

Parameter description

Defines the loop stiffness level gain for auto-tuning. A proper setpoint ensures a smooth and jitter-free auto-tuning process and reduces the auto-tuning action range.

1. An excessively low setpoint can lead to a large movement value during auto-tuning, which is normal. An excessively high setpoint can lead to oscillation caused by gain mismatch.

H32.40 Left/Right limit function

Comm. address:	2032-29h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

1. Left limit being positive
2. Left limit being negative

Parameter description

The motor with left and right limits is supported. After setting, the left and right limit functions are enabled.

1. Left limit being positive
2. Left limit being negative

H32.41 Angle auto-tuning timeout upon power-on

Comm. address:	2032-2Ah	Effective mode:	Real time
Min.:	0	Unit:	s
Max.:	65535	Data type:	UInt16
Default:	3	Change mode:	Real time

Range:

0 to 65535

Parameter description

Used to set automatic angle auto-tuning delay upon power-on.

H32.45 Black box channel 26 function

Comm. address:	2032-2Eh	Effective mode:	Real time
Min.:	0	Unit:	-

Max.:	1	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: Real-time target speed (60FFh)

1: Electrical angle

Parameter description

Used to switch the function of black box monitoring channel 21.

0: Real-time target position (607Ah)

1: Electrical angle

H32.50 32-bit dimension compatibility enable

Comm. address:	2032-33h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	99	Data type:	UInt16
Default:	1	Change mode:	At stop

Range:

0 to 99

Parameter description

Used to enable 32-bit dimension compatibility.

H32.51 Hall auto-tuning mode selection

Comm. address:	2032-34h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: Open-loop Hall auto-tuning

1: Closed-loop Hall auto-tuning

Parameter description

Defines the dynamic Hall auto-tuning mode.

H32.52 Maximum current in Hall auto-tuning

Comm. address:	2032-35h	Effective mode:	Real time
Min.:	10	Unit:	%
Max.:	300	Data type:	UInt16
Default:	100	Change mode:	At stop

Range:

10% to 300%

Parameter description

Defines the maximum current during dynamic Hall auto-tuning.

H32.53 Motor standstill threshold in angle auto-tuning through position lock

Comm. address:	2032-36h	Effective mode:	At stop
Min.:	0.1	Unit:	s

Max.:	10.0	Data type:	UInt16
Default:	1.0	Change mode:	At stop

Range:
0.1s to 10.0s
Parameter description
Defines the time for determining whether the motor is at a standstill during auto-tuning. The default value applies to most of applications.

H32.54 Hall auto-tuning enable

Comm. address:	2032-37h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
When this parameter is enabled, the Hall auto-tuning will be started automatically after basic angle auto-tuning is done.

H32.55 Manual tuning of Hall signal U/V/W

Comm. address:	2032-38h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	7	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 7
Parameter description
Defines the Hall level state.

H32.56 U/V/W filter time of Hall signal

Comm. address:	2032-39h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	10	Data type:	UInt16
Default:	5	Change mode:	Real time

Range:
0 ms to 10 ms
Parameter description
Defines the U/V/W filter time of Hall signals.

H32.57 Hall closed-loop stall speed

Comm. address:	2032-3Ah	Effective mode:	Real time
Min.:	0	Unit:	[mm/s]/[rpm]
Max.:	65535	Data type:	UInt16

Default:	2	Change mode:	At stop

Range:
0 [mm/s]/[rpm] to 65535 [mm/s]/[rpm]
Parameter description
Defines the stall threshold upon hitting the limit during closed-loop angle auto-tuning of hall position.

H32.58 Hall closed-loop stall current

Comm. address:	2032-3Bh	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	300.0	Data type:	UInt16
Default:	120.0	Change mode:	At stop

Range:
0.0% to 300.0%
Parameter description
Defines the stall current upon hitting the limit during closed-loop angle auto-tuning of hall position.

H32.59 Hall closed-loop stall window time

Comm. address:	2032-3Ch	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	2000	Data type:	UInt16
Default:	10	Change mode:	At stop

Range:
0 ms to 2000 ms
Parameter description
Defines the stall window time upon hitting the limit during closed-loop angle auto-tuning of hall position.

H32.60 Hall closed-loop inertia ratio

Comm. address:	2032-3Dh	Effective mode:	Real time
Min.:	0.00	Unit:	-
Max.:	120.00	Data type:	UInt16
Default:	0.00	Change mode:	At stop

Range:
0.00 to 120.00
Parameter description
Defines the inertia ratio in closed-loop angle auto-tuning of Hall position.

H32.61 Hall closed-loop stiffness

Comm. address:	2032-3Eh	Effective mode:	Real time
Min.:	4	Unit:	-
Max.:	31	Data type:	UInt16

Default:	12	Change mode:	At stop

Range:
4 to 31
Parameter description
Defines the stiffness level of closed-loop angle auto-tuning of Hall position.

H32.62 **Electrical angle save flag**

Comm. address:	2032-3Fh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:
0 to 65535
Parameter description
Automatic reset will be performed after the electrical angle is saved when dynamic Hall auto-tuning is done.

H32.63 **Electrical angle of Hall 1**

Comm. address:	2032-40h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the Hall 1 electrical angle corresponding to the Hall three-phase state after Hall auto-tuning is completed.

H32.64 **Electrical angle of Hall 2**

Comm. address:	2032-41h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the Hall 2 electrical angle corresponding to the Hall three-phase state after Hall auto-tuning is completed.

H32.65 **Electric angle of Hall 3**

Comm. address:	2032-42h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16

Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the Hall 3 electrical angle corresponding to the Hall three-phase state after Hall auto-tuning is completed.

H32.66 Electrical angle of Hall 4

Comm. address:	2032-43h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the Hall 4 electrical angle corresponding to the Hall three-phase state after Hall auto-tuning is completed.

H32.67 Electrical angle of Hall 5

Comm. address:	2032-44h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the Hall 5 electrical angle corresponding to the Hall three-phase state after Hall auto-tuning is completed.

H32.68 Electric angle of Hall 6

Comm. address:	2032-45h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the Hall 6 electrical angle corresponding to the Hall three-phase state after Hall auto-tuning is completed.

H32.70 Motor overload protection mode

Comm. address:	2032-47h	Effective mode:	Next power-on
Min.:	0	Unit:	-
Max.:	3	Data type:	UInt16

Default:	0	Change mode:	At stop

Range:

0: Internal motor overload curve

1: External motor overload curve

2: Current limit overload protection

3: Mask motor overload protection

Parameter description

Motor overload protection mode

0: Internal motor overload curve

1: External motor overload curve

2: Current limit overload protection

3: Mask motor overload protection

H32.73 Overload current limit thermal threshold current

Comm. address:	2032-4Ah	Effective mode:	Next power-on
Min. value:	10.0	Unit:	%
Max. value:	750.0	Data type:	UInt16
Default value:	115.0	Change mode:	At stop

Value range:

10.0% to 750.0%

Parameter description

This parameter takes effect when the motor overload current limit is enabled. It is the rated motor current percentage. When this value is exceeded, the motor keeps heating up. The default value 115% applies to Inovance motors. It is recommended to set this parameter to 100% for third-party motors. If the overload characteristics of the motor is of poor performance, it is recommended to reduce the values of H32.73, H32.74, H32.75, and H32.76 when motor current limit protection is enabled.

H32.74 Peak current of overload current limit

Comm. address:	2032-4Bh	Effective mode:	Next power-on
Min.:	100.0	Unit:	%
Max.:	750.0	Data type:	UInt16
Default:	300.0	Change mode:	At stop

Range:

100.0% to 750.0%

Parameter description

Defines the ratio of the peak current that can be reached by the motor to the rated current of the motor.

H32.75 Maximum current duration of overload protection

Comm. address:	2032-4Ch	Effective mode:	Real time
Min.:	0.01	Unit:	s
Max.:	655.35	Data type:	UInt16
Default:	1.00	Change mode:	At stop

Range:
0.01s to 655.35s
Parameter description
Calculate the maximum heat that can be reached by the motor based on the maximum current continuous time, and take this value as the motor overload alarm threshold.

H32.76 Current limit time constant of overload protection

Comm. address:	2032-4Dh	Effective mode:	Real time
Min.:	0.01	Unit:	-
Max.:	655.35	Data type:	UInt16
Default:	1.00	Change mode:	At stop

Range:
0.01 to 655.35
Parameter description
It is related to the maximum current continuous time. The higher the setpoint, the longer the maximum current continuous time will be.

H32.77 Current limit alarm threshold of overload protection

Comm. address:	2032-4Eh	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	750.0	Data type:	UInt16
Default:	0.0	Change mode:	At stop

Range:
0.0% to 750.0%
Parameter description
An alarm will be reported when the limited current falls below this threshold.

H32.78 Current limit fault threshold of overload protection

Comm. address:	2032-4Fh	Effective mode:	Real time
Min.:	0.0	Unit:	%
Max.:	750.0	Data type:	UInt16
Default:	0.0	Change mode:	At stop

Range:
0.0% to 750.0%
Parameter description
A fault will be reported when the limited current falls below this threshold.

H32.79 Thermal threshold current of overload

Comm. address:	2032-50h	Effective mode:	Next power-on
Min.:	10.0	Unit:	%
Max.:	750.0	Data type:	UInt16
Default:	115.0	Change mode:	At stop

Range:
10.0% to 750.0%

Parameter description
Defines thermal threshold current of overload.

H32.80 **Thermal current interval of overload**

Comm. address:	2032-51h	Effective mode:	Next power-on
Min.:	0.1	Unit:	%
Max.:	204.8	Data type:	UInt16
Default:	6.4	Change mode:	At stop

Range:
0.1% to 204.8%
Parameter description
Defines thermal current interval of overload.

H32.81 **Overload heat dissipation current interval**

Comm. address:	2032-52h	Effective mode:	Next power-on
Min.:	0.1	Unit:	%
Max.:	204.8	Data type:	UInt16
Default:	6.4	Change mode:	At stop

Range:
0.1% to 204.8%
Parameter description
Defines overload heat dissipation current interval.

H32.82 **Length of overload heat generation curve**

Comm. address:	2032-53h	Effective mode:	Next power-on
Min.:	1	Unit:	-
Max.:	200	Data type:	UInt16
Default:	1	Change mode:	At stop

Range:
1 to 200
Parameter description
Defines the length of overload heat generation curve.

H32.83 **Length of overload heat dissipation curve**

Comm. address:	2032-54h	Effective mode:	Next power-on
Min.:	1	Unit:	-
Max.:	200	Data type:	UInt16
Default:	1	Change mode:	At stop

Range:
1 to 200
Parameter description
Defines the length of overload heat dissipation curve.

10.33 H33 Compensation Parameters

H33.00 **Compensation data BUFFER0**

Comm. address:	2033-01h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the compensation data BUFFER0.

H33.01 **Compensation data BUFFER1**

Comm. address:	2033-02h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the compensation data BUFFER1.

H33.02 **Compensation data BUFFER2**

Comm. address:	2033-03h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the compensation data BUFFER2.

H33.03 **Compensation data BUFFER3**

Comm. address:	2033-04h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the compensation data BUFFER3.

H33.04 **Compensation data BUFFER4**

Comm. address:	2033-05h	Effective mode:	Real time

Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the compensation data BUFFER4.

H33.05 **Compensation data BUFFER5**

Comm. address:	2033-06h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the compensation data BUFFER5.

H33.06 **Compensation data BUFFER6**

Comm. address:	2033-07h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the compensation data BUFFER6.

H33.07 **Compensation data BUFFER7**

Comm. address:	2033-08h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the compensation data BUFFER7.

H33.08 **Compensation data BUFFER8**

Comm. address:	2033-09h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the compensation data BUFFER8.

H33.09 **Compensation data BUFFER9**

Comm. address:	2033-0Ah	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the compensation data BUFFER9.

H33.10 **Compensation data BUFFER10**

Comm. address:	2033-0Bh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the compensation data BUFFER10.

H33.11 **Compensation data BUFFER11**

Comm. address:	2033-0Ch	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the compensation data BUFFER11.

H33.12 **Compensation data BUFFER12**

Comm. address:	2033-0Dh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the compensation data BUFFER12.

H33.13 **Compensation data BUFFER13**

Comm. address:	2033-0Eh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the compensation data BUFFER13.

H33.14 **Compensation data BUFFER14**

Comm. address:	2033-0Fh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the compensation data BUFFER14.

H33.15 **Compensation data BUFFER15**

Comm. address:	2033-10h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the compensation data BUFFER15.

H33.16 **Compensation data BUFFER16**

Comm. address:	2033-11h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the compensation data BUFFER16.

H33.17 **Compensation data BUFFER17**

Comm. address:	2033-12h	Effective mode:	Real time
Min.:	0	Unit:	-

Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the compensation data BUFFER17.

H33.18 Compensation data BUFFER18

Comm. address:	2033-13h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the compensation data BUFFER18.

H33.19 Compensation data BUFFER19

Comm. address:	2033-14h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the compensation data BUFFER19.

H33.20 Compensation data BUFFER20

Comm. address:	2033-15h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the compensation data BUFFER20.

H33.21 Compensation data BUFFER21

Comm. address:	2033-16h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0 to 65535

Parameter description

Defines the compensation data BUFFER21.

H33.22 Compensation data BUFFER22

Comm. address:	2033-17h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0 to 65535

Parameter description

Defines the compensation data BUFFER22.

H33.23 Compensation data BUFFER23

Comm. address:	2033-18h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0 to 65535

Parameter description

Defines the compensation data BUFFER23.

H33.24 Compensation data BUFFER24

Comm. address:	2033-19h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0 to 65535

Parameter description

Defines the compensation data BUFFER24.

H33.25 Compensation data BUFFER25

Comm. address:	2033-1Ah	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0 to 65535

Parameter description

Defines the compensation data BUFFER25.

H33.26 **Compensation data BUFFER26**

Comm. address:	2033-1Bh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the compensation data BUFFER26.

H33.27 **Compensation data BUFFER27**

Comm. address:	2033-1Ch	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the compensation data BUFFER27.

H33.28 **Compensation data BUFFER28**

Comm. address:	2033-1Dh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the compensation data BUFFER28.

H33.29 **Compensation data BUFFER29**

Comm. address:	2033-1Eh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the compensation data BUFFER29.

H33.30 **Compensation data BUFFER30**

Comm. address:	2033-1Fh	Effective mode:	Real time
Min.:	0	Unit:	-

Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the compensation data BUFFER30.

H33.31 Compensation data BUFFER31

Comm. address:	2033-20h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the compensation data BUFFER31.

H33.32 Compensation data BUFFER32

Comm. address:	2033-21h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the compensation data BUFFER32.

H33.33 Compensation data BUFFER33

Comm. address:	2033-22h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the compensation data BUFFER33.

H33.34 Compensation data BUFFER34

Comm. address:	2033-23h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0 to 65535

Parameter description

Defines the compensation data BUFFER34.

H33.35 Compensation data BUFFER35

Comm. address:	2033-24h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0 to 65535

Parameter description

Defines the compensation data BUFFER35.

H33.36 Compensation data BUFFER36

Comm. address:	2033-25h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0 to 65535

Parameter description

Defines the compensation data BUFFER36.

H33.37 Compensation data BUFFER37

Comm. address:	2033-26h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0 to 65535

Parameter description

Defines the compensation data BUFFER37.

H33.38 Compensation data BUFFER38

Comm. address:	2033-27h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0 to 65535

Parameter description

Defines the compensation data BUFFER38.

H33.39 **Compensation data BUFFER39**

Comm. address:	2033-28h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the compensation data BUFFER39.

H33.40 **BUFFER group number compensated currently**

Comm. address:	2033-29h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 65535
Parameter description
Defines the BUFFER group number compensated currently.

H33.41 **Compensation data count**

Comm. address:	2033-2Ah	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	32767	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 32767
Parameter description
Defines the sum of the compensation data.

H33.44 **Data reference**

Comm. address:	2033-2Dh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	1	Change mode:	At stop

Range:
0 to 1
Parameter description
Defines the data reference.

H33.45 **Data storage position**

Comm. address:	2033-2Eh	Effective mode:	Real time
Min.:	0	Unit:	-

Max.:	2	Data type:	UInt16
Default:	1	Change mode:	At stop

Range:
0: Servo RAM
1: Servo FLASH
2: Encoder FLASH
Parameter description
Data storage position
0: Servo RAM
1: Servo FLASH
2: Encoder FLASH

H33.46 Clear data

Comm. address:	2033-2Fh	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	3	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 3
Parameter description
Used to clear the data.

H33.47 Software tool writing status

Comm. address:	2033-30h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	2	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 2
Parameter description
Displays the write status of the software tool: 0- Idle; 1- Writing BUFFER; 2- Done writing

H33.48 Servo read status

Comm. address:	2033-31h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0 to 65535
Parameter description
Displays the read status of the servo: 0 - Idle; 1 - Reading BUFFER; 2 - Done reading

H33.49 Software tool reading status

Comm. address:	2033-32h	Effective mode:	Real time

Min.:	0	Unit:	-
Max.:	2	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 2
Parameter description
Displays the read status of the software tool: 0- Idle; 1- Reading BUFFER; 2- Done reading

H33.50 **Servo write status**

Comm. address:	2033-33h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0 to 65535
Parameter description
Displays the write status of the servo: 0 - Idle; 1 - Writing BUFFER; 2 - Done writing

H33.51 **Data transmission completion flag**

Comm. address:	2033-34h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 1
Parameter description
Software tool data transmission completion flag: 0 - Not completed; 1 - Completed

H33.52 **Servo data transfer completion flag**

Comm. address:	2033-35h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0 to 65535
Parameter description
Servo data transmission completion flag: 0 - Not completed; 1 - Completed

H33.60 **Accuracy compensation function**

Comm. address:	2033-3Dh	Effective mode:	Next power-on
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 1
Parameter description
Used to enable accuracy compensation.

H33.61 **Accuracy compensation sum**

Comm. address:	2033-3Eh	Effective mode:	Next power-on
Min.:	0	Unit:	count
Max.:	2048	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 2048
Parameter description
Total accuracy compensation points

H33.62 **Starting offset address of accuracy compensation**

Comm. address:	2033-3Fh	Effective mode:	Next power-on
Min.:	-21474836.48	Unit:	[mm]/[deg]
Max.:	21474836.47	Data type:	Int32
Default:	0.00	Change mode:	At stop

Range:
-21474836.48 [mm]/[deg] to +21474836.47 [mm]/[deg]
Parameter description
The direct-drive motor compensation home of incremental encoder is the home of the mechanical system coordinate.

H33.64 **Accuracy compensation data interval**

Comm. address:	2033-41h	Effective mode:	Next power-on
Min.:	-327.67	Unit:	[mm]/[deg]
Max.:	327.67	Data type:	Int16
Default:	0.00	Change mode:	At stop

Range:
-327.67 [mm]/[deg] to +327.67 [mm]/[deg]
Parameter description
Clearance of adjacent compensation points of accuracy compensation

H33.65 **Phase sequence for generating accuracy compensation table**

Comm. address:	2033-42h	Effective mode:	Next power-on
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	At stop

Range:
0x0 to 0xFFFF

Parameter description
Records the phase sequence during generating accuracy compensation table.

H33.66 **Reference direction for generating accuracy compensation table**

Comm. address:	2033-43h	Effective mode:	Next power-on
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 1
Parameter description
Records the reference direction for generating accuracy compensation table.

H33.67 **Servo homing completed**

Comm. address:	2033-44h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0 to 65535
Parameter description
Indicates the accuracy compensation homing completion signal.

H33.68 **Current active index of accuracy compensation**

Comm. address:	2033-45h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
0 to 65535
Parameter description
Defines the number of the compensation data segment that corresponds to the current compensation position of accuracy compensation (the start segment corresponds to segment 0 and the end segment corresponds to the compensation sum - 2).

H33.69 **Forced homing start**

Comm. address:	2033-46h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:
0 to 1
Parameter description
Used to start accuracy compensation homing forcibly.

H33.70 **Forced homing mode**

Comm. address:	2033-47h	Effective mode:	Next power-on
Min.:	-32768	Unit:	-
Max.:	32767	Data type:	Int16
Default:	-2	Change mode:	At stop

Range:

-32768 to +32767

Parameter description

Records homing mode in accuracy compensation generation.

H33.71 **Forced homing at low speed**

Comm. address:	2033-48h	Effective mode:	Next power-on
Min.:	0	Unit:	[mm/s]/[rpm]
Max.:	1000	Data type:	UInt16
Default:	10	Change mode:	At stop

Range:

0 [mm/s]/[rpm] to 1000 [mm/s]/[rpm]

Parameter description

Records homing speed in accuracy compensation table generation.

H33.72 **Single-turn absolute position of accuracy compensation home of absolute encoder**

Comm. address:	2033-49h	Effective mode:	Next power-on
Min.:	0	Unit:	Encoder unit
Max.:	4294967295	Data type:	UInt32
Default:	0	Change mode:	At stop

Range:

0 to 4294967295

Parameter description

Defines the single-turn absolute value of direct-drive motor compensation home of absolute encoder.

H33.74 **Minimum pulse width of frequency-division output accuracy compensation**

Comm. address:	2033-4Bh	Effective mode:	Next power-on
Min.:	2	Unit:	count
Max.:	7	Data type:	UInt16
Default:	3	Change mode:	At stop

Range:

2 to 7

Parameter description

Defines the minimum pulse width of accuracy compensation frequency-division output.

H33.75 **Accuracy compensation data unit**

Comm. address:	2033-4Ch	Effective mode:	Real time

Min.:	0	Unit:	-
Max.:	1	Data type:	UInt16
Default:	0	Change mode:	At stop

Range:

0: [um]/[arcsec]

1: [mm]/[mrad]

Parameter description

Defines the accuracy compensation data unit.

For DDL: 0 - um; 1 - mm

For DDR: 0 - arcsec; 2 - mrad

H33.81 **Motor cogging torque fluctuation compensation sum**

Comm. address:	2033-52h	Effective mode:	Real time
Min.:	0	Unit:	count
Max.:	65535	Data type:	UInt16
Default:	2000	Change mode:	At stop

Range:

0count to 65535count

Parameter description

Defines the motor cogging torque fluctuation compensation sum.

10.34 H34 Servo Motor Parameters 2

H34.12 **Error types supported by EnDat 2.2 encoders**

Comm. address:	2034-0Dh	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:

0x0 to 0xFFFF

Parameter Description

Bit0: Light source fault; bit1: Analog signal amplitude error; bit2: Position information error; bit3: Overvoltage; bit4: Undervoltage; bit5: Overcurrent; bit6: Battery fault.

H34.13 **Alarm types supported by EnDat 2.2 encoders**

Comm. address:	2034-0Eh	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:

0x0 to 0xFFFF

Parameter Description

bit0: Transmission rate too high; bit1: Over-temperature; bit2: Internal light source near limit position; bit3: Battery voltage low; bit4: Reference point not reached; bit5: Not available temporarily; bit6: Near limit position; bit7: Probe not reaching the position; bit8: Value change too small.

H34.14 **Error values outputted by EnDat 2.2 encoders**

Comm. address:	2034-0Fh	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:

0x0 to 0xFFFF

Parameter Description

Bit0: Light source fault; bit1: Analog signal amplitude error; bit2: Position information error; bit3: Overvoltage; bit4: Undervoltage; bit5: Overcurrent; bit6: Battery fault.

H34.15 **Alarm values outputted by EnDat 2.2 encoders**

Comm. address:	2034-10h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Range:

0x0 to 0xFFFF

Parameter Description

bit0: Transmission rate too high; bit1: Over-temperature; bit2: Internal light source near limit position; bit3: Battery voltage low; bit4: Reference point not reached; bit5: Not available temporarily; bit6: Near limit position; bit7: Probe not reaching the position; bit8: Value change too small.

10.35 1000h Object Dictionary

1000.00h **Device type**

Comm. address:	1000-00h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFFFFFF

Parameter description

Defines the device type.

1001.00h **Error register**

Comm. address:	1001-00h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFF	Data type:	UInt8
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFF
Parameter description
Error Register

1018.01h **Vendor ID**

Comm. address:	1018-01h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Defines the vendor ID.

1018.02h **Product code**

Comm. address:	1018-02h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Product code

1018.03h **Revision**

Comm. address:	1018-03h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Defines the revision.

1018.04h **Serial number**

Comm. address:	1018-04h	Effective mode:	-
Min.:	0x0	Unit:	-

Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Serial number

1600.00h Number of valid mapped objects in RPDO1

Comm. address:	1600-00h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	20	Data type:	UInt8
Default:	0	Change mode:	Read only

Range:
0 to 20
Parameter description
This object can be modified only when PDO is inactive. When 0 is written, the mapping objects of other sub-indexes are cleared.

1600.01h Mapped object 1 in RPDO1

Comm. address:	1600-01h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
The total length of a mapping object cannot exceed 64 bits. Mapping based on bytes instead of bits is supported. The indexes and sub-indexes of mapping objects must exist in the object dictionary list. The attribute of mapping objects is readable and the objects can be mapped.
Sub-indexes are written in the following format:
bit31 to bit16: index
bit15 to bit8:
Object length
bit7 to bit0:
Sub-index

1600.02h Mapped object 2 in RPDO1

Comm. address:	1600-02h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Same as 1600.01h.

1600.03h **Mapped object 3 in RPDO1**

Comm. address:	1600-03h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Same as 1600.01h.

1600.04h **Mapped object 4 in RPDO1**

Comm. address:	1600-04h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Same as 1600.01h.

1600.05h **Mapped object 5 in RPDO1**

Comm. address:	1600-05h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Same as 1600.01h.

1600.06h **Mapped object 6 in RPDO1**

Comm. address:	1600-06h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Same as 1600.01h.

1600.07h **Mapped object 7 in RPDO1**

Comm. address:	1600-07h	Effective mode:	-
Min.:	0x0	Unit:	-

Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Same as 1600.01h.

1600.08h Mapped object 8 in RPDO1

Comm. address:	1600-08h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Same as 1600.01h.

1600.09h Mapped object 9 in RPDO1

Comm. address:	1600-09h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Same as 1600.01h.

1600.0Ah Mapped object 10 in RPDO1

Comm. address:	1600-0Ah	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Same as 1600.01h.

1600.0Bh Mapped object 11 in RPDO1

Comm. address:	1600-0Bh	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFFFFFF

Parameter description

Same as 1600.01h.

1600.0Ch **Mapped object 12 in RPDO1**

Comm. address:	1600-0Ch	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFFFFFF

Parameter description

Same as 1600.01h.

1600.0Dh **Mapped object 13 in RPDO1**

Comm. address:	1600-0Dh	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFFFFFF

Parameter description

Same as 1600.01h.

1600.0Eh **Mapped object 14 in RPDO1**

Comm. address:	1600-0Eh	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFFFFFF

Parameter description

Same as 1600.01h.

1600.0Fh **Mapped object 15 in RPDO1**

Comm. address:	1600-0Fh	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFFFFFF

Parameter description

Same as 1600.01h.

1600.10h **Mapped object 16 in RPDO1**

Comm. address:	1600-10h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Same as 1600.01h.

1600.11h **Mapped object 17 in RPDO1**

Comm. address:	1600-11h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Same as 1600.01h.

1600.12h **Mapped object 18 in RPDO1**

Comm. address:	1600-12h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Same as 1600.01h.

1600.13h **Mapped object 19 in RPDO1**

Comm. address:	1600-13h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Same as 1600.01h.

1600.14h **Mapped object 20 in RPDO1**

Comm. address:	1600-14h	Effective mode:	-
Min.:	0x0	Unit:	-

Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Same as 1600.01h.

1A00.00h Number of valid mapped objects in TPDO1

Comm. address:	AM300/00h series PLC	Effective mode:	-
Min.:	0	Unit:	-
Max.:	20	Data type:	UInt8
Default:	0	Change mode:	Read only

Range:
0 to 20
Parameter description
This object can be modified only when PDO is inactive. When 0 is written, the mapping objects of other sub-indexes are cleared.

1A00.01h Mapped object 1 in TPDO1

Comm. address:	1A00-01h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
The total length of a mapping object cannot exceed 64 bits. Mapping based on bytes instead of bits is supported. The indexes and sub-indexes of mapping objects must exist in the object dictionary list. The attribute of mapping objects is readable and the objects can be mapped.
Sub-indexes are written in the following format:
bit31 to bit16: index
bit15 to bit8:
Object length
bit7 to bit0:
Sub-index

1A00.02h Mapped object 2 in TPDO1

Comm. address:	1A00-02h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Same as 1A00.01h

1A00.03h **Mapped object 3 in TPDO1**

Comm. address:	1A00-03h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Same as 1A00.01h

1A00.04h **Mapped object 4 in TPDO1**

Comm. address:	1A00-04h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Same as 1A00.01h

1A00.05h **Mapped object 5 in TPDO1**

Comm. address:	1A00-05h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Same as 1A00.01h

1A00.06h **Mapped object 6 in TPDO1**

Comm. address:	1A00-06h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Same as 1A00.01h

1A00.07h **Mapped object 7 in TPDO1**

Comm. address:	1A00-07h	Effective mode:	-
Min.:	0x0	Unit:	-

Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Same as 1A00.01h

1A00.08h Mapped object 8 in TPDO1

Comm. address:	1A00-08h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Same as 1A00.01h

1A00.09h Mapped object 9 in TPDO1

Comm. address:	1A00-09h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Same as 1A00.01h

1A00.0Ah Mapped object 10 in TPDO1

Comm. address:	1A00-0Ah	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Same as 1A00.01h

1A00.0Bh Mapped object 11 in TPDO1

Comm. address:	1A00-0Bh	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFFFFFF

Parameter description

Same as 1A00.01h

1A00.0Ch **Mapped object 12 in TPDO1**

Comm. address:	1A00-0Ch	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFFFFFF

Parameter description

Same as 1A00.01h

1A00.0Dh **Mapped object 13 in TPDO1**

Comm. address:	1A00-0Dh	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFFFFFF

Parameter description

Same as 1A00.01h

1A00.0Eh **Mapped object 14 in TPDO1**

Comm. address:	1A00-0Eh	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFFFFFF

Parameter description

Same as 1A00.01h

1A00.0Fh **Mapped object 15 in TPDO1**

Comm. address:	1A00-0Fh	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFFFFFF

Parameter description

Same as 1A00.01h

1A00.10h **Mapped object 16 in TPDO1**

Comm. address:	1A00-10h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Same as 1A00.01h

1A00.11h **Mapped object 17 in TPDO1**

Comm. address:	1A00-11h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Same as 1A00.01h

1A00.12h **Mapped object 18 in TPDO1**

Comm. address:	1A00-12h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Same as 1A00.01h

1A00.13h **Mapped object 19 in TPDO1**

Comm. address:	1A00-13h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Same as 1A00.01h

1A00.14h **Mapped object 20 in TPDO1**

Comm. address:	1A00-14h	Effective mode:	-
Min.:	0x0	Unit:	-

Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Same as 1A00.01h

1C12.00h Number of assigned PDOs

Comm. address:	1C12-00h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0x2	Data type:	UInt8
Default:	0x2	Change mode:	Read only

Range:
0x0 to 0x2
Parameter description
Defines the number of assigned PDOs.

1C12.01h PDO mapping object index of assigned RxPDO1

Comm. address:	1C12-01h	Effective mode:	-
Min.:	0x1600	Unit:	-
Max.:	0x17FF	Data type:	UInt16
Default:	0x1701	Change mode:	Read only

Range:
0x1600 to 0x17FF
Parameter description
Defines the index of the PDO mapping object of the assigned RxPDO1.

1C12.02h PDO mapping object index of assigned RxPDO2

Comm. address:	1C12-02h	Effective mode:	-
Min.:	0x1600	Unit:	-
Max.:	0x17FF	Data type:	UInt16
Default:	0x170A	Change mode:	Read only

Range:
0x1600 to 0x17FF
Parameter description
Defines the index of the PDO mapping object of the assigned RxPDO2.

1C13.00h Number of assigned PDOs

Comm. address:	AM300/00h series PLC	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0x2	Data type:	UInt8
Default:	0x2	Change mode:	Read only

Range:

0x0 to 0x2

Parameter description

Defines the number of assigned PDOs.

1C13.01h PDO mapping object index of assigned TxPDO1

Comm. address:	1C13-01h	Effective mode:	-
Min.:	0x1A00	Unit:	-
Max.:	0x1BFF	Data type:	UInt16
Default:	0x1B01	Change mode:	Read only

Range:

0x1A00 to 0x1BFF

Parameter description

Defines the index of the PDO mapping object of the assigned TxPDO1.

1C13.02h PDO mapping object index of assigned TxPDO2

Comm. address:	1C13-02h	Effective mode:	-
Min.:	0x1A00	Unit:	-
Max.:	0x1BFF	Data type:	UInt16
Default:	0x1B0A	Change mode:	Read only

Range:

0x1A00 to 0x1BFF

Parameter description

Defines the index of the PDO mapping object of the assigned TxPDO2.

1C32.01h Sync mode

Comm. address:	1C32-01h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFF

Parameter description

Synchronization mode

1C32.02h Cycle time

Comm. address:	1C32-02h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFFFFFF

Parameter description

Defines the cycle time.

1C32.04h **Sync modes supported**

Comm. address:	1C32-04h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFF
Parameter description
Defines the synchronization mode supported.

1C32.05h **Minimum cycle time**

Comm. address:	1C32-05h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Defines the minimum cycle time.

1C33.01h **Sync mode**

Comm. address:	1C33-01h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFF
Parameter description
Synchronization mode

1C33.02h **Cycle time**

Comm. address:	AM300/02h series PLC	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Defines the cycle time.

1C33.04h **Sync modes supported**

Comm. address:	1C33-04h	Effective mode:	-
Min.:	0x0	Unit:	-

Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFF
Parameter description
Defines the synchronization mode supported.

1C33.05h **Minimum cycle time**

Comm. address:	1C33-05h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFFFFFF
Parameter description
Defines the minimum cycle time.

10.36 6000h Object Dictionary

603Fh **Error code**

Comm. address:	603Fh	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFF
Parameter description
When an error described in the DSP402 profile occurs on the drive, 603Fh is the same as that described in DSP402.
When an error specified by the user occurs on the servo drive, 603Fh is 0xFF00. The value of 603Fh is in hexadecimal.
In addition, the object dictionary 203Fh displays auxiliary bytes of fault codes in hexadecimal. 203Fh is a UInt32 value, in which the high 16 bits indicate the internal fault code of the manufacturer, and the low 16 bits indicate the external fault code of the manufacturer.

6040h **Control word**

Comm. address:	6040h	Effective mode:	Real time
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Real time

Range:
0x0 to 0xFFFF

Parameter description

See section “Basic Functions of the Servo Drive” for the description of the control word.

6041h **Status word**

Comm. address:	6041h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFF

Parameter description

For details on the status word, see section "Basic Servo Functions" in the user guide.

605Ah **Quick stop mode**

Comm. address:	605Ah	Effective mode:	At stop
Min.:	0	Unit:	-
Max.:	7	Data type:	Int16
Default:	2	Change mode:	Real time

Range:

0: Coast to stop, keeping de-energized state

1: Ramp to stop as defined by 6084h/609Ah (HM), keeping de-energized state

2: Ramp to stop as defined by 6085h, keeping de-energized state

3: Stop at emergency stop torque, keeping de-energized state

5: Ramp to stop as defined by 6084h/609Ah (HM), keeping position lock state

6: Ramp to stop as defined by 6085h, keeping position lock state

7: Stop at emergency stop torque, keeping position lock state

Parameter description

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

0: Coast to stop, keeping de-energized state

1: Ramp to stop as defined by 6084h/609Ah (HM), keeping de-energized state

2: Ramp to stop as defined by 6085h, keeping de-energized state

3: Stop at emergency stop torque, keeping de-energized state

5: Ramp to stop as defined by 6084h/609Ah (HM), keeping position lock state

6: Ramp to stop as defined by 6085h, keeping position lock state

7: Stop at emergency stop torque, keeping position lock state

Note: If the setpoint of 605Ah is lower than 4 after the brake is enabled, 605Ah will be set to 2 forcibly.

605Ch **Stop mode at S-OFF**

Comm. address:	605Ch	Effective mode:	At stop
Min.:	-4	Unit:	-
Max.:	2	Data type:	Int16
Default:	0	Change mode:	Real time

Range:

-4: Ramp to stop as defined by 6085h, keeping dynamic braking state

-3: Stop at zero speed, keeping dynamic braking state

-2: Ramp to stop as defined by 6084h/609Ah (HM), keeping dynamic braking state

-1: Dynamic braking stop, keeping dynamic braking state

0: Coast to stop, keeping de-energized state

1: Ramp to stop as defined by 6084h/609Ah (HM), keeping de-energized state

2: Dynamic braking stop, keeping de-energized state

Parameter description

Defines the deceleration mode of the motor for stopping rotating upon S-ON OFF and the motor status after stop.

-4: Ramp to stop as defined by 6085h, keeping dynamic braking state

-3: Stop at zero speed, keeping dynamic braking state

-2: Ramp to stop as defined by 6084h/609Ah, keeping dynamic braking state

-1: Dynamic braking stop, keeping dynamic braking state

0: Coast to stop, keeping de-energized state

1: Ramp to stop as defined by 6084h/609Ah, keeping de-energized state

2: Dynamic braking stop, keeping de-energized state

Note: After the brake is enabled, 605Ch will be set to "-4: Ramp to stop as defined by 6085h, keeping dynamic braking state".

605Dh **Halt mode**

Comm. address:	605Dh	Effective mode:	At stop
Min.:	1	Unit:	-
Max.:	3	Data type:	Int16
Default:	1	Change mode:	Real time

Range:

1: Ramp to stop as defined by 6084h/609Ah (HM), keeping position lock state

2: Ramp to stop as defined by 6085h, keeping position lock state

3: Stop at emergency stop torque, keeping position lock state

Parameter description

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

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

605Eh **Stop mode at No. 2 fault**

Comm. address:	605Eh	Effective mode:	At stop
Min.:	-5	Unit:	-
Max.:	4	Data type:	Int16
Default:	2	Change mode:	Real time

Range:

-5: Stop at zero speed, keeping dynamic braking state
-4: Stop at emergency stop torque, keeping dynamic braking state
-3: Ramp to stop as defined by 6085h, keeping dynamic braking state
-2: Ramp to stop as defined by 6084h/ 609Ah (HM), keeping dynamic braking state
-1: Dynamic braking stop, keeping dynamic braking state
0: Coast to stop, keeping de-energized state
1: Ramp to stop as defined by 6084h/ 609Ah (HM), keeping de-energized state
2: Ramp to stop as defined by 6085h, keeping de-energized state
3: Stop at emergency stop torque, keeping de-energized state
4: Dynamic braking stop, keeping de-energized state

Parameter description

Defines the deceleration mode of the servo motor for stopping rotating and the servo motor status when a No. 2 fault occurs.
-5: Stop at zero speed, keeping dynamic braking state
-4: Stop at emergency stop torque, keeping dynamic braking state
-3: Ramp to stop as defined by 6085h, keeping dynamic braking state
-2: Ramp to stop as defined by 6084h/609Ah (HM), keeping dynamic braking state
-1: Dynamic braking stop, keeping dynamic braking state
0: Coast to stop, keeping de-energized state
1: Ramp to stop as defined by 6084h/609Ah (HM), keeping de-energized state
2: Ramp to stop as defined by 6085h, keeping de-energized stat
3: Stop at emergency stop torque, keeping de-energized state
4: Dynamic braking stop, keeping de-energized state

Note: After the brake is enabled, 605Eh will be set to "-3: Ramp to stop as defined by 6085h, keeping dynamic braking state".

6060h **Modes of operation**

Comm. address:	6060h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	10	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

1: Profile position (PP) mode
3: Profile velocity (PV) mode
4: Profile torque (PT) mode
6: Homing (HM) mode
8: Cyclic synchronous position (CSP) mode
9: Cyclic synchronous velocity (CSV) mode
10: Cyclic synchronous torque (CST) mode

Parameter description

Defines the operation mode of the drive.

1: Profile position mode (PP)
3: Profile velocity (PV) mode
4: Profile torque (PT) mode
6: Homing (HM) mode
8: Cyclic synchronous position (CSP) mode
9: Cyclic synchronous velocity (CSV) mode
10: Cyclic synchronous torque (CST) mode
If an operation mode not supported is selected through SDO, an SDO error can be returned.
If an unsupported operation mode is selected through a PDO, the change of the operation mode will be invalid.

6061h **Operation mode display**

Comm. address:	6061h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	10	Data type:	UInt16
Default:	0	Change mode:	Read only

Range:
1: Profile position (PP) mode
3: Profile velocity (PV) mode
4: Profile torque (PT) mode
6: Homing (HM) mode
8: Cyclic synchronous position (CSP) mode
9: Cyclic synchronous velocity (CSV) mode
10: Cyclic synchronous torque (CST) mode
Parameter description
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: Cyclic synchronous position (CSP) mode
9: Cyclic synchronous velocity (CSV) mode
10: Cyclic synchronous torque (CST) mode

6062h **Position demand value**

Comm. address:	6062h	Effective mode:	-
Min.:	-2147483648	Unit:	Reference unit
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Read only

Range:
-2147483648 to +2147483647
Parameter description
Indicates the real-time position reference (in reference unit).

6063h **Position actual value**

Comm. address:	6063h	Effective mode:	-
Min.:	-2147483648	Unit:	Encoder unit
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Read only

Range:

-2147483648 to +2147483647

Parameter description

Indicates the absolute position feedback (in encoder unit) of the motor in real time.

6064h **Position actual value**

Comm. address:	6064h	Effective mode:	-
Min.:	-2147483648	Unit:	Reference unit
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Read only

Range:

-2147483648 to +2147483647

Parameter description

Indicates the absolute position feedback (in reference unit) in real time.

Position actual value in user-defined unit (6064h) x Gear ratio (6091h) = Position actual value in encoder unit (6063h)

6065h **Following error window**

Comm. address:	6065h	Effective mode:	Real time
Min.:	0	Unit:	Reference unit
Max.:	4294967295	Data type:	UInt32
Default:	219895614	Change mode:	Real time

Range:

0 to 4294967295

Parameter description

Defines the threshold of excessive position deviation (in reference unit).

When the difference value between position demand value (6062h) and position actual value (6064h) keeps exceeding ±6065h after the time defined by 6066h elapses, B00.0 (Position deviation too large) occurs.

6066h **Excessive position deviation timeout**

Comm. address:	6066h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0 ms to 65535 ms

Parameter description

Defines the time lapse to trigger excessive position deviation, which must be used together with 6065h.

6067h **Position window**

Comm. address:	6067h	Effective mode:	Real time
Min.:	0	Unit:	Reference unit
Max.:	4294967295	Data type:	UInt32
Default:	46976	Change mode:	Real time

Range:

0 to 4294967295

Parameter description

Defines the threshold for position reach.

If the difference between 6062h and 6064h is within ±6067h, and such status lasts for the time defined by 6068h, the position is reached. In this case, bit10 of status word 6041h is set to 1 in profile position mode.

This flag bit is valid only when the S-ON signal is valid in profile position control mode.

6068h **Position window time**

Comm. address:	6068h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0 ms to 65535 ms

Parameter description

Defines the window time for position reach, which is used together with 6067h.

606Ch **Velocity actual value**

Comm. address:	606Ch	Effective mode:	-
Min.:	-2147483648	Unit:	Reference unit/s
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Read only

Range:

-2147483648 to +2147483647

Parameter description

It indicates the velocity actual value.

606Dh **Velocity window**

Comm. address:	606Dh	Effective mode:	Real time
Min.:	0	Unit:	[mm/s]/[rpm]
Max.:	65535	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:

0 [mm/s]/[rpm] to 65535 [mm/s]/[rpm]

Parameter description

Defines the threshold for speed reach.

If the difference between 60FFh and 606Ch is within ±606Dh, and such status lasts for the time defined by 606Eh, the speed is reached. In this case, bit10 of status word 6041h is set to 1 in profile speed mode.

This flag bit is meaningful only when drive is enabled in profile velocity mode.

606Eh **Velocity window time**

Comm. address:	606Eh	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

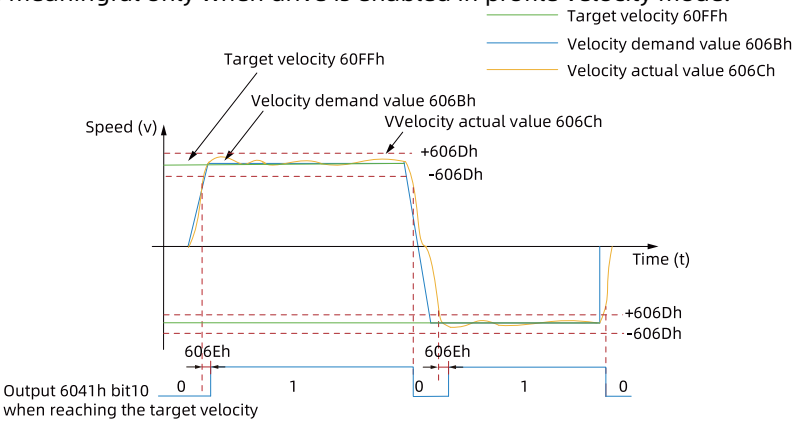
0 ms to 65535 ms

Parameter description

Defines the window time for speed reach, which is used together with 606Dh.

Defines the time window for speed arrival. If the difference value between the target speed 60FFh and the actual speed 606Ch is within ±606Dh and the time reaches 606Eh, the speed is reached and bit 10 of the status word 6041h is set to 1 in the profile velocity (PV) mode.

This flag bit is meaningful only when drive is enabled in profile velocity mode.



606Fh **Zero speed signal threshold**

Comm. address:	606Fh	Effective mode:	Real time
Min.:	0	Unit:	[mm/s]/[rpm]
Max.:	65535	Data type:	UInt16
Default:	10	Change mode:	Real time

Range:

0 [mm/s]/[rpm] to 65535 [mm/s]/[rpm]

Parameter description

Defines the threshold for determining whether the user velocity is 0.

When 606Ch is within ±606Fh and such status lasts for the time defined 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 profile velocity mode.

This flag bit is not related to the enable/disable state of the drive.

6070h **Velocity threshold time**

Comm. address:	6070h	Effective mode:	Real time
Min.:	0	Unit:	ms
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Real time

Range:

0 ms to 65535 ms

Parameter description

Defines the time window for determining whether the user velocity is 0, which is used together with 606Fh.

6071h **Target torque**

Comm. address:	6071h	Effective mode:	Real time
Min.:	-4000	Unit:	0.10%
Max.:	4000	Data type:	Int16
Default:	0	Change mode:	Real time

Range:

Setting range: -4000 to +4000

Actual value range: -400.0% to +400.0%

Note: Actual value = Reference value x Unit

Parameter description

Defines the target torque of the servo drive in the profile torque mode.

The value 1000 corresponds to the rated torque of the motor.

6072h **Maximum torque reference**

Comm. address:	6072h	Effective mode:	Real time
Min.:	0	Unit:	0.10%
Max.:	4000	Data type:	UInt16
Default:	3500	Change mode:	Real time

Range:

Setting range: 0 to 4000

Actual value range: 0.0% to 400.0%

Note: Actual value = Reference value x Unit

Parameter description

Defines the maximum torque reference limit.

The value 1000 corresponds to the rated torque of the motor.

6074h **Torque reference**

Comm. address:	6074h	Effective mode:	-
Min.:	-4000	Unit:	0.10%
Max.:	4000	Data type:	Int16
Default:	0	Change mode:	Read only

Range:

Setting range: -4000 to +4000

Actual value range: -400.0% to +400.0%

Note: Actual value = Reference value x Unit

Parameter description

Defines the target torque value.

The value 1000 corresponds to the rated torque of the motor.

6077h **Torque actual value**

Comm. address:	6077h	Effective mode:	-
Min.:	-4000	Unit:	0.10%
Max.:	4000	Data type:	Int16
Default:	0	Change mode:	Read only

Range:

Setting range: -4000 to +4000

Actual value range: -400.0% to +400.0%

Note: Actual value = Reference value x Unit

Parameter description

Displays the internal torque feedback of the drive.

The value 1000 corresponds to the rated torque of the motor.

607Ah **Target position**

Comm. address:	607Ah	Effective mode:	Real time
Min.:	-2147483648	Unit:	Reference unit
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Defines the target position of the drive in the profile position mode.

When bit 6 of 6040h is set to 0, 607Ah indicates the absolute target position of current segment.

After positioning of current segment is done, the value of 6064h will be the same as the value of 607Ah.

When bit 6 of 6040h is set to 1, 607Ah indicates the target increment displacement of current segment.

After positioning of current segment is done, user displacement increment will be the same as the value of 607Ah.

607Ch **Home offset**

Comm. address:	607Ch	Effective mode:	At stop
Min.:	-2147483648	Unit:	Reference unit
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Defines the physical location of mechanical zero that deviates from the home of the motor in position control modes (profile position mode, interpolation mode, and homing mode).
The home offset is activated only after homing is done upon power-on and bit15 of 6041h is set to 1.
After homing is done, the position actual value (6064h) will be the same as the value of 607Ch.
If 607Ch is outside the value of 607Dh (Software position limit), E09.1 (Home setting error) will occur.

607D.01h Min. position limit

Comm. address:	607D-01h	Effective mode:	Real time
Min.:	-2147483648	Unit:	Reference unit
Max.:	2147483647	Data type:	Int32
Default:	-2147483648	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Defines the minimum software position limit relative to the mechanical zero point.
Minimum software position limit = (607D.01h)
The software position limit is used to judge the absolute position. When homing is not performed, the internal software position limit is invalid.
The condition for activating the software position limit is set in H0A.01 (object dictionary 0x200A.02h).

607D.02h Max. position limit

Comm. address:	607D-02h	Effective mode:	Real time
Min.:	-2147483648	Unit:	Reference unit
Max.:	2147483647	Data type:	Int32
Default:	2147483647	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Defines the maximum software position limit relative to the mechanical zero.
Maximum software position limit = (607D.02h)

607Eh Polarity

Comm. address:	607Eh	Effective mode:	Real time
Min.:	0x0	Unit:	-
Max.:	0xFF	Data type:	UInt16
Default:	0x0	Change mode:	Real time

Range:

0x0 to 0xFF

Parameter description

Defines the polarity of position or speed references.
When bit 7 is 1, it indicates the position reference is multiplied by "-1" and the motor direction is reversed in the standard position mode or interpolation mode.

When bit 6 is 1, it indicates the speed reference (60FFh) is multiplied by "-1" and the motor direction is reversed in the speed mode.
When bit 5 is 1, it indicates the torque demand value (6071h) is multiplied by "-1" and the motor direction is reversed in the torque mode.
Other bits are meaningless.

607Fh **Max. speed**

Comm. address:	607Fh	Effective mode:	Real time
Min.:	0	Unit:	Reference unit/s
Max.:	4294967295	Data type:	UInt32
Default:	4294967295	Change mode:	Real time:

Range:
0 to 4294967295
Parameter description
Defines the maximum speed in user-defined unit.
Set a proper gear ratio (8:1 recommended) when using a 26-bit encoder. Otherwise, the motor speed will be limited to 3840 [mm/s]/[rpm].

6081h **Profile velocity**

Comm. address:	6081h	Effective mode:	Real time
Min.:	0	Unit:	Reference unit/s
Max.:	4294967295	Data type:	UInt32
Default:	111848106	Change mode:	Real time

Range:
0 to 4294967295
Parameter description
Defines the constant operating speed of current displacement reference in the profile position mode.
The setpoint takes effect after the slave receives the displacement reference.

6083h **Profile acceleration**

Comm. address:	6083h	Effective mode:	Real time
Min.:	0	Unit:	Reference unit/s^2
Max.:	4294967295	Data type:	UInt32
Default:	4294967295	Change mode:	Real time

Range:
0 to 4294967295
Parameter description
Defines the acceleration rate in the acceleration stage of the displacement reference in the profile position mode.
The following formula applies if a 23-bit motor needs to run at 400 [mm/s]/[rpm] (6081h: 400 x 8388608/60) with acceleration rate being 400 [mm/s]/[rpm]/s (6083h: 400 x 8388608/60) and deceleration rate being 200 [mm/s]/[rpm]/s (6084h: 200 x 8388608/60) under a gear ratio of 1:1:

Acceleration time tup = Δ6081h/ Δ6083h = 1 (s); Deceleration time tdown = Δ6081h/ Δ6084h = 2 (s).
The setpoint 0 will be forcibly changed to 1.

6084h **Profile deceleration**

Comm. address:	6084h	Effective mode:	Real time
Min.:	0	Unit:	Reference unit/s²
Max.:	4294967295	Data type:	UInt32
Default:	4294967295	Change mode:	Real time

Range:
0 to 4294967295
Parameter description
Defines the deceleration rate in the deceleration stage of the displacement reference in the profile position mode.
The following formula applies if a 23-bit motor needs to run at 400 [mm/s]/[rpm] (6081h: 400 x 8388608/60) with acceleration rate being 400 [mm/s]/[rpm]/s (6083h: 400 x 8388608/60) and deceleration rate being 200 [mm/s]/[rpm]/s (6084h: 200 x 8388608/60) under a gear ratio of 1:1:
Acceleration time tup = Δ6081h/ Δ6083h = 1 (s); Deceleration time tdown = Δ6081h/ Δ6084h = 2 (s).
The setpoint 0 will be forcibly changed to 1.

6085h **Quick stop deceleration**

Comm. address:	6085h	Effective mode:	Real time
Min.:	0	Unit:	Reference unit/s²
Max.:	4294967295	Data type:	UInt32
Default:	2147483647	Change mode:	Real time:

Range:
0 to 4294967295
Parameter description
Defines the deceleration rate when the quick stop command (6040h = 0x0002) is active and 605Ah (Quick stop option code) is set to 2 or 5.
The setpoint 0 will be changed to 1 forcibly.

6087h **Torque slope**

Comm. address:	6087h	Effective mode:	Real time
Min.:	0	Unit:	0.1%/s
Max.:	4294967295	Data type:	UInt32
Default:	4294967295	Change mode:	Real time

Range:
Setting range: 0 to 4294967295

Actual value range: 0.0%/s to 429496729.5%/s

Note: Actual value = Reference value x Unit
Parameter description

Defines the rate of change of torque in profile torque mode, in unit of torque increment per second.

For example, when the target torque 6071 is set to 3000 and the torque slope 6087 is set to 6000 (slope = 600%/s), then 0.5s is needed for the torque to change from 0 to 300%.
In profile torque mode, if 605Ah (Quick stop option code) = 1/2/5/6 or 605Dh (Halt option code) = 1/2, the drive decelerates to stop as defined by 6087h.
If the value exceeds the torque reference limit, the servo drive runs at the limit.
The setting value 0 will be forcibly changed into 1.

6091.01h **Motor resolution**

Comm. address:	6091-01h	Effective mode:	Real time
Min.:	1	Unit:	-
Max.:	4294967295	Data type:	UInt32
Default:	1	Change mode:	At stop

Range:
1 to 4294967295
Parameter description
Defines the numerator of the gear ratio.
Defines the proportional relation between the load shaft displacement designated by the user and the motor shaft displacement.
The relation between motor position feedback (encoder unit) and load shaft position feedback (reference unit) is as follows.
Motor position feedback = Load shaft position feedback x Gear ratio
The relation between the motor speed ([mm/s]/[rpm]) and the load shaft speed (reference unit/s) is as follows.
Motor speed ([mm/s]/[rpm]) = Load shaft speed x 6091h x 60/Encoder resolution
The motor acceleration ([mm/s]/[rpm]/ms) and the load shaft acceleration (reference unit/s^2) is in the following relationship.
Motor acceleration ([mm/s]/[rpm]/ms) = Load shaft acceleration x 6091h x 1000/Encoder resolution/60

6091.02h **Shaft resolution**

Comm. address:	6091-02h	Effective mode:	Real time
Min.:	1	Unit:	-
Max.:	4294967295	Data type:	UInt32
Default:	1	Change mode:	At stop

Range:
1 to 4294967295
Parameter description
Defines the denominator of the gear ratio.

6098h **Homing method**

Comm. address:	6098h	Effective mode:	Real time
Min. value:	-3	Unit:	-
Max. value:	35	Data type:	Int8

Default value: 1 Change mode: Real time

Value range:

-3 to 35

Parameter description

Defines the homing method.

-3: Nearest homing, motor Z signal as home

-2: Forward homing, positive mechanical limit as deceleration point, and motor Z signal as home

-1: Reverse homing, negative mechanical limit as deceleration point, and motor Z signal as home.

1: Reverse homing, negative limit switch as deceleration point and motor Z signal as home.

The falling edge of the negative limit switch signal must be reached before the Z signal.

2: Forward homing, positive limit switch as deceleration point and motor Z signal as home.

The falling edge of the positive limit switch signal must be reached before the Z signal.

3: Forward homing, home switch as deceleration point and motor Z signal as home.

The falling edge on the same side of the home switch signal must be reached before the Z signal.

4: Reverse homing, home switch as deceleration point and motor Z signal as home.

The rising edge on the same side of the home switch signal must be reached before the Z signal.

5: Reverse homing, home switch as deceleration point and motor Z signal as home.

The falling edge on the same side of the home switch signal must be reached before the Z signal.

6: Forward homing, home switch as deceleration point and motor Z signal as home.

The rising edge on the same side of the home switch signal must be reached before the Z signal.

7: Forward homing, home switch as deceleration point and motor Z signal as home.

The falling edge on the same side of the home switch signal must be reached before the Z signal.

8: Forward homing, home switch as deceleration point and motor Z signal as home.

The rising edge on the same side of the home switch signal must be reached before the Z signal.

9: Forward homing, home switch as deceleration point and motor Z signal as home.

The rising edge on the other side of the home switch signal must be reached before the Z signal.

10: Forward homing, home switch as deceleration point and motor Z signal as home.

The falling edge on the other side of the home switch signal must be reached before the Z signal.

11: Reverse homing, home switch as deceleration point and motor Z signal as home.

The falling edge on the same side of the home switch signal must be reached before the Z signal.

12: Reverse homing, home switch as deceleration point and motor Z signal as home.

The rising edge on the same side of the home switch signal must be reached before the Z signal.

13: Reverse homing, home switch as deceleration point and motor Z signal on the other side of the home switch signal as home.

The rising edge on the other side of the home switch signal must be reached before the Z signal.

14: Reverse homing, home switch as deceleration point and motor Z signal on the other side of the home switch signal as home.
The falling edge on the other side of the home switch signal must be reached before the Z signal.
Setpoints 17 to 30 are similar to setpoints 1 to 14 except that the deceleration point overlaps with the home.
33: Reverse homing, and motor Z signal as the home.
34: Forward homing, and motor Z signal as the home.
35: Current position as the home.
When 6098h is set to 15, 16, 31 or 32, it is invalid, and the drive does not perform the homing operation.

6099.01h Speed during search for switch

Comm. address:	6099-01h	Effective mode:	Real time
Min.:	0	Unit:	Reference unit/s
Max.:	4294967295	Data type:	UInt32
Default:	111848106	Change mode:	At stop

Range:
0 to 4294967295
Parameter description
Defines the speed during search for the deceleration point signal. A high setpoint helps prevent the homing timeout.

6099.02h Speed during search for zero

Comm. address:	6099-02h	Effective mode:	Real time
Min.:	0	Unit:	Reference unit/s
Max.:	4294967295	Data type:	UInt32
Default:	11184810	Change mode:	At stop

Range:
0 reference unit/s to 4294967295 reference unit/s
Parameter description
Defines the speed in searching for the home signal. Setting this speed to a low value prevents overshoot during stop at high speed, avoiding excessive deviation between the stop position and the set mechanical home.

609Ah Homing acceleration

Comm. address:	609Ah	Effective mode:	Real time
Min.:	0	Unit:	Reference unit/s^2
Max.:	4294967295	Data type:	UInt32
Default:	4294967295	Change mode:	Real time

Range:
0 to 4294967295
Parameter description
Defines the acceleration in the homing mode.

60B0h **Position offset**

Comm. address:	60B0h	Effective mode:	Real time
Min.:	-2147483648	Unit:	Reference unit
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Used to set the position offset.

60B1h **Velocity offset**

Comm. address:	60B1h	Effective mode:	Real time
Min.:	-2147483648	Unit:	Reference unit/s
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Used to set the speed offset.

60B2h **Torque offset**

Comm. address:	60B2h	Effective mode:	Real time
Min.:	-4000	Unit:	0.10%
Max.:	4000	Data type:	Int16
Default:	0	Change mode:	Real time

Range:

Setting range: -4000 to +4000

Actual value range: -400.0% to +400.0%

Note: Actual value = Reference value x Unit

Parameter description

Used to set the torque offset.

60B8h **Touch probe mode**

Comm. address:	60B8h	Effective mode:	Real time
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Real time

Range:

0x0 to 0xFFFF

Parameter description

For details, see the touch probe section.

Bit	Name	Description
0	Touch probe 1 function selection 0: Probe 1 disabled 1: Probe 1 enabled	bit0 to bit5: settings related to probe 1 When a DI is used to trigger the touch probe function, the DI source cannot be changed once the touch probe function is enabled. For absolute encoders, Z signal refers to the zero point of the single-turn position feedback.
1	Touch probe 1 trigger mode 0: Single trigger mode (Latches the position at the first trigger event.) 1: Continuous trigger mode	
2	Touch probe 1 trigger signal selection 0: DI signal 1: Z signal	
3	N/A	
4	Touch probe 1 positive edge 0: Latching at positive edge disabled 1: Latching at positive edge enabled	
5	Touch probe 1 negative edge 0: Latching at negative edge disabled 1: Latching at negative edge enabled	
6 to 7	N/A	-
8	Touch probe 2 function selection 0: Probe 2 disabled 1: Probe 2 enabled	Bit8 to bit13: settings related to probe 2
9	Touch probe 2 trigger mode 0: Single trigger mode (Latches the position at the first trigger event.) 1: Continuous trigger mode	
10	Touch probe 2 trigger signal selection 0: DI signal 1: Z signal	
11	N/A	
12	Touch probe 2 positive edge 0: Latching at positive edge disabled 1: Latching at positive edge enabled	
13	Touch probe 2 negative edge 0: Latching at negative edge disabled 1: Latching at negative edge enabled	
14 to 15	N/A	-

60B9h **Touch probe status**

Comm. address:	60B9h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFF

Parameter description

For details, see the section related to the touch probe.

bit	Name	Description
0	Touch probe 1 function selection 0: Probe 1 disabled 1: Probe 1 enabled	bit0 to bit2: State of probe 1
1	Touch probe 1 positive edge value 0: Positive edge value not latched 1: Positive edge value latched	
2	Touch probe 1 negative edge value 0: Negative edge value not 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 to 3) the probe is triggered
8	Probe 2 enable: 0: Probe 2 disabled 1: Probe 2 enabled	bit8 to bit10: State of probe 2
9	Touch probe 2 positive edge value 0: Positive edge value not latched 1: Positive edge value latched	
10	Touch probe 2 negative edge value 0: Negative edge value not 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 to 3) the probe is triggered

60BAh **Touch probe 1 positive edge**

Comm. address:	60BAh	Effective mode:	-
Min.:	-2147483648	Unit:	Reference unit
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Read only

Range:

-2147483648 to +2147483647

Parameter description

Indicates the position feedback value (reference unit) latched at positive edge of touch probe 1 signal.

60BBh **Touch probe 1 negative edge**

Comm. address:	60BBh	Effective mode:	-
Min.:	-2147483648	Unit:	Reference unit
Max.:	2147483647	Data type:	Int32

Default:	0	Change mode:	Read only

Range:
-2147483648 to +2147483647
Parameter description
Indicates the position feedback value (reference unit) latched at negative edge of touch probe 1 signal.

60BCh **Touch probe 2 positive edge**

Comm. address:	60BCh	Effective mode:	-
Min.:	-2147483648	Unit:	Reference unit
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Read only

Range:
-2147483648 to +2147483647
Parameter description
Indicates the position feedback value (reference unit) latched at positive edge of touch probe 2 signal.

60BDh **Touch probe 2 negative edge**

Comm. address:	60BDh	Effective mode:	-
Min.:	-2147483648	Unit:	Reference unit
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Read only

Range:
-2147483648 to +2147483647
Parameter description
Indicates the position feedback value (reference unit) latched at negative edge of touch probe 2 signal.

60C5h **Maximum acceleration**

Comm. address:	60C5h	Effective mode:	Real time
Min.:	0	Unit:	Reference unit/s^2
Max.:	4294967295	Data type:	UInt32
Default:	4294967295	Change mode:	Real time

Range:
0 to 4294967295
Parameter description
Defines the maximum permissible acceleration rate of the acceleration segment in the profile position mode, profile velocity mode, and homing mode.
The setpoint 0 will be forcibly changed to 1.

60C6h **Maximum deceleration**

Comm. address:	60C6h	Effective mode:	Real time
Min.:	0	Unit:	Reference unit/s^2

Max.:	4294967295	Data type:	UInt32
Default:	4294967295	Change mode:	Real time

Range:
0 to 4294967295
Parameter description
Defines the maximum permissible deceleration in the profile position mode, profile velocity mode, and homing mode.
The setpoint 0 will be forcibly changed to 1.

60D5h **Touch probe 1 positive edge counter**

Comm. address:	60D5h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFF
Parameter description
The counting value is added by "1" each time this object is triggered.

60D6h **Touch probe 1 negative edge counter**

Comm. address:	60D6h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFF
Parameter description
The counting value is added by "1" each time this object is triggered.

60D7h **Touch probe 2 positive edge counter**

Comm. address:	60D7h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:
0x0 to 0xFFFF
Parameter description
The counting value is added by "2" each time this object is triggered.

60D8h **Touch probe 2 negative edge counter**

Comm. address:	60D8h	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFF	Data type:	UInt16
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFF

Parameter description

The counting value is added by "2" each time this object is triggered.

60E0h **Positive torque limit**

Comm. address:	60E0h	Effective mode:	Real time
Min.:	0	Unit:	0.10%
Max.:	4000	Data type:	UInt16
Default:	3000	Change mode:	Real time

Range:

Setting range: 0 to 4000

Actual value range: 0.0% to 400.0%

Note: Actual value = Reference value x Unit

Parameter description

Defines the maximum positive torque limit.

60E1h **Negative torque limit**

Comm. address:	60E1h	Effective mode:	Real time
Min.:	0	Unit:	0.10%
Max.:	4000	Data type:	UInt16
Default:	3000	Change mode:	Real time

Range:

Setting range: 0 to 4000

Actual value range: 0.0% to 400.0%

Note: Actual value = Reference value x Unit

Parameter description

Defines the maximum negative torque limit.

60F4h **Following error actual value**

Comm. address:	60F4h	Effective mode:	-
Min.:	-2147483648	Unit:	Reference unit
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Read only

Range:

-2147483648 to +2147483647

Parameter description

Displays the position deviation (in reference unit).

60FCh **Position demand value**

Comm. address:	60FCh	Effective mode:	-
Min.:	-2147483648	Unit:	-
Max.:	2147483647	Data type:	Int32

Default:	0	Change mode:	Read only

Range:

-2147483648 to +2147483647

Parameter description

Displays the position reference (in encoder unit).

If no alarm is detected when the S-ON signal is active, the relation between the position reference in reference unit and that in encoder unit is as follows:
60FCh (in encoder unit) = 6062h (in reference unit) x 6091h

60FDh **DI state**

Comm. address:	60FDh	Effective mode:	-
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Read only

Range:

0x0 to 0xFFFFFFFF

Parameter description

Indicates current DI logic of the drive.

0: Inactive

1: Active

The DI signal indicated by each bit is described as follows.

bit signal

0: Reverse overtravel active

1: Forward overtravel active

2: Home signal active

3 to 4: N/A

bit5 to bit9 can be disabled through bit11 of H0C.73.

5: Safety DI1 input valid

6: Safety DI2 input valid

7: Safety DI3 input valid

8: Safety DI4 input valid

9: Safe DI5 input valid

10 to 15: N/A

16: DI1 input valid

17: DI2 input valid

18: DI3 input valid

19: DI4 input valid

20: DI5 input valid

21 to 26: N/A

27: STO1 signal input

28: STO2 signal input

29: EDM output valid

30: Z signal valid

31: N/A

60FFh **Speed reference in PV/CSV mode**

Comm. address:	60FFh	Effective mode:	Real time
Min.:	-2147483648	Unit:	Reference unit/s
Max.:	2147483647	Data type:	Int32
Default:	0	Change mode:	Real time

Range:

-2147483648 to +2147483647

Parameter description

Defines the target speed in the cyclic synchronous velocity mode/profile velocity mode.

60FE.01h **Physical output**

Comm. address:	60FE-01h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Real time

Value range:

0x0 to 0xFFFFFFFF

Parameter description

Indicates the DO logic.

The signal indicated by each bit is described as follows:

Description of bits

0–15: N/A

16: DO1 forced output (0: off, 1: on), when bit16 of 60FE.02h is set to 1

17: DO2 forced output (0: off, 1: on), when bit17 of 60FE.02h is set to 1

18–25: N/A

26: Gain switching performs P/PI switching, only when bit 26 of 60FE.02h is set to 1

27–31: N/A

60FE.02h **Bitmask**

Comm. address:	60FE-02h	Effective mode:	Real time
Min.:	0x0	Unit:	-
Max.:	0xFFFFFFFF	Data type:	UInt32
Default:	0x0	Change mode:	Real time

Range:

0x0 to 0xFFFFFFFF

Parameter description

0 to 15: N/A

16: Forced DO1 output enable

17: Forced DO2 output enable

18 to 25: N/A

26: P/PI switchover enable

27 to 31: N/A

11 Safety Parameters

11.1 H02 Basic Control Parameters

H02.02 **Rotation direction selection**

Hex:	2002-03h	Effective mode:	Upon the next power-on
Min.:	0	Unit:	-
Max.:	1	Data Type:	UInt16
Default:	0	Change:	At stop

Value Range:

0: Counterclockwise (CCW) as forward direction

1: Clockwise (CW) as forward direction

Description

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

H02.11 **Motor speed threshold at brake output OFF in rotation state**

Hex:	2002-0Ch	Effective mode:	Real-time
Min.:	20	Unit:	rpm
Max.:	3000	Data Type:	UInt16
Default:	30	Change:	Real-time

Value Range:

20 rpm to 3000 rpm

Description

Defines the motor speed threshold when brake (BK) output is OFF in the rotation state.

H02.12 **Delay from S-ON OFF to brake output OFF in rotation state**

Hex:	2002-0Dh	Effective mode:	Real-time
Min.:	1	Unit:	ms
Max.:	65535	Data Type:	UInt16
Default:	500	Change:	Real-time

Value Range:

1 ms-65535 ms

Description

Defines the delay from the moment the S-ON signal is OFF to the moment the brake (BK) output is OFF in the rotation state.

11.2 H0A Fault and Protection Parameters

H0A.73 **STO 24 V disconnection filter time**

Hex:	200A-4Ah	Effective mode:	Real time
Min.:	1	Unit:	ms
Max.:	5	Data Type:	UInt16
Default:	5	Change:	Real-time

Value Range:

1ms to 5ms

Description

Defines the filter time from the moment when STO2 is disconnected from the 24 V power supply to the moment when the STO status is displayed or E150.0 is reported.

H0A.74 **Filter time for two inconsistent STO channels**

Hex:	200A-4Bh	Effective mode:	Real time
Min.:	1	Unit:	ms
Max.:	1000	Data Type:	UInt16
Default:	100	Change:	Real-time

Value Range:

1ms to 1000ms

Description

Defines the filter time from the moment when STO2 is input with different voltage to the moment when E150.1 is reported.

H0A.75 **Servo OFF delay after STO triggered**

Hex:	200A-4Ch	Effective mode:	Real-time
Min.:	0	Unit:	ms
Max.:	25	Data Type:	UInt16
Default:	20	Change:	Real-time

Value Range:

0 ms–25 ms

Description

Defines filter time from the moment when the STO status is displayed or E150.0/E150.1 is reported to the moment when the servo drive is off.

11.3 H20 Functional Safety Parameters

Note

It is recommended to verify the safety function when you are configuring the safety parameters.

H20.00 **Safety module software version**

Min.:	0.00	Unit:	-
Max.:	655.35	Data Type:	UInt16
Default:	0.00	Change:	Unchangeable
Effective mode:	-		

Value Range:

0.00 to 655.35

Description

Displays the software version of the safety module and consists of two decimal places.

H20.01 **Safety function trigger selection**

Min.:	0	Unit:	-
Max.:	3	Data Type:	UInt16
Default:	0	Change:	At stop

Effective mode: Upon the next power-on

Value Range:

0: Locally triggered

1: FSoE triggered-SRA

3: FSoE triggered-nSRA

Description

Sets the trigger of the safety function.

H20-01=1: The FSoE safety bus that supports SRA parameters, adapted to the safety PLC that supports SRA parameters, such as Beckhoff EL6900/EL6910.

H20-01=3: The FSoE safety bus without SRA parameters, adapted to safety PLCs that do not support SRA parameters, such as Pilz's safety PLCs.

H20.02 Safety module DI1 function selection

Min.:	0	Unit:	-
Max.:	11	Data Type:	UInt16
Default:	0	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:

0: Inactive

1: STO

2: SBC

3: SS1

4: SS2

5: SLS1

6: SLS2

7: SLS3

8: SLS4

9: SDIp

10: SDIn

11: Ack

Description

Assigns function to DI1 terminal of the safety module.

H20.03 Safety module DI2 function selection

Min.:	0	Unit:	-
Max.:	11	Data Type:	UInt16
Default:	0	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:

0: Inactive

1: STO

2: SBC

3: SS1

4: SS2

5: SLS1

6: SLS2

7: SLS3

8: SLS4

9: SDIp

10: SDIn

11: Ack

Description

Assigns function to DI2 terminal of the safety module.

H20.04 **Safety module DI3 function selection**

Min.:	0	Unit:	-
Max.:	11	Data Type:	UInt16
Default:	0	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:

0: Inactive

1: STO

2: SBC

3: SS1

4: SS2

5: SLS1

6: SLS2

7: SLS3

8: SLS4

9: SDIp

10: SDIn

11: Ack

Description

Assigns function to DI3 terminal of the safety module.

H20.05 **Safety module DI4 function selection**

Min.:	0	Unit:	-
Max.:	11	Data Type:	UInt16
Default:	0	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:

0: Inactive
1: STO
2: SBC
3: SS1
4: SS2
5: SLS1
6: SLS2
7: SLS3
8: SLS4
9: SDIp
10: SDIn
11: Ack

Description

Assigns function to DI4 terminal of the safety module.

H20.06 **Safety module DI5 function selection**

Min.:	0	Unit:	-
Max.:	11	Data Type:	UInt16
Default:	0	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:

0: Inactive
1: STO
2: SBC
3: SS1
4: SS2
5: SLS1
6: SLS2
7: SLS3
8: SLS4
9: SDIp
10: SDIn
11: Ack

Description

Assigns function to DI5 terminal of the safety module.

H20.08 **Safety module DI1 noise rejection filter time**

Min.:	1	Unit:	ms
Max.:	500	Data Type:	UInt16
Default:	5	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:

1 ms–500 ms

Description

Sets the noise filter time of DI1 of the safety module. Only when the signal change of DI1 is continuously maintained above the filter time, the safety module performs the corresponding safety function.

H20.09 **Safety module DI2 noise rejection filter time**

Min.:	1	Unit:	ms
Max.:	500	Data Type:	UInt16
Default:	5	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
1 ms–500 ms
Description
Sets the noise filter time of DI2 of the safety module. Only when the signal change of DI2 is continuously maintained above the filter time, the safety module performs the corresponding safety function.

H20.10 **Safety module DI3 noise rejection filter time**

Min.:	1	Unit:	ms
Max.:	500	Data Type:	UInt16
Default:	5	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
1 ms–500 ms
Description
Sets the noise filter time of DI3 of the safety module. Only when the signal change of DI3 is continuously maintained above the filter time, the safety module performs the corresponding safety function.

H20.11 **Safety module DI4 noise rejection filter time**

Min.:	1	Unit:	ms
Max.:	500	Data Type:	UInt16
Default:	5	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
1 ms–500 ms
Description
Sets the noise filter time of DI4 of the safety module. Only when the signal change of DI4 is continuously maintained above the filter time, the safety module performs the corresponding safety function.

H20.12 **Safety module DI5 noise rejection filter time**

Min.:	1	Unit:	ms
Max.:	500	Data Type:	UInt16
Default:	5	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
1 ms–500 ms
Description
Sets the noise filter time of DI5 of the safety module. Only when the signal change of DI5 is continuously maintained above the filter time, the safety module performs the corresponding safety function.

H20.14 **Safety module DI1 allowable discrepancy time**

Min.:	5	Unit:	ms
Max.:	60000	Data Type:	UInt16
Default:	10	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
5 ms-60000 ms
Description
If the discrepancy at two input signals of DI1 lasts for a period of time exceeding the time set by this parameter, fault E134.1 is reported.

H20.15 **Safety module DI2 allowable discrepancy time**

Min.:	5	Unit:	ms
Max.:	60000	Data Type:	UInt16
Default:	10	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
5 ms-60000 ms
Description
If the discrepancy at two input signals of DI2 lasts for a period of time exceeding the time set by this parameter, fault E134.2 is reported.

H20.16 **Safety module DI3 allowable discrepancy time**

Min.:	5	Unit:	ms
Max.:	60000	Data Type:	UInt16
Default:	10	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
5 ms-60000 ms
Description
If the discrepancy at two input signals of DI3 lasts for a period of time exceeding the time set by this parameter, fault E134.3 is reported.

H20.17 **Safety module DI4 allowable discrepancy time**

Min.:	5	Unit:	ms
Max.:	60000	Data Type:	UInt16
Default:	10	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
5 ms-60000 ms
Description
If the discrepancy at two input signals of DI4 lasts for a period of time exceeding the time set by this parameter, fault E134.4 is reported.

H20.18 **Safety module DI5 allowable discrepancy time**

Min.:	5	Unit:	ms
Max.:	60000	Data Type:	UInt16
Default:	10	Change:	At stop

Effective mode: Upon the next power-on

Value Range:

5 ms–60000 ms

Description

If the discrepancy at two input signals of DI5 lasts for a period of time exceeding the time set by this parameter, fault E134.5 is reported.

H20.20 Safety module DO1 function selection

Min.:	0	Unit:	-
Max.:	14	Data Type:	UInt16
Default:	0	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:

0: Inactive

1: STO Active

2: SBC Active

3: SS1 Active

4: SS2 Active

5: SLS1 Active

6: SLS2 Active

7: SLS3 Active

8: SLS4 Active

9: SDIp Active

10: SDIn Active

11: SOS Active

12: SSM Active

13: SS1-r Active

14: SS2-r Active

Description

Assigns function to DO1 terminal of the safety module.

H20.21 Safety module DO2 function selection

Min.:	0	Unit:	-
Max.:	14	Data Type:	UInt16
Default:	0	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:

0: Inactive
1: STO Active
2: SBC Active
3: SS1 Active
4: SS2 Active
5: SLS1 Active
6: SLS2 Active
7: SLS3 Active
8: SLS4 Active
9: SDIp Active
10: SDIn Active
11: SOS Active
12: SSM Active
13: SS1-r Active
14: SS2-r Active

Description

Assigns function to DO2 terminal of the safety module.

H20.22 Safety module DO3 function selection

Min.:	0	Unit:	-
Max.:	14	Data Type:	UInt16
Default:	0	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:

0: Inactive
1: STO Active
2: SBC Active
3: SS1 Active
4: SS2 Active
5: SLS1 Active
6: SLS2 Active
7: SLS3 Active
8: SLS4 Active
9: SDIp Active
10: SDIn Active
11: SOS Active
13: SS1-r Active
14: SS2-r Active

Description

Assigns function to DO3 terminal of the safety module.
This DO is a non-safety DO circuit and cannot be configured with SSM function.

H20.23 Safety module DO4 function selection

Min.:	0	Unit:	-
Max.:	14	Data Type:	UInt16
Default:	0	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
0: Inactive
1: STO Active
2: SBC Active
3: SS1 Active
4: SS2 Active
5: SLS1 Active
6: SLS2 Active
7: SLS3 Active
8: SLS4 Active
9: SDIp Active
10: SDIn Active
11: SOS Active
12: SSM Active
13: SS1-r Active
14: SS2-r Active
Description
Assigns function to DO4 terminal of the safety module.

H20.24 **Safety module DO5 function selection**

Min.:	0	Unit:	-
Max.:	14	Data Type:	UInt16
Default:	0	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
0: Inactive
1: STO Active
2: SBC Active
3: SS1 Active
4: SS2 Active
5: SLS1 Active
6: SLS2 Active
7: SLS3 Active
8: SLS4 Active
9: SDIp Active
10: SDIn Active
11: SOS Active
12: SSM Active
13: SS1-r Active
14: SS2-r Active
Description
Assigns function to DO5 terminal of the safety module.

H20.25 **Safety module DO6 function selection**

Min.:	0	Unit:	-
Max.:	14	Data Type:	UInt16
Default:	0	Change:	At stop

Effective mode:	Upon the next power-on		

Value Range:

0: Inactive

1: STO Active

2: SBC Active

3: SS1 Active

4: SS2 Active

5: SLS1 Active

6: SLS2 Active

7: SLS3 Active

8: SLS4 Active

9: SDIp Active

10: SDIn Active

11: SOS Active

13: SS1-r Active

14: SS2-r Active

Description

Assigns function to DO6 terminal of the safety module.

This DO is a non-safety DO circuit and cannot be configured with SSM function.

H20.28 **STO trigger-to-SBC active delay time**

Min.:	-30000	Unit:	ms
Max.:	30000	Data Type:	UInt16
Default:	-30	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:

-30000 ms–30000 ms

Description

Sets the delay time from the triggering of the STO function to output of the active SBC state. This parameter can be used to set the sequence of activation of STO and SBC.

H20.29 **SS1/SS2 stop mode**

Min.:	0	Unit:	-
Max.:	1	Data Type:	UInt16
Default:	1	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:

0: Stop according to ramp

1: Stop by host controller

Description

Sets the stop mode for SS1/SS2.

H20.30 **SS1/SS2 ramp-to-stop reference speed**

Min.:	60	Unit:	rpm
Max.:	6000	Data Type:	UInt16
Default:	1000	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
60 rpm to 6000 rpm
Description
Sets the reference speed for deceleration to stop. The deceleration is equal to reference speed/ deceleration time.

H20.31 **SS1/ SS2 ramp-to-stop deceleration time**

Min.:	1	Unit:	ms
Max.:	65535	Data Type:	UInt16
Default:	500	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
1 ms-65535 ms
Description
Sets the time required to decelerate from the reference speed to 0. The deceleration is equal to reference speed/deceleration time.

H20.32 **SS1 monitor mode**

Min.:	0	Unit:	-
Max.:	1	Data Type:	UInt16
Default:	0	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
0:SS1-t
1:SS1-r
Description
Sets the monitoring mode for SS1.

H20.33 **SS1 trigger-to-STO delay time/SS2 trigger-to-STO delay time**

Min.:	0	Unit:	ms
Max.:	65535	Data Type:	UInt16
Default:	1000	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
0 ms-65535 ms
Description
After SS1 is triggered, the drive enters the STO state after a period of time exceeding the value set by this parameter has elapsed.
After SS2 is triggered, the drive enters the SOS state after a period of time exceeding the value set by this parameter has elapsed.

H20.34 **SS1/ SS1 zero speed threshold**

Min.:	1	Unit:	rpm
Max.:	6000	Data Type:	UInt16
Default:	10	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
1 rpm to 6000 rpm

Description
During SS1 deceleration, if the speed falls below the the value set by this parameter for a period of time exceeding the zero speed threshold time, the drive enters the STO state.
During SS2 deceleration, if the speed falls below the the value set by this parameter for a period of time exceeding the zero speed threshold time, the drive enters the SOS state.

H20.35 **SS1/SS2 zero speed threshold time**

Min.:	0	Unit:	ms
Max.:	65535	Data Type:	UInt16
Default:	0	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
0 ms-65535 ms
Description
During SS1 deceleration, if the speed falls below the zero speed threshold for a period of time exceeding the value set by this parameter, the drive enters the STO state.
During SS2 deceleration, if the speed falls below the zero speed threshold for a period of time exceeding the value set by this parameter, the drive enters the SOS state.

H20.36 **SS1/SS2 ramp monitor start delay time**

Min.:	5	Unit:	ms
Max.:	65535	Data Type:	UInt16
Default:	10	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
5 ms-65535 ms
Description
After SS1 is triggered, the speed ramp monitoring starts after a period of time set by this parameter has elapsed, which is only valid in SS1-r mode.
After SS2 is triggered, the speed ramp monitoring starts after a period of time set by this parameter has elapsed, which is only valid in SS2-r mode.

H20.37 **SS1/SS2 ramp monitor reference speed**

Min.:	60	Unit:	rpm
Max.:	6000	Data Type:	UInt16
Default:	1000	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
60 rpm to 6000 rpm
Description
Sets the reference speed for calculating the range of ramp monitoring. Speed ramp monitoring threshold is equal to reference speed/ramp deceleration monitor time.

H20.38 **SS1/SS2 ramp deceleration monitor time**

Min.:	1	Unit:	ms
Max.:	65535	Data Type:	UInt16
Default:	65535	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
1 ms-65535 ms
Description
sets the time required to decelerate from the reference speed to 0 during ramp monitoring.
Speed ramp monitoring threshold is equal to reference speed/ramp deceleration monitor time.

H20.41 **SS1/SS2 ramp limit trigger-to-alarm time**

Min.:	0	Unit:	ms
Max.:	65535	Data Type:	UInt16
Default:	5	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
0 ms-65535 ms
Description
During the deceleration process of SS1, if the motor speed exceeds the ramp monitoring limit for a period of time exceeding the value set by this parameter, a fault is reported and the drive enters the STO state.
During the deceleration process of SS2, if the motor speed exceeds the ramp monitoring limit for a period of time exceeding the value set by this parameter, a fault is reported and the drive enters the STO state.

H20.42 **SS1/SS2 ramp monitor stop speed**

Min.:	0	Unit:	rpm
Max.:	6000	Data Type:	UInt16
Default:	1	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
0 rpm to 6000 rpm
Description
During the deceleration process of SS1, when the motor speed falls below the value set by this parameter, the ramp monitoring is stopped.
During the deceleration process of SS2, when the motor speed falls below the value set by this parameter, the ramp monitoring is stopped.

H20.43 **SS2 monitor mode**

Min.:	0	Unit:	-
Max.:	1	Data Type:	UInt16
Default:	0	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
0:SS2-t
1:SS2-r
Description
Sets the monitoring mode for SS2.

H20.44 **SOS speed change threshold**

Min.:	1	Unit:	rpm
Max.:	6000	Data Type:	UInt16
Default:	10	Change:	At stop

Effective mode: Upon the next power-on

Value Range:

1 rpm to 6000 rpm

Description

Sets the maximum allowable difference between motor speed and 0 rpm in SOS state.

H20.45 **SOS position change threshold**

Min.:	1	Unit:	encoder unit
Max.:	536870912	Data Type:	UInt16
Default:	932067	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:

1 to 536870912

Description

Sets the maximum allowable variation of position feedback in SOS state.

H20.47 **SOS overthreshold-to-alarm time**

Min.:	0	Unit:	ms
Max.:	65535	Data Type:	UInt16
Default:	5	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:

0 ms–65535 ms

Description

In the SOS state, if the speed feedback or position feedback exceeds the threshold for a period of time exceeding the value set by this parameter, a fault will be reported.

H20.48 **SLS1 switchover delay**

Min.:	0	Unit:	ms
Max.:	65535	Data Type:	UInt16
Default:	100	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:

0 ms–65535 ms

Description

Sets the delay time from activation of SLS1 request command to activation of SLS1 monitoring.

H20.49 **SLS2 switchover delay**

Min.:	0	Unit:	ms
Max.:	65535	Data Type:	UInt16
Default:	100	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:

0 ms–65535 ms

Description

Sets the delay time from activation of SLS2 request command to activation of SLS2 monitoring.

H20.50 **SLS3 switchover delay**

Min.:	0	Unit:	ms
Max.:	65535	Data Type:	UInt16
Default:	100	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
0 ms-65535 ms
Description
Sets the delay time from activation of SLS3 request command to activation of SLS3 monitoring.

H20.51 **SLS4 switchover delay**

Min.:	0	Unit:	ms
Max.:	65535	Data Type:	UInt16
Default:	100	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
0 ms-65535 ms
Description
Sets the delay time from activation of SLS4 request command to activation of SLS4 monitoring.

H20.52 **SLS1 threshold**

Min.:	0	Unit:	rpm
Max.:	6000	Data Type:	UInt16
Default:	1000	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
0 rpm to 6000 rpm
Description
Sets the speed threshold for SLS1 monitoring.

H20.53 **SLS2 threshold**

Min.:	0	Unit:	rpm
Max.:	6000	Data Type:	UInt16
Default:	1000	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
0 rpm to 6000 rpm
Description
Sets the speed threshold for SLS2 monitoring.

H20.54 **SLS3 threshold**

Min.:	0	Unit:	rpm
Max.:	6000	Data Type:	UInt16
Default:	1000	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
0 rpm to 6000 rpm

Description
Sets the speed threshold for SLS3 monitoring.

H20.55 **SLS4 threshold**

Min.:	0	Unit:	rpm
Max.:	6000	Data Type:	UInt16
Default:	1000	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
0 rpm to 6000 rpm
Description
Sets the speed threshold for SLS4 monitoring.

H20.56 **SLS1 filter time**

Min.:	0	Unit:	ms
Max.:	65535	Data Type:	UInt16
Default:	100	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
0 ms–65535 ms
Description
Sets the filtering time for determining that the motor speed is within the SLS1 limit.

H20.57 **SLS2 filter time**

Min.:	0	Unit:	ms
Max.:	65535	Data Type:	UInt16
Default:	100	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
0 ms–65535 ms
Description
Sets the filtering time for determining that the motor speed is within the SLS2 limit.

H20.58 **SLS3 filter time**

Min.:	0	Unit:	ms
Max.:	65535	Data Type:	UInt16
Default:	100	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
0 ms–65535 ms
Description
Sets the filtering time for determining that the motor speed is within the SLS3 limit.

H20.59 **SLS4 filter time**

Min.:	0	Unit:	ms
Max.:	65535	Data Type:	UInt16
Default:	100	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
0 ms–65535 ms
Description
Sets the filtering time for determining that the motor speed is within the SLS4 limit.

H20.60 **SLS fault response mode**

Min.:	0	Unit:	-
Max.:	1	Data Type:	UInt16
Default:	0	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
0:STO
1:SS1-t
Description
Sets the mode for stopping the motor when its speed exceeds the speed limit after the SLS monitoring takes effect.

H20.61 **Safety bus function enabled (FSoE)**

Min.:	0	Unit:	-
Max.:	59039	Data Type:	UInt16
Default:	25247	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
bit0: STO enabled
bit1: SS1 enabled
bit2: SS2 enabled
bit3: SOS enabled
bit4: SLS enabled
bit5: Reserved
bit6: Reserved
bit7: SDI enabled
bit8: Reserved
bit9: SBC enabled
bit10: ACK (nSRA) enabled
bit11: Reserved
bit12: Reserved
bit13: SLS speed limit (low bit)
bit14: SLS speed limit high bit)
15: No STO prompt before FSoE connection
Description
Defines the safety function to be enabled in the bus mode. When bit0-bit9 is set to 0, the servo drive does not respond to the corresponding safety command input if you use the bus trigger mode.

H20.70 **SSM upper limit**

Min.:	-6000	Unit:	rpm
Max.:	6000	Data Type:	Int16
Default:	200	Change:	At stop

Effective mode: Upon the next power-on

Value Range:
-6000 rpm to 6000 rpm

Description
Upper limit for SSM monitoring

H20.71 **SSM lower limit**

Min.:	-6000	Unit:	rpm
Max.:	6000	Data Type:	Int16
Default:	-200	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
-6000 rpm to 6000 rpm

Description
Lower limit for SSM monitoring

H20.72 **SSM hysteresis threshold**

Min.:	0	Unit:	rpm
Max.:	6000	Data Type:	UInt16
Default:	10	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
0 rpm to 6000 rpm

Description
Sets the hysteresis threshold of SSM monitoring to avoid the SSM output jumping too frequently when the speed fluctuates near the upper or lower threshold.

H20.74 **SDI zero position threshold**

Min.:	1	Unit:	encoder unit
Max.:	536870912	Data Type:	UInt32
Default:	932067	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
1 to 536870912

Description
Sets the position threshold for stopping the monitoring.
(Position window for stop position)

H20.76 **SDI zero speed threshold**

Min.:	0	Unit:	rpm
Max.:	3000	Data Type:	UInt16
Default:	10	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
0 rpm to 3000 rpm

Description

Sets the speed threshold for stopping the monitoring.
(Velocity window for n=0)

H20.77 **SDI delay time**

Min.:	0	Unit:	ms
Max.:	65535	Data Type:	UInt16
Default:	0	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
0 ms–65535 ms
Description
Sets the delay time from activation of SDI command to activation of SDI monitoring.

H20.78 **SDI fault response mode**

Min.:	0	Unit:	-
Max.:	1	Data Type:	UInt16
Default:	0	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
0:STO
1:SS1-t
Description
Sets the mode for stopping the motor when it runs in the forbidden direction after the SDI monitoring takes effect.

H20.80 **Speed/Position monitoring setting**

Min.:	0	Unit:	-
Max.:	1	Data Type:	UInt16
Default:	0	Change:	At stop
Effective mode:	Upon the next power-on		

Value Range:
0: No speed and position monitoring
1: Use safety motor and speed and position monitoring
Description
Enable/disable safety functions related to speed and position monitoring. This parameter can only be set to 0 when using a non-safety motor.

H20.90 **FSoE protocol stack version**

Min.:	0.00	Unit:	-
Max.:	655.35	Data Type:	UInt16
Default:	0.00	Change:	Unchangeable
Effective mode:	-		

Value Range:
0.00 to 655.35
Description
Displays the FSoE protocol stack version number, with 2 decimal places.

11.4 6000h Object Dictionary

6620.01h Safety control word low 8 bits

Hex:	6620-01h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	255	Data Type:	UInt8
Default:	0	Change:	Unchangeable

Value Range:

0 to 255

Description

Reflects the current state of the RPDO control command issued by the host controller.

Variable PDO	Description
bit0	Displays STO command state 0: STO trigger command present 1: No STO trigger command
bit1	Displays SS1 command state 0: SS1 trigger command present 1: No SS1 trigger command
bit2	Displays SS2 command state 0: SS2 trigger command present 1: No SS2 trigger command
bit3	Displays SOS command state 0: SOS trigger command present 1: No SOS trigger command
bit5	Displays SDIp command state 0: SDIp trigger command present 1: No SDIp trigger command
bit6	Displays SDIn command state 0: SDIn trigger command present 1: No SDIn trigger command
bit7	Displays Ack fault state 0: No Ack command 1: Ack command present

6620.02h Safety control word high 8 bits

Hex:	6620-02h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	255	Data Type:	UInt8
Default:	0	Change:	Unchangeable

Value Range:

0 to 255

Description

Reflects the current state of the RPDO control command issued by the host controller.

Variable PDO	Description
bit0	Displays reset command state 0: No reset command 1: Reset command present
bit1	Displays SBC command state 0: SBC trigger command present 1: No SBC trigger command
bit2	Displays SLS1 command state 0: SLS1 trigger command present 1: No SLS1 trigger command
bit3	Displays SLS2 command state 0: SLS2 trigger command present 1: No SLS2 trigger command
bit4	Displays SLS3 command state 0: SLS3 trigger command present 1: No SLS3 trigger command
bit5	Displays SLS4 command state 0: SLS4 trigger command present 1: No SLS4 trigger command

6621.01h Safety status word low 8 bits

Hex:	6621-01h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	255	Data Type:	UInt8
Default:	0	Change:	Unchangeable

Value Range:

0 to 255

Description

Reflects the current TPDO state uploaded by the safety module.

Variable PDO	Description
bit0	Displays STO state 0: Non-STO state 1: STO state
bit1	Displays SSM state 0: The speed is within SSM limit range 1: The speed is out of SSM limit range
bit3	Displays SOS state 0: Non-SOS state 1: SOS state
bit5	Displays SDIp state 0: Motor is not in forward motion 1: Motor is in forward motion
bit6	Displays SDIn state 0: Motor is not in reverse motion 1: Motor is in reverse motion
bit7	Displays safety function fault state 0: Normal 1: Faulty

6621.02h Safety status word high 8 bits

Hex:	6621-02h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	255	Data Type:	UInt8
Default:	0	Change:	Unchangeable

Value Range:

0 to 255

Description

Reflects the current TPDO state uploaded by the safety module.

Variable PDO	Description
bit0	Displays reset state 0: Non-reset state 1: Reset state
bit1	Displays SBC state 0: Non-SBC state 1: SBC state
bit2	Displays SLS1 state 0: Non-SLS1 state 1: SLS1 state
bit3	Displays SLS2 state 0: Non-SLS2 state 1: SLS2 state
bit4	Displays SLS3 state 0: Non-SLS3 state 1: SLS3 state
bit5	Displays SLS4 state 0: Non-SLS4 state 1: SLS4 state
bit7	Displays FSoE connection status 0: Connection is normal 1: Connection is abnormal

6630h **Restart Ack reset signal**

Hex:	6630h	Effective mode:	Real time
Min.:	0	Unit:	-
Max.:	1	Data type:	Boolean
Default:	0	Change mode:	Real time

Setpoint:

0 to 1

Description

Variable PDO	Remarks
RPDO	Executes reset command 0: Reset not triggered 1: Reset triggered
TPDO	Displays the reset state. 0: Non-reset state 1: Reset state

6632h **Fault state**

Hex:	6632h	Effective mode:	Real-time

Min.:	0	Unit:	-
Max.:	1	Data Type:	Boolean
Default:	0	Change:	Real-time

Value Range:
0 to 1
Description

Variable PDO	Description
TPDO	Displays fault state 0: Non-faulty 1: Faulty

6640h **STO signal**

Hex:	6640h	Effective mode:	Real-time
Min.:	0	Unit:	-
Max.:	1	Data Type:	Boolean
Default:	0	Change:	Real-time

Value Range:
0 to 1
Description

Variable PDO	Description
RPDO	Executes STO command 0: Trigger STO 1: Do not trigger STO
TPDO	Displays STO state 0: Non-STO state 1: STO state

6641h **STO reset mode selection**

Hex:	6641h	Effective mode:	Real-time
Min.:	0	Unit:	-
Max.:	1	Data Type:	Boolean
Default:	0	Change:	Real-time

Value Range:
0 to 1
Description
Select the STO reset mode.

Variable SDO	Description
SDO	STO reset mode selection 0: Restart Ack signal is not required 1: Restart Ack signal is required

6650.01h **SS1 signal**

Hex:	6650-01h	Effective mode:	Real-time

Min.:	0	Unit:	-
Max.:	1	Data Type:	Boolean
Default:	0	Change:	Real-time

Value Range:
0 to 1
Description

Variable PDO	Description
RPDO	Executes SS1 command 0: Trigger SS1 1: Do not trigger SS1
TPDO	Displays SS1 state 0: Non-SS1 state 1: SS1 state

6651.01h SS1 trigger-to-STO delay time

Hex:	6651-01h	Effective mode:	At stop
Min.:	0	Unit:	ms
Max.:	65535	Data Type:	UInt16
Default:	1000	Change:	Real-time

Value Range:
0ms to 65535ms
Description
After SS1 is triggered, OD Index STO state after a period of time exceeding the value set by this parameter has elapsed.

6653.01h SS1 zero speed threshold

Hex:	6653-01h	Effective mode:	At stop
Min.:	1	Unit:	RPM
Max.:	6000	Data Type:	UInt32
Default:	10	Change:	Real-time

Value Range:
1rpm to 6000rpm
Description
During SS1 deceleration, if the speed falls below the the value set by this parameter for a period of time exceeding the zero speed threshold time, the drive enters the STO state.

6654.01h SS1 zero speed threshold time

Hex:	6654-01h	Effective mode:	At stop
Min.:	0	Unit:	ms
Max.:	65535	Data Type:	UInt16
Default:	0	Change:	Real-time

Value Range:
0ms to 65535ms
Description
During SS1 deceleration, if the speed falls below the zero speed threshold for a period of time exceeding the value set by this parameter, the drive enters the STO state.

6656.01h SS1 deceleration limit

Hex:	6656-01h	Effective mode:	At stop
Min.:	0	Unit:	Encoder unit/s²
Max.:	4294967295	Data Type:	UInt32
Default:	15	Change:	Real-time

Value Range:

0 encoder unit/s²–4294967295 encoder unit/s²

Description

Sets the minimum deceleration threshold for SS1 when ramp monitoring is performed.

6657.01h SS1 ramp monitor start delay time

Hex:	6657-01h	Effective mode:	At stop
Min.:	0	Unit:	ms
Max.:	65535	Data Type:	UInt16
Default:	10	Change:	Real-time

Value Range:

0 ms–65535 ms

Description

After SS1 is triggered, the speed ramp monitoring starts after a period of time set by this parameter has elapsed, which is only valid in SS1-r mode.

6660h SBC signal

Hex:	6660h	Effective mode:	Real-time
Min.:	0	Unit:	-
Max.:	1	Data Type:	Boolean
Default:	0	Change:	Real-time

Value Range:

0 to 1

Description

Variable PDO	Description
RPDO	Executes SBC command 0: SBC active 1: SBC deselected
TPDO	Displays SBC state 0: Normal state 1: SBC state

6668.01h SOS signal

Hex:	6668-01h	Effective mode:	Real-time
Min.:	0	Unit:	-
Max.:	1	Data Type:	Boolean
Default:	0	Change:	Real-time

Value Range:

0 to 1

Description

Variable PDO	Description
RPDO	Executes SOS command 0: Trigger SOS 1: Do not trigger SOS
TPDO	Displays SOS state 0: Non-SOS state 1: SOS state

666A.01h SOS zero position threshold

Hex:	666A-01h	Effective mode:	At stop
Min.:	0	Unit:	encoder unit
Max.:	536870912	Data Type:	UInt32
Default:	932067	Change:	Real-time

Value Range:
0 to 536870912
Description
Sets the maximum allowable variation of position feedback in SOS state.

666C.01h SOS zero speed threshold

Hex:	666C-01h	Effective mode:	At stop
Min.:	0	Unit:	rpm
Max.:	6000	Data Type:	UInt32
Default:	10	Change:	Real-time

Value Range:
0 rpm to 6000 rpm
Description
Sets the maximum allowable difference between motor speed and 0 rpm in SOS state.

6670.01h SS2 signal

Hex:	6670-01h	Effective mode:	Real-time
Min.:	0	Unit:	-
Max.:	1	Data Type:	Boolean
Default:	0	Change:	Real-time

Value Range:
0 to 1
Description

Variable PDO	Description
RPDO	Executes SS2 command 0: Trigger SS2 1: Do not trigger SS2
TPDO	Displays SS2 state 0: Non-SS2 state 1: SS2 state

6671.01h SS2 trigger-to-STO delay time

Hex:	6671-01h	Effective mode:	At stop
Min.:	0	Unit:	ms
Max.:	65535	Data Type:	UInt16
Default:	10	Change:	Real-time

Value Range:
0 ms–65535 ms
Description
After SS2 is triggered, the drive enters the SOS state after a period of time exceeding the value set by this parameter has elapsed.

6672.01h SS2 zero speed threshold time

Hex:	6672-01h	Effective mode:	At stop
Min.:	0	Unit:	ms
Max.:	65535	Data Type:	UInt16
Default:	0	Change:	Real-time

Value Range:
0ms to 65535ms
Description
During SS2 deceleration, if the speed falls below the zero speed threshold for a period of time exceeding the value set by this parameter, the drive enters the SOS state.

6674.01h SS2 deceleration limit

Hex:	6674-01h	Effective mode:	At stop
Min.:	0	Unit:	Encoder unit/s^2
Max.:	4294967295	Data Type:	UInt32
Default:	15	Change:	Real-time

Value Range:
0 encoder unit/s^2–4294967295 encoder unit/s^2
Description
Sets the minimum deceleration threshold for SS2 when ramp monitoring is performed.

6675.01h SS2 ramp monitor start delay time

Hex:	6675-01h	Effective mode:	At stop
Min.:	0	Unit:	ms
Max.:	65535	Data Type:	UInt16
Default:	10	Change:	Real-time

Value Range:
0ms to 65535ms
Description
After SS2 is triggered, the speed ramp monitoring starts after a period of time set by this parameter has elapsed, which is only valid in SS2-r mode.

6676.01h SS2 reset mode selection

Hex:	6676-01h	Effective mode:	At stop
Min.:	0	Unit:	-
Max.:	1	Data Type:	Boolean

Default: 0 Change: Real-time

Value Range:

0 to 1

Description

Variable SDO	Description
SDO	SS2 reset mode 0: Restart Ack signal is not required upon SS2 reset 1: Restart Ack signal is required upon SS2 reset upon SS2 reset

6690.01h SLS1 signal

Hex: 6690-01h Effective mode: Real-time

Min.: 0 Unit: -

Max.: 1 Data Type: Boolean

Default: 0 Change: Real-time

Value Range:

0 to 1

Description

Variable PDO	Description
RPDO	Executes SLS1 command 0: SLS1 active 1: SLS1 deselected
TPDO	Displays SLS1 state 0: Normal state 1: SLS1 monitoring state

6690.02h SLS2 signal

Hex: 6690-02h Effective mode: Real-time

Min.: 0 Unit: -

Max.: 1 Data Type: Boolean

Default: 0 Change: Real-time

Value Range:

0 to 1

Description

Displays SLS function state and executes SLS command.

Variable PDO	Description
RPDO	Executes SLS2 command 0: SLS2 active 1: SLS2 deselected
TPDO	Displays SLS2 state 0: Normal state 1: SLS2 monitoring state

6690.03h SLS3 signal

Hex:	6690-03h	Effective mode:	Real-time
Min.:	0	Unit:	-
Max.:	1	Data Type:	Boolean
Default:	0	Change:	Real-time

Value Range:

0 to 1

Description

Displays SLS function state and executes SLS command.

Variable PDO	Description
RPDO	Executes SLS3 command 0: SLS3 active 1: SLS3 deselected
TPDO	Displays SLS3 state 0: Normal state 1: SLS3 monitoring state

6690.04h SLS4 signal

Hex:	6690-04h	Effective mode:	Real-time
Min.:	0	Unit:	-
Max.:	1	Data Type:	Boolean
Default:	0	Change:	Real-time

Value Range:

0 to 1

Description

Displays SLS function state and executes SLS command.

Variable PDO	Description
RPDO	Executes SLS4 command 0: SLS4 active 1: SLS4 deselected
TPDO	Displays SLS4 state 0: Normal state 1: SLS4 monitoring state

6691.01h SLS1 switchover delay

Hex:	6691-01h	Effective mode:	At stop
Min.:	0	Unit:	ms
Max.:	65535	Data Type:	UInt16
Default:	100	Change:	Real-time

Value Range:

0ms to 65535ms

Description

Sets the delay time from activation of SLS1 request command to activation of SLS1 monitoring. (Time delay to initiate SLS1 limits)

6691.02h SLS2 switchover delay

Hex:	6691-02h	Effective mode:	At stop
Min.:	0	Unit:	ms
Max.:	65535	Data Type:	UInt16
Default:	100	Change:	Real-time

Value Range:
0ms to 65535ms
Description
Sets the delay time from activation of SLS2 request command to activation of SLS2 monitoring.

6691.03h SLS3 switchover delay

Hex:	6691-03h	Effective mode:	At stop
Min.:	0	Unit:	ms
Max.:	65535	Data Type:	UInt16
Default:	100	Change:	Real-time

Value Range:
0 ms-65535 ms
Description
Sets the delay time from activation of SLS3 request command to activation of SLS3 monitoring.

6691.04h SLS4 switchover delay

Hex:	6691-04h	Effective mode:	At stop
Min.:	0	Unit:	ms
Max.:	65535	Data Type:	UInt16
Default:	100	Change:	Real-time

Value Range:
0 ms-65535 ms
Description
Sets the delay time from activation of SLS4 request command to activation of SLS4 monitoring.

6693.01h SLS1 threshold

Hex:	6693-01h	Effective mode:	At stop
Min.:	0	Unit:	rpm
Max.:	6000	Data Type:	UInt32
Default:	1000	Change:	Real-time

Value Range:
0 rpm to 6000 rpm
Description
Sets the threshold for SLS1.

6693.02h SLS2 threshold

Hex:	6693-02h	Effective mode:	At stop
Min.:	0	Unit:	rpm
Max.:	6000	Data Type:	UInt32
Default:	1000	Change:	Real-time

Value Range:
0 rpm to 6000 rpm

Description
Sets the threshold for SLS2.

6693.03h SLS3 threshold

Hex:	6693-03h	Effective mode:	At stop
Min.:	0	Unit:	RPM
Max.:	6000	Data Type:	UInt32
Default:	1000	Change:	Real-time

Value Range:
0rpm to 6000rpm
Description
Sets the threshold for SLS3.

6693.04h SLS4 threshold

Hex:	6693-04h	Effective mode:	At stop
Min.:	0	Unit:	rpm
Max.:	6000	Data Type:	UInt32
Default:	1000	Change:	Real-time

Value Range:
0 rpm to 6000 rpm
Description
Sets the threshold for SLS4.

6694.01h SLS1 filter time

Hex:	6694-01h	Effective mode:	At stop
Min.:	0	Unit:	ms
Max.:	65535	Data Type:	UInt16
Default:	10	Change:	Real-time

Value Range:
0ms to 65535ms
Description
Sets the filter time within SLS1 window
(Time for speed within SLS1 window)

6694.02h SLS2 filter time

Hex:	6694-02h	Effective mode:	At stop
Min.:	0	Unit:	ms
Max.:	65535	Data Type:	UInt16
Default:	10	Change:	Real-time

Value Range:
0ms to 65535ms
Description
Sets the filter time within SLS2 window

6694.03h SLS3 filter time

Hex:	6694-03h	Effective mode:	At stop
Min.:	0	Unit:	ms

Max.:	65535	Data Type:	UInt16
Default:	10	Change:	Real-time

Value Range:
0 ms-65535 ms
Description
Sets the filter time within SLS3 window

6694.04h SLS4 filter time

Hex:	6694-04h	Effective mode:	At stop
Min.:	0	Unit:	ms
Max.:	65535	Data Type:	UInt16
Default:	10	Change:	Real-time

Value Range:
0 ms-65535 ms
Description
Sets the filter time within SLS4 window

66D0h SDIp signal

Hex:	66D0h	Effective mode:	Real-time
Min.:	0	Unit:	-
Max.:	1	Data Type:	Boolean
Default:	0	Change:	Real-time

Value Range:
0 to 1
Description
Displays the forward rotation state of the motor and issues the SDI forward command.

Variable PDO	Description
RPDO	Executes SDIp monitoring function. 0: Forward rotation prohibited 1: Forward rotation allowed
TPDO	Indicates forward rotation state of the motor. 0: Motor is not in forward rotation 1: Motor is in forward rotation

66D1h SDIn signal

Hex:	66D1h	Effective mode:	Real-time
Min.:	0	Unit:	-
Max.:	1	Data Type:	Boolean
Default:	0	Change:	Real-time

Value Range:
0 to 1

Description

Displays the reverse rotation state of the motor and issues the SDI reverse command.

Variable PDO	Description
RPDO	Executes SDIn monitoring function. 0: Reverse direction is not allowed 1: Reverse direction is allowed
TPDO	Displays SDIn state 0: Motor is not running reversely 1: Motor is running reversely

66D3h **SDI zero position threshold**

Hex:	66D3h	Effective mode:	At stop
Min.:	0	Unit:	Encoder unit
Max.:	536870912	Data Type:	UInt32
Default:	932067	Change:	Real-time

Value Range:

0 to 536870912

Description

Sets the position window for stopping the monitoring.

66D5h **SDI zero speed threshold**

Hex:	66D5h	Effective mode:	At stop
Min.:	0	Unit:	RPM
Max.:	3000	Data Type:	UInt32
Default:	10	Change:	Real-time

Value Range:

0rpm to 3000rpm

Description

Zero speed threshold for SDI monitoring

66E0.01h **SSM state**

Hex:	66E0-01h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	1	Data Type:	Boolean
Default:	0	Change:	Unchangeable

Value Range:

0 to 1

Description

SSM can be implemented as a bit in the safety state.

Variable PDO	Description
TPDO	Displays SSM state 0: Motor speed out of SSM limit 1: Motor speed within SSM limit

66E2.01h **SSM upper limit**

Hex:	66E2-01h	Effective mode:	At stop
Min.:	-6000	Unit:	RPM
Max.:	6000	Data Type:	Int32
Default:	200	Change:	Real-time

Value Range:
-6000 rpm to +6000 rpm
Description
Upper limit for SSM monitoring

66E4.01h **SSM lower limit**

Hex:	66E4-01h	Effective mode:	At stop
Min.:	-6000	Unit:	rpm
Max.:	6000	Data Type:	Int32
Default:	-200	Change:	Real-time

Value Range:
-6000 rpm to 6000 rpm
Description
Lower limit for SSM monitoring

E600.01h **FSoE slave command**

Hex:	E600-01h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	255	Data Type:	UInt8
Default:	0	Change:	Unchangeable

Value Range:
0 to 255
Description
FSoE slave command

E600.02h **FSoE slave connection ID**

Hex:	E600-02h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data Type:	UInt16
Default:	0	Change:	Unchangeable

Value Range:
0 to 65535
Description
FSoE slave connection ID

E600.03h **FSoE slave CRC value**

Hex:	E600-03h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data Type:	UInt16
Default:	0	Change:	Unchangeable

Value Range:
0 to 65535

Description
FSoE slave CRC value

E601.01h FSoE connection status

Hex:	E601-01h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	1	Data Type:	Boolean
Default:	0	Change:	Unchangeable

Value Range:
0 to 1
Description

Variable PDO	Description
TPDO	Displays FSoE connection status 0: Connection is normal. 1: Connection is abnormal.

E700.01h FSoE master command

Hex:	E700-01h	Effective mode:	Real-time
Min.:	0	Unit:	-
Max.:	255	Data Type:	UInt8
Default:	0	Change:	Real-time

Value Range:
0 to 255
Description
FSoE master command

E700.02h FSoE master connection ID

Hex:	E700-02h	Effective mode:	Real-time
Min.:	0	Unit:	-
Max.:	65535	Data Type:	UInt16
Default:	0	Change:	Real-time

Value Range:
0 to 65535
Description
FSoE master connection ID

E700.03h FSoE master CRC value

Hex:	E700-03h	Effective mode:	Real-time
Min.:	0	Unit:	-
Max.:	65535	Data Type:	UInt16
Default:	0	Change:	Real-time

Value Range:
0 to 65535
Description
FSoE master CRC value

E901.01h **FSoE version**

Hex:	E901-01h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data Type:	UInt16
Default:	0	Change:	Unchangeable

Value Range:
0 to 65535
Description
Supported FSoE version

E901.02h **FSoE address**

Hex:	E901-02h	Effective mode:	-
Min.:	1	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	1	Change mode:	Read only

Setpoint:
1 to 65535
Description
Defines the FSoE address.

E901.03h **PSoE connection ID**

Hex:	E901-03h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data Type:	UInt16
Default:	0	Change:	Unchangeable

Value Range:
0 to 65535
Description
ID of connection between FSoE master and slave.

E901.04h **Watchdog time**

Hex:	E901-04h	Effective mode:	-
Min.:	1	Unit:	-
Max.:	65535	Data Type:	UInt16
Default:	500	Change:	Unchangeable

Value Range:
1 to 65535
Description
Watchdog timeout

E901.06h **Connection type**

Hex:	E901-06h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data Type:	UInt16
Default:	0	Change:	Unchangeable

Value Range:

0 to 65535

Description

0: Master connection

1: Slave connection

E901.07h **Communication parameter length**

Hex:	E901-07h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data Type:	UInt16
Default:	0	Change:	Unchangeable

Value Range:

0 to 65535

Description

The length of the communication parameters in the parameter set.

E901.08h **Application layer parameter length**

Hex:	E901-08h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data Type:	UInt16
Default:	0	Change:	Unchangeable

Value Range:

0 to 65535

Description

The length of the application parameters in the parameter set.

E901.09h **SRA CRC**

Hex:	E901-09h	Effective mode:	-
Min.:	0	Unit:	-
Max.:	65535	Data Type:	UInt16
Default:	0	Change:	Unchangeable

Value Range:

0 to 65535

Description

CRC checksum of safety-related application parameter sets.

F980.01h **FSoE address**

Hex:	F980-01h	Effective mode:	-
Min.:	1	Unit:	-
Max.:	65535	Data type:	UInt16
Default:	0	Change mode:	Read only

Setpoint:

0 to 65535

Description

Defines the FSoE slave address.

12 Troubleshooting

12.1 Fault Severity Level and Display

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

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

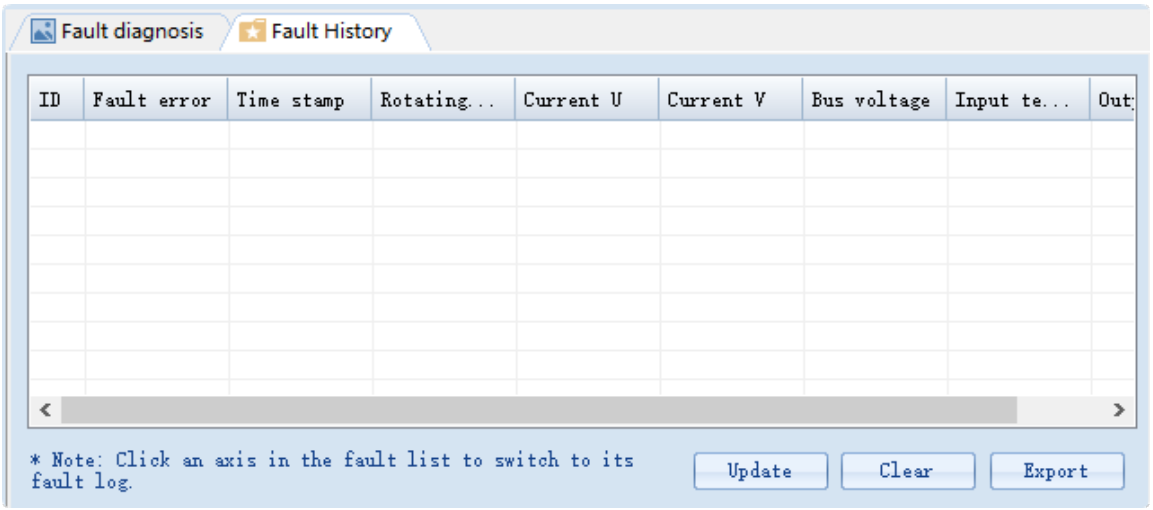
Note

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

Fault and alarm log

The servo drive can record the latest 20 faults and alarms and values of status parameters upon faults and alarms. If a fault is repeated in the latest 5 records, the fault can be logged more than once after being cleared. If an alarm is repeated in the latest 5 records, the alarm is logged only once.

A fault or an alarm will still be saved in the fault log after reset. To remove the fault or alarm from the fault log, set H02.31 to 2. as shown in the following figure.



Read the value of H0b.34 in the InoDriverShop software tool to obtain the fault or warning code, as described in the following table.

H0b.34 (Hexadecimal)	Description of H0b.34 (hexadecimal)
0101	0: Fault subcode 101: Fault code

12.2 Fault Reset

Operating procedure:

- To stop the keypad from displaying the fault/alarm, set H0d.01 (Fault reset) to 1 or activate the DI terminal assigned with DI function 2 (FunIN.2: ALM- RST, fault and alarm reset).
- To reset No. 1 and No. 2 faults, switch off the S-ON signal, and then set H0d.01 to 1 or activate the DI terminal allocated with DI function 2.
- To reset No. 3 alarms, set H0d.01 to 1 or activate the DI terminal allocated with DI function 2.

Note

- Some faults and alarms can be reset only after the fault causes are rectified by modifying the settings. The fault can be reset only after the fault causes are rectified.
- For modifications that can be activated only at next power-on. Power off and on the drive again.
- For modifications that can be activated only after stop, switch off the S-ON signal. The drive can operate normally after the modification is activated.

☆Related function No.:

Start Process	Fault	Cause	Troubleshooting
FunIN.2	ALM-RST	Fault/alarm reset signal	The servo drive may, depending on the alarm type, continue running after reset. When FunIN.2 is assigned to a low-speed DI, the effective level change of this DI must be kept for more than 3 ms. Otherwise, fault reset will be inactive. Do not assign FunIN.2 to a high-speed DI. Otherwise, fault/alarm reset will be inactive. • Inactive: Not resetting the fault/alarm • Active: Resetting the fault/alarm

12.3 Troubleshooting

12.3.1 List of Fault Codes

No.1 non-resettable faults:

Table 12–1 List of No. 1 non-resettable faults

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Auxiliary code (203Fh)
E101.0	Abnormal parameters in groups H02 and above	1	No	0x6320	0x01010101
E101.1	Abnormal parameters in group H00/H01	1	No	0x6320	0x11010101
E101.2	Address error in read/write operation after the number of parameters changes	1	No	0x6320	0x21010101
E101.3	CRC error during safety parameter initialization	1	No	0x0101	0x31010101

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Auxiliary code (203Fh)
E101.4	Error in upper and lower limits check during safety parameter initialization	1	No	0x0101	0x41010101
E101.5	Address error in read/write operation after the number of parameters changes	1	No	0x0101	0x51010101
E101.9	Parameter attribute initialization check error	1	No	0x0101	0x91010101
E102.0	FPGA communication establishment error	1	No	0x7500	0x01020102
E102.1	FPGA initialization start error	1	No	0x7500	0x11020102
E102.8	Software versions of MCU and FPGA mismatch	1	No	0x7500	0x81020102
E104.1	MCU operation timeout (MCU crashed)	1	No	0x7500	0x11040104
E104.2	FPGA operation timeout (FPGA crashed)	1	No	0x7500	0x21040104
E104.4	MCU reference update timeout	1	No	0x7500	0x41040104
E104.5	Abnormal interrupt count in safety module FPGA	1	No	0x0104	0x51040104
E104.6	Safety module FPGA interrupt timeout	1	No	0x0104	0x61040104
E120.0	Unknown encoder type	1	No	0x7122	0x01200120
E120.1	Unknown motor model	1	No	0x7122	0x11200120
E120.2	Unknown drive model	1	No	0x7122	0x21200120
E120.5	Motor and drive current mismatch	1	No	0x7122	0x51200120
E120.6	FPGA and motor model mismatch	1	No	0x7122	0x61200120
E120.7	Model check error	1	No	0x0120	0x71200120
E120.8	Junction temperature parameter check error	1	No	0x0120	0x81200120
E136.0	Encoder ROM motor parameter verification error	1	No	0x7305	0x01360136
E136.1	Encoder ROM motor parameter read error	1	No	0x7305	0x11360136
E136.9	Range parameter initialization error	1	No	0x7305	0x11360136
E138.0	Accuracy compensation data error	1	No	0x0138	0x01380138
E138.1	Cogging fluctuation compensation data check failure	1	No	0x0138	0x11380138
E138.2	Gantry synchronization compensation data check failure	1	No	0x0138	0x21380138
E138.3	Overload compensation data check failure	1	No	0x0138	0x31380138
E140.0	Encryption integrated circuit verification fault	1	No	0x0140	0x01400140
E140.2	Encryption chip version error	1	No	0x0140	0x21400140
E140.3	Encryption integrated circuit damaged	1	No	0x0140	0x31400140

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Auxiliary code (203Fh)
E145.0	Safety module integrated circuit diagnosis failure	1	No	0x0145	0x01450145
E145.1	Safety module program execution error	1	No	0x0145	0x11450145
E154.0	Speed-related functions enabled for non-safety encoder	1	No	0x0154	0x01540154
E154.1	Incorrect selection of safety function trigger mode	1	No	0x0154	0x11540154
E201.0	Phase-P overcurrent	1	No	0x2312	0x02010201
E201.1	Phase-U overcurrent	1	No	0x2312	0x12010201
E201.2	Phase-V overcurrent	1	No	0x2312	0x22010201
E201.4	Phase-N overcurrent	1	No	0x2312	0x42010201
E210.0	Output ground fault	1	No	0x2330	0x02100210
E210.2	Output ground fault detection hardware error	1	No	0x2330	0x22100210
E234.0	Runaway (protection scheme 1)	1	No	0x0234	0x02340234
E234.1	Runaway (protection scheme 2)	1	No	0x0234	0x12340234
E308.0	Pulse encoder phase A disconnected	1	No	0x0308	0x03080308
E308.1	Pulse encoder phase B disconnected	1	No	0x0308	0x13080308
E308.2	Pulse encoder phase Z disconnected (no alarm reported for encoders without phase Z)	1	No	0x0308	0x23080308
E603.0	Gantry communication CRC error	1	No	0x0603	0x06030603
E603.1	Gantry communication timeout	1	No	0x0603	0x16030603
E603.2	Communication not established	1	No	0x0603	0x26030603
E606.0	Gantry torque alignment timeout	1	No	0x0606	0x06060606
E619.0	Absolute accuracy compensation parameter setting error	1	No	0x0619	0x06190619
E619.1	Absolute accuracy compensation overflow	1	No	0x0619	0x16190619
E720.0	Encoder interface incorrect	1	No	0x0720	0x07200720
E740.0	Absolute encoder communication timeout	1	No	0x0740	0x07400740
E740.2	Absolute encoder error	1	No	0x7305	0x27400740
E740.3	Absolute encoder single-turn calculation error	1	No	0x7305	0x37400740
E740.6	Encoder write error	1	No	0x7305	0x67400740
E740.7	BiSS-C encoder data fault	1	No	0x7305	0x77400740
E740.8	BISSC register communication fault	1	No	0x7305	0x87400740
E740.9	Encoder data transmission delay too long	1	No	0x7305	0x97400740

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Auxiliary code (203Fh)
E750.0	Master/Slave initial position deviation of safety encoder too large	1	No	0x0750	0x07500750
E750.1	Difference between safety encoder master and slave positions too large	1	No	0x0750	0x17500750
E750.2	Excessive QEP difference between encoder master and slave	1	No	0x0750	0x27500750
E750.3	Difference between safety encoder master and slave analog values too large	1	No	0x0750	0x37500750
E750.4	Encoder integrated circuit power supply diagnosis error	1	No	0x0750	0x47500750
E750.5	Encoder master and slave SN mismatch	1	No	0x0750	0x57500750
E750.6	Encoder integrated circuit diagnosis error	1	No	0x0750	0x67500750
E750.7	Encoder SPI communication error, no response from slave	1	No	0x0750	0x77500750
E751.0	Safety module encoder CRC check error	1	No	0x0751	0x07510751
E751.1	Excessive deviation between speeds calculated by MCU1 and MCU2 of safety module	1	No	0x0751	0x17510751
E751.2	Safety module positions 1 and 2 check error	1	No	0x0751	0x27510751
E751.3	Safety encoder version number CRC error	1	No	0x0751	0x37510751
E755.0	Nikon encoder communication fault	1	No	0x0FFF	0x07552755
E765.0	Third-party encoder over-temperature or overspeed	1	No	0x0765	0x07650765
E770.6	Secondary encoder initialization communication error in fully closed-loop mode	1	No	0x7305	0x67700770
E770.7	Secondary encoder communication error in fully closed-loop mode	1	No	0x7305	0x77700770
E771.0	Communication handshake between the interpolator and the drive failed	1	No	0x0771	0x07710771
EA33.0	Encoder read/write verification error	1	No	0x7305	0x0A330A33
EA33.1	Fully closed-loop Inovance secondary encoder data read/write error	1	No	0x7305	0X1A330A33
EA34.0	The Hall state is abnormal.	1	No	0x0A34	0x0A340A34
EA34.1	Dynamic Hall auto-tuning error	1	No	0x0A34	0x1A340A34
EA34.2	Static Hall auto-tuning error	1	No	0x0A34	0x2A340A34
EE12.0	EtherCAT initialization failure	1	No	0x0E12	0x0E120E12
EE16.0	MCU and ESC communication error	1	No	0x0E16	0x0E160E16
EEE0.0	The gantry pairing axis is faulty.	1	No	0x0EE0	0x0EE00EE0

No.1 resettable faults:

Table 12–2 List of No. 1 resettable faults

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Auxiliary code (203Fh)
E124.0	Different DIs assigned with the same function	1	Yes	0x0124	0x01240124
E124.1	Safety DI1 input circuit diagnosis error	1	Yes	0x0124	0x11240124
E124.2	Safety DI2 input circuit diagnosis error	1	Yes	0x0124	0x21240124
E124.3	Safety DI3 input circuit diagnosis error	1	Yes	0x0124	0x31240124
E124.4	DI4 input circuit diagnosis error	1	Yes	0x0124	0x41240124
E124.5	DI5 input circuit diagnosis error	1	Yes	0x0124	0x51240124
E125.0	SSM assigned with non-safety DO serial number	1	Yes	0x0125	0x01250125
E125.1	DO1 output circuit diagnosis error	1	Yes	0x0125	0x11250125
E125.2	Safety DO2 output circuit diagnosis exception	1	Yes	0x0125	0x21250125
E125.4	DO4 output circuit diagnosis error	1	Yes	0x0125	0x41250125
E125.5	DO5 output circuit diagnosis error	1	Yes	0x0125	0x51250125
E134.1	Discrepancy at two input signals of safety DI1	1	Yes	0x0134	0x11340134
E134.2	Discrepancy at two input signals of DI2	1	Yes	0x0134	0x21340134
E134.3	Discrepancy at two input signals of DI3	1	Yes	0x0134	0x31340134
E134.4	Discrepancy at two input signals of DI4	1	Yes	0x0134	0x41340134
E134.5	Discrepancy at two input signals of DI5	1	Yes	0x0134	0x51340134
E135.0	Chip 3.3 V signal diagnosis exception	1	Yes	0x0135	0x01350135
E150.0	STO safety state applied	1	Yes	0x0150	0x01500150
E150.1	STO input state abnormal	1	Yes	0x0150	0x11500150
E150.2	Buffer 5 V supply error	1	Yes	0x0150	0x21500150
E150.3	STO input circuit hardware diagnosis failure	1	Yes	0x0150	0x31500150
E150.4	PWM Buffer hardware diagnosis failure	1	Yes	0x0150	0x41500150
E150.5	STO input signal interference	1	Yes	0x0150	0x51500150
E151.0	SCI communication error between servo drive and safety module	1	Yes	0x0151	0x01510151
E151.1	SCI communication error between two MCUs of the safety module	1	Yes	0x0151	0x11510151
E152.0	Failure of parameter check between two MCUs of the safety module	1	Yes	0x0152	0x01520152
E152.1	Timeout for sending CRC between two MCUs of the safety module	1	Yes	0x0152	0x11520152
E152.2	Safety module failed to get initial servo drive parameters	1	Yes	0x0152	0x21520152

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Auxiliary code (203Fh)
E160.0	SLS1 threshold exceeded	1	Yes	0x0160	0x01600160
E160.1	SLS2 threshold exceeded	1	Yes	0x0160	0x11600160
E160.2	SLS3 threshold exceeded	1	Yes	0x0160	0x21600160
E160.3	SLS4 threshold exceeded	1	Yes	0x0160	0x31600160
E165.0	SDIp running direction exception	1	Yes	0x0165	0x01650165
E165.1	SDIn running direction exception	1	Yes	0x0165	0x11650165
E170.0	SS1 deceleration ramp exception	1	Yes	0x0170	0x01700170
E170.1	SS2 deceleration ramp exception	1	Yes	0x0170	0x11700170
E170.2	SOS speed or position exceeds the threshold	1	Yes	0x0170	0x21700170
E202.0	Bus discharge overcurrent	1	Yes	0x2312	0x02022202
E202.1	Bus phase P overcurrent	1	Yes	0x2312	0x12022202
E202.2	Bus phase N overcurrent	1	Yes	0x2312	0x22022202
E202.3	Bus current sampling hardware error	1	Yes	0x2312	0x32022202
E203.0	Current feedback closed-loop error of the power cable	1	Yes	0x2312	0x02032203
E203.1	Phase U overcurrent of the power cable	1	Yes	0x2312	0x12032203
E203.2	Phase V overcurrent of the power cable	1	Yes	0x2312	0x22032203
E203.3	Phase W overcurrent of the power cable	1	Yes	0x2312	0x32032203
E203.4	Current detection hardware error of the power cable	1	Yes	0x2312	0x42032203
E208.2	Encoder communication timeout	1	Yes	0x0208	0x22080208
E208.4	FPGA current loop operation timeout	1	Yes	0x0208	0x42080208
E240.0	Excessive deviation between the observed electrical angle and feedback electrical angle	1	Yes	0x0240	0x02402240
E240.1	Angle auto-tuning verification error	1	Yes	0x1240	0x12402240
E240.2	Hall operation verification fault	1	Yes	0x2240	0x22402240
E243.0	Brake release error	1	Yes	0x0243	0x02430243
E243.1	Brake apply error	1	Yes	0x0243	0x12430243
E247.1	Torque saturation fault	1	Yes	0x0247	0x12470247
E248.0	Overspeed reference	1	Yes	0x0248	0x02480248
E320.0	Braking resistor overloaded	1	Yes	0x0320	0x03200320
E320.1	Enclosure temperature of the braking resistor excessively high	1	Yes	0x0320	0x13202320
E321.0	Dynamic brake resistor overloaded	1	Yes	0x0321	0x03210321
E400.0	Main circuit overvoltage	1	Yes	0x3210	0x04000400
E410.0	Main circuit undervoltage	1	Yes	0x3220	0x04100410
E410.1	Main circuit powered off	1	Yes	0x0410	0x14100410

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Auxiliary code (203Fh)
E500.0	Motor overspeed	1	Yes	0x8400	0x05000500
E500.1	Speed feedback overflow	1	Yes	0x8400	0x15000500
E500.2	FPGA position feedback pulse overspeed	1	Yes	0x0500	0x25000500
E602.0	Angle auto-tuning failure	1	Yes	0x0602	0x06022602
E602.1	Angle auto-tuning overtravel	1	Yes	0x0602	0x16022602
E602.2	U/V/W phase sequence reversed	1	Yes	0x0602	0x26020602
E602.3	Excessive encoder feedback fluctuation during angle auto-tuning	1	Yes	0x0602	0x36022602
E602.4	Angle auto-tuning timeout	1	Yes	0x0602	0x46022602
E602.5	Angle auto-tuning failed and Z signal not found	1	Yes	0x0602	0x56022602
E602.6	Angle auto-tuning not convergent	1	Yes	0x0602	0x66022602
E604.0	Inconsistent configurations between gantry axes	1	Yes	0x0604	0x06040604
E604.1	Gantry not set in position mode	1	Yes	0x0604	0x16040604
E604.2	Gantry operates in unsupported functions	1	Yes	0x0604	0x26040604
E604.3	The gantry torque loop scheduling is set improperly.	1	Yes	0x0604	0x36040604
E605.0	Overspeed upon S-ON	1	Yes	0x0605	0x06050605
E612.0	Stall detected in phase sequence auto-tuning	1	Yes	0x0612	0x06122612
E612.1	Overtravel in phase sequence auto-tuning	1	Yes	0x0612	0x16122612
E612.3	Excessive encoder change in angle auto-tuning	1	Yes	0x0612	0x36122612
E612.4	Phase sequence auto-tuning failed, leading to auto-tuning timeout	1	Yes	0x0612	0x46122612
E613.0	Resistance/Inductance auto-tuning timeout	1	Yes	0x0613	0x06132613
E620.0	Motor overload	1	Yes	0x3230	0x06200620
E620.1	Motor overload in overload current limit mode	1	Yes	0x3230	0x16200620
E621.0	Overload current limit torque reached	1	Yes	0x0621	0x06210621
E630.0	Motor stall over-temperature protection	1	Yes	0x7121	0x06300630
E631.0	SBC brake circuit diagnosis exception	1	Yes	0x0631	0x06310631
E631.1	24 V power supply or brake not connected	1	Yes	0x0631	0x16310631
E631.2	P-MOS open circuit	1	Yes	0x0631	0x26310631
E631.3	N-MOS disconnection	1	Yes	0x0631	0x36310631

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Auxiliary code (203Fh)
E640.0	IGBT junction temperature excessively high	1	Yes	0x4210	0x06400640
E640.1	Flywheel diode junction temperature excessively high	1	Yes	0x0640	0x16400640
E650.0	Heatsink temperature excessively high	1	Yes	0x4210	0x06500650
E660.0	Motor temperature excessively high	1	Yes	0x4210	0x06600660
E744.0	Absolute encoder communication timeout	1	Yes	0x7305	0x07442744
E744.2	Absolute encoder error	1	Yes	0x7305	0x27442744
E770.0	Phase A input disconnected in fully closed-loop mode	1	Yes	0x7305	0x07700770
E770.1	Phase B input disconnected in fully closed-loop mode	1	Yes	0x7305	0x17700770
E770.2	Phase Z input disconnected in fully closed-loop mode	1	Yes	0x7305	0x27700770
E770.3	Fully closed-loop external loop encoder communication timeout	1	Yes	0x7305	0x37700770
E770.8	The encoder data transmission delay is too large in fully closed-loop mode	1	Yes	0x7305	0x87700770
E939.0	Motor power cable disconnected	1	Yes	0x0939	0x09390939
EB00.0	Excessive position deviation	1	Yes	0x8611	0x0B000B00

No.2 resettable faults

Table 12–3 No. 2 resettable faults

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Auxiliary code (203Fh)
E122.0	Multi-turn absolute encoder setting error	2	Yes	0x6320	0x01220122
E122.1	DI function allocation error	2	Yes	0x6320	0x11220122
E122.2	DO function assignment fault	2	Yes	0x0122	0x21220122
E122.3	Excessively high upper limit in rotation mode	2	Yes	0x6320	0x31220122
E122.4	VDI function assignment error	2	Yes	0x0122	0x41220122
E122.5	DI and VDI assigned the same function	2	Yes	0x0122	0x51220122
E122.6	Absolute function setting fault of secondary encoder	2	Yes	0x6320	0x61220122
E122.7	Fully closed-loop parameter setting error	2	Yes	0x6320	0x71220122
E122.8	Interpolater version mismatch	2	Yes	0x6320	0x81220122
E126.0	Process segment number error	2	Yes	0x0126	0x01260126

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Auxiliary code (203Fh)
E126.1	Internal operation mode error of the process segment	2	Yes	0x0126	0x11260126
E126.2	Position reference type error in process segment position mode	2	Yes	0x0126	0x21260126
E246.0	Encoder PPR (H0b.70) before power-off different from that after power-off	2	Yes	0x0246	0x02460246
E246.1	Single-turn absolute position (H0b.71) of the encoder before power-off different from that after power-off	2	Yes	0x0246	0x12460246
E246.2	Position feedback changes before and after power-off	2	Yes	0x0246	0x22460246
E249.0	Excessive speed deviation	2	Yes	0x0249	0x02490249
E24A.0	Hard limit reached in the wrong direction	2	Yes	0x6320	0x024A024A
E420.0	Main circuit phase loss	2	Yes	0x3130	0x04200420
E661.0	STune failure	2	Yes	0x0661	0x06610661
E662.0	ETune failure	2	Yes	0x0662	0x06620662
E664.0	Excessive resonance	2	Yes	0x0664	0x06640664
E731.0	Encoder multi-turn position data loss	2	Yes	0x7305	0x07310731
E731.1	Inovance secondary encoder multi-turn position data loss	2	Yes	0x7305	0x17310731
E733.0	Encoder multi-turn counting error	2	Yes	0x7305	0x07330733
E733.1	Inovance secondary encoder multi-turn counting error	2	Yes	0x7305	0x17330733
E735.0	Encoder multi-turn counting overflow	2	Yes	0x7305	0x07350735
E760.0	Encoder over-temperature	2	Yes	0x4210	0x07600760
EB00.1	Position deviation overflow	2	Yes	0x8611	0x1B000B00
EB01.1	Individual position reference increment excessively high	2	Yes	0x6320	0x1B010B01
EB01.2	Position reference increment remains excessively high	2	Yes	0x6320	0x2B010B01
EB01.3	Reference overflow	2	Yes	0x6320	0x3B010B01
EB02.0	Excessive position deviation in fully closed-loop mode	2	Yes	0x8611	0x0B020B02
EB02.1	Position deviation overflow in fully closed-loop mode	2	Yes	0x8611	0x1B020B02
EB03.0	Electronic gear ratio overlimit - H05.02	2	Yes	0x0B03	0x0B030B03
EB03.1	Electronic gear ratio overlimit - Electronic gear ratio 1	2	Yes	0x0B03	0x1B030B03
EB03.2	Electronic gear ratio overlimit - Electronic gear ratio 2	2	Yes	0x0B03	0x2B030B03

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Auxiliary code (203Fh)
EB04.0	Excessive gantry position deviation	2	Yes	0x0B04	0x0B040B04
EB04.1	Gantry position deviation overlimit	2	Yes	0x0B04	0x1B040B04
EB05.0	Excessive standstill deviation	2	Yes	0x0B05	0x1B050B05
ED02.0	Modbus communication timeout	2	Yes	0x0D02	0x0D020D02
EE08.0	Synchronization signal loss	2	Yes	0x0E08	0x0E080E08
EE08.1	Status switchover error	2	Yes	0x0E08	0x1E080E08
EE08.3	Unstable network connection	2	Yes	0x0E08	0x3E080E08
EE08.4	Data frame loss protection error	2	Yes	0x0E08	0x4E080E08
EE08.5	Data frame transfer error	2	Yes	0x0E08	0x5E080E08
EE08.6	Data update timeout	2	Yes	0x0E08	0x6E080E08
EE09.0	Software position limit setting error	2	Yes	0x6320	0x0E090E09
EE09.1	Home setting error	2	Yes	0x6320	0x1E090E09
EE09.2	Gear ratio overlimit	2	Yes	0x6320	0x2E090E09
EE09.3	No synchronization signal	2	Yes	0x6320	0x3E090E09
EE09.5	PDO mapping overlimit	2	Yes	0x6320	0x5E090E09
EE10.0	Protection against MailBox setting error	2	Yes	0x0E10	0x0E100E10
EE10.1	SM2 setting error	2	Yes	0x0E10	0x1E100E10
EE10.2	SM3 setting error	2	Yes	0x0E10	0x2E100E10
EE10.3	PDO watchdog setting error	2	Yes	0x0E10	0x3E100E10
EE10.4	Protection against PLL completion interrupt (no sync signal)	2	Yes	0x0E10	0x4E100E10
EE10.5	PHY setting error	2	Yes	0x0E10	0x5E100E10
EE11.0	ESI validation error	2	Yes	0x5530	0x0E110E11
EE11.1	EEPROM bus read failure	2	Yes	0x5530	0x1E110E11
EE11.2	EEPROM update failure	2	Yes	0x5530	0x2E110E11
EE11.3	Mismatch between ESI file and actual drive model	2	Yes	0x0E11	0x3E110E11
EE13.0	EtherCAT synchronization cycle setting error	2	Yes	0x6320	0x0E130E13
EE15.0	Excessive EtherCAT synchronization cycle error	2	Yes	0x0E15	0x0E150E15
EE17.0	Unexpected FSoE command	2	Yes	0x0E17	0x0E170E17
EE17.1	Unknown FSoE command	2	Yes	0x0E17	0x1E170E17
EE17.2	FSoE invalid connection ID	2	Yes	0x0E17	0x2E170E17
EE17.3	FSoE CRC error	2	Yes	0x0E17	0x3E170E17
EE17.4	FSoE watchdog expired	2	Yes	0x0E17	0x4E170E17
EE17.5	FSoE invalid slave address	2	Yes	0x0E17	0x5E170E17
EE17.6	Invalid FSoE safety data	2	Yes	0x0E17	0x6E170E17

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Auxiliary code (203Fh)
EE17.7	Invalid FSoE communication parameter length	2	Yes	0x0E17	0x7E170E17
EE17.8	Invalid FSoE communication parameter data	2	Yes	0x0E17	0x8E170E17
EE17.9	Invalid FSoE application program parameter length	2	Yes	0x0E17	0x9E170E17
EE17.A	Invalid FSoE application program parameter data	2	Yes	0x0E17	0xAE170E17

12.3.2 List of Alarm Codes

Table 12–4 List of Alarm Codes

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Auxiliary code (203Fh)
E108.0	Storage parameter write error	3	Supported	0x5530	0x01080108
E108.1	Storage parameter read error	3	Supported	0x5530	0x11080108
E108.2	Invalid check on data written in EEPROM	3	Supported	0x5530	0x21080108
E108.3	Invalid check on data read in EEPROM	3	Supported	0x5530	0x31080108
E108.4	A single piece of data is stored too many times	3	Supported	0x0108	0x41080108
E108.5	Safety module EEPROM write timed out	3	Supported	0x0108	0x51080108
E108.6	Safety module EEPROM read timed out	3	Supported	0x0108	0x61080108
E108.7	Safety module EEPROM write check error	3	Supported	0x0108	0x71080108
E108.8	Safety module EEPROM read check error	3	Supported	0x0108	0x81080108
E110.0	Frequency-division pulse output setting error	3	Supported	0x0110	0x01100110
E115.0	SSM parameter setting exception	3	Supported	0x0115	0x01150115
E116.0	SLS overspeed	3	Supported	0x0116	0x01160116
E116.1	SDI out of tolerance	3	Supported	0x0116	0x11160116
E120.3	Drive and motor power not match	3	Supported	0x7122	0x31200120
E121.0	Invalid S-ON command	3	Supported	0x0121	0x01210121
E126.3	PR process segment parameter beyond the upper/lower limit	3	Supported	0x0126	0x31260126
E244.0	Abnormal input torque reference	3	Supported	0x0244	0x02440244
E244.1	An error occurs during internal torque/ speed limit calculation	3	Supported	0x0244	0x12440244
E247.0	Torque saturation alarm	3	Supported	0x0247	0x02470247
E510.0	Frequency division pulse output overspeed	3	Supported	0x0510	0x05100510
E600.0	Inertia auto-tuning failure	3	Supported	0x0600	0x06000600

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Auxiliary code (203Fh)
E601.0	Homing alarm	3	Supported	0x0601	0x06010601
E601.1	Homing switch error	3	Supported	0x0601	0x16010601
E601.2	Homing mode setting error	3	Supported	0x0601	0x26010601
E601.3	Position feedback error	3	No	0x0601	0x36010601
E601.4	Gantry homing mode setting error	3	Supported	0x0601	0x46010601
E602.9	Angle auto-tuning not performed on incremental encoder	3	Supported	0x0602	0x96022602
E607.0	Excessive gantry torque deviation	3	Supported	0x0607	0x06070607
E608.0	Incorrect master-to-slave parameter settings	3	Supported	0x0608	0x06080608
E609.0	Data storage timeout	3	Supported	0x0609	0x06090609
E609.1	Data storage overflow	3	Supported	0x0609	0x16090609
E609.2	Data storage failure	3	Supported	0x0609	0x26090609
E609.3	Data erasure failure	3	Supported	0x0609	0x36090609
E621.1	Overload current limit torque reached	3	Supported	0x0621	0x16210621
E631.4	P-MOS disconnection	3	Supported	0x0631	0x46310631
E631.5	N-MOS disconnection	3	Supported	0x0631	0x56310631
E730.0	Encoder battery alarm	3	Supported	0x7305	0x07300730
E730.1	Inovance secondary encoder battery voltage too low	3	Supported	0x7305	0x17300730
E831.1	AI1 zero offset too large	3	Supported	0x0831	0x18310831
E831.2	AI2 zero offset too large	3	Supported	0x0831	0x28310831
E834.1	AI1 overvoltage alarm	3	Supported	0x0834	0x18340834
E834.2	AI2 overvoltage	3	Supported	0x0834	0x28340834
E900.0	DI emergency braking	3	Supported	0x0900	0x09000900
E902.0	DI/VDI setting invalid	3	Supported	0x6320	0x09020902
E902.1	DO/VDO setting invalid	3	Supported	0x0902	0x19020902
E902.2	Torque reach setting invalid	3	Supported	0x0902	0x29020902
E909.0	Motor overload alarm	3	Supported	0x3230	0x09090909
E910.0	Control circuit overvoltage	3	Supported	0x3210	0x09100910
E920.0	Braking resistor overload	3	Supported	0x3210	0x09200920
E921.0	Dynamic braking resistor overload alarm	3	Supported	0x3210	0x09210921
E922.0	Resistance of the external braking resistor too small	3	Supported	0x6320	0x09220922
E924.0	Braking transistor over-temperature	3	Supported	0x3230	0x09240924
E940.0	The controlled motor changes. It is recommended to restore default values before use.	3	Supported	0x0940	0x09400940

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Auxiliary code (203Fh)
E941.0	Modified parameters activated at next power-on	3	No	0x6320	0x09410941
E942.0	Parameter storage too frequent	3	Supported	0x7600	0x09420942
E950.0	Forward overtravel	3	Supported	0x5443	0x09500950
E952.0	Reverse overtravel	3	Supported	0x5444	0x09520952
E954.0	Position reference overflow	3	Supported	0x0954	0x09540954
E956.0	Overtravel upon forward run in process segment mode	3	Supported	0x0956	0x09560956
E958.0	Overtravel upon reverse run in process segment mode	3	Supported	0x0958	0x09580958
E971.0	Undervoltage alarm for voltage drop protection	3	Supported	0x0971	0x09710971
E980.0	Frequency-division output overflow	3	Supported	0x0980	0x09800980
EA34.9	Hall not configured during Hall auto-tuning	3	Supported	0x0A34	0x9A340A34
EA41.0	Torque fluctuation compensation failure	3	Supported	0X0A41	0x0A410A41
EE08.7	Error frame alarm	3	Supported	0x0E08	0x7E08EE08

12.3.3 Description of Fault Codes

12.3.3.1 Troubleshooting Faults

E101.0: Abnormal parameters in groups H02 and above

Fault 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 also occurs after software update generally.

Troubleshooting:

Cause	Verification method	Solution
1. The actual parameter value exceeds the upper/lower limit of the parameter.	View the abnormal parameter group number through H0b.90 and H0b.91.	1. Rectify the wrong values value. 2. Restore the default settings.
2. The voltage of the control circuit power supply drops instantaneously.	1. Check whether the control circuit (L1C, L2C) is in the process of power-off or instantaneous power failure occurs. 2. Measure whether the voltage input of the control cable on the non-drive side during operation is within the following specifications: 200 V servo drive: Effective value: 200 V to 240 V Allowable deviation: 10% to +10% (180 V to 264 V) 400 V servo drive: Effective value: 380V to 480 V Allowable deviation: 10% to +10% (342 V to 528 V)	1. Restore system parameters to default (H02.31 = 1) and write parameters again. 2. Enlarge the power capacity or replace with a power supply of higher capacity, restore system parameters to default values (H02.31 = 1), and then write parameters again.
3. Instantaneous power failure occurs during parameter storage.	Check whether instantaneous power failure occurs during parameter storage.	Power on the system again, restore system parameters to default (H02.31 = 1), and write parameters again.
4. The parameter write count within a certain period exceeds the limit.	1. Check whether instantaneous power failure occurs during parameter storage. 2. Check whether parameters are updated frequently through the host controller.	1. If the drive is faulty, replace the drive. 2. Change the way of writing and write parameters again. 3. Power on the system, restore default setting (H02.31 = 1) and write parameters again.
5. The software is upgraded.	Check whether parameter values in group H02 and above exceed the upper/lower limit due to software update.	Reset the servo drive model and servo motor model, and restore system parameters to default (H02.31 = 1).
6. The servo drive is faulty.	Restart the power supply and restore parameters to default settings. If the fault persists, the drive is faulty.	Replace the servo drive.

E101.1: Parameter error in group H00/H01

Fault cause:

The total number of parameters changes, which generally occurs after software update. Values of parameters in groups H00 or H01 exceed the limit, which generally occurs after software update.

Troubleshooting:

Cause	Verification method	Solution
The drive detects whether parameter values in groups H00 and H01 exceed the upper/lower limit range during initialization upon power-on. If yes, the 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.	View the abnormal parameter group number through H0b.90 and H0b.91. Check which parameter in groups H00 and H01 exceeds the limit range. Check whether this parameter range is abnormal.	Replace the motor or servo drive.

E101.2: Address error in read/write operation after the number of parameters changes

Fault cause:

Address error in read/write operation after the number of parameters changes.

Troubleshooting:

Cause	Verification method	Solution
The total number of parameters changes after software update, leading to an address error in read/ write operation.	View the abnormal parameter group number through H0b.90 and H0b.91.	1. Rectify the wrong values value.2. Restore the default settings.

E101.3: CRC error during safety parameter initialization

Fault cause:

The CRC value of the safety parameters is abnormal, which generally occurs after software update.

Troubleshooting:

Cause	Verification method	Solution
1. The software is upgraded.	Check whether the software is upgraded.	Restore safety parameters to default settings.
2. The voltage of the control circuit power supply drops instantaneously.	1. Check whether the control power is being cut off (L1C, L2C) or instantaneous power failure occurs. 2. Measure whether the input voltage of the control cable on the non-drive side during operation meets the following specifications: 200 V drive: Effective value: 200 V to 240 V Allowable deviation: -10% to 10% (180 V to 264 V) 400 V drive: Effective value: 380V to 480 V Allowable deviation: -10% to +10% (342 V to 528 V)	1. Restore safety parameters to default settings and write parameters again. 2. Increase the power supply capacity or replace the power supply with a power supply of higher capacity. Restore the safety parameters to default settings and write the parameters again.
3. Instantaneous power failure occurs during parameter storage.	Check whether instantaneous power failure occurs when saving parameters.	Power on again, restore the safety parameters to default settings and write parameters again.

Cause	Verification method	Solution
4. The parameter write count within a certain period exceeds the limit.	Check whether parameters are updated frequently through the host controller.	Change the parameter writing method and write parameters again.
5. The safety module has failed.	If the fault persists after powering on the device multiple times and restoring the default parameters, the safety module is faulty.	Replace the safety module.

E101.4: Error in upper and lower limits verification during safety parameter initialization

Fault cause:

1. The total number of parameters changes, which generally occurs after software update.
2. Values of parameters in groups H02 and above exceed the limit, which generally occurs after software update.

Troubleshooting:

Cause	Verification method	Solution
1. The software is upgraded.	Check whether the software is upgraded.	Restore safety parameters to default settings.
2. The voltage of the control circuit power supply drops instantaneously.	1. Check whether the control power is being cut off (L1C, L2C) or instantaneous power failure occurs. 2. Measure whether the input voltage of the control cable on the non-drive side during operation meets the following specifications: 200 V drive: Effective value: 200 V to 240 V Allowable deviation: -10% to 10% (180 V to 264 V) 400 V drive: Effective value: 380V to 480 V Allowable deviation: -10% to +10% (342 V to 528 V)	1. Restore safety parameters to default settings and write parameters again. 2. Increase the power supply capacity or replace the power supply with a power supply of higher capacity. Restore the safety parameters to default settings and write the parameters again.
3. Instantaneous power failure occurs during parameter storage.	Check whether instantaneous power failure occurs during parameter storage.	Power on again, restore the safety parameters to default settings and write parameters again.
4. The parameter write count within a certain period exceeds the limit.	Check whether parameters are updated frequently through the host controller.	Change the parameter writing method and write parameters again.
5. The safety module has failed.	If the fault persists after powering on the device multiple times and restoring the default parameters, the safety module is faulty.	Replace the safety module.

E101.5: Address error in read/write operation after the number of parameters changes

Fault cause:

The total number of the safety parameters changes, which generally occurs after software update.

Troubleshooting:

Cause	Verification method	Solution
1. The software is upgraded.	Check whether the software is upgraded.	Restore safety parameters to default settings.
2. The safety module is faulty.	If the fault persists after parameters are restored to default and the servo drive is powered off and on repeatedly, the safety module is faulty.	Replace the safety module.

E101.9: Parameter attribute initialization check error

Fault cause:

An error occurs during parameter property initialization verification.

Troubleshooting:

Cause	Verification method	Solution
Parameter attribute initialization check error	Check whether a parameter has been written to H0A.99.	Restore parameters to default first, then restart the drive. If the fault persists after repeated restart, replace the drive.

E102.0: FPGA communication establishment error

Fault cause:

The communication between MCU and FPGA cannot be established.

Troubleshooting:

Cause	Verification method	Solution
The communication between MCU and FPGA cannot be established.	Check whether the fault persists after the drive is powered off and on repeatedly.	Replace the servo drive.

E102.1: FPGA initialization startup error

Fault cause:

FPGA failed.

Troubleshooting:

Cause	Verification method	Solution
FPGA cannot start.	Check whether the fault persists after the drive is powered off and on repeatedly.	Replace the servo drive.

E102.8: FPGA and MCU versions mismatch

Fault cause:

FPGA and MCU software versions do not match.

Troubleshooting:

Cause	Verification method	Solution
The software versions of MCU and FPGA are inconsistent.	1. Check whether the MCU version of H01.00 is 9xx.x (the 4th digit on the keypad is 9). 2. Check whether the FGPA version of H01.01 is 9xx.x (the 4th digit on the keypad is 9).	Contact Inovance for technical support. Update the FPGA or MCU software.

E104.1: MCU operation timeout (MCU crashed)

Fault cause:

The access to MCU times out.

Troubleshooting:

Cause	Verification method	Solution
1. The FPGA is faulty. 2. The communication handshake between FPGA and HOST is abnormal. 3. Access timeout occurs between the HOST and the coprocessor.	Check whether the fault persists after the drive is powered off and on repeatedly.	Replace the servo drive.

E104.2: FPGA operation timeout (FPGA crashed)

Fault cause:

The MCU torque interrupt scheduling time is abnormal. This fault is reported only in the commissioning phase.

Troubleshooting:

Cause	Verification method	Solution
1. The FPGA is faulty. 2. The communication handshake between the FPGA and the MCU is abnormal.	Check whether the fault persists after the drive is powered off and on repeatedly.	Replace the servo drive.

E104.4: MCU reference update timeout

Fault cause:

Take the moment when interrupt starts as the start time, an alarm can be triggered if the time taken for the command to be written to the MCU is longer than the time taken for FPGA to start the position and speed regulator.

Troubleshooting:

Cause	Verification method	Solution
The system reports that the encoder communication time is set improperly, or the command calculation time is excessively long.	Check whether the fault persists after the drive is powered off and on repeatedly.	1. Hide unnecessary functions. 2. Replace the servo drive.

E104.5: The number of interrupts in the safety module FPGA is abnormal

Fault cause:

The number of interrupts detected in 1 ms is less than four.

Troubleshooting:

Cause	Verification method	Solution
1. The FPGA is abnormal. 2. The connection between the servo drive and the safety module is abnormal. 3. The connection between the drive and safety module is abnormal.	Frequent power-off/on operations can lead to this fault.	Replace the drive and safety module.

E104.6: Safety module FPGA interrupt timed out

Fault cause:

The FPGA interrupt execution time exceeds the interrupt scheduling time.

Troubleshooting:

Cause	Verification method	Solution
The safety module is faulty.	Frequent power-off/on operations can lead to this fault.	Replace the drive and safety module.

E120.0: Unknown encoder type

Fault cause:

The servo drive detects the encoder model during initialization upon power-on. If the encoder model does not comply with the requirement, E120.0 occurs.

Troubleshooting:

Cause	Verification method	Solution
1. The product (motor or servo drive) code does not exist.	Read the nameplates of the servo drive and motor to check whether SV680N series servo drive and 26-bit servo motor are used. Meanwhile, check whether H00.00 (Motor code) is set to 14102. View the servo drive code (H01.02) to check whether this servo drive code exists.	If the motor code is unknown, set H00.00 to 14102 when the SV680N series servo drive and servo motor equipped with 26-bit encoder are used. If the drive code does not exist, check whether the servo drive model is correct according to the nameplate. If incorrect, contact Inovance technical support.
2. The power rating of the motor does not match that of the servo drive.	Check whether the servo drive model (H01.02) matches the bus motor model (H00.05).	Replace the product that does not match.

E120.1: Unknown motor model

Fault cause:

The drive detects the motor model defined by H00.00 during initialization upon power-on. If the motor model does not exist, E120.1 occurs.

Troubleshooting:

Cause	Verification method	Solution
The motor model defined by H00.00 is abnormal.	Check whether the motor code (H00.00) matches the nameplate of the motor used.	Rectify the value of H00.00 and set the motor code correctly.

E120.2: Unknown drive model

Fault cause:

The servo drive detects the drive model defined by H01.10 during initialization upon power-on. If the servo drive model does not exist, E120.2 occurs.

Troubleshooting:

Cause	Verification method	Solution
H01.10 is set improperly.	Check the value of H01.10.	Replace the servo drive.

E120.5: Motor and drive current mismatch

Fault cause:

The rated output of the drive is much higher than the rated current of the motor. Use a servo drive of lower rated output or a motor with higher rated current.

Troubleshooting:

Cause	Verification method	Solution
The internal scale value is abnormal.	Check whether the servo drive model is correct. If the current sampling coefficient is excessively high, calculation overflow can occur.	Replace the servo drive.

E120.6: FPGA and motor model mismatch

Fault cause:

1. The motor model is set improperly, causing mismatch and malfunction of the drive.
2. The motor model is set properly, but the motor encoder is not supported by the drive.

Troubleshooting:

Cause	Verification method	Solution
The FPGA software version does not match the motor model specified by H00.00.	Check whether the FPGA software version (H01.01) supports the motor model set by H00.00.	Update the FPGA software to support the motor model set by H00.00 or replace the motor.

E120.7: Model parameter verification error

Fault cause:

The servo drive model parameter is not correct.

Troubleshooting:

Cause	Verification method	Solution
Model parameter CRC failed.	Check whether the model parameters are lost or not programmed.	Program the model parameters again.

E120.8: Junction temperature parameter verification error

Fault cause:

The junction temperature parameter is identified incorrectly.

Troubleshooting:

Cause	Verification method	Solution
Junction temperature parameter CRC failed.	Check whether the junction temperature parameters are lost or not programmed.	Program the junction temperature parameter again.

E122.0: Multi-turn absolute encoder setting error

Fault cause:

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

Troubleshooting:

Cause	Verification method	Solution
The motor does not match the absolute position mode or the motor code is set incorrectly.	1. View the motor nameplate to confirm if the motor is a multi-turn absolute encoder motor. 2. Check whether the motor model (H00.00) is correct.	Reset H00.00 (motor code) according to the motor nameplate or use a suitable motor.

E122.1: Different DIs assigned with the same function

Fault cause:

1. The same function is assigned to different DIs.
2. The DI function No. exceeds the maximum number allowed for DI functions.

Troubleshooting:

Cause	Verification method	Solution
1. The same function is assigned to different DIs.	Check whether parameters in groups H03 (H03.02, and H03.04 to H03.20) and H17 (H17.00, and H17.02 to H17.30) are assigned with the same non-zero DI function number.	Assign different DI function numbers to parameters in groups H03 or H17, and then restart the control circuit to activate the assignment, or switch off the S-ON signal and send a RESET signal to activate the assignment.
2. The DI function No. exceeds the maximum number allowed for DI functions.	Check whether the MCU program is updated.	Restore system parameters to default values (H02.31 = 1) and restart the servo drive.

E122.2: Different DOs assigned with the same function

Fault cause:

The DO function No. exceeds the maximum number allowed for DO functions.

Troubleshooting:

Cause	Verification method	Solution
The DO function No. exceeds the maximum number allowed for DO functions.	Check whether DO function numbers defined by H04.00 and H04.02 are abnormal.	Set the correct DO function No.

E122.3: Invalid upper limit in rotation mode

Fault cause:

The upper limit of mechanical single-turn position exceeds 2^{31} in absolute rotation mode.

Troubleshooting:

Cause	Verification method	Solution
The upper limit (reference range) of the mechanical single-turn position exceeds 2^{31}.	Check the setting of the mechanical gear ratio, the upper limit of the mechanical single-turn position, and the electronic gear ratio when the servo drive runs in absolute rotation mode (H02.01 = 2).	Reset the mechanical gear ratio, the upper limit of mechanical single-turn position and the electronic gear ratio to ensure the upper limit of mechanical single-turn position (reference range) does not exceed 2^{31}.

E122.4: Different VDIs assigned with the same function

Fault cause:

The same function is assigned to different VDIs. The VDI function No. exceeds the maximum number allowed for VDI functions.

Troubleshooting:

Cause	Verification method	Solution
1. The same function is assigned to different VDIs.	Check whether parameters in groups H03 (H03.02, and H03.04 to H03.20) and H17 (H17.00, and H17.02 to H17.30) are assigned with the same non-zero DI function number.	Assign different DI function numbers to parameters in groups H03 or H17, and then restart the control circuit to activate the assignment, or switch off the S-ON signal and send a RESET signal to activate the assignment.
2. The VDI function No. exceeds the maximum number allowed for VDI functions.	Check whether the MCU program is updated.	Restore system parameters to default values (H02.31 = 1) and restart the servo drive.

E122.5: DI and VDI assigned with the same function

Fault cause:

The same function is assigned to different VDIs. The VDI function No. exceeds the maximum number allowed for VDI functions.

Troubleshooting:

Cause	Verification method	Solution
Two or more DIs and VDIs are assigned with the same function No.	Check whether DI function numbers set in groups H03 and H17 are repetitive.	Make sure that each DI or VDI is assigned a unique function No.

E122.6: Absolute function setting fault of the secondary encoder

Fault cause:

The motor does not match the absolute mode.

Troubleshooting:

Cause	Verification method	Solution
The motor does not match the absolute mode.	Check the motor nameplate to confirm whether the motor is configured with a multi-turn absolute encoder.	Set H0F.02 to 0.

E122.7: Fully closed-loop parameter setting error

Fault cause:

In fully closed-loop applications, the rotation mode is set in the inner loop.

Troubleshooting:

Cause	Verification method	Solution
When H0F.00 is not 0, set H02.01 to 2 (absolute position rotation mode).	Check the value of H02.01 if fully closed-loop is used.	Set the value of H02.01 to 2 if fully closed-loop is used.

E122.8: Interpolater version mismatch

Fault cause:

Interpolater version mismatch

Troubleshooting:

Cause	Verification method	Solution
T2 Interpolator mismatch with motor	Check whether the setting of H00.50 is consistent with that of H00.51 and neither of them are set to 65535.	1. Avoid cross-utilization of the interpolator. 2. For alarms caused by replacement of the interpolator, write the corresponding parameter default values to the interpolator.

E124.0: Different DIs allocated with the same function

Fault cause:

The function numbers of the safety DI terminals are duplicated.

Troubleshooting:

Cause	Verification method	Solution
One DI function cannot be reused by two or more DI terminals.	Check whether the same number is selected for different DIs.	Ensure that the number is unique.

E124.1: DI1 input circuit diagnosis exception

Fault cause:

Send a diagnostic signal to DI1 to detect whether the feedback signal is correct.

Troubleshooting:

Cause	Verification method	Solution
The MCU sends a diagnostic signal. The feedback signal is incorrect.	1. Check whether the DI1 input circuit is normal. 2. Disconnect and then reconnect the 24 V input voltage of DI1, and observe whether the input signal of DI1 changes (You can sample and analyze the input signal of DI1 through the oscilloscope in the software tool).	1. If the DI1 circuit is abnormal, hide DI1 by setting its function number to 0. 2. If it cannot be hidden, it is recommended to replace the safety control board.

E124.2: Safety DI2 input circuit diagnosis exception

Fault cause:

Send a diagnostic signal to DI2 to check whether the feedback signal is correct.

Troubleshooting:

Cause	Verification method	Solution
The MCU sends a diagnostic signal. The feedback signal is incorrect.	1. Check whether the DI2 input circuit is normal. 2. Disconnect and then reconnect the 24 V input voltage of DI2, and observe whether the input signal of DI2 changes (You can sample and analyze the input signal of DI2 through the oscilloscope in the software tool).	1. If the DI2 circuit is abnormal, hide DI2 by setting its function number to 0. 2. If it cannot be hidden, it is recommended to replace the safety control board.

E124.3: DI3 input circuit diagnosis exception

Fault cause:

Send a diagnostic signal to DI3 to check whether the feedback signal is correct.

Troubleshooting:

Cause	Verification method	Solution
The MCU sends a diagnostic signal. The feedback signal is incorrect.	1. Check whether the DI3 input circuit is normal. 2. Disconnect and then reconnect the 24 V input voltage of DI3, and observe whether the input signal of DI3 changes (You can sample and analyze the input signal of DI3 through the oscilloscope in the software tool).	1. If the DI3 circuit is abnormal, hide DI3 by setting its function number to 0. 2. If it cannot be hidden, it is recommended to replace the safety control board.

E124.4: DI4 input circuit diagnosis exception

Fault cause:

Send a diagnostic signal to DI4 to check whether the feedback signal is correct.

Troubleshooting:

Cause	Verification method	Solution
The MCU sends a diagnostic signal. The feedback signal is incorrect.	1. Check whether the DI4 input circuit is normal. 2. Disconnect and then reconnect the 24 V input voltage of DI4, and observe whether the input signal of DI4 changes (You can sample and analyze the input signal of DI4 through the oscilloscope in the software tool).	1. If the DI4 circuit is abnormal, mask DI4 by setting its function number to 0. 2. If it cannot be masked, it is recommended to replace the safety control board.

E124.5: DI5 input circuit diagnosis exception

Fault cause:

Send a diagnostic signal to DI5 to detect whether the feedback signal is correct.

Troubleshooting:

Cause	Verification method	Solution
The MCU sends a diagnostic signal. The feedback signal is incorrect.	1. Check whether the DI5 input circuit is normal. 2. Disconnect and then reconnect the 24 V input voltage of DI5, and observe whether the input signal of DI5 changes (You can sample and analyze the input signal of DI5 through the oscilloscope in the software tool).	1. If the DI5 circuit is abnormal, mask DI5 by setting its function number to 0. 2. If it cannot be masked, it is recommended to replace the safety control board.

E125.0: SSM assigned with non-safety DO serial number

Fault cause:

Check whether SSM is assigned to DO3 and DO6.

Troubleshooting:

Cause	Verification method	Solution
The SSM cannot use non-safety DO as signal output.	Check whether the function numbers of DO3 and DO6 are set to "12: SSM-active".	Do not assign the DO3 and DO6 with SSM functions.

E125.1: DO1 output circuit diagnosis exception

Fault cause:

When DO1 is active, the MCU sends a diagnostic pulse to DO1 to detect whether the AD sampling value of the feedback signal is below 0.3 V.

Troubleshooting:

Cause	Verification method	Solution
After the MCU sends a diagnostic pulse to DO1, the feedback voltage received by the MCU is not below the expected 0.3 V.	Perform fault reset to check whether the fault can be cleared. If the fault persists, check whether there is leakage current in the DO1 output circuit.	Disable DO1, and the safety module no longer detects whether there is a leakage current risk in DO1.

E125.2: Safety DO2 output circuit diagnosis exception

Fault cause:

When DO2 is active, the MCU sends a diagnostic pulse to DO2 to detect whether the AD sampling value of the feedback signal is lower than 0.3 V.

Troubleshooting:

Cause	Verification method	Solution
After the MCU sends a diagnostic pulse to DO2, the feedback voltage received by the MCU is higher than 0.3 V.	Perform fault reset to check whether the fault can be cleared. If the fault persists, check whether there is leakage current in the DO2 output circuit.	Disable DO2, and the safety module no longer detects whether there is a leakage current risk in DO2.

E125.4: Safety DO4 output circuit diagnosis exception

Fault cause:

When DO4 is active, the MCU sends a diagnostic pulse to DO4 to detect whether the AD sampling value of the feedback signal is lower than 0.3 V.

Troubleshooting:

Cause	Verification method	Solution
After the MCU sends a diagnostic pulse to DO4, the feedback voltage received by the MCU is higher than 0.3 V.	Perform fault reset to check whether the fault can be cleared. If the fault persists, check whether there is leakage current in the DO4 output circuit.	Disable DO4, and the safety module no longer detects whether there is a leakage current risk in DO4.

E125.5: Safety DO5 output circuit diagnosis exception

Fault cause:

When DO4 is active, the MCU sends a diagnostic pulse to DO5 to detect whether the AD sampling value of the feedback signal is lower than 0.3 V.

Troubleshooting:

Cause	Verification method	Solution
After the MCU sends a diagnostic pulse to DO5, the feedback voltage received by the MCU is higher than 0.3 V.	Execute fault reset to check whether the fault can be cleared. If the fault persists, check whether there is leakage current in the DO5 output circuit.	Disable DO5, and the safety module no longer detects whether there is a leakage current risk in DO5.

E126.0: Process segment number error

Fault cause:

The process segment number is not 1000 or any other value from 0 to 15 in the process segment mode.

Troubleshooting:

Cause	Verification method	Solution
The process segment number is not 1000 or any other value from 0 to 15 in the process segment mode.	Check whether the value of H22.00 exceeds the specified range of process segment number (0–15 or 1000).	Write 0 to 15 to H22.00 in process segment mode.

E126.1: Process segment internal operation mode error

Fault cause:

The process segment operation mode is not 0, 1, 2, 3, 7, or 8.

Troubleshooting:

Cause	Verification method	Solution
The process segment operation mode is not 0, 1, 2, 3, 7, or 8.	Check whether the values of bit0 to bit3 of the parameter defined by the process segment in fault state are 0, 1, 2, 3, 7, and 8.	Set the process segment operation mode to 0, 1, 2, 3, 7, and 8.

E126.2: Position reference type error in process segment position mode

Fault cause:

The position reference type in the process segment position mode is not 00 (Absolute reference) or 10 (incremental mode).

Troubleshooting:

Cause	Verification method	Solution
The position reference type in the process segment position mode is not 00 (Absolute reference) or 10 (incremental mode).	Check whether the value of bit6 or bit7 of the parameter defined by the process segment at fault is 00 or 10.	Set the position reference type in the process segment position mode to 00 (Absolute reference) or 10 (Incremental reference).

E134.1: Discrepancy at two input signals of DI1

Fault cause:

Check whether the DI1 input signal exceeds the value of H20.14.

Troubleshooting:

Cause	Verification method	Solution
The fault code is reported when the difference between two inputs of safety DI1 exceeds the value of H20.14.	Check whether the difference lasts longer than the setpoint of H20.14.	Ensure the difference does not last for a period of time longer than the value of H20.14.

E134.2: Discrepancy at two input signals of DI2

Fault cause:

Check whether the two input signals of DI2 exceed the value of H20.15.

Troubleshooting:

Cause	Verification method	Solution
The fault code is reported when the difference between two inputs of safety DI2 exceeds the value of H20.15.	Check whether the difference lasts longer than the setpoint of H20.15.	Ensure the difference does not last longer than the setpoint of H20.15.

E134.3: Discrepancy at two input signals of DI3

Fault cause:

Check whether the two input signals of DI3 exceed the value of H20.16.

Troubleshooting:

Cause	Verification method	Solution
The fault code is reported when the difference between two inputs of safety DI3 exceeds the value of H20.16.	Check whether the difference lasts longer than the setpoint of H20.16.	Ensure the difference does not last longer than the value of H20.16.

E134.4: Discrepancy at two input signals of DI4

Fault cause:

Check whether the two input signals of DI4 exceed the value of H20.17.

Troubleshooting:

Cause	Verification method	Solution
The fault code is reported when the difference between two inputs of safety DI4 exceeds the value of H20.17.	Check whether the difference lasts longer than the setpoint of H20.17.	Ensure the difference does not last longer than the value of H20.17.

E134.5: Discrepancy at two input signals of DI5

Fault cause:

Check whether the DI5 input signal exceeds the value of H20.18.

Troubleshooting:

Cause	Verification method	Solution
The fault code is reported when the difference between two inputs of safety DI5 exceeds the value of H20.18.	Check whether the difference lasts longer than the setpoint of H20.18.	Ensure the difference does not last longer than the value of H20.18.

E135.0: Chip 3.3V signal diagnosis error

Fault cause:

The two integrated circuits diagnose whether the supply voltage of each other is within the allowable range of 3.0 V to 3.6 V.

Troubleshooting:

Cause	Verification method	Solution
The chip voltage is out of the range of 3.0 V to 3.6 V.	Power cycle the drive to check whether the fault persists.	Replace the servo drive.

E136.0: Encoder ROM motor parameter check error

Fault cause:

When reading parameters from the encoder ROM, the servo drive detects that no parameters are saved or parameter values are inconsistent with the setpoints.

Troubleshooting:

Cause	Verification method	Solution
1. The servo drive model does not match the motor model.	View the servo drive and servo motor nameplates to check whether the SV680N series servo drive and servo motor are used.	Replace the servo drive and motor.
2. A parameter check error occurs, or no parameter is saved in the serial incremental encoder ROM.	1. Check whether the encoder cable provided by Inovance is used. Cables are connected securely without scratching, breaking or poor contact on both ends. 2. Measure signals PS+, PS-, +5 V and GND on both ends of the encoder cable and observe whether signals at both ends are consistent. For signal assignment, see Chapter "Wiring" in the hardware guide.	1. Use the encoder cable provided by Inovance. Ensure motor terminals are connected securely and servo drive screws are tightened properly. Use a new encoder cable if necessary. 2. Route encoder cables and power cables (R/S/T, U/V/W) through different routes.
3. The drive is faulty.	The fault persists after the servo drive is restarted.	Replace the servo drive.

E136.1: Encoder ROM motor parameter read error

Fault cause:

The encoder cable is not connected properly.

A communication error occurs on the encoder due to interference.

Troubleshooting:

Cause	Verification method	Solution
1. The encoder cable connections are incorrect or loosened.	Check the encoder cable connection. Check whether ambient vibration is excessive, which loosens the encoder cable and even damages the encoder.	1. Connect the cables again according to the correct wiring diagram. 2. Connect the cables again and ensure encoder terminals are connected securely.
2. The servo drive is faulty.	The fault persists after the servo drive is restarted.	Replace the servo drive.
3. The encoder communication is being disturbed.	Check whether the fault 136.1 occurs.	Install the magnetic ring and ensure that the power cable and communication cable are routed through different routes.

E136.9: Dimension parameter initialization error

Fault cause:

Range parameter initialization error

Troubleshooting:

Cause	Verification method	Solution
An encoder read/write error causes 32-bit scaling compatibility initialization error.	Check whether compatibility is enabled in H32.50.	1. Disable the compatibility function. If the encoder communication fault persists, take corresponding measures. 2. If the drive can be powered on normally after the compatibility function is disabled but an alarm is reported, contact Inovance technical support.

E138.0: Accuracy compensation data error

Fault cause:

The accuracy compensation data is lost, leading to check failure.

Troubleshooting:

Cause	Verification method	Solution
1. The accuracy compensation data is lost, leading to check failure. 2. The flash hardware is faulty.	Read the drive compensation data through the software tool to observe whether the data is normal.	1. Perform compensation through the software tool again, and restart the drive. 2. If the fault persists, contact Inovance.

E138.1: Cogging fluctuation compensation data check failure

Fault cause:

The cogging fluctuation compensation data is lost, leading to check failure.

Troubleshooting:

Cause	Verification method	Solution
1. The cogging fluctuation compensation data is lost, leading to check failure. 2. The flash hardware is faulty.	Read the data through software tool.	1. Perform compensation again, and restart the drive. 2. If the fault persists, contact Inovance.

E138.2: Gantry synchronization compensation data validation failure

Fault cause:

The gantry synchronization compensation data is lost, leading to validation failure.

Troubleshooting:

Cause	Verification method	Solution
1. The gantry synchronization compensation data is lost, leading to validation failure. 2. The flash hardware is faulty.	Read the data through software tool.	1. Perform compensation again, and restart the drive. 2. If the fault persists, contact Inovance.

E138.3: Overload compensation data validation failure

Fault cause:

The overload compensation data is lost, leading to validation failure.

Troubleshooting:

Cause	Verification method	Solution
1. The overload compensation data is lost, leading to validation failure. 2. The flash hardware is faulty.	Read the data through software tool.	1. Perform compensation again, and restart the drive. 2. If the fault persists, contact Inovance.

E140.0: Encryption integrated circuit verification fault

Fault cause:

Encryption integrated circuit verification failure

Troubleshooting:

Cause	Verification method	Solution
The encryption software is not programmed.	Check whether the fault persists after restart.	Contact the manufacturer to re-program the encryption software.

E140.2: Encryption chip version error

Fault cause:

The MCU does not establish communication with the encryption chip.

Troubleshooting:

Cause	Verification method	Solution
The encryption software is not programmed.	Check whether the fault persists after restart.	Contact the manufacturer to re-program the encryption software.

E140.3: Encryption chip damaged

Fault cause:

The MCU does not establish communication with the encryption chip.

Troubleshooting:

Cause	Verification method	Solution
The MCU does not establish communication with the encryption chip.	Check whether the fault persists after restart.	Contact the manufacturer to re-program the encryption software.

E145.0: Safety module chip diagnosis failure

Fault cause:

The diagnosis on the safety module integrated circuit failed.

Troubleshooting:

Cause	Verification method	Solution
1. The CPU diagnosis on the integrated circuit failed. 2. The RAM diagnosis on the integrated circuit failed. 3. The FLASH diagnosis on the integrated circuit failed. 4. Stack overflow occurs on the software program.	Frequent power-off/on operations can lead to this fault.	Replace the drive and safety module.

E145.1: Safety module program execution exception

Fault cause:

The internal program execution of the safety module is abnormal and the 16 kHz interrupt function is not executed.

Troubleshooting:

Cause	Verification method	Solution
The internal program execution of the safety module is abnormal and the 16 kHz interrupt function is not executed.	The fault still exists after power off and restart.	Return it to the manufacturer for service.

E150.0: STO safety state applied

Fault cause:

The STO input protection applies (safety state).

Troubleshooting:

Cause	Verification method	Solution
One or two 24 V inputs are disconnected, triggering the STO function.	1. Check whether the STO function is activated. 2. Check whether the STO power supply is normal. 3. Check whether the fault persists after the preceding causes are rectified.	There is no need to take any corrective actions. After the STO terminal is back to normal, clear the fault using the fault reset function. Check whether the 24 V power supply for the STO is stable. Tighten the cables that are loose or disconnected. Replace the drive.

E150.1: STO input state error

Fault cause:

The single-channel input of STO is inactive.

Troubleshooting:

Cause	Verification method	Solution
1. The STO input power supply is abnormal.	Check whether the STO power supply is normal.	Check whether the 24 V power supply for the STO is stable. Tighten the cables that are loose or disconnected.
2. The STO input resistor is abnormal.	After STO is triggered, only one STO signal is sent to MCU after the 24 V power supply is cut off due to input resistor drift.	Replace the servo drive.
3. STO is inactive.	The fault persists after preceding causes are rectified.	Replace the servo drive.

E150.2: Buffer 5 V voltage detection error

Fault cause:

The MCU monitors the 5 V power supply of the PWM Buffer to detect whether overvoltage or undervoltage occurs. If the voltage is abnormal, this fault code will be displayed.

Troubleshooting:

Cause	Verification method	Solution
The 5 V voltage supplied to the STOBuffer 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

Fault cause:

Short circuit occurs on the optocoupler of the upstream hardware circuit of STO.

Troubleshooting:

Cause	Verification method	Solution
Shoot-through occurs on the upstream optocoupler of STO1 or STO2.	Check whether the fault persists and the keypad displays E150.3 after the drive is powered on again.	Replace the servo drive.

E150.4: PWM buffer hardware diagnosis failure

Fault cause:

An error occurs on the PWM Buffer integrated circuit during initialization upon power-on (the PWM signal cannot be blocked).

Troubleshooting:

Cause	Verification method	Solution
An error occurs on the STO buffer during detection upon power-on.	The fault persists and the keypad displays E150.4 after restart.	Replace the servo drive.

E150.5: STO input signal interference

Fault cause:

The STO signal is being disturbed, and the noise filtering condition defined by H0A.73 is not met.

Troubleshooting:

Cause	Verification method	Solution
The STO terminal is in poor contact or the external 24 V input voltage is unstable, which may lead to malfunction of STO.	Check whether the 24 V input voltage of the STO terminal is unstable, leading to frequent restart.	Replace the 24 V power supply to ensure the STO terminal input voltage is stable.

E151.0: SCI communication exception between servo drive and safety module

Fault cause:

The NXP integrated circuit diagnoses in real time whether the heartbeat of the InoBus communication with the main MCU is normal.

Troubleshooting:

Cause	Verification method	Solution
This fault code is reported when the heartbeat detection between the servo drive and the safety module is abnormal.	Check whether the hardware connection between the drive and the board card is normal.	Ensure that the physical connection between the board card and the drive is normal.

E151.1: SCI communication exception between two MCUs of the safety module

Fault cause:

The internal RS232 data interaction and communication of the safety board card is abnormal.

Troubleshooting:

Cause	Verification method	Solution
The internal RS232 data interaction and communication of the safety board card is abnormal.	-	1. Detect whether interference near the drive affects RS232 communication transmission. 2. If the problem persists after the power supply is restarted, contact Inovance.

E152.0: Failure of parameter verification between two MCUs of the safety module

Fault cause:

The CRC values of the safety parameters read from the EEPROM by the dual MCUs of the safety module are inconsistent.

Troubleshooting:

Cause	Verification method	Solution
1. The software is upgraded.	Check whether the software is upgraded.	Restore safety parameters to default settings.
2. The voltage of the control circuit power supply drops instantaneously.	1. Check whether the control power is being cut off (L1C, L2C) or instantaneous power failure occurs. 2. Measure whether the input voltage of the control cable on the non-drive side during operation meets the following specifications: 200 V drive: Effective value: 200 V to 240 V Allowable deviation: -10% to 10% (180 V to 264 V) 400 V drive: Effective value: 380V to 480 V Allowable deviation: -10% to +10% (342 V to 528 V)	1. Restore safety parameters to default settings and write parameters again.2. Increase the power supply capacity or replace the power supply with a power supply of higher capacity. Restore the safety parameters to default settings and write the parameters again.
3. Instantaneous power failure occurs during parameter storage.	Check whether instantaneous power failure occurs during parameter storage.	Power on again, restore the safety parameters to default settings and write parameters again.
4. The safety module has failed.	If the fault persists after powering on the device multiple times and restoring the default parameters, the safety module is faulty.	Replace the safety module.

E152.1: Timeout for sending CRC between two MCUs of the safety module

Fault cause:

When the two MCUs of the safety module are powered on for communication, CRC transmission times out.

Troubleshooting:

Cause	Verification method	Solution
1. The communication between MCU1 and MCU2 of the safety module is disturbed.	Check for interference around the safety module.	Reduce interference around the safety module.
2. The safety module is faulty.	Check whether the fault can be rectified by replacing the safety module.	Replace the safety module.

E152.2: Timeout for safety module to get initial servo parameters

Fault cause:

When the safety module communicates with the drive upon power-on, the attempt to get initial servo drive parameters times out.

Troubleshooting:

Cause	Verification method	Solution
1. The communication between the safety module and the servo drive is disturbed.	Check whether the connection between the safety module and the servo drive is normal.	Connect the safety module and servo drive correctly.
2. The safety module is faulty.	Check whether the fault can be rectified by replacing the safety module.	Replace the safety module.

E154.0: Speed-related functions enabled for non-safety encoder

Fault cause:

The speed-related safety functions are enabled when a non-safety encoder is used, or when a safety encoder is used but H00.00 is not set to 14102.

Troubleshooting:

Cause	Verification method	Solution
1. A non-safety encoder is used.	Check whether the encoder used is a non-safety encoder.	Use a safety encoder.
2. A safety encoder is used but H00.00 is not set to 14102.	Check whether H00.00 is set to 14102.	Set H00.00 to 14102.
3. When a non-safety encoder is used, the DI is set to speed-related functions.	When a non-safety encoder is used, check whether the DI is set to speed-related functions.	When a non-safety encoder is used, set the DI to functions not related to speed.
4. When a non-safety encoder is used, the DI is set to SS1 and the monitoring mode is set to SS1-r.	When a non-safety encoder is used, check whether the DI is set to SS1 and the monitoring mode is set to SS1-r.	When a non-safety encoder is used and the DI is set to SS1, set the monitoring mode to SS1-t.

E154.1: Incorrect selection of safety function trigger mode

Fault cause:

For non-EtherCAT models, the safety function is triggered through FSoE mode.

Troubleshooting:

Cause	Verification method	Solution
For non-EtherCAT models, the safety function trigger mode is selected as FSoE trigger	1. Check whether the servo drive is a EtherCAT model. 2. Check whether the safety function trigger mode is selected to "FSoE-triggered".	For non-EtherCAT models, select the safety function trigger mode as local trigger.

E160.0: SLS1 exceeded

Fault cause:

The speed feedback real-time value exceeds the limit value of SLS1 after SLS1 monitoring is active.

Troubleshooting:

Cause	Verification method	Solution
The speed feedback real-time value exceeds the limit value of SLS1 after SLS1 monitoring is active.	When the stop mode upon SLS fault is STO, check the fault record to see if the corresponding speed exceeds the limit value of SLS1 when the SLS1 fault occurs.	Control the motor speed so that it does not exceed the limit value of SLS1 after SLS1 monitoring is active.

E160.1: SLS2 speed monitoring threshold exceeded

Fault cause:

The real-time speed feedback exceeds the threshold of SLS2 after SLS2 monitoring is enabled.

Troubleshooting:

Cause	Verification method	Solution
The real-time speed feedback exceeds the threshold of SLS2 after SLS2 monitoring is enabled.	When the stop mode upon SLS fault is STO, view the fault record to check whether the speed feedback exceeds the threshold of SLS2 when the SLS2 fault occurs.	Control the motor speed so that it does not exceed the threshold of SLS2 after SLS2 monitoring is enabled.

E160.2: SLS3 speed monitoring threshold exceeded

Fault cause:

The real-time speed feedback exceeds the threshold of SLS3 after SLS3 monitoring is enabled.

Troubleshooting:

Cause	Verification method	Solution
The speed feedback real-time value exceeds the limit value of SLS3 after SLS3 monitoring is active.	When the stop mode upon SLS fault is STO, view the fault record to check whether the speed feedback exceeds the threshold of SLS3 when the SLS3 fault occurs.	Control the motor speed so that it does not exceed the threshold of SLS3 after SLS3 monitoring is enabled.

E160.3: SLS4 speed monitoring threshold exceeded

Fault cause:

The real-time speed feedback exceeds the threshold of SLS4 after SLS4 monitoring is enabled.

Troubleshooting:

Cause	Verification method	Solution
The real-time speed feedback exceeds the threshold of SLS4 after SLS4 monitoring is enabled.	When the stop mode upon SLS fault is STO, view the fault record to check whether the speed feedback exceeds the threshold of SLS4 when the SLS4 fault occurs.	Control the motor speed so that it does not exceed the threshold of SLS4 after SLS4 monitoring is enabled.

E165.0: SDIp running direction exception

Fault cause:

The motor cannot move in the positive direction or the positive movement exceeds the limit.

Troubleshooting:

Cause	Verification method	Solution
The motor moves in the positive direction when not allowed to do so, or the positive movement exceeds the limit.	When the stop mode upon SDI fault is STO, check the fault log to see if the positive rotation speed upon fault exceeds the zero speed window of SDI or if the positive rotation position exceeds the zero position window of SDI.	When forward movement is inhibited, ensure that the motor does not exceed the allowable conditions for forward movement.

E165.1: SDIn running direction exception

Fault cause:

The motor cannot move in the negative direction or the negative movement exceeds the limit.

Troubleshooting:

Cause	Verification method	Solution
The motor moves in the negative direction when not allowed to do so, or the negative movement exceeds the limit.	When the stop mode upon SDI fault is STO, view the fault record to check whether the negative rotation speed at the time of fault exceeds the zero speed window of SDI or if the negative rotation position exceeds the zero position window of SDI.	When reverse movement is inhibited, ensure that the motor does not exceed the allowable conditions for reverse movement.

E170.0: SS1 deceleration ramp exception

Fault cause:

After SS1 deceleration ramp monitoring is started, the actual deceleration ramp exceeds the preset monitoring threshold.

Troubleshooting:

Cause	Verification method	Solution
The deceleration and monitoring threshold are not properly set, and the actual deceleration ramp exceeds the monitoring threshold.	Check whether the preset deceleration is within the monitoring threshold range.	Set the SS1 deceleration and ramp monitoring threshold properly to ensure that the deceleration is within the monitoring threshold range.

E170.1: SS2 deceleration ramp exception

Fault cause:

After SS2 deceleration ramp monitoring is started, the actual deceleration ramp exceeds the preset monitoring threshold.

Troubleshooting:

Cause	Verification method	Solution
The deceleration and monitoring threshold are not properly set, and the actual deceleration ramp exceeds the monitoring threshold.	Check whether the preset deceleration is within the monitoring threshold range.	Set SS2 deceleration and ramp monitoring threshold properly to ensure that the deceleration is within the monitoring threshold range.

E170.2: SOS speed or position exceeds threshold

Fault cause:

In the SOS state, the actual speed or position change exceeds the preset monitoring threshold.

Troubleshooting:

Cause	Verification method	Solution
1. The delay time from SS2 to SOS is excessively short, as a result the position and speed monitoring start before the motor stops.	Check whether the set delay time from SS2 to SOS is proper.	Set a proper delay time from SS2 to SOS.
2. The SOS speed and position monitoring thresholds are improper.	Check whether the set speed and position monitoring thresholds of the SOS are proper.	Set proper speed and position monitoring thresholds for SOS.
3. The load is excessive, resulting in insufficient motor output to lock the position.	Check whether the motor model is proper.	Select a proper motor model.

E201.0: Phase P overcurrent

Fault cause:

An excessively high current flows through the positive pole of the DC-AC circuit.

Troubleshooting:

Cause	Verification method	Solution
1. Gains are set improperly, leading to motor oscillation.	Check whether the motor vibrates or generates a sharp noise during startup and operation, or view the current feedback through Inovance commissioning software.	1. Motor parameters are set improperly, change motor parameters. 2. Current loop parameters are set improperly, re-adjust the current loop parameters. 3. Speed loop parameters are set improperly, leading to motor oscillation. 4. The servo drive operates improperly. Replace it.
2. The encoder cable is aged, corroded, or connected improperly or loosely.	Check whether the encoder cable provided by Inovance is used and whether the cable is aging, corroded, or connected loosely. Switch off the S-ON signal and rotate the motor shaft manually. Check whether the value of H0b.17 (Electrical angle) changes as motor shaft rotates.	Re-solder, tighten, or replace the encoder cable.
3. The drive is faulty.	1. Switch off the S-ON signal and rotate the motor shaft manually. Check whether the value of H0b.17 (Electrical angle) changes as motor shaft rotates. 2. Disconnect the motor cable and power on the servo drive again, but the fault persists. 3. Check whether resistance of the external braking resistor is too small or the braking resistor is short-circuited (between terminals P⊕ and C).	1. Replace with a regenerative resistor with matching resistance and perform wiring again. 2. Replace the servo drive.
4. Overcurrent occurs on the braking resistor.	Check whether resistance of the external braking resistor is excessively low or the braking resistor is short-circuited (between terminals P⊕ and C).	Replace with a braking resistor of proper resistance. Perform wiring again.

E201.1: Phase U overcurrent

Fault cause:

A current higher than the detection threshold is collected in the phase-U current.

Troubleshooting:

Cause	Verification method	Solution
1. The motor cables are in poor contact.	Check whether the drive power cables and motor cables on the U, V, and W sides of the drive are loose.	Tighten the cables that are loose or disconnected.
2. The motor cables are grounded.	After confirming the drive power cables and motor cables are connected properly, measure whether the insulation resistance between the drive U/V/W side and the PE cable is at MΩ level.	Replace the motor if the insulation is degraded.
3. The motor cables (U/V/W) are short-circuited.	Disconnect motor cables and check whether short circuit occurs among motor U/V/W cables and whether burrs exist in the wiring.	Connect the motor cables correctly.
4. The motor is damaged.	Disconnect the motor cables and measure whether the resistance among U/V/W phases of motor cables is balanced.	Replace the motor if the resistance is unbalanced.

E201.2: Phase-V overcurrent

Fault cause:

A current higher than the threshold is collected in the phase-V current.

Troubleshooting:

Cause	Verification method	Solution
1. The motor cables are in poor contact.	Check whether the drive power cables and motor cables on the U, V, and W sides of the drive are loose.	Tighten the cables that are loose or disconnected.
2. The motor cables are grounded.	After confirming the drive power cables and motor cables are connected properly, measure whether the insulation resistance between the drive U/V/W side and the PE cable is at MΩ level.	Replace the motor if the insulation is degraded.
3. The motor cables (U/V/W) are short-circuited.	Disconnect motor cables and check whether short circuit occurs among motor U/V/W cables and whether burrs exist in the wiring.	Connect the motor cables correctly.
4. The motor is damaged.	Disconnect the motor cables and measure whether the resistance among U/V/W phases of motor cables is balanced.	Replace the motor if the resistance is unbalanced.

E201.4: Phase N overcurrent

Fault cause:

An excessively high current flows through the negative pole of the DC-AC circuit.

Troubleshooting:

Cause	Verification method	Solution
1. Gains are set improperly, leading to motor oscillation.	Check whether the motor vibrates or generates a sharp noise during startup and operation, or view the current feedback through Inovance commissioning software.	Perform gain tuning.
2. The encoder cable is aged, corroded, or connected improperly or loosely.	Check whether the encoder cable provided by Inovance is used and whether the cable is aged, corroded, or connected loosely.	Re-solder, tighten, or replace the encoder cable.
3. Overcurrent occurs on the braking resistor.	Check whether resistance of the external braking resistor is excessively low or the braking resistor is short-circuited (between terminals P⊕ and C).	Replace with a braking resistor of proper resistance. Perform wiring again.
4. Overcurrent is caused by the superposition of the braking current and phase current.	Check whether the drive accelerates abruptly during braking. Check whether the voltage feedback exceeds the braking threshold through the Inovance drive software tool and whether the torque reference increases abruptly.	Increase the acceleration/ deceleration time.
5. The servo drive is faulty.	Switch off the S-ON signal and rotate the motor shaft manually. Check whether the value of H0b.17 (Electrical angle) changes as motor shaft rotates. Disconnect the motor cables and check whether the fault persists at next power-on.	Replace the servo drive.

E202.0: Bus discharge overcurrent

Fault cause:

When in the discharge state, excessive current flows through phase P or N of the bus in the DC-AC circuit.

Troubleshooting:

Cause	Verification method	Solution
1. The braking resistor is set improperly.	Check whether resistance of the external braking resistor is excessively low or the braking resistor is short-circuited (between terminals P⊕ and C).	Replace with a braking resistor of proper resistance. Perform wiring again.
2. The gain is set improperly, leading to motor oscillation.	Check whether the motor vibrates or generates a sharp noise during startup and operation, or view the current feedback through Inovance commissioning software.	1. Motor parameters are set improperly, change motor parameters. 2. Current loop parameters are set improperly, re-adjust the current loop parameters. 3. Speed loop parameters are set improperly, leading to motor oscillation. 4. The servo drive operates improperly. Replace it.

Cause	Verification method	Solution
3. Overcurrent is caused by the superposition of the braking current and phase current.	Check whether the drive accelerates abruptly during braking. Check whether the voltage feedback exceeds the braking threshold through the Inovance drive software tool and whether the torque reference increases abruptly.	Increase the acceleration/ deceleration time.
4. The servo drive is faulty.	1. Switch off the S-ON signal and rotate the motor shaft manually. Check whether the value of H0b.17 (Electrical angle) changes as motor shaft rotates. 2. Disconnect the motor cable and power on the servo drive again, but the fault persists. 3. Check whether resistance of the external braking resistor is too small or the braking resistor is short-circuited (between terminals P⊕ and C).	1. Replace with a regenerative resistor with matching resistance and perform wiring again. 2. Replace the servo drive.

E202.1: Bus phase N overcurrent

Fault cause:

Overcurrent occurs on phase P of the bus in DC-AC circuit.

Troubleshooting:

Cause	Verification method	Solution
1. Gains are set improperly, leading to motor oscillation.	Check whether the motor vibrates or generates a sharp noise during startup and operation, or view the current feedback through Inovance commissioning software.	Perform gain tuning.
2. The encoder cable is aged, corroded, or connected improperly or loosely.	Check whether the encoder cable provided by Inovance is used and whether the cable is aged, corroded, or connected loosely.	Re-solder, tighten, or replace the encoder cable.
3. The drive is faulty.	Switch off the S-ON signal and rotate the motor shaft manually. Check whether the value of H0b.17 (Electrical angle) changes as motor shaft rotates. Disconnect the motor cables and check whether the fault persists at next power-on.	Replace the servo drive.

E202.2: Bus phase N overcurrent

Fault cause:

Overcurrent occurs on phase N of the bus in DC-AC circuit.

Troubleshooting:

Cause	Verification method	Solution
1. Gains are set improperly, leading to motor oscillation.	Check whether the motor vibrates or generates a sharp noise during startup and operation, or view the current feedback through Inovance commissioning software.	Perform gain tuning.
2. The encoder cable is aged, corroded, or connected improperly or loosely.	Check whether the encoder cable provided by Inovance is used and whether the cable is aged, corroded, or connected loosely.	Re-solder, tighten, or replace the encoder cable.
3. The drive is faulty.	Switch off the S-ON signal and rotate the motor shaft manually. Check whether the value of H0b.17 (Electrical angle) changes as motor shaft rotates. Disconnect the motor cables and check whether the fault persists at next power-on.	Replace the servo drive.

E202.3: Bus current sampling hardware error

Fault cause:

Excessively high current flows through the phase P or phase N of the bus in the DC-AC circuit in the S-OFF state.

Troubleshooting:

Cause	Verification method	Solution
Check whether the servo drive is faulty.	Switch off the S-ON signal and rotate the motor shaft manually. Check whether the value of H0b.17 (Electrical angle) changes as motor shaft rotates. Disconnect the motor cables and check whether the fault persists at next power-on.	Replace the servo drive.

E203.0: Current feedback closed-loop error of the power cable

Fault cause:

The current feedback exceeds 20% of the torque reference for a period longer than 1 ms.

Troubleshooting:

Cause	Verification method	Solution
1. Gains are set improperly, leading to motor oscillation.	Check whether the motor vibrates or generates a sharp noise during startup and operation, or view the current feedback through Inovance commissioning software.	1. Motor parameters are set improperly, change motor parameters. 2. Current loop parameters are set improperly, re-adjust the current loop parameters. 3. Speed loop parameters are set improperly, leading to motor oscillation. 4. The servo drive operates improperly. Replace it.
2. The encoder cable is aged, corroded, or connected improperly or loosely.	Check whether the encoder cable provided by Inovance is used and whether the cable is aging, corroded, or connected loosely. Switch off the S-ON signal and rotate the motor shaft manually. Check whether the value of H0b.17 (Electrical angle) changes as motor shaft rotates.	Re-solder, tighten, or replace the encoder cable.
3. The drive is faulty.	After enabling the drive, keep the reference to 0 and check whether H0b.24 is within the normal range.	Replace the servo drive.

E203.1: Phase-U overcurrent of the power cable

Fault cause:

A current higher than the detection threshold is collected in the phase-U current.

Troubleshooting:

Cause	Verification method	Solution
1. The motor cables are in poor contact.	Check whether the drive power cables and motor cables on the U, V, and W sides of the drive are loose.	Tighten the cables that are loose or disconnected.
2. The motor cables are grounded.	After confirming the drive power cables and motor cables are connected properly, measure whether the insulation resistance between the drive U/V/W side and the PE cable is at MΩ level.	Replace the motor if the insulation is degraded.
3. The motor cables (U/V/W) are short-circuited.	Disconnect motor cables and check whether short circuit occurs among motor U/V/W cables and whether burrs exist in the wiring.	Connect the motor cables correctly.
4. The motor is damaged.	Disconnect the motor cables and measure whether the resistance among U/V/W phases of motor cables is balanced.	Replace the motor if the resistance is unbalanced.

E203.2: Phase-V overcurrent of the power cable

Fault cause:

A current higher than the threshold is collected in the phase-V current.

Troubleshooting:

Cause	Verification method	Solution
1. The motor cables are in poor contact.	Check whether the drive power cables and motor cables on the U, V, and W sides of the drive are loose.	Tighten the cables that are loose or disconnected.
2. The motor cables are grounded.	After confirming the drive power cables and motor cables are connected properly, measure whether the insulation resistance between the drive U/V/W side and the PE cable is at MΩ level.	Replace the motor if the insulation is degraded.
3. The motor cables (U/V/W) are short-circuited.	Disconnect motor cables and check whether short circuit occurs among motor U/V/W cables and whether burrs exist in the wiring.	Connect the motor cables correctly.
4. The motor is damaged.	Disconnect the motor cables and measure whether the resistance among U/V/W phases of motor cables is balanced.	Replace the motor if the resistance is unbalanced.

E203.3: Phase-W overcurrent of the power cable

Fault cause:

A current higher than the detection threshold is detected in the phase W current.

Troubleshooting:

Cause	Verification method	Solution
1. The motor cables are in poor contact.	Check whether the drive power cables and motor cables on the U, V, and W sides of the drive are loose.	Tighten the cables that are loose or disconnected.
2. The motor cables are grounded.	After confirming the drive power cables and motor cables are connected properly, measure whether the insulation resistance between the drive U/V/W side and the PE cable is at MΩ level.	Replace the motor if the insulation is degraded.
3. The motor cables (U/V/W) are short-circuited.	Disconnect motor cables and check whether short circuit occurs among motor U/V/W cables and whether burrs exist in the wiring.	Connect the motor cables correctly.
4. The motor is damaged.	Disconnect the motor cables and measure whether the resistance among U/V/W phases of motor cables is balanced.	Replace the motor if the resistance is unbalanced.

E203.4: Current error detected by power cable

Fault cause:

In the S-OFF state, a high current that exceeds the detection threshold is detected in the U/V/W power cables.

Troubleshooting:

Cause	Verification method	Solution
Check whether the servo drive is faulty.	Disconnect the motor cables and check whether the fault persists at next power-on.	Replace the servo drive.

E208.2: Encoder communication timeout

Fault cause:

The FPGA detects a communication timeout with the encoder.

Troubleshooting:

Cause	Verification method	Solution
The servo drive fails to receive the data fed back by the encoder in three consecutive cycles.	1. Check whether the motor model is correct. 2. Check whether the encoder cable is wired incorrectly, damaged, connected incorrectly, disturbed, or too long. 3. Check whether the encoder version (H00.04) is correct (not 0 or 65535). (View the version only for Inovance encoders.) 4. Check whether the encoder is faulty (see H0B.28). 5. Check whether bit12 of parameter H0b.30 is 1. If bit12 is 1, an error is reported. If bit12 is 0, no error is reported.	1. Modify the motor model according to the nameplate or replace it with a correct motor. 2. Replace the cable or add anti-interference measures. If the cable is excessively long, you can change the H01.60 (FPGA scheduling frequency). 3. Power on the system again to read the version. 4. Use H0d.20 or power on again to check whether any faults are present. 5. The drive is abnormal, replace the drive.

E208.4: FPGA current loop operation timeout

Fault cause:

The operating time of the current loop exceeds the interval threshold.

Troubleshooting:

Cause	Verification method	Solution
FPGA operation timeout	Internal fault code H0b.45 = 4208: Current loop operation timeout	Disable some unnecessary functions to reduce the operating load of the current loop. Modify the FPGA scheduling frequency (H01.60). After modification, the motor may respond slowly and generate unusual noise.

E210.0: Output ground fault

Fault cause:

The drive detects an abnormal motor phase current or bus voltage during self-test upon power-on.

1. The bus voltage exceeds the discharge threshold.
2. The phase U current of drives in size C/D/E exceeds 1/4 of the value of H01.07.
3. Overcurrent occurs on phase P and phase N of drives in sizes A and B.

Troubleshooting:

Cause	Verification method	Solution
1. The drive power cables (U/V/W) are short-circuited to ground.	Disconnect the motor cables, and measure whether the servo drive power cables (U/V/W) are short-circuited to ground (PE).	Connect the cables again or replace the servo drive power cables.
2. The motor is short-circuited to ground.	After confirming the servo drive power cables and motor cables are connected properly, measure whether the insulation resistance between the servo drive U/V/W side and the PE cable is at MΩ level.	Replace the motor.
3. The drive is faulty.	Disconnect the servo drive power cables from the servo drive. Check whether the fault persists after the power supply is switched on multiple times.	Replace the servo drive.
4. The motor speed is excessively high during ground fault detection.	Check whether the motor is rotating upon power-on.	Reduce the motor speed to a value lower than 10 rpm.
5. The bus voltage of the control circuit is higher than the discharge threshold.	Check whether the bus voltage upon fault is greater than the bus voltage discharge threshold.	Set a proper DC bus voltage discharge threshold.

E210.2: Output ground fault

Fault cause:

The drive detects that the motor phase current is at full scale during self-test upon power-on.

Troubleshooting:

Cause	Verification method	Solution
1. The motor is short-circuited to ground.	After confirming the servo drive power cables and motor cables are connected properly, measure whether the insulation resistance between the servo drive U/V/W side and the PE cable is at MΩ level.	Replace the motor.
2. The servo drive is faulty.	Disconnect the servo drive power cables from the servo drive. Check whether the fault persists after the power supply is switched on multiple times.	Replace the servo drive.

E234.0: Runaway (protection scheme 1)

Fault cause:

The speed feedback direction is opposite to torque reference direction, and the speed feedback reaches the runaway speed threshold (H0A.57). The torque reference reaches the runaway current threshold (H0A.55) and the minimum value of torque limit in the speed or position control mode, or is non-zero in the torque control mode. The fault duration reaches the value of H0A.59 (Runaway protection detection time).

Troubleshooting:

Cause	Verification method	Solution
1. The U/V/W cables are connected improperly.	Check whether the servo drive power cables are connected in the correct sequence at both ends.	Connect the U/V/W cables according to the correct sequence.
2. The motor rotor initial phase error is detected due to interference signals upon power-on.	The U/V/W phase sequence is correct, but E234.0 is reported when the servo drive is enabled.	Power cycle the motor.
3. The encoder type is set incorrectly, or the wiring is incorrect.	Check whether the set motor code (H00.00) matches the one on the motor nameplate.	Set the correct motor code (H00.00) according to the motor nameplate.
4. The encoder cable is aged or corroded, or connected incorrectly or loosely.	1. Check whether the encoder cable provided by Inovance is used and whether the cable is aging, corroded, or connected loosely. 2. Switch off the S-ON signal and rotate the motor shaft manually. Check whether the value of H0b.10 (Electrical angle) changes as motor shaft rotates.	Re-solder, tighten, or replace the encoder cable.
5. The gravity load is excessive in a vertical axis application.	Check whether the load of the vertical axis is excessive. Adjust brake parameters H02.09 to H02.12 to check whether the fault can be cleared.	Reduce the load on the vertical axis or increase the stiffness level. You can also mask this fault if it does not affect safety performance and normal use.
6. Improper parameter setting leads to excessive vibration.	The stiffness level is set to an excessively high value, leading to excessive vibration.	Set a proper stiffness level to avoid excessive vibration.

E234.1: Runaway (protection scheme 2)

Fault cause:

The speed feedback direction is opposite to the torque reference direction, and the speed feedback reaches the runaway speed threshold (H13.03) of scheme 2 in speed or position mode or runaway speed threshold (H13.04) of scheme 2 in torque mode. The torque reference reaches the runaway current threshold (H13.02) of scheme 2 and the minimum value of the torque limit in speed or position mode, or is non-zero in torque mode. The runaway distance meets the abnormal distance threshold (H13.01).

Troubleshooting:

Cause	Verification method	Solution
1. The torque limit or equipment model is inadequate, triggering a runway false alarm.	Check whether the torque is limited or the current is saturated during operation, leading to insufficient torque output and false runaway fault.	1. Increase the torque limit (60E0h/60E1h/6072h) for N-series models as appropriate. 2. Check whether the motor load is excessive due to mechanical factors. 3. Reduce the acceleration/deceleration speed or operating speed. 4. Re-calculate the device power rating needed. 5. Increase the runaway threshold properly or mask this fault without affecting safety performance and operation.
2: Abnormal collision, triggering a runway false alarm.	Check whether a collision occurs on site. If yes: 1. Check whether 607Ah and 6064h are not aligned in the host controller program and whether the host controller commands jump abnormally. 2. Check whether the electronic gear ratio of the drive is excessively high. 3. Check whether the host controller instructions are planned properly and whether the trajectory overlaps with other mechanisms. 4. For models without dynamic brake, check whether the stop distance at zero speed is excessive. 5. Check whether the motor runs beyond the specifications, resulting in excessively long deceleration distance.	1. Align 607Ah and 6064h to avoid data error. This parameter applies to the CSP mode of the N model and the IP mode of the C model. 2. Set a proper electronic gear ratio. 3. Optimize the instruction planning of the host controller or increase the safety distance between mechanisms. 4. For models without dynamic brake, you can install a dynamic brake box or decrease the safety distance for stop at zero speed. 5. Reduce the acceleration/deceleration speed and operating speed to avoid operation beyond specifications, or re-calculate the device power rating needed.
3. The gravity load in vertical axis scenarios is excessive, triggering a false runaway alarm.	Check whether the load of the vertical axis is excessive. Adjust brake parameters H02.09 to H02.12 to check whether the fault can be cleared.	Reduce the load in the vertical axis or increase the stiffness level, or increase the runaway threshold. You can also mask this fault without affecting safety or operation.
4. Strong vibration occurs, leading to a false runaway fault.	1. Check whether the stiffness level is excessively high, leading to excessive vibration. 2. Check whether the load is excessive, leading to vibration during stop at overtravel.	1. Set a proper stiffness level to avoid excessive vibration. 2. Modify the stop mode from "Stop at overtravel" to "Ramp to stop".

Cause	Verification method	Solution
5. The electrical angle is abnormal.	1. Check whether the U/V/W phase sequence is incorrect. 2. Check whether the encoder cable and power cable belong to the same motor. 3. Check whether the electrical angle is not auto-tuned. 4. Check whether the Hall is installed improperly. 5. Check whether deviation exists in the electrical angle and absolute position feedback in the same physical position after motor runaway occurs or after the motor operates for a period of time.	1. Connect the U/V/W cables according to the correct phase sequence. 2. Connect the encoder cable and power cable properly. 3. Perform angle auto-tuning again. 4. Install the Hall sensor properly. 5. Perform angle auto-tuning repeatedly and restart to perform auto-tuning again, or replace the encoder.
6. The encoder cable is faulty.	1. Check whether the encoder cable is aged, corroded, connected loosely, or broken. 2. Check whether the encoder cable shield fails, the power cable is being disturbed, or whether the read head is contaminated.	1. Re-solder, tighten, or replace the encoder cable. 2. Route the encoder cable and power cable of high-power devices through different routes, take measures to prevent disturbance to the signal cable, and clean the read head.
7. Power cables are damaged.	Check whether the power cable is aged, corroded, connected loosely, or broken.	Re-solder, tighten, or replace the power cable.
8. The motor or drive is damaged.	Check whether the motor and drive are damaged. Perform cross-verification to check whether the fault follows.	Replace the motor or drive.

E240.0: Excessive deviation between the observed value and feedback values of the electrical angle

Fault cause:

The deviation between the observed value and the feedback value of the encoder exceeds the threshold.

Troubleshooting:

Cause	Verification method	Solution
1. Inaccurate initial angle from auto tuning. 2. The encoder feedback value is incorrect. 3. Observer alarms are enabled during angle auto-tuning. During angle auto-tuning, excessive deviation can be detected if the speed threshold condition is met. 4. The observed deviation during acceleration/deceleration is excessive. 5. Excessive motor inductance/ resistance parameter deviation affects the observed value of electrical angle. 6. Unstable loop operation and improper gain parameters affect the observed value of electrical angle.	1. Perform angle auto-tuning again and check whether the alarm persists. 2. Check whether the encoder is contaminated. Observe the position feedback signal waveform to check for pulse loss or abnormal feedback value. Mark a fixed position, record current position feedback, run the motor back and forth for a period of time, then manually rotate the motor to marked position, record position feedback again, and compare whether the two position feedback values are consistent. If not, the encoder is abnormal. 3. Check whether the alarm is reported in the angle auto-tuning state. 4. Set the function switch to "Observe only, without reporting alarm". The oscilloscope monitors the waveform of H13.71. If the value of H13.71 in the constant speed segment is high, the electrical angle may be abnormal. If the value of H13.71 is small in the constant-speed segment but large in the acceleration/deceleration segment, increase the value of H13.19/H13.20 accordingly and perform observation again. 5. Check whether the inductance/ resistance parameters of the motor deviate greatly. 6. Check whether the control loop operates improperly, the speed fluctuates, or the position deviation is abnormal, leading to deviation in the electrical angle observed.	1. Perform angle auto-tuning again to get the correct initial angle. 2. Check whether the encoder grating scale is contaminated and whether the position feedback is abnormal. Replace the motor encoder. 3. Disable the electrical angle observer alarm during angle auto-tuning. 4. If the acceleration/deceleration segment (H13.71) is high, increase H13.19/H13.20 properly and observe again. 5. Perform inductance/resistance auto-tuning again. Adjust the loop gain parameters to ensure normal operation of the motor. 6. Re-adjust the gain parameters to ensure normal operation of the control loop. For details, see the section on parameter tuning in the manual.

E240.1: Angle auto-tuning check error alarm

Fault cause:

Incremental encoder: After the drive is enabled, the difference between two angle auto-tuning values exceeds the threshold.
Absolute encoder: After the drive is enabled, the difference between the angle auto-tuning value and the original value of H00.28 exceeds the threshold.

Troubleshooting:

Cause	Verification method	Solution
1. The angle auto-tuning value is inaccurate. 2. The original value of H00.28 is incorrect.	1. Check whether the angle auto-tuning value is abnormal. Perform angle auto-tuning again and observe whether the value of H00.28 changes by more than 20 degrees (electrical angle). 2. Check whether the encoder is disturbed by an external interference source during angle auto-tuning.	Perform angle auto-tuning again by using a proper angle auto-tuning method.

E240.2: Hall operation check fault

Fault cause:

The Hall signal is abnormal in static Hall auto-tuning upon start of the motor.

Troubleshooting:

Cause	Verification method	Solution
1. The Hall is connected loosely or the installed improperly. 2. The six Hall electrical angles saved are incorrect (H32.63 to H32.68).	1. Check whether the Hall element is installed properly. 2. Move the motor and observe whether the Hall signal waveform is abnormal.	1. Install the Hall sensor properly. 2. Perform dynamic Hall auto-tuning again.

E243.0: Brake released improperly

Fault cause:

Brake release error

Troubleshooting:

Cause	Verification method	Solution
The brake of the brake motor is released improperly, and the load in forward/reverse run is excessive.	Check whether the brake is wired properly. During operation, check whether the current feedback exceeds the threshold defined by H13.39.	1. Connect the brake cable correctly according to the instructions in the user guide. 2. Check that the brake is wired properly. If the current feedback exceeds H13.39 due to excessive load, increase the value of H13.39 properly based on the auto-tuned values of H13.75 and H13.76. 3. Check that the brake is wired properly. If the load is not the cause for current feedback error, replace the motor.

E243.1: Brake applied improperly

Fault cause:

Brake apply error

Troubleshooting:

Cause	Verification method	Solution
On a motor with brake, the displacement distance after the brake is closed exceeds the set threshold.	Apply the brake when the motor is switched off, stops at overtravel, and stops at a No.2 fault, and calculate whether the travel distance is longer than H13.40. Check whether the brake is wired properly and whether the motor can rotate after the brake applies.	1. Connect the brake cable correctly according to the instructions in the user guide. 2. Verify that the brake is wired properly. If the brake backlash does not match the default range, increase the value of H13.40 properly based on the brake backlash or auto-tuned value of H13.77. 3. Verify that the brake is wired properly. After the parameters are adjusted, if the alarm persists after the S-ON and S-OFF signals are triggered several times, replace the motor.

E246.0: Encoder PPR (H0b.70) changed before and after power-off

Fault cause:

The deviation between the number of encoder multi-turn revolutions before and after power-off exceeds the set threshold (H0b.70).

Troubleshooting:

Cause	Verification method	Solution
The difference in encoder multi-turn data before and after power-off exceeds the set threshold.	1. Check whether H13.43 is set properly. 2. Check whether the encoder battery is faulty.	1. Adjust the threshold and set the absolute value mode. 2. Check the encoder battery. 3. Identify the fault cause and contact the manufacturer.

E246.1: Single-turn absolute position (H0b.71) of the encoder changed before and after power-off

Fault cause:

The difference between the encoder single-turn absolute position values (H0b.71) before and after power-off exceeds the set threshold.

Troubleshooting:

Cause	Verification method	Solution
The difference in encoder single-turn position data before and after power-off exceeds the set threshold.	1. Check whether H13.44 is set properly. 2. Check whether the encoder battery is faulty.	1. Adjust the threshold and set the absolute value mode. 2. Check the encoder battery. 3. Identify the fault cause and contact the manufacturer.

E246.2: Position feedback changes before and after power-off

Fault cause:

The difference between the servo feedback position data before and after power-off exceeds the set threshold.

Troubleshooting:

Cause	Verification method	Solution
The difference between the servo feedback position data before and after power-off exceeds the set threshold.	1. Check whether H13.46 is set properly. 2. Check whether the encoder battery is faulty.	1. Adjust the threshold and set the absolute value mode. 2. Check the encoder battery. 3. Identify the fault cause and contact the manufacturer.

E247.1: Torque saturation fault

Fault cause:

The motor torque reference remains excessively high for a long time.

Troubleshooting:

Cause	Verification method	Solution
The motor torque reference remains excessively high for a long time.	1. Check whether the acceleration/ deceleration is excessively high. 2. Check whether the torque is limited. 3. Check whether the load is excessive and the motor is running out of specification.	1. Reduce the acceleration/ deceleration rate properly. 2. Adjust the torque limit value. 3. Optimize the operation parameters or adjust the model.

E248.0: Reference speed excessively high

Fault cause:

The reference speed exceeds the motor speed limit.

Troubleshooting:

Cause	Verification method	Solution
The reference speed exceeds the motor speed limit.	1. Check whether the electronic gear ratio is improper. 2. Check whether the speed reference in the current operation mode exceeds H00.15 × H13.52. 3. Check whether the object dictionary unit (H0E.07) is set improperly.	Adjust the parameter value or increase the threshold as appropriate.

E249.0: Excessive speed deviation

Fault cause:

The deviation between the speed feedback and speed reference remains above the set threshold for the set period of time.

Troubleshooting:

Cause	Verification method	Solution
The deviation between the speed feedback and speed reference remains above the set threshold for the set period of time.	Check whether the deviation between the speed feedback and speed reference exceeds the set threshold.	1. Increase the values of H13.53 and H13.54. 2. Reduce the value of H13.55.

E24A.0: Hardware limit reached in the wrong direction

Fault cause:

The negative limit switch signal is triggered during positive operation or the positive limit switch signal is triggered during negative operation.

Troubleshooting:

Cause	Verification method	Solution
The hardware limit signal is wired to the incorrect terminal.	Check whether the hardware limit signal is connected to the correct terminal.	Wire the hardware limit signal to the correct terminal.

E308.0: Pulse encoder phase A disconnected

Fault cause:

Phase A of the pulse encoder is disconnected.

Troubleshooting:

Cause	Verification method	Solution
1. The encoder phase A is connected improperly. 2. The motor model is set to pulse encoder, which is the incorrect type.	1. Check the encoder wiring. 2. Check whether the motor code (H00.00) is set to a value matching the actual encoder type.	1. Re-connect the encoder and perform a restart. 2. Check whether the motor code (H00.00) is set to a value matching the actual encoder type.

E308.1: Pulse encoder phase B disconnected

Fault cause:

Phase B of the pulse encoder is disconnected.

Troubleshooting:

Cause	Verification method	Solution
1. The encoder phase B is connected improperly.	Check the wiring of the encoder.	1. Re-connect the encoder and perform a restart. 2. Check whether the motor code (H00.00) is set to a value matching the actual encoder type.

E308.2: Phase Z of the pulse encoder disconnected (no alarm reported for the encoder without Z)

Fault cause:

Phase Z of the pulse encoder is disconnected.

Troubleshooting:

Cause	Verification method	Solution
1. The encoder phase Z is connected improperly. 2. The set encoder type is incorrect. Only phases A and B of the encoder are used.	1. Check the wiring. Check whether the Z signal is wired correctly according to the user guide. 2. Check the encoder user guide for Z signal output.	1. Wire the encoder properly. 2. Re-install the motor and select phase A/B encoder in the encoder configuration interface.

E320.0: braking resistor overload

Fault cause:

The braking resistor is overloaded.

Troubleshooting:

Cause	Verification method	Solution
The cumulative heat of the braking resistor exceeds its maximum thermal capacity.	Check whether the value of H0b.67 exceeds 100%.	1. Check whether the bus voltage is excessively high, leading to excessive high discharge current. 2. To avoid excessively high discharge current, take measures to prevent the motor from being driven by the load. 3. Replace the servo drive.

E320.1: Enclosure temperature of the braking resistor excessively high

Fault cause:

The accumulative heat of the built-in braking resistor is excessive.

Troubleshooting:

Cause	Verification method	Solution
The accumulative heat of the built-in braking resistor is excessive.	Power off and check whether the built-in braking resistor is overheated.	1. Check whether the bus voltage is excessively high, leading to excessive high discharge current. 2. To avoid excessively high discharge current, take measures to prevent the motor from being driven by the load. 3. Replace the servo drive.

E321.0: Dynamic brake resistor overload

Fault cause:

The dynamic braking resistor is overloaded.

Troubleshooting:

Cause	Verification method	Solution
The accumulative heat of the dynamic braking resistor exceeds the maximum thermal capacity of the resistor.	Check whether the value of H0b.98 exceeds 100%.	To avoid excessively high discharge current, prevent the motor from being driven reversely.

E400.0: Main circuit overvoltage

Fault cause:

The DC bus voltage between P⊕ and N⊖ exceeds the overvoltage threshold.
200 V servo drive: Normal value: 280 V; Overvoltage threshold: 420 V
400 V servo drive: Normal value: 560 V; Overvoltage threshold: 820 V

Troubleshooting:

Cause	Verification method	Solution
1. The main circuit input voltage is excessively high.	Check the input power supply specifications of the drive and measure whether the input voltage of the main circuit cable (RST) on the drive side meets the following specifications: 200 V servo drive: Effective value: 200 V to 240 V Allowable deviation: -10% to +10% (180 V to 264 V) 400 V servo drive: Effective value: 380V to 480 V Allowable deviation: -10% to +10% (342 V to 528 V)	Replace or adjust the power supply according to the specified range.
2. The power supply is unstable or affected by the lightning strike.	Check whether the power supply is unstable, affected by lightning, or complies with the preceding range.	Connect a surge protection device (SPD) and switch on the power supplies of the control circuit and the main circuit. If the fault persists, replace the servo drive.
3. The braking resistor fails.	If a built-in braking resistor is used (H02.25 = 0), check whether terminals P⊕ and D are jumpered. If yes, measure the resistance between terminals C and D. If an external braking resistor is used (H02.25 = 1 or 2), measure the resistance of the external braking resistor connected between terminals P⊕ and C. For details, See table "Specifications of the braking resistor" in the user guide.	1. If the resistance is "∞" (infinite), the braking resistor is disconnected internally. 2. If a built-in braking resistor is used, change to use an external braking resistor (H02.25 = 1 or 2) and remove the jumper between terminals P ⊕ and D. Select an external braking resistor of the same resistance and equal or higher power than the built-in one. 3. If an external braking resistor is used, replace with a new one and connect it between terminals P⊕ and C. 4. Set H02.26 (Power of external braking resistor) and H02.27 (Resistance of external braking resistor) to values consistent with the specifications of the external braking resistor used.
4. The resistance of the braking resistor is excessively high, and energy absorption during braking is insufficient.	Measure the resistance of the external braking resistor connected between terminals P⊕ and C. Compare the measured value with the recommended value.	1. Replace with an external braking resistor of recommended resistance, and connect it between terminals P⊕ and C. 2. Set H02.26 (Power of external braking resistor) and H02.27 (Resistance of external braking resistor) to values consistent with the specifications of the external braking resistor used.
5. The motor is in abrupt acceleration/deceleration status. The maximum braking energy exceeds the energy absorption value.	Confirm the acceleration/ deceleration time during operation and measure whether the DC bus voltage between P⊕ and N⊖ exceeds the overvoltage threshold during deceleration.	After verifying that the input voltage of the main circuit is within the specified range, increase the acceleration/deceleration time if allowed.

Cause	Verification method	Solution
6. The bus voltage sampling value deviates greatly from the measured value.	Check whether H0b.26 (Bus voltage) is within the following range: 200 V servo drive: H0b.26 > 420 V 400 V servo drive: H0b.26 > 820 V Measure whether the DC bus voltage between P⊕ and N⊖ is within the normal range and lower than H0b.26.	Contact Inovance for technical support.
7. The servo drive is faulty.	Check whether the fault persists after repeated power cycling of the main circuit.	Replace the servo drive.

E410.0: Main circuit undervoltage

Fault cause:

The DC bus voltage between terminals P⊕ and N⊕ is lower than the threshold:
200 V servo drive: Normal value: 280 V; Undervoltage threshold: 200 V (180 V for S5R5 models)
400 V servo drive: Normal value: 560 V; Undervoltage threshold: 380V

Troubleshooting:

Cause	Verification method	Solution
1. The power supply of the main circuit is unstable or a power failure occurs. 2. An instantaneous power failure occurs.	Check the input power supply specifications of the drive. Measure whether the input voltage of the main circuit cable on the non-drive side and drive side (RST) meets the following specifications. 200 V drive: Effective value: 200 V to 240 V Allowable deviation: -10% to +10% (180 V to 264 V) All three phases need to be measured.	Increase the power capacity.
3. The power voltage drops during operation.	Check the power input voltage and check whether the main circuit power supply is applied to other devices, resulting in insufficient power capacity and a voltage dip.	Increase the power capacity.
4. A three-phase servo drive is connected to a single-phase power supply, leading to phase loss.	Check the wiring of the main circuit.	Replace the cables and connect the main circuit cables in the correct phase sequence (three-phase: R/S/T).
5. The servo drive is faulty.	Check whether the value of H0b.26 (Bus voltage) is within the following range: 200 V drive: H0b.26 < 200 V 400 V drive: H0b.26 < 380V The fault persists after the main circuit is restarted several times.	Replace the servo drive.

E410.1: Main circuit de-energized

Fault cause:

Phase loss occurs on the three-phase servo drive.

Troubleshooting:

Cause	Verification method	Solution
The power supply is disconnected during operation.	1. Check the input power specifications of the servo drive. Measure whether the input voltage on the power supply side and the drive side (RST) of the main circuit cable meets the following specifications. 200 V servo drive: Effective value: 200 V to 240 V Allowable deviation: -10% to +10% 400 V servo drive: Effective value: 380V to 480 V Allowable deviation: -10% to +10% All three phases need to be measured. 2. Monitor the power supply voltage and check whether the main circuit power supply is applied to other devices, resulting in insufficient power capacity and voltage drop. 3. Check whether the value of H0b.26 (Bus voltage) is in the following range: 200 V drive: H0b.26 < 200 V 400 V drive: H0b.26 < 380V. The fault persists after the main circuit is powered off and on repeatedly. 4. Check the wiring of the main circuit.	1. Increase the capacity of the power supply. 2. Replace the servo drive. 3. Replace the cables and connect the main circuit cables (three-phase: RST/L1L2L3) properly.

E420.0: Main circuit phase loss

Fault cause:

Drive three-phase input phase loss

Troubleshooting:

Cause	Verification method	Solution
1. The three-phase power cables are not connected well.	Check whether the R/S/T cables on the drive side and cables on the non-drive side are in good condition and connected properly.	Replace the cables and connect the main circuit cables properly.
2. A single-phase power supply is used for a three-phase drive. 3. The three-phase power supply is unbalanced or the voltages of the three phases are excessively low.	Check the input power supply specifications of the drive and check the actual input voltage specifications. Measure whether the input voltage of the main circuit meets the following specifications: 200 V servo drive: Effective value: 200 V to 240 V Allowable deviation: -10% to +10% (180 V to 264 V) 400 V servo drive: Effective value: 380V to 480 V Allowable deviation: -10% to +10% (342 V to 528 V) All the three phases need to be measured.	Servo drives of 0.75 kW (H01.10 = 5) can be supplied by single-phase power supplies. If the input voltage is within the specified range, set H0A.00 to 2 (Inhibit power input phase loss fault and alarm). If it exceeds the specified range, replace or adjust the power supply according to the specified range.

E500.0: Motor overspeed

Fault cause:

The motor speed fed back by the motor exceeds the overspeed threshold.

Troubleshooting:

Cause	Verification method	Solution
1. The U/V/W phase sequence of the motor is incorrect.	Check whether the drive power cables are connected in the correct sequence at both ends.	Connect the U/V/W cables according to the correct sequence.
2. H0A.08 is set to an improper value.	Check whether the overspeed threshold is lower than the maximum speed needed in actual applications: Overspeed threshold = 1.2 times the maximum motor speed (H0A-08 = 0); Overspeed threshold = H0A-08 (H0A-08 ≠ 0, and H0A-08 < 1.2 times the maximum motor speed).	Reset the overspeed threshold according to the actual mechanical requirement.

Cause	Verification method	Solution
3. The input reference is higher than the overspeed threshold.	Check whether the motor speed corresponding to the input reference exceeds the overspeed fault threshold. Position control mode: In CSP mode, view the gear ratio 6091.01h/6091.02h to check the position reference increment for a single synchronous cycle and convert it to the speed information. In PP mode, view the gear ratio 6091.01h/6091.02h and define the value of 6081h (Profile velocity). In HM mode, view the gear ratio 6091.01h/6091.02h, and define the value of 6099.01h and 6099.02h. In speed control mode, view the gear ratio 6091h, and the values of 60FFh (Target velocity), H06.06 to H06.09, and 607Fh. In torque control mode, view the speed limit defined by H07.17 and check the corresponding speed limit.	Position control mode: In CSP mode, decrease the position reference increment for a single synchronous cycle. The host controller should cover the position ramp when generating references. In PP mode, decrease the value of 6081h or increase the acceleration/deceleration ramp (6083h, 6084h). In HM mode, decrease the value of 6099.01h and 6099.02h or increase the acceleration/deceleration ramp (609Ah). Decrease the gear ratio according to actual conditions. Speed control mode: Decrease the target velocity, speed limit value, gear ratio. In PV mode, increase the speed ramp 6083h and 6084h. In CSV mode, the host controller should add speed ramp processing. Torque control mode: Set the speed limit threshold to a value lower than the overspeed threshold.
4. The motor speed overshoots.	When H0A.08 is set to 0, check whether the speed feedback exceeds 1.2 × Maximum motor speed (H00.15). When H0A.08 is not set to 0, check whether the speed feedback exceeds the value set by H0A.08.	Adjust the gain or mechanical operating conditions.
5. The servo drive is faulty.	The fault persists after the drive is powered off and on again.	Replace the servo drive.
6. Encoder data errors occur.	Check whether there is interference, whether the encoder type is incorrect, and whether the encoder parameter settings are incorrect.	1. Take measures to prevent interference, such as installing magnetic ring and connecting shielded cables. 2. Check whether the encoder type is correct. If not, replace it with the correct encoder type. 3. Configure the encoder parameters correctly according to the encoder user guide.
7. The motor type selected is incorrect.	Check whether the motor type is set incorrectly, for example, the linear motor is set to rotary motor or the rotary motor is set to a linear motor.	Replace with the correct motor type or change the value of H00.00 based on the motor used.

E500.1: Speed feedback overflow

Fault cause:

The FPGA speed measurement overflows.

Troubleshooting:

Cause	Verification method	Solution
1. FPGA internal speed overflows.	Check whether the drive power cables are connected in the correct sequence at both ends.	Connect the U/V/W cables according to the correct sequence.
2. The motor speed overshoots.	Check whether the speed feedback exceeds the overspeed threshold through the software tool. Overspeed threshold: 16384 rpm for the rotary motor, 8192 rpm for the DDR motor, and 16384 mm/s for the linear motor	Adjust the gain or mechanical operating conditions.
3. The encoder data is incorrect.	Check whether there is interference, whether the encoder type is incorrect, and whether the encoder parameter settings are incorrect.	1. Take measures to prevent interference, such as installing magnetic ring and connecting shielded cables . 2. Check whether the encoder type is correct. If not, replace it with the correct encoder type. 3. Configure the encoder parameters correctly according to the encoder user guide.
4. The motor type is incorrect.	Check whether the motor type is set incorrectly, for example, the linear motor is set to rotary motor or the rotary motor is set to a linear motor.	Replace with the correct motor type or change the value of H00.00 based on the motor used.

E500.2: FPGA position feedback pulse overspeed

Fault cause:

The MCU has detected that the position feedback increment from the FPGA is excessively large.

Troubleshooting:

Cause	Verification method	Solution
1. The MCU has detected that the position feedback increment from the FPGA is excessively large.	Check whether the value of H0b.17 changes abruptly.	Modify the value of H0A.70 (Overspeed threshold), which is 0 by default. Use the maximum speed of the motor as the threshold for excessive feedback increment.
2. The encoder data is incorrect.	Check whether there is interference, whether the encoder type is incorrect, and whether the encoder parameter settings are incorrect.	1. Take measures to prevent interference, such as installing magnetic ring and connecting shielded cables . 2. Check whether the encoder type is correct. If not, replace it with the correct encoder type. 3. Configure the encoder parameters correctly according to the encoder user guide.
3. The motor type selected is incorrect.	Check whether the motor type is set incorrectly, for example, the linear motor is set to rotary motor or the rotary motor is set to a linear motor.	Replace with the correct motor type or change the value of H00.00 based on the motor used.

E602.0: Angle auto-tuning failure

Fault cause:

Unusual jitter occurs on the encoder feedback during angle auto-tuning.

Troubleshooting:

Cause	Verification method	Solution
1. The mechanical device is stalled. 2. The data fed back by the encoder is abnormal. 3. The U/V/W power cables are connected improperly or disconnected. 4. The drive hardware or the motor is faulty.	1. Try to Rotate a stopped motor to check whether the mechanical device is stalled. 2. After rotating the motor, check whether the encoder feedback is normal by observing whether the encoder generates feedback, whether the feedback data is consecutive, and whether the observed displacement is consistent with actual displacement through the oscilloscope. 3. Check the wiring of U/V/W power cables and test whether they are disconnected with a multimeter. 4. If the preceding fault causes are ruled out, contact the manufacturer to locate the drive or motor fault.	1. After confirming the mechanical device has been stalled, rectify the stall causes and perform angle auto-tuning (phase sequence auto-tuning) again. 2. After confirming the encoder feedback data is wrong, replace the encoder and perform angle auto-tuning (phase sequence auto-tuning) again. 3. After confirming the U/V/W cables are connected improperly or disconnected, perform wiring and angle auto-tuning (phase sequence auto-tuning) again. 4. After preceding causes are ruled out, contact the manufacturer to locate the drive or motor fault.

E602.1: Angle auto-tuning overtravel

Fault cause:

Angle auto-tuning overtravel

Troubleshooting:

Cause	Verification method	Solution
Excessive displacement occurs during angle auto-tuning, leading to overtravel. 1. The auto-tuning parameters does not match the load characteristics, leading to overtravel due to excessive impact during auto-tuning. 2. An encoder feedback data error occurs, leading to false overtravel alarm.	1. Observe whether the displacement is excessive to check whether the overtravel alarm is caused by improper setting of auto-tuning parameters. 2. Observe whether the encoder feedback action is consecutive, whether the displacement is consistent with actual displacement, and whether the encoder feedback data is normal through the oscilloscope.	1. If excessive displacement occurs during auto-tuning, prevent the overtravel alarm by adjusting auto-tuning parameters properly. Reduce the current rising slope [H32.21 for closed-loop pre-positioning] [H32.31 for position lock] or the maximum auto-tuning current [H32.20 for closed-loop pre-positioning] [H32.30 for position lock]. 2. If an encoder feedback data error occurs, perform angle auto-tuning/phase sequence auto-tuning again after replacing the encoder.

E602.2: U/V/W phase sequence reversed

Fault cause:

An incorrect U/V/W phase sequence is detected during angle auto-tuning.

Troubleshooting:

Cause	Verification method	Solution
The drive indicates the U/V/W cables are wired improperly, preventing the motor from getting out of control.	Check whether U/V/W phases of the motor are wired correctly through phase sequence auto-tuning.	1. After adjusting the phase sequence through phase sequence auto-tuning, perform angle auto-tuning again. 2. Exchange any two of U/V/W phases manually and perform angle auto-tuning again.

E602.3: Excessive encoder runout during angle auto-tuning

Fault cause:

Excessive encoder feedback fluctuation during angle auto-tuning

Troubleshooting:

Cause	Verification method	Solution
The encoder feedback data fluctuates excessively.	Check whether the data changes normally when the encoder is in the static state.	1. Check the wiring of the encoder. 2. Check whether external electromagnetic interference exists. If yes, install a magnetic ring and connect a shielded cable. 3. Manually increase the values of H32.14/H32.16 for angle auto-tuning through inching or the values of H32.34/H32.36 for angle auto-tuning through position lock.

E602.4: Angle auto-tuning timeout

Fault cause:

Angle auto-tuning timeout

Troubleshooting:

Cause	Verification method	Solution
The angle auto-tuning process lasts for an excessively long time, leading to a timeout alarm (angle auto-tuning not done within 30s). The causes may be: 1. External interference exists (such as vibration generated by other devices), leading to angle auto-tuning failure. 2. The encoder feedback data characteristics are inadequate, disturbed, or abnormal, leading to angle auto-tuning failure.	1. Check whether the machine is affected by other devices that generate vibration. 2. Check whether the encoder generates feedback, whether the feedback data is consecutive, whether the displacement is consistent with the actual displacement, and whether the data changes during standby through the oscilloscope in the software tool.	1. Check the wiring of the encoder to ensure the shielded cable is connected properly. If the encoder data is abnormal, replace the encoder and perform angle auto-tuning or phase sequence auto-tuning again. 2. Adjust angle auto-tuning parameters properly to reduce the threshold for angle auto-tuning completion.

E602.5: Angle auto-tuning failed and Z signal not found

Fault cause:

Angle auto-tuning failed and Z signal not found

Troubleshooting:

Cause	Verification method	Solution
1. The encoder is configured improperly. The actual motor encoder has no Z signal. 2. The polarity of the Z signal is configured improperly. 3. The encoder feedback data is abnormal. There is no Z signal.	1. Check whether the motor has Z signal. 2. Check the configuration of Z signal polarity through bit13 of H00.26. 3. Check whether the encoder generates feedback, whether the feedback data is consecutive, and whether the displacement is consistent with the actual displacement through the oscilloscope in the software tool.	1. Check the wiring of the encoder to ensure the shielded cable is connected properly. Check whether the Z signal polarity is configured properly. 2. If the encoder data is abnormal, replace the encoder and perform angle auto-tuning again.

E602.6: Angle auto-tuning not convergent

Fault cause:

Angle auto-tuning not convergent

Troubleshooting:

Cause	Verification method	Solution
1. The angle auto-tuning is not convergent due to external disturbance, such as vibration of other components. 2. Angle auto-tuning is not convergent due to improper auto-tuning parameter setting.	1. Check whether the machine is affected by other vibration sources. 2. Check whether the angle gain is so high that the angle auto-tuning is not convergent.	1. Check whether external electromagnetic interference exists. Install a magnetic ring and connect the shielded cable. 2. For the position lock mode, decrease the angle gain (H32.37) manually. 3. For the inching mode, decrease the action judgment threshold (H32.13/H32.15) manually or increase the standstill threshold (H32.14/H32.16).

E603.0: Gantry communication CRC fault

Fault cause:

Gantry communication CRC error

Troubleshooting:

Cause	Verification method	Solution
The gantry communication error persists.	Check the wiring of the gantry and electromagnetic environment.	Check the wiring of the gantry and electromagnetic environment.

E603.1: Communication timeout after gantry communication is established

Fault cause:

Gantry communication timeout

Troubleshooting:

Cause	Verification method	Solution
The gantry communication signal is abnormal or the gantry is wired improperly.	Check the wiring of the gantry and electromagnetic environment. Check whether H14.02 is set to 1.	Check the wiring of the gantry and electromagnetic environment.

E603.2: Communication not established

Fault cause:

Communication not established

Troubleshooting:

Cause	Verification method	Solution
Gantry communication is disconnected or cannot be established within a long time.	Check the wiring of the gantry and electromagnetic environment. Check whether H14.02 is set to 1.	Check the wiring of the gantry and electromagnetic environment.

E604.0: Inconsistent configurations between gantry axes

Fault cause:

Inconsistent configurations between gantry axes

Troubleshooting:

Cause	Verification method	Solution
Parameter settings between the gantry axes are inconsistent.	Check whether the parameters settings between the gantry axes are inconsistent.	Reset the parameters of the gantry axes to make them consistent.

E604.1: Gantry not in position mode

Fault cause:

Gantry not set in position mode

Troubleshooting:

Cause	Verification method	Solution
The drive does not operate in position mode when the gantry function is enabled.	Check whether the servo operation mode is position mode when the gantry function is enabled.	Change the servo operation mode to the position mode (H02.00).

E604.2: Gantry operates in an unsupported function

Fault cause:

Gantry operates in unsupported functions

Troubleshooting:

Cause	Verification method	Solution
The present gantry control solution operates in unsupported functions.	Check whether gantry configuration parameters match the current control solution. For example, the rigid gantry control solution 2 does not support the torque alignment mode, homing torque pre-alignment, and auto-tuning of gantry alignment deviation compensation value.	Check whether the gantry parameter settings match the present control solution. If not, made necessary modifications.

E604.3: Improper gantry torque loop scheduling settings

Fault cause:

The gantry torque loop scheduling is set improperly.

Troubleshooting:

Cause	Verification method	Solution
The gantry torque loop scheduling is set improperly, leading to an alarm.	Power cycle the drive to check whether the alarm persists.	Power cycle the drive.

E605.0: Motor overspeed upon S-ON

Fault cause:

The motor speed exceeds the rated speed when the servo drive in size A/B is enabled.

Troubleshooting:

Cause	Verification method	Solution
The motor speed exceeds the rated speed when the servo drive is switched on.	Check whether the drive is enabled when the motor is being driven.	Enable the drive when the motor is at standstill.

E606.0: Gantry torque alignment timeout

Fault cause:

Gantry torque alignment timeout

Troubleshooting:

Cause	Verification method	Solution
Gantry torque alignment times out.	Check whether the alignment time exceeds the threshold defined by 14.30.	Increase the threshold defined by 14.30 and check whether related parameters are set properly.

E612.0: Motor stalled during phase sequence auto-tuning

Fault cause:

Stall detected in phase sequence auto-tuning

Troubleshooting:

Cause	Verification method	Solution
1. The mechanical device is stalled . 2. The data fed back by the encoder is abnormal. 3. The U/V/W power cables are connected improperly or disconnected. 4. The drive hardware or the motor is faulty.	1. Try to Rotate a stopped motor to check whether the mechanical device is stalled. 2. After rotating the motor, check whether the encoder feedback is normal by observing whether the encoder generates feedback, whether the feedback data is consecutive, and whether the observed displacement is consistent with actual displacement through the oscilloscope. 3. Check the wiring of U/V/W power cables and test whether they are disconnected with a multimeter. 4. If the preceding fault causes are ruled out, contact the manufacturer to locate the drive or motor fault.	1. After confirming the mechanical device has been stalled, rectify the stall causes and perform angle auto-tuning (phase sequence auto-tuning) again. 2. After confirming the encoder feedback data is wrong, replace the encoder and perform angle auto-tuning (phase sequence auto-tuning) again. 3. After confirming the U/V/W cables are connected improperly or disconnected, perform wiring and angle auto-tuning (phase sequence auto-tuning) again. 4. After preceding causes are ruled out, contact the manufacturer to locate the drive or motor fault.

E612.1: Overtravel during phase sequence auto-tuning

Fault cause:

Overtravel in phase sequence auto-tuning

Troubleshooting:

Cause	Verification method	Solution
Excessive displacement occurs during angle auto-tuning, leading to overtravel. 1. The auto-tuning parameters does not match the load characteristics, leading to overtravel due to excessive impact during auto-tuning. 2. An encoder feedback data error occurs, leading to false overtravel alarm.	1. Observe whether the displacement is excessive to check whether the overtravel alarm is caused by improper setting of auto-tuning parameters. 2. Observe whether the encoder feedback action is consecutive, whether the displacement is consistent with actual displacement, and whether the encoder feedback data is normal through the oscilloscope.	1. If excessive displacement occurs during auto-tuning, prevent the overtravel alarm by adjusting auto-tuning parameters properly. Reduce the current rising slope manually [H32.21]. 2. If an encoder feedback data error occurs, perform angle auto-tuning/phase sequence auto-tuning again after replacing the encoder.

E612.3: Excessive encoder runout in phase sequence auto-tuning

Fault cause:

Excessive encoder change in angle auto-tuning

Troubleshooting:

Cause	Verification method	Solution
The encoder feedback data fluctuates excessively.	Check whether the data changes normally when the encoder is in the static state.	1. Check the wiring of the encoder. 2. Check whether external electromagnetic interference exists. If yes, install a magnetic ring and connect a shielded cable. 3. Increase the values of H32.24 and H32.25 manually.

E612.4: Phase sequence auto-tuning timeout

Fault cause:

Phase sequence auto-tuning failed, leading to auto-tuning timeout

Troubleshooting:

Cause	Verification method	Solution
The angle auto-tuning process lasts for an excessively long time, leading to a timeout alarm (angle auto-tuning not done within 30s). This may be caused by: 1. External interference exists (such as vibration generated by other devices), leading to angle auto-tuning failure 2. The encoder feedback data characteristics are inadequate, disturbed, or abnormal, leading to angle auto-tuning failure.	1. Check whether the machine is affected by other devices that generate vibration. 2. Check whether the encoder generates feedback, whether the feedback data is consecutive, whether the displacement is consistent with the actual displacement, and whether the data changes during standby through the oscilloscope in the software tool.	1. Check the wiring of the encoder to ensure the shielded cable is connected properly. If the encoder data is abnormal, replace the encoder and perform phase sequence auto-tuning again. 2. Adjust phase sequence auto-tuning parameters properly to reduce the threshold for phase sequence auto-tuning completion.

E613.0: Resistor inductance auto-tuning timeout

Fault cause:

Resistance/Inductance auto-tuning timeout

Troubleshooting:

Cause	Verification method	Solution
The resistor inductance auto-tuning is not done within 30 s, leading to a timeout alarm. The current feedback cannot reach the reference value because the motor power cables are disconnected or in poor contact.	Check whether the motor power cables are disconnected or in poor contact.	Check the motor power cables and ensure that they are connected properly.

E619.0: Absolute accuracy compensation parameter setting error

Fault cause:

The accuracy compensation parameter setting is improper.

Troubleshooting:

Cause	Verification method	Solution
1. Set the accuracy compensation interval (H33.64) to 0. 2. Inovance communication encoder DDL: 1. The distance from the mechanical home to the calibrated home exceeds the upper limit of Inovance communication-type encoder (encoder unit 2^{34}). 2. The length of the calibration exceeds the upper limit of the Inovance communication-type encoder (encoder unit 2^{34}). 3. The homing mode record is incorrect. The value of H33.70 is not within the values of {-2, -1, 1, 2, 4, 6, 17, 18, 24, 28, 33, 34}.	1. Check whether H33.64 is set to 0. 2. Check whether the distance between the mechanical home and the calibrated home (start position) exceeds the limit (encoder unit 2^{34}). 3. Check whether the value of H33.70 is within the values of {-2, -1, 1, 2, 4, 6, 17, 18, 24, 28, 33, 34}.	1. Set a correct compensation point interval. 2. Set a correct distance from the mechanical home to the calibrated home. 3. Set H33.70 to a proper value.

E619.1: Absolute accuracy compensation overflow

Fault cause:

1. The input quadrature pulse frequency (quadrupled) is higher than 1 ÷ (H33_74 × 25 ns).
2. The pulse count per-cycle compensation is higher than 1.

Troubleshooting:

Cause	Verification method	Solution
1. The input quadrature pulse frequency (quadrupled) is higher than 1 ÷ (H33_74 × 25 ns). 2. The pulse count per-cycle compensation is higher than 1.	1. Check the motor speed upon occurrence of the alarm. 2. View the compensation list to check whether a length longer than one index range exists.	1. Reduce the operating speed of motor. 2. Load the correct error compensation list.

E620.0: Motor overload

Fault cause:

Heat accumulation of the motor reaches the fault threshold.

Troubleshooting:

Cause	Verification method	Solution
1. Wiring of the motor and encoder is incorrect or in poor contact.	Check the wiring between the servo drive, servo motor and the encoder according to the correct "wiring diagram".	Connect cables according to the correct wiring diagram. Preferably use the cables provided by Inovance. When customized cables are used, prepare and connect the cables according to the hardware wiring instructions.
2. The load is excessive. The motor keeps outputting effective torque that higher than the rated torque for a long time.	Check the overload characteristics of the servo drive or servo motor. Check whether the average load rate (H0b.12) of the drive keeps exceeding 100.0%.	Use a drive of higher capacity and a matching motor. Alternatively, reduce the load and increase the acceleration/deceleration time.

Cause	Verification method	Solution
3. Acceleration/deceleration is frequent, or the load inertia is large.	Calculate the mechanical inertia ratio or perform inertia auto-tuning and view H08.15 (Inertia ratio). Confirm the single-shot operation cycle when the motor runs cyclically.	Increase the acceleration/ deceleration time for single-shot operation.
4. The gain is improper, or the stiffness is excessively high.	Check whether the motor vibrates and generates unusual noise during operation.	Adjust the gains.
5. The set servo drive model or motor model are incorrect.	View the motor model in H00.00 and drive model in H01.10.	Check the servo drive nameplate and set the correct servo drive model (H01.10) and motor model according to section "Servo Drive Model and Nameplate" in the hardware guide.
6. The motor is stalled due to mechanical problems, resulting in excessive load during operation.	Check the reference and motor speed (H0b.00) through the software tool or keypad: Reference in position control mode: H0b.13 (Input position reference counter); Reference in speed control mode: H0b.01 (Speed reference); Reference in torque control mode: H0b.02 (Internal torque reference). Check whether the reference is not 0 but the motor speed is 0 in the corresponding mode.	Rectify mechanical problems.
7. The servo drive is faulty.	The fault persists after the drive is power-cycled.	Replace the servo drive.

E620.1: Motor overload in overload current limit mode

Fault cause:

Motor overload in overload current limit mode

Troubleshooting:

Cause	Verification method	Solution
1. The load is too heavy and the effective torque output by the motor remains above the rated torque. 2. Acceleration/deceleration is too frequent or the load inertia is too large. 3. The motor and encoder are wired improperly. 4. The gain is improper or the stiffness level is too high. 5. The motor is stalled due to mechanical factors, resulting in overload during operation. 6. The drive is faulty.	Confirm the overload characteristics of the servo drive or servo motor. Check whether the average load ratio (H0b.12) remains above 100.0%.	1. Replace with a drive of larger capacity and a matching motor, or reduce the load and increase the acceleration/deceleration time.

E621.0: Overload current limit torque reached

Fault cause:

Overload current limit torque reached

Troubleshooting:

Cause	Verification method	Solution
1. The load is too heavy and the effective torque output by the motor remains above the rated torque. 2. Acceleration/deceleration is too frequent or the load inertia is too large . 3. The motor and encoder are wired improperly. 4. The gain is improper or the stiffness level is too high . 5. The motor is stalled due to mechanical factors, resulting in overload during operation. 6. The drive is faulty.	1. Confirm the overload characteristics of the servo drive or servo motor. Check whether the average load rate (H0b.12) of the servo drive remains above 100.0%. 2. Check whether H32.78 is set to an excessively high value.	1. Replace with a drive of larger capacity and a matching motor, or reduce the load and increase the acceleration/deceleration time.

E630.0: Motor stall over-temperature protection

Fault cause:

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

Troubleshooting:

Cause	Verification method	Solution
1. U/V/W output phase loss, open circuit, or incorrect phase sequence occurs on the servo drive.	Perform a motor trial run without load and check cable connections and the phase sequence with a multimeter.	Re-connect the cables according to the wiring diagram or replace the cables.
2. The motor parameter settings (especially the number of pole pairs) are improper, motor angle auto-tuning is not performed, or the motor power is higher than the drive power.	Read parameters in group H00 to check whether the number of pole pairs are set properly. Perform angle auto-tuning on the motor several times and check whether the value of H00.28 is consistent during angle auto-tuning. Check whether the motor power matches the drive power.	Modify the motor parameter values and replace with a drive of the same power.

Cause	Verification method	Solution
3. The references set through communication are disturbed.	Check whether jitter occurs on the references sent from the host controller and whether communication is disturbed.	Check whether communication between the host controller and the drive is disturbed.
4. The motor is stalled due to mechanical problems.	Check the reference and motor speed (H0B.00) through the software tool or keypad: Reference in position control mode: H0B.13 (Input position reference counter); Reference in speed control mode: H0B.01 (Speed reference); Reference in torque control mode: H0B.02 (Internal torque reference). Check whether the reference is not 0 but the motor speed is 0 in the corresponding mode. Check the current feedback (torque reference) waveform.	Check whether any mechanical part is stuck or eccentric.

E631.0: SBC brake circuit diagnosis exception

Fault cause:

The brake circuit is faulty or the external 24 V voltage is abnormal.

Troubleshooting:

Cause	Verification method	Solution
1. The SBC circuit is abnormal when the board 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

Fault cause:

The brake circuit is faulty.

Troubleshooting:

Cause	Verification method	Solution
1. The brake or the 24 V power supply is not connected when the built-in brake function is enabled. 2. The DO or VDO is assigned with function 9 (Brake function) and H04.24 is set to 0.	1. Check whether 24 V power supply or the brake is not connected when H02.16 is set to 1. 2. The DO or VDO is assigned with function 9 (Brake function) and H04.24 is set to 0.	1. Connect the brake cable and 24 V power supply cable when a built-in brake is used. 2. If the DO brake is used, set H04_ 24 to 1.

E631.2: P-MOS open circuit

Fault cause:

The brake circuit is faulty.

Troubleshooting:

Cause	Verification method	Solution
When braking is used, P-MOS open circuit occurred on the brake circuit.	Ensure the brake cable is connected properly, and check whether the fault persists after a power cycle.	1. Replace the drive. 2. Turn off the brake switch (H02.16).

E631.3: N-MOS open circuit

Fault cause:

The brake circuit is faulty.

Troubleshooting:

Cause	Verification method	Solution
When braking is used, N-MOS open circuit occurred on the brake circuit.	Ensure the brake cable is connected properly, and check whether the fault persists after a power cycle.	1. Replace the drive. 2. Turn off the brake switch (H02.16).

E640.0: IGBT junction temperature excessively high

Fault cause:

The IGBT temperature reaches the fault threshold defined by H0A.18.

Troubleshooting:

Cause	Verification method	Solution
1. The ambient temperature is excessively high. 2. The drive is restarted repeatedly to reset the overload fault.	Measure the ambient temperature and view the fault log (set H0b.33 and view H0b.34) to check whether an overload fault/alarm is reported (E620.0, E630.0, E650.0, E909.0, E920.0, E922.0).	Improve the cooling conditions of the drive to lower down the ambient temperature. Change the fault reset method. After overload occurs, wait for 30s and then perform the reset operation. Increase the capacities of the servo drive and servo motor. Increase the acceleration/ deceleration time and reduce the load.
3. The fan is damaged.	Check whether the fan works properly during operation.	Replace the servo drive.
4. The installation direction and clearance between servo drives are improper.	Check whether the drive is installed properly.	Install the drive according to the installation requirements.
5. The servo drive is faulty.	The fault persists upon restart five minutes after power-off.	Replace the servo drive.

E640.1: Flywheel diode junction temperature excessively high

Fault cause:

The temperature of the flywheel diode reaches the fault threshold defined by H0A.18.

Troubleshooting:

Cause	Verification method	Solution
1. The ambient temperature is excessively high. 2. The drive is restarted repeatedly to reset the overload fault.	Measure the ambient temperature and view the fault log (set H0b.33 and view H0b.34) to check whether an overload fault/alarm is reported (E620.0, E630.0, E650.0, E909.0, E920.0, E922.0).	Improve the cooling conditions of the drive to lower down the ambient temperature. Change the fault reset method. After overload occurs, wait for 30s and then perform the reset operation. Increase the capacities of the servo drive and servo motor. Increase the acceleration/ deceleration time and reduce the load.
3. The fan is damaged.	Check whether the fan works properly during operation.	Replace the servo drive.
4. The installation direction and clearance between servo drives are improper.	Check whether the drive is installed properly.	Install the drive according to the installation requirements.
5. The servo drive is faulty.	The fault persists upon restart five minutes after power-off.	Replace the servo drive.

E650.0: Heatsink over-temperature

Fault cause:

The temperature of the drive power module is higher than the over-temperature threshold.

Troubleshooting:

Cause	Verification method	Solution
1. The ambient temperature is excessively high. 2. The drive is restarted repeatedly to reset the overload fault.	Measure the ambient temperature and view the fault log (set H0b.33 and view H0b.34) to check whether an overload fault/alarm is reported (E620.0, E630.0, E650.0, E909.0, E920.0, E922.0).	Improve the cooling conditions of the drive to lower down the ambient temperature. Change the fault reset method. After overload occurs, wait for 30s and then perform the reset operation. Increase the capacities of the servo drive and servo motor. Increase the acceleration/ deceleration time and reduce the load.
3. The fan is damaged.	Check whether the fan works properly during operation.	Replace the servo drive.
4. The installation direction and clearance between servo drives are improper.	Check whether the drive is installed properly.	Install the drive according to the installation requirements.
5. The servo drive is faulty.	The fault persists upon restart five minutes after power-off.	Replace the servo drive.

E660.0: Motor over-temperature

Fault cause:

The temperature of the air-cooled motor is too high. The PTC function is triggered inadvertently in H00.26.

Troubleshooting:

Cause	Verification method	Solution
The temperature of the air-cooled motor is too high. The PTC function is triggered inadvertently in H00.26.	Measure whether the temperature of the air-cooled motor is excessively high. Check whether the PTC function is enabled but the motor does not carry a PTC. Check whether PTC is connected properly. For Inovance motors, the temperature threshold is 130°C. For third-party motors, measure the PTC resistance and determine the motor temperature based on the resistance specifications.	1. Cool the motor down. 2. Check whether the PTC function is enabled but the motor does not carry a PTC. 3. Check whether PTC is connected properly.

E661.0: STune failure

Fault cause:

During STune tuning, gain reduction has reached the lower limit:
Position loop gain < 5;
Speed loop gain < 5;
Model loop gain < 10.

Troubleshooting:

Cause	Verification method	Solution
During STune tuning, gain reduction has reached the lower limit: Position loop gain < 5; Speed loop gain < 5; Model loop gain < 10.	Check whether vibration resonance is properly suppressed in the system. The torque resonance amplitude exceeds the setpoint of H09.11.	1. Set the notch manually when vibration cannot be suppressed automatically. 2. Modify the electronic gear ratio to improve the command resolution, the command filter time constant in the "Parameter configuration" interface. 3. Check the machine for cyclic fluctuation. 4. Set H09.58 to 1 to clear resonance suppression parameter and perform STune again.

E662.0: ETune failure

Fault cause:

Check whether resonance during ETune operation can be suppressed.

Troubleshooting:

Cause	Verification method	Solution
Check whether resonance during ETune operation can be suppressed.	Check whether unusual noise or torque fluctuation occurs during operation.	1. When vibration cannot be suppressed automatically, set the notch manually. 2. Modify the electronic gear ratio to improve the reference resolution, or increase the reference filter time properly in the parameter configuration interface. 3. Increase the value of H09.11 properly. 4. Check whether the machine fluctuates periodically. 5. Check whether positioning threshold is excessively low. Increase the reference acceleration/deceleration time.

E664.0: Excessive resonance

Fault cause:

Resonance occurs on the servo system and the torque fluctuation amplitude is higher than the value of H09.54.

Troubleshooting:

Cause	Verification method	Solution
Resonance occurs on the servo system and the torque fluctuation amplitude is higher than the value of H09.54.	Check whether unusual noise or torque fluctuation occurs during operation.	1. Check whether the inertia ratio or loop gain parameters are set properly. 2. Check whether resonance suppression parameters are set properly. 3. Increase the value of H09.54 or set this parameter to 0 to hide this function.

E720.0: Encoder interface selected improperly

Fault cause:

The drive does not support the present encoder interface.

Troubleshooting:

Cause	Verification method	Solution
The drive does not support the present encoder interface.	Check whether H32.01 and H0F.06 are set to correct values. If the gantry function is enabled, check whether the gantry function is in conflict with the master encoder or fully closed-loop encoder setting.	1. Check whether the signal cable required by current encoder interface solution exceeds the upper limit of an individual interface. 2. Change the values of H32.01 and H0F.01.

E731.0: Encoder multi-turn position data loss

Fault cause:

Encoder multi-turn position data loss

Troubleshooting:

Cause	Verification method	Solution
1. The primary encoder battery is not connected during power-off.	Check whether the battery is connected during power-off.	Set H0d.20 to 1 to clear the fault.
2. The primary encoder battery voltage is lower than 2.9 V.	Measure the battery voltage.	Replace the battery with a new one that provides matching voltage.
3. The primary encoder is disturbed by a strong magnetic field.	Check whether the encoder is in an environment with a strong magnetic field.	Remove the strong magnetic field source and set H0d.20 to 1.

E731.1: Inovance secondary encoder multi-turn position data loss

Fault cause:

Inovance secondary encoder multi-turn position data loss

Troubleshooting:

Cause	Verification method	Solution
1. The secondary encoder battery is not connected during power-off.	Check whether the battery is connected during power-off.	Set H0d.20 to 1 to clear the fault.
2. The battery voltage of the Inovance secondary encoder is lower than 2.9 V.	Measure the battery voltage.	Replace the battery with a new one that provides matching voltage.
3. The Inovance secondary encoder is disturbed by a strong magnetic field.	Check whether the encoder is in an environment with a strong magnetic field.	Remove the strong magnetic field source and set H0d.20 to 1.

E733.0: Encoder multi-turn counting error

Fault cause:

An encoder multi-turn counting error occurs.

Troubleshooting:

Cause	Verification method	Solution
The encoder is faulty.	Set H0d.20 to 2 to clear the fault, but E733.0 persists after a power cycle.	Replace the motor.

E733.1: Inovance secondary encoder multi-turn counting error

Fault cause:

Inovance secondary encoder multi-turn counting error

Troubleshooting:

Cause	Verification method	Solution
Inovance secondary encoder fault.	Set H0d.20 to 3 to clear the fault, but E733.1 persists after restart.	Replace the motor.

E735.0: Encoder multi-turn count overflow

Fault cause:

A multi-turn counting overflow occurs on the absolute encoder.

Troubleshooting:

Cause	Verification method	Solution
The number of forward revolutions exceeds 32767 or the number of reverse revolutions exceeds 32768.	Check whether the value of H0b.70 (Number of absolute encoder revolutions) is 32767 or 32768 when the servo drive works in the absolute linear mode (H02.01 = 1).	Set H0d.20 to 2 to power on again. Perform homing if necessary.

E740.0: Absolute encoder communication timeout

Fault cause:

The real-time communication timeout fault state of the encoder has been set for 100 consecutive current loop cycles.

Troubleshooting:

Cause	Verification method	Solution
1. The encoder cable is abnormal, disconnected, or in poor contact. 2. The motor type is set incorrectly. 3. The encoder is damaged.	1. Check the wiring of the encoder and power on the drive again. Check whether H30.16 exceeds 100. 2. Check whether the motor type is set properly. 3. Replace the encoder.	1. After checking that the encoder is connected properly, restart the drive. 2. Check whether the encoder type is consistent with the setting. After checking that the motor type is set correctly, restart the drive. 3. Replace the encoder for cross-verification.

E740.2: Absolute encoder error

Fault cause:

This fault is caused by encoder communication timeout, stop bit error, CRC error, data field error, or position counter error during non-real-time communication (initialization upon power-on or during reading ROM).
Or, this fault is caused by N (defined by H0A.50) errors that occurred consecutively during real-time communication.

Troubleshooting:

Cause	Verification method	Solution
1. The encoder cable is abnormal or communication with the encoder is disturbed. 2. The data bit of the third-party encoder is set improperly.	1. Check whether the value of H0b.28 is not 0. Check whether the signal transmission process is disturbed. 2. Check the motor encoder user guide and confirm that the data bits (H00.43/H00.44) are set correctly.	1. Ensure that the drive and motor are grounded properly. You can wind the encoder cable on a magnetic ring to reduce interference. Use a twisted pair to connect the encoder. 2. Check the encoder user guide and set a correct encoder data length.

E740.3: Absolute encoder single-turn calculation error

Fault cause:

An internal fault occurs on the encoder.

Troubleshooting:

Cause	Verification method	Solution
An internal fault occurs on the encoder.	Check whether bit7 of H0b.28 is set to 1.	1. Check whether encoder version (H00.04) is set properly. 2. Check whether the encoder cable is proper. 3. Replace the motor.

E740.6: Encoder write fault

Fault cause:

The attempt to write the encoder data fails.

Troubleshooting:

Cause	Verification method	Solution
1. The attempt to write position offset after angle auto-tuning/ phase sequence auto-tuning failed. 2. The attempt to write auto-tuned parameters after resistance/ inductance auto-tuning failed. 3. The attempt to write the current loop gain after current loop auto-tuning failed.	Replace with a new encoder cable. If the fault no longer occurs after cable replacement, it indicates the original encoder cable is damaged. Keep the motor in a certain position, power on the system several times, and observe the change of H0b.17 (Electrical angle). The electrical angle deviation should be within ±30° when the motor position does not change.	Use a new encoder cable. If the fault persists after the encoder cable is replaced, the encoder may be faulty. In this case, replace the servo motor.

E740.7: BiSS-C encoder data fault

Fault cause:

BiSS-C encoder data fault

Troubleshooting:

Cause	Verification method	Solution
1. The BiSS-C read head is installed loosely, and the clearance between the read head and grating scale does not fulfill the installation requirements. 2. The BiSS-C grating scale has been polluted. 3. The BiSS-C encoder read head is damaged.	1. Check whether the read head lights up abnormally. 2. Check whether the read head lights up at a certain position.	1. Install the read head again. 2. Replace the grating scale . 3. Replace the read head.

E740.8: BiSS-C register communication fault

Fault cause:

This fault is caused by encoder communication timeout, stop bit error, CRC error, and data field in non-real-time communication.

Troubleshooting:

Cause	Verification method	Solution
1. The BiSS-C read head is installed loosely, and the clearance between the read head and grating scale does not fulfill the installation requirements. 2. The BiSS-C grating scale has been polluted. 3. The BiSS-C encoder read head is damaged.	1. Check whether the read head lights up abnormally. 2. Check whether the read head lights up at a certain position.	1. Install the read head again. 2. Replace the grating scale . 3. Replace the read head.

E740.9: Encoder data transmission delay too long

Fault cause:

The set encoder data transmission delay exceeds the time of one current loop cycle.

Troubleshooting:

Cause	Verification method	Solution
1. H01.59 is set to an excessively high value. 2. The number of encoder data bits is excessive.	Power off and restart the drive.	1. Reduce the value of H01.59. 2. Replace with an encoder with lower number of bits.

E744.0: Absolute encoder communication timeout

Fault cause:

Communication timeout occurs on the absolute encoder.

Troubleshooting:

Cause	Verification method	Solution
The communication between the servo drive and the encoder times out.	Check the wiring of the encoder. After clearing the fault source, reset the fault.	1. Check whether the values of H30.16 and H30.18 are excessively high. 2. Check the wiring of the encoder.

E744.2: Absolute encoder error

Fault cause:

A communication error occurs on the RX side of the encoder.

Troubleshooting:

Cause	Verification method	Solution
An error occurs on the communication between the servo drive and the encoder due to disturbance.	Check whether the shielded cable of the encoder is connected properly. After the fault source is cleared, reset the fault.	1. Check whether the value of H30.17 is excessively high. 2. Check whether the encoder cable is connected properly. 3. Check whether the servo drive and motor are grounded properly. You can wind the encoder cable onto the magnetic ring to reduce interference.

E750.0: Master/Slave initial position deviation of safety encoder too large

Fault cause:

The internal master/slave initial position deviation of the safety encoder is too large.

Troubleshooting:

Cause	Verification method	Solution
The internal master/slave initial position deviation of the safety encoder is excessively large.	Power off and restart the drive.	Return it to the manufacturer for service.

E750.1: Difference between safety encoder master and slave positions too large

Fault cause:

The internal master/slave initial position deviation of the safety encoder is excessively large.

Troubleshooting:

Cause	Verification method	Solution
The internal master/slave initial position deviation of the safety encoder is excessively large.	Power off and restart the drive.	Return it to the manufacturer for service.

E750.2: QEP difference between encoder master and slave too large

Fault cause:

The difference in QEP count between master and slave is greater than two.

Troubleshooting:

Cause	Verification method	Solution
Board-level signal interference, encoder disk contamination, chip peripherals exception.	Check the encoder surroundings for interference source.	Replace the motor or encoder.

E750.3: Deviation between safety encoder master and slave analog values too large

Fault cause:

The deviation between safety encoder master and slave sampling analog values is excessively large.

Troubleshooting:

Cause	Verification method	Solution
The deviation between safety encoder master and slave sampling analog values is excessively large.	Power off and restart the drive.	Return it to the manufacturer for service.

E750.4: Encoder chip power supply diagnosis exception

Fault cause:

The LDO or battery voltage is lower than 3.1 V.

Troubleshooting:

Cause	Verification method	Solution
The external power supply of the encoder is in the undervoltage state, the LDO device is damaged, or the battery voltage is low.	1. Check whether the battery is correctly connected. 2. Check whether the encoder is powered normally.	Replace the motor or encoder.

E750.5: Encoder master and slave SN mismatch

Fault cause:

The SN counts of the master and slave are not equal.

Troubleshooting:

Cause	Verification method	Solution
The integrated circuit operates improperly, and the master and slave do not exchange data normally.	Check whether the integrated circuit is abnormal due to excessively high ambient temperature.	Replace the motor or encoder.

E750.6: Encoder chip diagnosis exception

Fault cause:

The flash, RAM, and chip of the master or slave are diagnosed faulty.

Troubleshooting:

Cause	Verification method	Solution
The integrated circuit is abnormal.	Check whether the integrated circuit is abnormal due to excessively high ambient temperature.	Replace the motor or encoder.

E750.7: Encoder SPI communication error, no response from the slave

Fault cause:

The slave fails to receive the command word from the master, or the master fails to receive the reply frame from the slave.

Troubleshooting:

Cause	Verification method	Solution
Board-level communication interference causes internal CRC failure, and peripheral errors.	Check whether the integrated circuit is abnormal due to excessively high ambient temperature.	Replace the motor or encoder.

E751.0: Safety module encoder CRC error

Fault cause:

1. The SN increment received by the safety module is abnormal.
2. The CRC value calculated by the safety module is inconsistent with the received CRC value.

Troubleshooting:

Cause	Verification method	Solution
1. The encoder cable is faulty.	Check whether the encoder cables are normal.	Check whether encoder cables are connected properly.
2. The communication with encoder is disturbed.	Check for interference around the encoder cables.	1. Check whether the servo drive and motor are properly grounded, and you can put a magnetic ring on the encoder to reduce the interference. 2. Replace the motor or encoder.

E751.1: Excessive deviation between speeds calculated by MCU1 and MCU2 of safety module

Fault cause:

The deviation between the speeds calculated by MCU1 and MCU2 exceeds the threshold.

Troubleshooting:

Cause	Verification method	Solution
1. The communication between MCU1 and MCU2 of the safety module is disturbed.	Check for interference around the safety module.	Reduce interference around the safety module.
2. The safety module is faulty.	Check whether the fault can be rectified by replacing the safety module.	Replace the safety module.

E751.2: Safety module position 1 and 2 check error

Fault cause:

The deviation between position 1 and position 2 received by the safety module exceeds the threshold.

Troubleshooting:

Cause	Verification method	Solution
The safety encoder is faulty.	Check whether the fault can be rectified by replacing the safety encoder.	Replace the safety encoder.

E751.3: Safety encoder version number CRC error

Fault cause:

1. The safety encoder software version is not 264xx.
2. The CRC value of the safety encoder version number is abnormal.

Troubleshooting:

Cause	Verification method	Solution
The safety encoder version (H00-04) is not 264xx.	Power off and restart the drive.	Contact the manufacturer.
The CRC value of the safety encoder version number is wrong.	1. Check the wiring. 2. If the fault persists after the servo drive is powered off and on several times, the encoder is faulty. 3. Check for interference around the cables.	1. Check the cable connection or connect cables again. 2. If the fault persists after repeated restart, replace the encoder.

E755.0: Nikon encoder communication fault

Fault cause:

Nikon encoder communication failed.

Troubleshooting:

Cause	Verification method	Solution
An error occurs on the communication between the drive and encoder.	Check whether the shielded cable of the encoder is connected properly. After the fault source is cleared, reset the fault.	1. Check whether the value of H30.17 is excessively high. 2. Check whether the encoder cable is connected properly. 3. Check whether the servo drive and motor are grounded properly. You can wind the encoder cable onto the magnetic ring to reduce interference.

E760.0: Encoder over-temperature

Fault cause:

The temperature of the absolute encoder is excessively high.

Troubleshooting:

Cause	Verification method	Solution
The temperature of the absolute encoder is too high.	The measured encoder temperature or motor temperature cannot exceed 120℃. The temperature measured refers to the actual temperature of enclosure, which is 20℃ to 40℃ lower than the internal temperature.	Switch off the S-ON signal to wait for the encoder to cool down.

E765.0: Third-party encoder over-temperature or overspeed

Fault cause:

Encoder over-temperature or overspeed

Troubleshooting:

Cause	Verification method	Solution
Motor over-temperature or overspeed.	1. Check whether the ambient temperature or the average load rate is too high, leading to motor overtemperature (above 140℃). 2. Check whether the motor overspeed occurs.	Switch off the S-ON signal to wait for the encoder to cool down.

E770.0: Fully-closed input phase A disconnected

Fault cause:

The phase A differential voltage input is disconnected in closed-loop control.

Troubleshooting:

Cause	Verification method	Solution
The phase A differential voltage input is disconnected in closed-loop control.	Measure whether the differential voltage of phase A is lower than 2.5 V.	Adjust the fully-closed loop phase A input voltage.

E770.1: Fully-closed loop input phase B disconnected

Fault cause:

The phase B differential voltage input is disconnected in closed-loop control.

Troubleshooting:

Cause	Verification method	Solution
The phase B differential voltage input is disconnected in closed-loop control.	Measure the phase B differential voltage to check whether it is below 2.5 V.	Adjust the fully-closed loop phase B input voltage.

E770.2: Fully-closed loop input phase Z disconnected

Fault cause:

The phase Z differential voltage input is disconnected in closed-loop control.

Troubleshooting:

Cause	Verification method	Solution
The phase Z differential voltage input is disconnected in closed-loop control.	Measure the phase Z differential voltage to check whether it is below 2.5 V.	Adjust the fully-closed loop phase Z input voltage.

E770.3: Outer loop encoder communication timed out in fully closed-loop mode

Fault cause:

Fully closed-loop external loop encoder communication timeout

Troubleshooting:

Cause	Verification method	Solution
Fully closed-loop external loop encoder communication timeout	Check the wiring.	Check whether the wiring is correct.

E770.6: Fully closed-loop Inovance secondary encoder initialization communication error

Fault cause:

Inovance secondary encoder initialization failed.

Troubleshooting:

Cause	Verification method	Solution
1. The encoder cable connections are incorrect or loosened.	1. Check the encoder cable connection. 2. Check whether ambient vibration is too large, which loosens the encoder cable and even damages the encoder.	1. Connect the cables again according to the correct wiring diagram. 2. Connect the cables again and ensure encoder terminals are connected securely.
2. The servo drive is faulty.	The fault persists after the servo drive is restarted.	Replace the servo drive.

E770.7: Fully closed-loop secondary encoder communication fault

Fault cause:

Secondary encoder communication failed.

Troubleshooting:

Cause	Verification method	Solution
1. The encoder is wired improperly. 2. The encoder cable is loosened. 3. The encoder Z signal is being disturbed. 4. The encoder is faulty. 5. Check whether H0F.29 to H0F.33 are set properly.	Check the wiring of the encoder. Check whether on-site vibration is excessive, which loosens the encoder cable and even damages the encoder. Replace with a new encoder cable. If the fault no longer occurs after cable replacement, it indicates the original encoder cable is damaged. Check whether ambient devices are generating interference and whether multiple interference sources are present in the cabinet. Make the servo drive stay in the "Rdy" status and rotate the 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. Keep the motor in a certain position, power on the system several times, and observe the change of H0b.17 (Electrical angle). The electrical angle deviation should be within ±30° when the motor position does not change. Check whether H0F.29 to H0F.33 are set to proper values.	1. Connect the cables again and ensure encoder terminals are connected securely. It is recommended to use the cables provided by Inovance. For use of custom cables, check whether the custom 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. 4. Set H0F.29 to H0F.33 to proper values.

E770.8: Encoder data transmission delay set excessively in fully closed-loop mode

Fault cause:

The set encoder data transmission delay exceeds the time of one current loop cycle.

Troubleshooting:

Cause	Verification method	Solution
1. H01.59 is set to an excessively high value. 2. The number of encoder data bits is excessive.	The fault persists after restart.	1. Reduce the value of H01.59. 2. Replace with an encoder with lower number of bits.

E771.0: Communication handshake between the interpolator and the drive failed

Fault cause:

Communication handshake between the interpolator and the drive failed

Troubleshooting:

Cause	Verification method	Solution
The initialization communication between T2 interpolator and motor is abnormal.	1. Check whether the drive is not restarted after parameters are written to the interpolator. 2. Check the wiring between the interpolator and motor.	1. Power cycle the drive. 2. If the wiring is normal but the fault persists after repeated restart, replace the motor.

E939.0: Motor power cable disconnected

Fault cause:

At least one phase of the motor power cables is disconnected.

Troubleshooting:

Cause	Verification method	Solution
1. One or two phases of the motor power cables (U/V/W) are disconnected. 2. The current loop gain is set improperly.	1. Check the wiring of U/V/W power cables. 2. The power cable is not disconnected, and current feedback and torque reference following errors occur. The fault can be cleared after inductance resistance auto-tuning and current loop auto-tuning are performed.	1. Check whether the power cables are disconnected or in poor contact. Re-connect the power cables. 2. Replace the motor. 3. Perform inductance resistance auto-tuning and current loop auto-tuning again.

EA33.0: Encoder read/write check error

Fault cause:

Internal parameters of the encoder are abnormal.

Troubleshooting:

Cause	Verification method	Solution
1. The serial incremental encoder cable is disconnected or connected loosely.	Check the wiring.	Check whether the encoder cables are connected incorrectly, disconnected, or in poor contact. If the motor cables and encoder cables are bundled together, separate them.
2. The attempt to read/write bus incremental encoder parameters failed.	If the fault persists after the drive is powered off and on repeatedly, the encoder is faulty.	Replace the servo motor.

EA33.1: Fully closed-loop Inovance secondary encoder data read/write error

Fault cause:

Internal parameters of the encoder are abnormal.

Troubleshooting:

Cause	Verification method	Solution
1. The serial incremental encoder cable is disconnected or connected loosely.	Check the wiring.	Check whether the encoder cables are connected incorrectly, disconnected, or in poor contact. If the motor cables and encoder cables are bundled together, separate them.
2. The attempt to read/write bus incremental encoder parameters failed.	If the fault persists after the drive is powered off and on repeatedly, the encoder is faulty.	Replace the servo motor.

EA34.0: Hall state error

Fault cause:

The Hall device is faulty.

Troubleshooting:

Cause	Verification method	Solution
Hall signal outputs all high or low	Check whether the Hall is wired properly. Sample the Hall state with the oscilloscope in the software tool. Rotate the motor rotor to observe whether the Hall state ranges from 0 or 7.	1. Check the U/V/W wiring of the Hall. If the fault persists after repeated restart, the Hall unit is faulty. In this case, replace the Hall unit. 2. Check whether the shield of the encoder is connected. 3. If a certain phase of the Hall is connected improperly, modify H32.55 to adjust the active state of the single-phase level of the Hall.

EA34.1: Dynamic Hall auto-tuning error

Fault cause:

Dynamic Hall auto-tuning error

Troubleshooting:

Cause	Verification method	Solution
An electrical angle error is detected during dynamic Hall auto-tuning.	1. Check whether the motor rotates properly. 2. Check whether the Hall signal output corresponds to the electrical angle change. 3. Check whether the Hall function is enabled for the motor without Hall signal. 4. Check whether the Hall element is wired properly.	1. Ensure the motor can move by single side, without being affected by limit. 2. After checking parameters are set properly, test whether the Hall signal changes every time the electrical angle changes by nearly 60 degrees. If not, the Hall signal output is abnormal. In this case, replace the Hall components. 3. Check whether the motor is equipped with the Hall function. 4. Check whether Hall is wired properly.

EA34.2: Static Hall auto-tuning error

Fault cause:

Static Hall auto-tuning error

Troubleshooting:

Cause	Verification method	Solution
Static Hall auto-tuning cannot be enabled.	1. Check whether the motor is equipped with an incremental encoder. 2. Check whether H32.62 is set to 1 when H0A.13 is set to 6.	1. Static Hall auto-tuning is supported only by motors equipped with an incremental encoder. 2. Perform dynamic Hall auto-tuning again if H32.62 is not set to 1 but H0A.13 is set to 6.

EB00.0: Excessive position deviation

Fault cause:

The position deviation is larger than the value of 6065h in position control mode.

Troubleshooting:

Cause	Verification method	Solution
1. U/V/W output phase loss or incorrect phase sequence occurs on the servo drive.	Perform a no-load trial run on the motor and check the wiring.	Re-connect the cables according to the wiring diagram or replace the cables.
2. The servo drive U/V/W output cables or encoder cables are disconnected.	Check the wiring.	Connect the cables again. The servo drive power cables (U/V/W) must be connected in the correct order at both ends. If necessary, replace all cables and ensure a reliable connection.

Cause	Verification method	Solution
3. The motor rotor is stalled due to mechanical factors.	Check the reference and motor speed (H0b.00) through the software tool or keypad: Reference in position control mode: H0b.13 (Input position reference counter) Reference in speed control mode: H0b.01 (Speed reference) Reference in torque control mode: H0b.02 (Internal torque reference) Check whether the reference is not 0 but the motor speed is 0 in the corresponding mode.	Eliminate mechanical factors.
4. The servo drive gains are too low.	Check the position loop gain and speed loop gain of the drive: 1st gain set: H08.00 to H08.02; 2nd gain set: H08.03 to H08.05	Adjust the gain values manually or perform gain auto-tuning.
5. The position reference increment is excessive.	Position control mode: In CSP mode, check the gear ratio 6091.01h/6091.02h to determine the position reference increment for an individual synchronization period and convert it to 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 6099.01h and 6099.02h.	In CSP mode, decrease the position reference increment per synchronization period. The host controller should cover the position ramp when generating references. In PP mode, decrease the value of 6081h, or increase the acceleration/deceleration ramp (6083h, 6084h). In HM mode, decrease the values of 6099.01h and 6099.02h or increase the acceleration/deceleration ramp (609Ah). Decrease the gear ratio according to actual conditions.
6. The value of 6065h is excessively low relative to the operating conditions.	Check whether 6065h is set to an excessively low value.	Increase the value of 6065h.
7. The servo drive or motor is faulty.	Monitor the operation waveform through the oscilloscope function in the software tool: position reference, position feedback, speed reference, and torque reference.	If the position reference is not 0 but the position feedback remains 0, replace the servo drive or motor.

EB00.1: Position deviation overflow

Fault cause:

Deviation of the position calculated by the drive is excessive.

Troubleshooting:

Cause	Verification method	Solution
1. U/V/W output phase loss or incorrect phase sequence occurs on the servo drive.	Perform a no-load trial run on the motor and check the wiring.	Re-connect the cables according to the wiring diagram or replace the cables.
2. The servo drive U/V/W output cables or encoder cables are disconnected.	Check the wiring.	Connect the cables again. The servo drive power cables (U/V/W) must be connected in the correct order at both ends. If necessary, replace all cables and ensure a reliable connection.
3. The motor rotor is stalled due to mechanical factors.	Check the reference and motor speed (H0b.00) through the software tool or keypad: References in the position control mode: H0b.13 (Input position reference counter) References in speed control mode: H0b.01 (Speed reference) Operation reference in torque control mode: H0b.02 (Internal torque reference) Check whether the operation reference is not 0, but the motor speed is 0 in the corresponding mode.	Eliminate mechanical factors.
4. The servo drive gains are too low.	Check the position loop gain and speed loop gain of the drive: 1st gain set: H08.00 to H08.02; 2nd gain set: H08.03 to H08.05	Adjust the gain values manually or perform gain auto-tuning.
5. The position reference increment is excessive.	Position control mode: In CSP mode, check the gear ratio 6091.01h/6091.02h to determine the position reference increment for an individual synchronization period and convert it to 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 6099.01h and 6099.02h.	In CSP mode, decrease the position reference increment per synchronization period. The host controller should cover the position ramp when generating references. In PP mode, decrease the value of 6081h, or increase the acceleration/deceleration ramp (6083h, 6084h). In HM mode, decrease the values of 6099.01h and 6099.02h or increase the acceleration/deceleration ramp (609Ah). Decrease the gear ratio according to actual conditions.
6. The value of 6065h is excessively low relative to the operating conditions.	Check whether 6065h is set to an excessively low value.	Increase the value of 6065h.
7. The servo drive or motor is faulty.	Monitor the operation waveform through the oscilloscope function in the software tool: position reference, position feedback, speed reference, and torque reference.	If the position reference is not 0 but the position feedback remains 0, replace the servo drive or motor.

EB01.1: Individual position reference increment too large

Fault cause:

The incremental distance to the target position is excessively large.

Troubleshooting:

Cause	Verification method	Solution
The target position increment is too large.	Check the variation between two adjacent target positions by using the software tool.	1. Check whether the maximum motor speed fulfills the application requirement. If yes, reduce the target position reference increment, which is to lower the profiled reference speed. If not, replace the servo motor. 2. Before switching the modes or switching on the servo drive, check whether the target position is aligned with current position feedback. 3. The communication time sequence of the host controller is abnormal, leading to errors in the data received by slave. Check the communication time sequence of the host controller.

EB01.2: Excessive position reference increment persisted

Fault cause:

The target position increment is excessively large for a long time.

Troubleshooting:

Cause	Verification method	Solution
The target position increment is excessively large for a long time.	Check the variation between two adjacent target positions by using the software tool.	1. Check whether the maximum motor speed fulfills the application requirement. If yes, reduce the target position reference increment, which is to lower the profiled reference speed. If not, replace the servo motor. 2. Before switching the modes or switching on the servo drive, check whether the target position is aligned with current position feedback. 3. The communication time sequence of the host controller is abnormal, leading to errors in the data received by slave. Check the communication time sequence of the host controller.

EB01.3: Reference overflow

Fault cause:

The target position is still in the process of transmission when the servo limit or software position limit signal is activated and the 32-bit upper/lower limit is reached.

Troubleshooting:

Cause	Verification method	Solution
The target position is still in the process of transmission when the servo limit or software position limit signal is activated and the 32-bit upper/lower limit is reached.	Check whether the host controller keeps sending commands after the overtravel alarm is reported by the servo drive.	1. Detect the servo limit signal (bit0 and bit1 of 60FDh recommended) through the host controller. 2. The host controller stops transmitting the limit direction reference after detecting the active servo limit signal.

EB02.0: Excessive position deviation in fully closed-loop mode

Fault cause:

The absolute value of position deviation in fully closed-loop mode exceeds the value of H0F.08 (Excessive position deviation threshold in fully closed-loop mode).

Troubleshooting:

Cause	Verification method	Solution
1. U/V/W output phase loss or incorrect phase sequence occurs on the servo drive.	Perform a no-load trial run on the motor and check the wiring.	Re-connect the cables according to the wiring diagram or replace the cables.
2. The servo drive U/V/W cables or internal/external encoder cable is disconnected.	Check the wiring.	Connect the cables again. The servo drive power cables (U/V/W) must be connected in the correct order at both ends. If necessary, replace all cables and ensure a reliable connection.
3. The motor rotor is stalled due to mechanical factors.	Check the reference and motor speed (H0b.00) through the software tool or keypad: Reference in position control mode: H0b.13 (Input position reference counter); Reference in speed control mode: H0b.01 (Speed reference); Reference in torque control mode: H0b.02 (Internal torque reference). Check whether the reference is not 0 but the motor speed is 0 in the corresponding mode.	Eliminate mechanical factors.
4. The servo drive gains are too low.	Check the position loop gain and speed loop gain of the drive: 1st gain set: H08.00 to H08.02; 2nd gain set: H08.03 to H08.05	Adjust the gain values manually or perform gain auto-tuning.
5. The input pulse frequency is high.	When the pulse reference is used as the position reference source, check whether the pulse frequency is excessively high or whether the acceleration/deceleration time is set to 0 or an excessively low value.	Reduce the position reference frequency or the electronic gear ratio. If position pulses are outputted through the host controller, you can set the acceleration/deceleration time through the host controller directly. If not, increase the value of H05.04. H05.06

Cause	Verification method	Solution
6. The value of H0F.08 (Threshold of excessive position deviation) is excessively low under current operating conditions.	Check whether the value of H0F.08 is excessively low.	Increase the setpoint of H0F.08.
7. The servo drive or motor is faulty.	Monitor the operation waveform through the oscilloscope function in the software tool: position reference, position feedback, speed reference, and torque reference.	If the position reference is not 0 but the position feedback remains 0, replace the servo drive or motor.

EB02.1: Fully closed-loop position deviation overflow

Fault cause:

The absolute value of the fully closed-loop position deviation is greater than 2^{31}.

Troubleshooting:

Cause	Verification method	Solution
1. U/V/W output phase loss or incorrect phase sequence occurs on the servo drive.	Perform a no-load trial run on the motor and check the wiring.	Re-connect the cables according to the wiring diagram or replace the cables.
2. The servo drive U/V/W cables or encoder cable is disconnected.	Check the wiring.	Connect the cables again. The servo drive power cables (U/V/W) must be connected in the correct order at both ends. If necessary, replace all cables and ensure a reliable connection.
3. The motor rotor is stalled due to mechanical factors.	Check the reference and motor speed (H0b.00) through the software tool or keypad: Reference in position control mode: H0b.13 (Input position reference counter); Reference in speed control mode: H0b.01 (Speed reference); Reference in torque control mode: H0b.02 (Internal torque reference). Check whether the reference is not 0 but the motor speed is 0 in the corresponding mode.	Eliminate mechanical factors.
4. The servo drive gains are too low.	Check the position loop gain and speed loop gain of the drive: 1st gain set: H08.00 to H08.02; 2nd gain set: H08.03 to H08.05	Adjust the gain values manually or perform gain auto-tuning.

Cause	Verification method	Solution
5. The position reference increment is excessive.	Position control mode: In IP/CSP mode, view the gear ratio 6091.01h/6091.02h to check the position reference increment for a single synchronous cycle and convert it to the speed information. In PP mode, view the gear ratio 6091.01h/6091.02h and define the value of 6081h (Profile velocity). In HM mode, view the gear ratio 6091.01h/6091.02h, and define the value of 6099.01h and 6099.02h.	In IP/CSP mode, decrease the position reference increment for a single synchronous cycle. The host controller should cover the position ramp when generating references. In PP mode, decrease the value of 6081h or increase the acceleration/deceleration ramp (6083h, 6084h). In HM mode, decrease the value of 6099.01h and 6099.02h or increase the acceleration/deceleration ramp (609Ah). Decrease the gear ratio according to actual conditions.
6. The value of H0F.08 (Threshold of excessive position deviation) is excessively low under current operating conditions.	Check whether 6065h is set to an excessively low value.	Increase the value of 6065h.
7. The servo drive or motor is faulty.	Monitor the operation waveform through the oscilloscope function in the software tool: position reference, position feedback, speed reference, and torque reference.	If the position reference is not 0 but the position feedback remains 0, replace the servo drive or motor.

EB03.0: Electronic gear ratio beyond the limit - H05.02

Fault cause:

The electronic gear ratio (H05.02) exceeds the limit: (0.001, 4000 × Encoder resolution ÷ 10000).

Troubleshooting:

Cause	Verification method	Solution
The electronic gear ratio converted by H05.02 exceeds the maximum gear ratio or is lower than the minimum gear ratio.	Check whether the electronic gear ratio converted by H05.02 is within the range of 0.001–4000 × Encoder resolution ÷ 10000.	Change the value of H05.02.

EB03.1: Electronic gear ratio 1 beyond the limit

Fault cause:

The electronic gear ratio 1 exceeds the limit: (0.001 to 4000 × Encoder resolution ÷ 10000).

Troubleshooting:

Cause	Verification method	Solution
The electronic gear ratio 1 exceeds the maximum gear ratio or is lower than the minimum gear ratio.	Check whether the electronic gear ratio 1 is within the range of 0.001–4000 x Encoder resolution/10000.	Change the values of H05.07 and H05.09.

EB03.2: Electronic gear ratio 2 beyond the limit

Fault cause:

The electronic gear ratio 2 exceeds the limit: (0.001–4000 × Encoder resolution ÷ 10000).

Troubleshooting:

Cause	Verification method	Solution
The electronic gear ratio 2 exceeds the maximum gear ratio or is lower than the minimum gear ratio.	Check whether electronic gear ratio 2 is within the range of 0.001–4000 × Encoder resolution ÷ 10000.	Change the values of H05.11 and H05.13.

EB04.0: Excessive gantry position deviation

Fault cause:

Excessive gantry position deviation

Troubleshooting:

Cause	Verification method	Solution
1. The gantry position deviation is too large. 2. The gantry position deviation is too large after servo OFF when mechanical homing is done	Check whether the gantry position deviation exceeds the threshold defined by H14.45 or is related to the instrument.	Increase the threshold defined by H14.45.

EB04.1: Gantry position deviation overlimit

Fault cause:

Gantry position deviation overlimit

Troubleshooting:

Cause	Verification method	Solution
The deviation between two gantry axes exceeds the internal 32-bit data.	Check whether the gantry alignment mode is proper, whether the position references of the two axes are the same, and whether the mechanical structure is normal.	Check whether the gantry alignment mode is proper, whether the position references of the two axes are the same, and whether the mechanical structure is normal.

EB05.0: Excessive static error

Fault cause:

When the motor is at standstill, the motor moves beyond the set threshold for a period of time.

Troubleshooting:

Cause	Verification method	Solution
When the motor is at standstill, the motor moves beyond the set threshold for a period of time.	Check whether the motor moves beyond the set threshold when it is at standstill.	Check whether H13.12 and H13.13 are set to proper values.

ED02.0: Modbus communication timeout

Fault cause:

Modbus communication timeout

Troubleshooting:

Cause	Verification method	Solution
Modbus communication timeout	Increase the value of H0E.83.	Determine the Modbus access cycle by frame capture.

EE08.0: Synchronization (SYNC) signal loss

Fault cause:

The sync signal is turned off when the EtherCAT network is in the OP state.

Troubleshooting:

Cause	Verification method	Solution
1. The sync signal is not generated due to hardware errors.	Check whether the sync signal cycle is 0 using the oscilloscope in the software tool.	Replace the servo drive. Contact Inovance for maintenance.
2. The data received by the slave is abnormal during synchronous communication.	Check whether the communication cable is shielded twisted pairs. Check whether the drive is grounded properly. Check whether the network port of the drive is damaged.	Use shielded twisted pair cables. Connect cables according to wiring instructions. Check the network connection status through the first LED.
3. The data sent by the master is abnormal during synchronous communication.	The synchronization clock of the host controller is not activated. The synchronization clock error of the host controller is excessively high.	Measure the synchronization cycle through the oscilloscope in the software tool or the actual oscilloscope. If the synchronization cycle is 0, the synchronization clock of the host controller is not active. Check whether the network cables connected to each slave come in from the IN port and out from the OUT port. If yes, restart the network. If the network cables are connected in the correct sequence, without the need for prior check, restart the network directly. If the synchronization cycle is not 0 and within the permissible fluctuation range (2 us) of the drive, increase the synchronization loss threshold of the slave (H0E.32h).
4. The network switches from OP to non-OP when the drive is enabled.	Check whether the network status switches from the OP state to non-OP state.	Check the network status switchover program of the host controller.

EE08.1: Network status switchover error

Fault cause:

When the servo drive is enabled, the EtherCAT network status switches from OP state to other status.

Troubleshooting:

Cause	Verification method	Solution
This fault is caused by mal-operation of the master or the operator.	Check whether the master switches the network status when the servo drive is enabled.	Check the network status switchover program of the host controller.
2. The data received by the slave is abnormal during synchronous communication.	Check whether the communication cable is shielded twisted pairs. Check whether the drive is grounded properly. Check whether the network port of the drive is damaged.	Use shielded twisted pair cables. Connect cables according to wiring instructions. Check the network connection status through the first LED.

Cause	Verification method	Solution
3. The data sent by the master is abnormal during synchronous communication.	The synchronization clock of the host controller is not activated. The synchronization clock error of the host controller is excessively high.	Measure the synchronization cycle through the oscilloscope in the software tool or the actual oscilloscope. If the synchronization cycle is 0, the synchronization clock of the host controller is not active. Check whether the network cables connected to each slave come in from the IN port and out from the OUT port. If yes, restart the network. If the network cables are connected in the correct sequence, without the need for prior check, restart the network directly. If the synchronization cycle is not 0 and within the permissible fluctuation range (2 us) of the drive, increase the synchronization loss threshold of the slave (H0E.32h).
4. The network switches from OP to non-OP when the drive is enabled.	Check whether the network status switches from the OP state to non-OP state.	Check the network status switchover program of the host controller.

EE08.3: Network cable connected improperly

Fault cause:

The network cable of the drive is connected improperly. The low-order 16 bits of H0E.29 represents the IN port loss count. The high-order 16 bits of H0E.29 represents the OUT port loss count.

Troubleshooting:

Cause	Verification method	Solution
The physical connection of the data link is unstable, or the process data is lost due to plug-in/plug-out of the network cable.	Check whether the network cable of the servo drive is connected securely, whether strong vibration occurs on site, whether the network cable is plugged in or out, and whether a network cable provided by Inovance is used.	Check the connection of the network port through the change of the H0E.29 value. Use a new network cable that can connect reliably.

EE08.4 Data frame loss protection error

Fault cause:

The PDO data is corrupted due to EMC interference or improper network cables.

Troubleshooting:

Cause	Verification method	Solution
The data is lost due to EMC interference, poor quality of the network cable, or improper connection.	Check whether the high 16 bits of H0E-25 have values that are increased.	Check whether proper grounding is performed and rectify EMC measures. Check whether the network cable used is provided by Inovance. Check whether the network cable is reliable.

EE08.5: Data frame transfer error

Fault cause:

Incorrect data frames are generated from the upstream slave, and invalid data frames are transferred to the downstream slave.

Troubleshooting:

Cause	Verification method	Solution
The upstream station detects that the data frame has been corrupted and marked. Then the data frame is transferred to the local slave, triggering an alarm.	Check whether a processing unit error occurs due to transfer errors (H0E.27) or invalid frames (H0E.28) upon the fault, and check whether counting is not performed in RX-ERR of port 0.	Check the upstream station to locate the fault cause.

EE08.6: Data update timeout

Fault cause:

The slave is in the OP status and does not receive the data frame for a long time.

Troubleshooting:

Cause	Verification method	Solution
The data frame is lost or discarded in the upstream slave or the master performance is not up to standard.	Check through the software tool whether the phase difference between SYNC and IRQ exceeds the product of H0E.22 × communication period.	Check whether the CPU load of the master during operation is excessive. Reduce the communication time and set H0E-22 to a high value. Check whether link loss occurs to upstream stations.

EE09.0: Software limit setting error

Fault cause:

The lower limit of software position limit is equal to or higher than the upper limit.

Troubleshooting:

Cause	Verification method	Solution
The software lower limit is equal to or higher than the software upper limit.	Check the values of 607D.01h and 607D.02h.	Reset the values and ensure that the value of 607D.01h is smaller than that of 607D.02h.

EE09.1: Home setting error

Fault cause:

The home offset exceeds the upper/lower limit.

Troubleshooting:

Cause	Verification method	Solution
1. The home offset is outside the software limit defined by H0A.41 and H0A.43 (607C and 607D).	Check whether the home offset is outside the software limit range when the encoder works in the incremental mode, absolute linear mode, and single-turn absolute mode.	Set the home offset to a value within the software position limit range.
2. The home offset is beyond the upper/lower limit in rotation mode.	The home offset is outside the mechanical single-turn upper/ lower limit when the encoder works in rotation mode.	Set the home offset to a value within the mechanical single-turn upper/lower limit.

EE09.2: Gear ratio beyond limit

Fault cause:

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

Troubleshooting:

Cause	Verification method	Solution
The electronic gear ratio exceeds the limit (0.001, 4000 × Encoder ÷ 10000)	The gear ratio 6091.01h/6091.02h exceeds the preceding range.	Keep the gear ratio within the preceding range.

EE09.3: No synchronization signal

Fault cause:

The MCU does not receive the sync signal when the drive switches to the OP status.

Troubleshooting:

Cause	Verification method	Solution
1. The communication sync clock is configured improperly.	Replace with another master (such as Beckhoff or Omron PLC) and perform tests to compare between different masters.	Rectify the communication configuration of the master.
2. The communication IN and OUT ports are connected inversely.	Check the connection of the IN and OUT ports.	Connect the IN and OUT ports in the correct sequence.
3. The slave controller integrated circuit is damaged.	Replace the slave and perform the test.	Return it to the manufacturer for service.
4. The MCU pins are damaged.	Replace the drive for cross-verification.	Return it to the manufacturer for service.

EE09.5: PDO mapping beyond the limit

Fault cause:

The mapping objects in TPDO or RPDO exceeds 40 bytes.

Troubleshooting:

Cause	Verification method	Solution
The mapping objects in TPDO or RPDO exceeds 40 bytes.	Check the number of self-indexes configured in 1600h or 1A00h.	The mapping objects in TPDO or RPDO must not exceed 40 bytes.

EE10.0: Protection against MailBox setting error

Fault cause:

1. Check whether the SM channel is enabled.
2. Check whether the read/write direction is configured correctly.
3. Check whether the mailbox mode applies (single buffer mode).
4. Check whether the length of the data received is within the setting range.
5. Check whether the address of the data received is within the setting range.
6. Check whether the memory of the read/write mailbox overlaps.

Troubleshooting:

Cause	Verification method	Solution
1. The master is configured improperly. 2. The XML file of the slave is wrong.	The panel displays the fault code.	Check the configuration of SM0 and SM1 channels for errors.

EE10.1: SM2 setting error

Fault cause:

1. PDO mapping object dictionary index exceeds the set maximum value (0x1600-0x170A).
2. The length of SM and RxPDO is not 0 when SM2 is not enabled.
3. The RxPDO length does not match.
4. Not writing
5. In the preop state, the address of RxPDO is not in the set address field (maximum and minimum addresses), or in a non-preop state, the address of SM2 is equal to the starting address of RxPDO.
6. The memory of SM2 overlaps with adjacent SM1 or SM3.

Troubleshooting:

Cause	Verification method	Solution
1. The master is configured improperly. 2. The XML file of the slave is wrong.	Check the configuration of SM2 for errors. Check whether the index of the RxPDO mapping object dictionary exceeds the limit (the maximum index is 0x0A).	Ensure that the SM2 channel is configured correctly. The index of the RxPDO mapping object dictionary is correct.

EE10.2: SM3 configuration error

Fault cause:

1. PDO mapping object dictionary index exceeds the set maximum value (0x1A00-0x1B0A).
2. The length of SM and TxPDO is not 0 when SM3 is not enabled.
3. The TxPDO length does not match.
4. Not reading.
5. In the preop state, the address of TxPDO is not in the set address field (maximum and minimum addresses), or in a non-preop state, the address of SM3 is equal to the starting address of TxPDO.
6. Buffer overruns. The memory of SM2 overlaps SM3 and SM0 or SM1.

Troubleshooting:

Cause	Verification method	Solution
1. The master is configured improperly. 2. The XML file of the slave is wrong.	Check the configuration of SM3 for errors. Check whether the index of the TxPDO mapping object dictionary is out of bounds (the maximum index is 0x1A).	Ensure that the SM3 channel is configured correctly. The index of the TxPDO mapping object dictionary is correct.

EE10.3: PDO watchdog setting error

Fault cause:

1. The watchdog is enabled but the counting value is zero.
2. The watchdog is not enabled but the counting value is not zero.

Troubleshooting:

Cause	Verification method	Solution
1. The watchdog is enabled but the counting value is zero. 2. The watchdog is not enabled but the counting value is not zero.	The master is configured improperly.	Make sure that the watchdog time is correct.

EE10.4: Protection against PLL completion interrupt (no sync signal)

Fault cause:

During the process from SAFEOP to OP, DC is enabled but not running.

Troubleshooting:

Cause	Verification method	Solution
During SAFEOP-to-OP, DC is enabled but not running.	The master is configured improperly.	Make sure that a sync0 signal is generated.

EE10.5: PHY configuration error

Fault cause:

The PHY chip is configured improperly during initialization upon power-on, leading to mal-operation of PHY.

Troubleshooting:

Cause	Verification method	Solution
The PHY integrated circuit is damaged or the pins are soldered improperly.	The alarm persists in spite of repeated restart.	Return it to the manufacturer for service.

EE11.0: ESI check error

Fault cause:

The attempt to load the XML file fails during EtherCAT communication.

Troubleshooting:

Cause	Verification method	Solution
1. The XML configuration file is not programmed.	Check whether the XML version displayed in H0E.96 is normal.	Program the XML file.
2. The drive is faulty. The XML file is modified unexpectedly.	The XML version number is not empty.	H0E. 37 is set to 1 and restart again.

EE11.1: Failed to read from EEPROM by bus

Fault cause:

The EEPROM communication of external EtherCAT devices fails.

Troubleshooting:

Cause	Verification method	Solution
The attempt to read EtherCAT data from the EEPROM failed.	This fault persists after repeated power cycling.	Replace the servo drive.

EE11.2: EEPROM update failure by bus

Fault cause:

The communication is normal but the message in the EEPROM is incorrect or lost.

Troubleshooting:

Cause	Verification method	Solution
The EtherCAT data in the EEPROM cannot be updated.	This fault persists after repeated power cycling.	Replace the servo drive.

EE11.3: ESI and drive model mismatch

Fault cause:

The XML file does not match the drive model.

Troubleshooting:

Cause	Verification method	Solution
1. The XML file programmed does not match the drive model. 2. The drive is faulty and the XML file has been modified illegally.	Check whether the XML version displayed in H0E.96 is normal.	Program the XML file.

EE12.0: EtherCAT initialization failure

Fault cause:

EtherCAT peripheral initialization failed after power-on.

Troubleshooting:

Cause	Verification method	Solution
1. The device configuration file is not programmed.	The slave ID is empty when the host controller scans the slave.	Program the device configuration file.
2. The servo drive is faulty.	The servo drive is faulty.	Replace the servo drive.

EE13.0: EtherCAT sync period setting error

Fault cause:

After the network switches to the operation mode, the sync cycle is not an integer multiple of 125 us or 250 us.

Troubleshooting:

Cause	Verification method	Solution
The sync cycle is not an integer multiple of 125 us or 250 us.	Check the setting of the sync cycle in the controller.	Set the sync cycle to an integer multiple of 125 us or 250 us.

EE15.0: Excessive EtherCAT sync cycle error

Fault cause:

The sync cycle deviation exceeds the threshold.

Troubleshooting:

Cause	Verification method	Solution
The synchronization cycle deviation of the controller is excessive.	Measure the sync cycle of the controller. Use 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.

EE16.0: MCU and ESC communication error

Fault cause:

Communication between MCU and ESC times out.

Troubleshooting:

Cause	Verification method	Solution
The attempt to establish communication between MCU and ESC times out.	The fault persists after the servo drive is powered off and on repeatedly.	Replace the servo drive.

EE17.0: FSoE unexpected command

Fault cause:

In the current state of FSoE communication, this command should not appear.

Troubleshooting:

Cause	Verification method	Solution
1. The slave receives the Connection, Parameter, ProcessData, and FailSafeData commands in the reset state. 2. The slave receives the Parameter, ProcessData, and FailSafeData commands in the Session state. 3. The slave receives the ProcessData and FailSafeData commands in the Connection state. 4. The slave receives the Connection command in the Parameter state. 5. The slave receives the Connection and Parameter commands in the Data state. 6. The number of safety PDU transmitted is 0 in the Session, Connection, and Parameter states.	The panel displays the fault code.	1. Check whether the command sent by the safety master is wrong. 2. Check whether the safety PDO data has been modified.

EE17.1: Unknown FSoE command

Fault cause:

Unspecified command word appeared in FSoE communication.

Troubleshooting:

Cause	Verification method	Solution
The slave receives commands which are not reset, Session, Connection, Parameter, ProcessData, or FailSafeData commands.	The panel displays the fault code.	1. Check whether the command sent by the safety master is wrong. 2. Check whether the safety PDO data has been modified.

EE17.2: FSoE invalid connection ID

Fault cause:

The ID of the connection established by the FSoE does not match the ID received.

Troubleshooting:

Cause	Verification method	Solution
The connection ID is abnormal in the Connection, Parameter, ProcessData, and FailSafeData states.	The panel displays the fault code.	1. Check whether the connection ID sent by the safety master is wrong. 2. Check whether the safety PDO data has been modified.

EE17.3: FSoECRC error

Fault cause:

The CRC value of the FSoE data frame does not match the calculated value.

Troubleshooting:

Cause	Verification method	Solution
The CRC value received by the slave is inconsistent with the CRC value calculated by itself.	The panel displays the fault code.	1. Check whether the CRC sent by the safety master is wrong. 2. Check whether the safety PDO data has been modified.

EE17.4: FSoE watchdog expired

Fault cause:

No data frame was received within the FSoE communication cycle.

Troubleshooting:

Cause	Verification method	Solution
The slave failed to receive a data frame within the specified time.	The panel displays the fault code.	1. Check whether the safety master sends data. 2. Check whether the watchdog operates normally. 3. Check whether the circuit has been disconnected.

EE17.5: Invalid FSoE slave address

Fault cause:

The FSoE communication address does not meet the requirements.

Troubleshooting:

Cause	Verification method	Solution
In the Connection state, the received slave address is inconsistent.	The panel displays the fault code.	1. Check whether the slave address sent by the safety master is correct. 2. Check whether the slave address is set correctly.

EE17.6: Invalid FSoE safety data

Fault cause:

The FSoE communication parameters are incorrect or the connection fails. In this case, the safety data is invalid.

Troubleshooting:

Cause	Verification method	Solution
In the Connection and Parameter state, the safety data received by the slave is invalid.	The panel displays the fault code.	1. Check whether the data sent by the safety master is wrong. 2. Check whether the safety data has been modified.

EE17.7: Invalid FSoE communication parameter length

Fault cause:

The length and value of the FSoE communication parameters are out of the specified range.

Troubleshooting:

Cause	Verification method	Solution
The length of the parameters received by the slave is inconsistent with that set by the slave.	The panel displays the fault code.	1. Check whether the data sent by the safety master is wrong. 2. Check whether the data has been modified.

EE17.8: Invalid FSoE communication parameter data

Fault cause:

FSoE communication parameter data is out of range.

Troubleshooting:

Cause	Verification method	Solution
The watchdog time settings received by the slave are improper.	The panel displays the fault code.	1. Check whether the data sent by the safety master is wrong. 2. Check whether the data has been modified.

EE17.9: Invalid FSoE application program parameter length

Fault cause:

The length of the FSoE communication application parameters does not match the preset value.

Troubleshooting:

Cause	Verification method	Solution
The length of the application parameters received by the slave is inconsistent with that set by the slave.	The panel displays the fault code.	1. Check whether the data sent by the safety master is wrong. 2. Check whether the data has been modified.

EE17.A: FSoE invalid application parameter data

Fault cause:

The FSoE communication application program parameter data is out of the range.

Troubleshooting:

Cause	Verification method	Solution
The application parameters received by the slave are incorrect.	The panel displays the fault code.	1. Check whether the data sent by the safety master is wrong. 2. Check whether the data has been modified.

EEE0.0: Gantry pairing axis fault

Fault cause:

The gantry pairing axis is faulty.

Troubleshooting:

Cause	Verification method	Solution
The gantry pairing axis is faulty.	Check whether the gantry pairing axis is faulty.	Rectify the gantry pairing axis fault.

12.3.3.2 Internal Faults

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

- E111.0: Internal parameter error
- E602.0: Angle auto-tuning failure
- E220.0: Phase sequence incorrect
- EA40.0: Parameter auto-tuning failure

12.3.4 Description of Alarm Codes

E108.0: Storage parameter write fault

Fault cause:

Parameter values cannot be written to EEPROM.

Troubleshooting:

Cause	Verification method	Solution
Parameters failed to be written.	Modify a certain parameter, power cycle the drive, and check whether the modification is saved.	If the modification is not saved and the fault persists after the drive is restarted repeatedly, replace the drive.

E108.1: Storage parameter read fault

Fault cause:

Parameter values cannot be read from EEPROM.

Troubleshooting:

Cause	Verification method	Solution
A fault occurs when writing parameters, and the system indicates an EEPROM read failure.	Modify a certain parameter, power cycle the drive, and check whether the modification is saved.	If the modification is not saved and the fault persists after the drive is restarted repeatedly, replace the drive.

E108.2: EEPROM data write verification error

Fault cause:

The check on the data written to EEPROM failed.

Troubleshooting:

Cause	Verification method	Solution
The check on written parameters failed.	Modify a certain parameter, power cycle the drive, and check whether the modification is saved.	If the modification is not saved and the fault persists after the drive is restarted repeatedly, replace the drive.

E108.3: EEPROM data read verification error

Fault cause:

The check on the data read from EEPROM failed.

Troubleshooting:

Cause	Verification method	Solution
An error occurs when reading parameters.	Modify a certain parameter, power cycle the drive, and check whether the modification is saved.	If the modification is not saved and the fault persists after the drive is restarted repeatedly, replace the drive.

E108.4: Single data saved frequently

Fault cause:

A single piece of data is stored too frequently.

Troubleshooting:

Cause	Verification method	Solution
Saving single data frequently to the EEPROM may damage the EEPROM.	1. Check H0b.90 and H0b.91. H0b.90 displays parameters or object dictionaries that are saved frequently (displayed in hexadecimal). If H0b.91 is set to 15, H0b.90 displays the internal variable of the software. 2. Check "Func test 1" through the oscilloscope. This channel displays the address that is being saved by EEPROM. 3. Check the number of saving events through "Func test 2" of the oscilloscope.	1. If the alarm is caused by manual modification of a certain parameter or object dictionary, there will be no frequent storage of a certain data entry during operation, and you can reset the fault. 2. Check the abnormal parameter through H0b. 90 or the oscilloscope channel, and identify the cause. For example, if the host controller program frequently writes parameters through SDO, you can modify the program to stop it, or you can set H0E.01 to 0.

E108.5: Safety module EEPROM write timed out

Fault cause:

The maximum allowable time is exceeded when safety module parameters are being written to EEPROM.

Troubleshooting:

Cause	Verification method	Solution
EEPROM error	Power cycle the drive to check whether the new safety parameter settings take effect.	1. Power cycle the drive to modify the parameters again. 2. Replace the safety module.

E108.6: Safety module EEPROM read timed out

Fault cause:

The maximum allowable time is exceeded when parameters are being read.

Troubleshooting:

Cause	Verification method	Solution
EEPROM error	Power cycle the drive to check whether parameters can be read.	1. Power cycle the drive to read the parameters again. 2. Replace the safety module.

E108.7: Safety module EEPROM write check error

Fault cause:

When the safety module function is written to EEPROM, it is read again from EEPROM and compared with the value to be written. The comparison does not match.

Troubleshooting:

Cause	Verification method	Solution
EEPROM parameter write error	Reset the fault and write safety module parameters again.	If the fault persists, it is recommended to replace the safety module.

E108.8: Safety module EEPROM read check error

Fault cause:

The check on the data read in EEPROM fails.

Troubleshooting:

Cause	Verification method	Solution
The check on the data read in EEPROM fails.	Modify a certain parameter, power cycle the drive to check whether the modification is saved.	If the modification is not saved and the fault persists after the drive is powered off and on several times, replace the drive.

E110.0: Frequency-division pulse output setting error

Fault cause:

The frequency-division output setpoint (H05.17) exceeds the encoder resolution.

Troubleshooting:

Cause	Verification method	Solution
The number of frequency-division pulses (after quadrature multiplication) exceeds the motor resolution.	Check the setpoint of H05.17.	Adjust the value of H05.17 based on the motor resolution.

E115.0: SSM parameter setting error

Fault cause:

1.The lower limit of SSM is higher than or equal to the upper limit of SSM.
2. The backlash setting of SSM is higher than the result of SSM upper limit subtracted by SSM lower limit.

Troubleshooting:

Cause	Verification method	Solution
1. The lower limit of SSM is equal to or larger than the upper limit.	Local mode: 1. Check whether the value of H20.71 is greater than or equal to H20.70. 2. Check whether the value of H20.72 is greater than or equal to H20.70 minus H20.71.	1. Set SSM parameters properly. 2. The upper limit of SSM is greater than the lower limit.
2. The SSM hysteresis is equal to or larger than the upper limit minus the lower limit.	FSoE module: 1. Check whether the value of 66E4h is greater than or equal to 66E2. 2. Check whether the value of H20.72 is greater than or equal to the result of 66E2 minus H20.71.	The SSM hysteresis is smaller than the upper limit of SSM minus lower limit.

E116.0: SLS overspeed alarm

Fault cause:

The speed limit is exceeded during SLS speed limit monitoring.

Troubleshooting:

Cause	Verification method	Solution
The speed limit is exceeded during SLS speed limit monitoring.	View the fault log to check whether the corresponding speed of E116.0 exceeds the limit of SLS.	Control the motor speed so that it does not exceed the limit.

E116.1: SDI out of tolerance

Fault cause:

The limit is exceeded during SDI direction monitoring.

Troubleshooting:

Cause	Verification method	Solution
The limit is exceeded during SDI direction monitoring. An alarm is reported if either the zero speed window or zero position window exceeds the limit.	View the fault log to check whether the speed corresponding to E116.1 exceeds the SDI zero speed window or the motor rotational direction exceeds the zero position window allowed by SDI.	Control the motor speed so that it does not exceed the limit.

E120.3: Different power between motor and drive

Fault cause:

The rated power of the motor does not match that of the drive.

Troubleshooting:

Cause	Verification method	Solution
The rated current/voltage of the motor is higher than that of the servo drive.	Check whether the rated motor current/voltage is larger than the rated current of the servo drive.	Replace the motor or servo drive.

E121.0: S-ON command inactive

Fault cause:

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

Troubleshooting:

Cause	Verification method	Solution
The external S-ON signal is active when servo drive is enabled internally.	Check whether auxiliary functions (H0d.02, H0d.03, and H0d.12) are used and whether DI function 1 (FunIN.1: S-ON signal) is active.	Deactivate the DI assigned with FunIN.1 (both hardware DI and virtual DI).

E126.3: PR process segment parameter beyond the upper/lower limit

Fault cause:

In segment mode, the parameter written exceeds the upper limit of this parameter.

Troubleshooting:

Cause	Verification method	Solution
In segment mode, the parameter written exceeds the upper limit of this parameter.	Check the upper/lower limit value of the written parameter.	In segment mode, the parameter written exceeds the upper limit of this parameter.

E244.0: Abnormal input torque reference

Fault cause:

Abnormal input torque reference

Troubleshooting:

Cause	Verification method	Solution
The input torque reference is abnormal. The input torque reference of the motor with brake is 0 or the input torque reference is smaller than H13.41 while the input torque reference monitoring function is enabled.	Check whether the torque limit input is abnormal.	1. Adjust the torque limit input. 2. Adjust the alarm threshold (H13.41) according to the scenario.

E244.1: Positive/negative internal torque limit calculation error

Fault cause:

An error occurs during internal torque/speed limit calculation

Troubleshooting:

Cause	Verification method	Solution
An error occurs during internal torque/speed limit calculation	Adjust the input of torque/speed limit and electronic gear ratio to check whether the alarm is reported again.	1. Adjust the input of torque/speed limit and electronic gear ratio. 2. Identify the cause of error and contact the manufacturer.

E247.0: Torque saturation alarm

Fault cause:

The motor torque reference remains excessively high for a long time.

Troubleshooting:

Cause	Verification method	Solution
The motor torque reference remains excessively high for a long time.	1. Check whether the acceleration/ deceleration is excessively high. 2. Check whether the torque is limited. 3. Check whether the load is excessive and the motor is running out of specification.	1. Reduce the acceleration/ deceleration rate properly. 2. Adjust the torque limit value. 3. Optimize the operation parameters or adjust the model.

E510.0: Frequency division pulse output overspeed

Fault cause:

The single-channel output pulse frequency exceeds the frequency upper limit allowed by the hardware (4 MHz) when pulse output is used (H05.38 = 0/1/2).

Troubleshooting:

Cause	Verification method	Solution
The MCU detects excessive pulse increment fed back by FPGA.	1. When H05.38 is set to 0 (encoder frequency-division output) or 2 (secondary encoder frequency-division output), check whether the output pulse frequency corresponding to the motor speed upon fault exceeds the limit. Output pulse frequency (Hz) = Motor speed (rpm) ÷ 60 × H05.17 2. The input pulse frequency exceeds 2 MHz or interference exists in the pulse input pins when H05.38 is set to 1 (Reference pulse synchronous output). Low-speed pulse input pins: open-collector input terminals: PULLHI, PULSE+, PULSE-, SIGN+, SIGN-; maximum pulse frequency: 200 kpps. High-speed pulse input pins: differential input terminals: HPULSE +, HPULSE-, HSIGN+, HSIGN, maximum pulse frequency: 8 Mpps	1. Decrease the value of H05.17 (encoder frequency-division pulses) to allow the output pulse frequency, within the speed range required by the machine, to drop below the frequency upper limit allowed by the hardware. 2. Decrease the input pulse frequency to a value within the frequency upper limit allowed by hardware. In this case, if you do not modify the electronic gear ratio, the motor speed will decrease. If the input pulse frequency is high but is still within the frequency upper limit allowed by the hardware, take anti-interference measures (use STP cable for pulse input and set pin filter parameter H0A.24 or H0A.30). This is to prevent false alarms caused by interference pulses superimposed to actual pulse references.

E600.0: Angle auto-tuning failure

Fault cause:

Vibration cannot be suppressed. You can set notch parameters (H09.12 to H09.23) manually to suppress vibration.
The auto-tuned values fluctuate dramatically. Increase the maximum operating speed, reduce the acceleration/deceleration time, and shorten the stroke of the lead screw during ETune operation.
Mechanical couplings of the load are loose, or the mechanism is eccentric. Rectify mechanical faults.
An alarm occurs during auto-tuning and causes interruption. Clear the alarm and perform auto-tuning again.

The vibration cannot be suppressed if the load carries large inertia. In this case, increase the acceleration/deceleration time to ensure the motor current is not saturated.
The position following performance is inadequate. This is usually caused by the maximum motor speed being lower than the speed set for inertia auto-tuning, resulting in failure to follow the position. Ensure the speed setpoint is lower than the maximum motor speed.

Troubleshooting:

Cause	Verification method	Solution
1. Continuous vibration exists during auto-tuning. 2. The auto-tuned values fluctuate dramatically. 3. Mechanical connections of the load are loosened or eccentric. 4. An alarm occurs during auto-tuning and causes interruption. 5. The vibration cannot be suppressed if the load carries large inertia. In this case, increase the acceleration/deceleration time to ensure the motor current is unsaturated. 6. The position following performance is inadequate, which is usually caused by the situation that the maximum motor speed is lower than the speed set by inertia auto-tuning, leading to position following error.	The torque jitters upon stop at internal detection (not FFT). Three times more than the last auto-tuned value for variation less than 5 times. 0.5 times more than last auto-tuned value for variation above 5 times.	1. Clear the fault and perform inertia auto-tuning again. 2. Enable vibration suppression when the vibration cannot be suppressed automatically. 3. Check and ensure mechanical connections are secure. 4. During ETune operations, increase the maximum running speed, reduce the acceleration/deceleration time, and shorten the screw stroke. 5. Ensure that the speed setpoint is lower than the maximum speed of the motor.

E601.0: Homing alarm

Fault cause:

The homing time exceeds the setpoint.

Troubleshooting:

Cause	Verification method	Solution
1. The home switch is faulty.	During homing, the system continuously searches for the home at high speed. After high-speed searching, low-speed searching 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 home-searching time is too short.	Check whether the value of H05.35h is too low.	Increase the value of H05.35.
3. The speed for searching for the home switch signal at high speed is excessively low.	Check the distance between the start position of homing and the home switch. Then, check whether the setpoint of 6099.01h is too low, resulting in a long homing process.	Increase the value of 6099.01h.

E601.1: Homing switch error

Fault cause:

The home switch is set improperly.

Troubleshooting:

Cause	Verification method	Solution
The home switch is set improperly.	Check whether the limit signals at two sides are both active. Check whether the limit signal and the deceleration point signal/home signal are both active. Check whether the positive and negative position limits are activated successively.	Set the position of the hardware switch properly.

E601.2: Homing mode setting error

Fault cause:

The homing mode value exceeds the existing homing mode value.

Troubleshooting:

Cause	Verification method	Solution
The homing mode value exceeds the existing homing mode value.	Check whether the homing mode value exceeds the existing homing mode value (object dictionary 6098h).	Change the value of 6098h.

E601.3: Position feedback alarm

Fault cause:

After the encoder is disconnected and reconnected, the position feedback system reports an alarm.

Troubleshooting:

Cause	Verification method	Solution
1. After homing is completed in incremental mode, if bit4 of H0C.73 is set to 0 after the encoder is disconnected and reconnected, E601.3 (User position feedback error) is reported by the drive. 2. After homing is completed in absolute mode, if bit4 of H0C.73 is set to 0 after the encoder is disconnected and reconnected, E601.3 (User position feedback error) is reported by the drive.	1. Check whether the encoder was disconnected in incremental mode. 2. Check whether the encoder is connected improperly after disconnection in absolute mode.	1. The fault can be cleared after restart. 2. When bit4 of H0C_73 is set to 1, this alarm can be masked. 3. Perform homing again.

E601.4: Incorrect gantry homing mode

Fault cause:

Gantry homing mode setting error

Troubleshooting:

Cause	Verification method	Solution
The gantry is set with an incorrect homing mode (6098).	Check whether the gantry is set to an incorrect wrong homing mode.	Set a homing method that matches the gantry.

E602.9: Angle auto-tuning not performed on incremental encoder

Fault cause:

Angle auto-tuning not performed on incremental encoder

Troubleshooting:

Cause	Verification method	Solution
Angle auto-tuning is not performed on the incremental encoder and the corresponding alarm is enabled.	Confirm whether bit1 of H32.04 is set.	1. The alarm is automatically reset after angle auto-tuning is completed. 2. To suppress this alarm, reset bit1 of H32.04.

E607.0: Excessive gantry torque deviation

Fault cause:

Excessive gantry torque deviation

Troubleshooting:

Cause	Verification method	Solution
Excessive gantry torque deviation	Excessive gantry torque deviation	Check whether the gantry wiring structure is normal.

E608.0: Master-to-slave parameter setting error

Fault cause:

Incorrect master-to-slave parameter setting

Troubleshooting:

Cause	Verification method	Solution
Incorrect master-to-slave parameter setting	The parameter setpoint exceeds the limit or the communication between drives fails.	Check the parameter setpoint of the master/slave axis (H14.03).

E609.0: Data storage timeout

Fault cause:

Disconnection occurred during software tool data download.

Troubleshooting:

Cause	Verification method	Solution
Disconnection occurred during software tool data download.	Check the connection between the drive and software tool.	Download the data again.

E609.1: Data storage overflow

Fault cause:

Disconnection occurred during software tool data download.

Troubleshooting:

Cause	Verification method	Solution
Disconnection occurred during software tool data download.	Check the connection between the drive and software tool.	Download the data again.

E609.2: Data storage failure

Fault cause:

Data storage failure

Troubleshooting:

Cause	Verification method	Solution
The FLASH memory chip is faulty or the interface between MCU and FLASH is faulty.	Download the data again at next power-on.	If the fault persists after repeated restart, replace the drive.

E609.3: Data erasure failure

Fault cause:

Data erasure failure

Troubleshooting:

Cause	Verification method	Solution
The FLASH memory chip is faulty or the interface between MCU and FLASH is faulty.	Download the data again at next power-on.	If the fault persists after repeated restart, replace the drive.

E621.1: Overload current limit torque reached

Fault cause:

Overload current limit torque reached

Troubleshooting:

Cause	Verification method	Solution
1. The load is too heavy and the effective torque output by the motor remains above the rated torque. 2. Acceleration/deceleration is too frequent or the load inertia is too large. 3. The motor and encoder are wired improperly. 4. The gain is improper or the stiffness level is too high. 5. The motor is stalled due to mechanical factors, resulting in overload during operation. 6. The drive is faulty.	1. Confirm the overload characteristics of the servo drive or servo motor. Check whether the average load rate (H0b.12) of the servo drive remains above 100.0%. 2. Check whether H32.77 is set to an excessively high value.	Replace with a servo drive of higher capacity and a matching servo motor, or reduce the load and increase the acceleration/ deceleration time.

E631.4: P-MOS short-circuited

Fault cause:

The brake circuit is faulty.

Troubleshooting:

Cause	Verification method	Solution
When braking is used, the P-MOS short circuit occurred on the brake circuit.	Ensure the brake cable is connected properly, and check whether the fault persists after a power cycle.	1. Replace the drive. 2. Turn off the brake switch (H02.16).

E631.5: N-MOS short-circuited

Fault cause:

The brake circuit is faulty.

Troubleshooting:

Cause	Verification method	Solution
When braking is used, the N-MOS short circuit occurred on the brake circuit.	Ensure the brake cable is connected properly, and check whether the fault persists after a power cycle.	1. Replace the drive. 2. Turn off the brake switch (H02.16).

E730.0: Encoder battery alarm

Fault cause:

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

Troubleshooting:

Cause	Verification method	Solution
The battery voltage of the absolute encoder is lower than 3.0 V.	Measure the battery voltage.	Replace the battery with a new one that provides matching voltage.

E730.1: Inovance secondary encoder battery undervoltage

Fault cause:

Inovance secondary encoder battery voltage is lower than 3.0 V.

Troubleshooting:

Cause	Verification method	Solution
The battery of the Inovance secondary encoder is undervoltage.	Measure the battery voltage.	Replace the battery with a new one that provides matching voltage.

E831.1: Excessive AI1 zero offset

Fault cause:

The AI1 zero offset exceeds 500 mV.

Troubleshooting:

Cause	Verification method	Solution
1. Check whether the wiring is incorrect or interference exists.	Check the wiring according to the correct wiring diagram.	Use twisted shielded cables to perform wiring again, shorten the cable length, and increase the AI1 input filter time.
2. The servo drive is faulty.	Disconnect AI1 and measure whether the actual terminal voltage exceeds 0.5 V.	If not, replace the drive.

E831.2: AI2 zero offset too large

Fault cause:

The AI2 zero offset exceeds 500 mV.

Troubleshooting:

Cause	Verification method	Solution
1. Check whether the wiring is incorrect or interference exists.	Check the wiring according to the correct wiring diagram.	Use twisted shielded cables to perform wiring again, shorten the cable length, and increase the AI2 input filter time.
2. The servo drive is faulty.	Disconnect AI2 and measure whether the actual terminal voltage exceeds 0.5 V.	If not, replace the drive.

E834.1: AI1 overvoltage alarm

Fault cause:

AI1 input voltage exceeds 11.5 V.

Troubleshooting:

Cause	Verification method	Solution
1. Check whether the wiring is incorrect or interference exists.	Check the wiring according to the correct wiring diagram.	Use twisted shielded cables to perform wiring again, shorten the cable length, and increase the AI1 input filter time.
2. The input voltage is too high.	Measure whether the actual terminal voltage exceeds 11.5 V.	Adjust the input voltage to a value lower than 11.5 V.

E834.2: AI2 overvoltage

Fault cause:

AI2 input voltage exceeds 11.5 V.

Troubleshooting:

Cause	Verification method	Solution
1. Check whether the wiring is incorrect or interference exists.	Check the wiring according to the correct wiring diagram.	Use twisted shielded cables to perform wiring again, shorten the cable length, and increase the AI2 input filter time.
2. The input voltage is too high.	Measure whether the actual terminal voltage exceeds 11.5 V.	Adjust the input voltage to a value lower than 11.5 V.

E900.0: DI emergency braking

Fault cause:

The logic of the DI terminal (including the hardware DI and virtual DI) assigned with DI function 34 (FunIN.34: EmergencyStop) is activated.

Troubleshooting:

Cause	Verification method	Solution
The DI function 34 (FunIN.34: Emergency stop) is triggered.	Check whether the logic of DI assigned with FunIN.34: Emergency stop is activated.	Check the operation mode and deactivate the DI braking signal without affecting the safety performance.

E902.0: Invalid DI/VDI settings

Fault cause:

DI/VDI function parameters are set to invalid values.

Troubleshooting:

Cause	Verification method	Solution
DI or VDI function parameters are set to invalid values.	Check whether DI function configuration parameters in groups H03 and H17 are set to invalid values.	Set DI/VID function parameters to valid values.

E902.1: Invalid DO/VDO settings

Fault cause:

DO/VDO function parameters are set to invalid values.

Troubleshooting:

Cause	Verification method	Solution
DO or VDO function parameters are set to invalid values.	Check whether DI function configuration parameters in groups H04 and H17 are set to invalid values.	Set DO/VDO function parameters to valid values.

E902.2: Torque arrival setting inactive

Fault cause:

The DO parameters set for torque reach in torque control mode are inactive.

Troubleshooting:

Cause	Verification method	Solution
The DO parameters set for torque reach in torque control mode are inactive.	Check whether the value of H07.22 is lower than or equal to the value of H07.23 (unit: 0.1%).	Set H07.22 to a value higher than that of H07.23.

E909.0: Motor overload alarm

Fault cause:

The accumulative heat of the motor reaches 90% of the fault threshold.

Troubleshooting:

Cause	Verification method	Solution
1. Wiring of the motor and encoder is incorrect or in poor contact.	Check the wiring among the servo drive, servo motor and the encoder according to the correct wiring diagram.	Connect cables according to the correct wiring diagram. Preferably use the cables provided by Inovance. When customized cables are used, prepare and connect the cables according to the hardware wiring instructions.
2. The load is excessive. The motor keeps outputting effective torque that higher than the rated torque for a long time.	Check the overload characteristics of the servo drive or servo motor. Check whether the average load rate (H0b.12) of the servo drive remains above 100.0%.	Use a drive of higher capacity and a matching motor. Alternatively, reduce the load and increase the acceleration/ deceleration time.
3. Acceleration/deceleration is frequent, or the load inertia is high.	Check the mechanical inertia ratio or perform inertia auto-tuning. View the value of H08.15 (Load moment of inertia ratio). Check the single-shot operation cycle when the motor runs cyclically.	Increase the acceleration/ deceleration time.
4. The gain is improper, or the stiffness is excessively high.	Check whether the motor vibrates and generates unusual noise during operation.	Adjust the gains.
5. The set servo drive model or motor model are incorrect.	View the model of the motor equipped with a fieldbus encoder in H00.05 and the servo drive model in H01.10.	Read the servo drive nameplate and set the servo drive model (H01.10) and motor model properly.

Cause	Verification method	Solution
6. The motor is stalled due to mechanical factors, resulting in excessive load during operation.	Check the reference and motor speed (H0b.00) through the software tool or keypad: Reference in the position control mode: H0b.13 (Input position reference counter) Reference in the speed control mode: H0b.01 (Speed reference) Reference in the torque control mode: H0b.02 (Internal torque reference) Check whether the reference is not 0 but the motor speed is 0 in the corresponding mode.	Rectify mechanical problems.
7. The servo drive is faulty.	Power cycle the servo drive.	If the fault persists after a power cycle, replace the drive.

E910.0: Control circuit overvoltage

Fault cause:

The control circuit voltage exceeds the overvoltage threshold.

Troubleshooting:

Cause	Verification method	Solution
Overvoltage occurred on the control circuit of the drive.	1. Check the input power specifications of the servo drive and measure whether the input voltage of the control cable complies with the following specifications: 200 V servo drive: Valid value: 200 V to 240 V Allowable deviation: -10% to +10% (180 V to 264 V) 400 V servo drive: Valid value: 380V to 480 V Allowable deviation: -10% to +10% (342 V to 528 V) 2. Check whether control circuit cables are connected properly and whether the voltage of control circuit cables (L1C and L2C) on the drive side is within the specified range.	Re-connect or replace the cables.

E920.0: braking resistor overload

Fault cause:

The accumulative heat of the braking resistor exceeds the threshold.

Troubleshooting:

Cause	Verification method	Solution
1. The cable of the external braking resistor is in poor connection, connected loosely, or disconnected.	Remove the external braking resistor and measure whether its resistance is "∞" (infinite). Measure whether the resistance between terminals P⊕ and C is "∞" (infinite).	Use a new external braking resistor. If the resistance measured is the same as the nominal value, connect the resistor between P and C. Connect the external braking resistor between P and C with a new cable.
2. The jumper between terminals P⊕ and D is shorted or disconnected when the built-in braking resistor is used.	Measure whether the resistance between terminals P⊕ and D is "∞" (infinite).	Connect terminals P⊕ and D directly with a proper cable.
3. H02.25 is set to an incorrect value when an external braking resistor is used. 4. The resistance of the external braking resistor used is excessively high. 5. The value of H02.27 is higher than the resistance of the external braking resistor used.	Check the value of H02.25. Measure whether the resistance of the external resistor connected between P⊕ and C is too high. Check whether the value of H02.27 is larger than the resistance of the external braking resistor connected between P⊕ and C.	1. Refer to "Wiring and Setting of the Braking Resistor" in SV680N-INT Series Servo Drive Hardware Guide to set H02.25: H02.25=1 (External braking resistor, naturally ventilated) H02.25=2 (External braking resistor, forced-air cooling) 2. Select a proper braking resistor. 3. Set H02.27 according to the resistance of the external braking resistor used.
6. The input voltage of the main circuit exceeds the specifications.	Measure whether the main circuit input voltage on the drive side complies with the following specifications: 200 V servo drive: Valid value: 200 V to 240 V Allowable deviation: -10% to +10% (180 V to 264 V) 400 V servo drive: Valid value: 380V to 480V Allowable deviation: -10% to +10% (342 V to 528 V)	Replace or adjust the power supply according to the specified range.
7. The load moment of inertia ratio is excessively high. 8. The motor speed is excessively high and deceleration is not done within the set time. The motor is in the continuous deceleration status during cyclic operation. 9. The capacity of the drive or braking resistor is not sufficient.	1. Perform inertia auto-tuning or calculate total inertia according to mechanical parameters in "Inertia Auto-tuning" in SV680N-INT Series Servo Drive Function Guide. Check whether actual load inertia ratio exceeds 30. 2. View the motor speed curve during cyclic operation and check whether the motor is in the deceleration status for a long time. 3. View the motor speed curve in a single cycle and calculate whether the maximum braking energy can be absorbed completely.	Select an external braking resistor of large capacity and set H02.26 according to the actual value. Select a servo drive of large capacity. Reduce the load if allowed. Increase the acceleration/ deceleration time if allowed. Increase the motor running cycle if allowed.
10. The servo drive is faulty.	-	Replace the servo drive.

E921.0: Dynamic brake resistor overload alarm

Fault cause:

The dynamic braking resistor is close to overload.

Troubleshooting:

Cause	Verification method	Solution
The accumulative heat of the dynamic braking resistor is close to the maximum thermal capacity of the resistor.	Check whether the value of H0b.98 is higher than or equal to 70%.	To avoid excessively high discharge current, prevent the motor from being driven reversely.

E922.0: Resistance of the external braking resistor too small

Fault cause:

The value of H02.27 (Resistance of external braking resistor) is lower than the value of H02.21 (Allowable minimum resistance of external braking resistor).

Troubleshooting:

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

E924.0: Braking transistor overtemperature

Fault cause:

The estimated temperature of the braking transistor is higher than H0A.49 (IGBT overtemperature threshold).

Troubleshooting:

Cause	Verification method	Solution
1. The junction temperature of the braking transistor is too high. 2. The braking transistor will be turned off automatically after overload occurs.	The braking transistor temperature exceeds the threshold defined by H0A.49.	Control the braking transistor activation count (including increasing the acceleration/ deceleration time, reducing the gain, and replacing with a drive of higher power rating).

E940.0: The controlled motor changes. It is recommended to restore default settings before operating the motor.

Fault cause:

The controlled motor changes. It is recommended to restore default values before use.

Troubleshooting:

Cause	Verification method	Solution
The controlled motor type changes. To ensure proper operation of the drive, it is recommended to restore default values before use. The alarm will be reported only once.	Check whether the motor model (H00.00) changes.	It is recommended to restore default values before use when the controlled motor changes. Alternatively, you can also keep the original parameter values.

E941.0: Parameter modifications activated at next power-on

Fault cause:

This alarm is reported if the parameters modified are those whose "Effective time" is "Next power-on".

Troubleshooting:

Cause	Verification method	Solution
The parameters modified are those whose "Effective time" is "Next power-on".	Check whether parameters modified are designed to be activated at next power-on.	Power cycle the motor.

E942.0: Frequent parameter storage

Fault cause:

The number of parameters modified at a time exceeds 700.

Troubleshooting:

Cause	Verification method	Solution
An excessively large number of parameters are modified and saved to EEPROM at a brief interval.	Check whether parameters are modified through the host controller at a brief interval.	Check the operation mode. For parameters that need not be saved to EEPROM, set H0E.01 properly.

E950.0: Forward overtravel alarm

Fault cause:

The logic of the DI allocated with FunIN.14: P-OT (Positive limit switch) is valid.

Troubleshooting:

Cause	Verification method	Solution
1. The logic of the DI assigned with FunIN.14 (P-OT function 14, positive limit switch) is active.	Check whether a certain DI in group H03 is assigned with FunIN.14. Check whether the logic of DI corresponding to the bit of H0b.03 (Monitored DI status) is active.	Check the operation mode. Send a reverse run command or rotate the motor to deactivate the DI function 14 without affecting the safety performance.
2. The position feedback of the drive reaches the positive software position limit.	Check whether the position feedback (H0b.17) is close to the value of H0A.41 (Forward overtravel). Check whether the soft limit function is set in H0A.40.	Use proper servo drive references to ensure the load travel range is within the software position limit.

E952.0: Reverse overtravel alarm

Fault cause:

The logic of the DI allocated with FunIN.15: N-OT (negative limit switch) is valid.

Troubleshooting:

Cause	Verification method	Solution
1. The logic of the DI assigned with FunIN.15 is active.	Check whether a certain DI in group H03 is assigned with FunIN.15. Check whether the logic of DI corresponding to the bit of H0b.03 (Monitored DI status) is active.	Check the operation mode. On the prerequisite of safety, send a forward run command or rotate the motor to deactivate the logic of DI assigned with FunIN.15.
2. The position feedback of the drive reaches the negative software position limit.	Check whether the value of H0b.17 (Position feedback) is close to that of H0A.43 (Reverse overtravel). Check whether the soft limit function is set in H0A.40.	Use proper servo drive references to ensure the load travel range is within the software position limit.

E954.0: Position command overflow

Fault cause:

Position reference overflow

Troubleshooting:

Cause	Verification method	Solution
In process segment mode, the position reference exceeds the limit.	Check the position reference. Check the limit value.	Change the value of the position reference and the limit.

E956.0: Forward position reference overtravel in process segment position mode

Fault cause:

Forward position reference overtravel occurs in the process segment position mode.

Troubleshooting:

Cause	Verification method	Solution
The position reference exceeds the limit upon forward run in the process segment, leading to an alarm.	In position control mode of the process segment, E956.0 occurs when the motor runs in the forward direction and the position reference exceeds the value of H22.04.	Reduce the position reference to a value lower than the setpoint of H22.04.

E958.0: Reverse position reference overtravel in process segment position mode

Fault cause:

Reverse direction position reference overtravel occurs in process segment position mode.

Troubleshooting:

Cause	Verification method	Solution
The position reference exceeds the limit upon reverse run in the process segment, leading to an alarm.	In position control mode of the process segment, E958.0 occurs when the motor runs in the reverse direction and the position reference exceeds the value of H22.06.	Increase the position reference to a value greater than the setpoint of H22.06.

E971.0: Undervoltage alarm for voltage drop protection

Fault cause:

If the bus voltage is lower than the undervoltage threshold when the voltage drop protection is enabled, you can set bit1 of H0A.88 to 1 to hide this alarm.

Troubleshooting:

Cause	Verification method	Solution
The bus voltage is lower than the undervoltage threshold.	Check the bus voltage. This alarm can be masked by setting bit1 of H0A.88 to 1.	Check the grid power supply.

E980.0: Frequency-division output overflow alarm

Fault cause:

Frequency-division output frequency calculation overflow

Troubleshooting:

Cause	Verification method	Solution
The frequency-division output frequency is excessive, leading to calculation overflow.	Check whether E510.0 alarm occurred and set H05.17 to a value until E510.0 is not reported.	Set H05.17 properly or decrease the maximum operating speed.

EA34.9: Hall not configured during Hall auto-tuning

Fault cause:

Missing Hall configurations during Hall auto-tuning

Troubleshooting:

Cause	Verification method	Solution
H00.26 is not configured when dynamic Hall auto-tuning is enabled.	1. When H0A.13 is set to 6, check whether bit3 of H00.26 is not set to 1. 2. Check whether H0A.13 is set to 6 by mistake for encoders without Hall (bit3 of H00.26 is 0).	1. For motors with Hall, Hall auto-tuning is required (H0A.13 = 6). Set bit3 of H00.26 to 1. 2. For motors without Hall, Hall auto-tuning cannot be used (H0A.13 cannot be set to 6).

EA41.0: Torque fluctuation compensation failure

Fault cause:

Torque fluctuation compensation failure

Troubleshooting:

Cause	Verification method	Solution
Auto-tuning torque fluctuation compensation failure	1. Check whether homing is not performed during cogging force fluctuation auto-tuning of the incremental encoder. 2. Check whether cogging force fluctuation auto-tuning is interrupted due to emergency stop or external fault. 3. Perform auto-tuning on the torque fluctuation compensation value again.	1. Check whether homing is performed during cogging force fluctuation auto-tuning of the incremental encoder. 2. Check whether cogging force fluctuation auto-tuning is interrupted due to emergency stop or external fault. 3. Perform auto-tuning on the torque fluctuation compensation value again.

EE08.7: Error frame early warning

Fault cause:

Check the 0x300 register value increment at a regular interval (determined by H16.44). When the increment reaches the threshold set by H16.43 (Error frame alarm function switch/threshold), the keypad displays E08.7 and the value of H30.30 is incremented by 1. The error frame alarm is cleared when the increment is within the set threshold for 10 consecutive intervals (defined by H16.44).

Related parameters:

1. H16.43 - Error frame alarm function switch/threshold
   0: Disable; 1, 2, 3...: Enabled, with threshold being 1, 2, 3...; The default value is 4.
2. H16.44 - Error frame pre-alarm sampling interval in ms (The default value is 1000.)
3. H30.30 - Number of error frame alarms (The value is incremented by 1 every time the pre-alarm is triggered.)

Cause	Verification method	Solution
There is interference on site or the network cable of the IN port is faulty.	Replace the network cable in the IN port of the alarm device and install a magnetic ring to check whether the alarm persists.	Replace the network cable in the IN port of the alarm device and install a magnetic ring.

Note:

1. If you need to mask this alarm, set bit10 of H0C.72 to 1.
2. If there is interference on site and the error frame alarm threshold is set to a low value, all devices may display the error frame alarm.
3. To view error frame alarms:

   a. View H30.30 through the keypad.
   b. View H30.30 through SDO in the PLC software.

13 Appendix

13.1 Expansion Safety Function Terminals CN9 and CN10

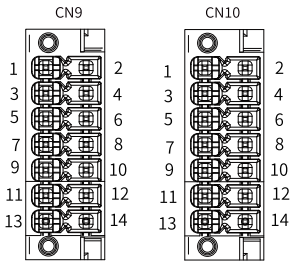


Figure 13-1 Description of CN9 and CN10 pins

Table 13–1 Description of CN9 pins

No.	Definition	Function	No.	Definition	Function
1	DO3-	Common DO3 output (-)	2	DO3+	Common DO3 output (+)
3	DO2	Safety DO2 output	4	DO1	Safety DO1 output
5	DO24VA	24 V power supply of DO1 and DO2	6	DO0VA	Output reference ground of DO1 and DO2
7	COM	DIA reference ground	8	DI5A_IN	Safety DI5A input
9	DI4A_IN	Safety DI4A input	10	DI3A_IN	Safety DI3A input
11	DI2A_IN	Safety DI2A input	12	DI1A_IN	Safety DI1A input
13	PE	Protective grounding	14	-	-

Table 13–2 Description of CN10 pins

No.	Definition	Function	No.	Definition	Function
1	DO6-	Common DO6 output (-)	2	DO6+	Common DO6 output (+)
3	DO5	Safety DO5 output	4	DO4	Safety DO4 output
5	DO24VB	24 V power supply of DO4 and DO5	6	DO0VB	Output reference ground of DO4 and DO5
7	COM	DIB reference ground	8	DI5B_IN	Safety DI5B input
9	DI4B_IN	Safety DI4B input	10	DI3B_IN	Safety DI3B input
11	DI2B_IN	Safety DI2B input	12	DI1B_IN	Safety DI1B input
13	PE	Protective grounding	14	-	-

Basic DI information

Item	Description
Five dual-channel digital inputs	Voltage: 24 V DC±15% (must be powered by SELV/ PELV power supply)
Assignment of logic levels	Low level: "0" < 3 V High level: "1" > 15 V
Switch contact	Only supports normally closed switch contacts.
Current consumption of single DI	10 mA max. (dual-channel)
Maximum allowable cable length between drive and safety switch	30m

Basic DO information

Item	Description
Four single-channel digital outputs	Maximum output current: 50 mA per channel Voltage: 24 V DC±15% (must be powered by SELV/ PELV power supply)
Two common DO outputs	Maximum output current: DC 50 mA Maximum allowable external voltage: DC 30 V
Safety state	Close
DO open circuit/OFF	Maximum output voltage: 2.4 V
Maximum allowable cable length between drive and safety switch	30m
The status of SSM can be indicated by predefined parameters using DO1, DO2, DO4, and DO5	

Note

"Open circuit/OFF" indicates the DO is in the open circuit state. "Closed circuit/ON" indicates the DO can transmit the output current.

Wiring precautions

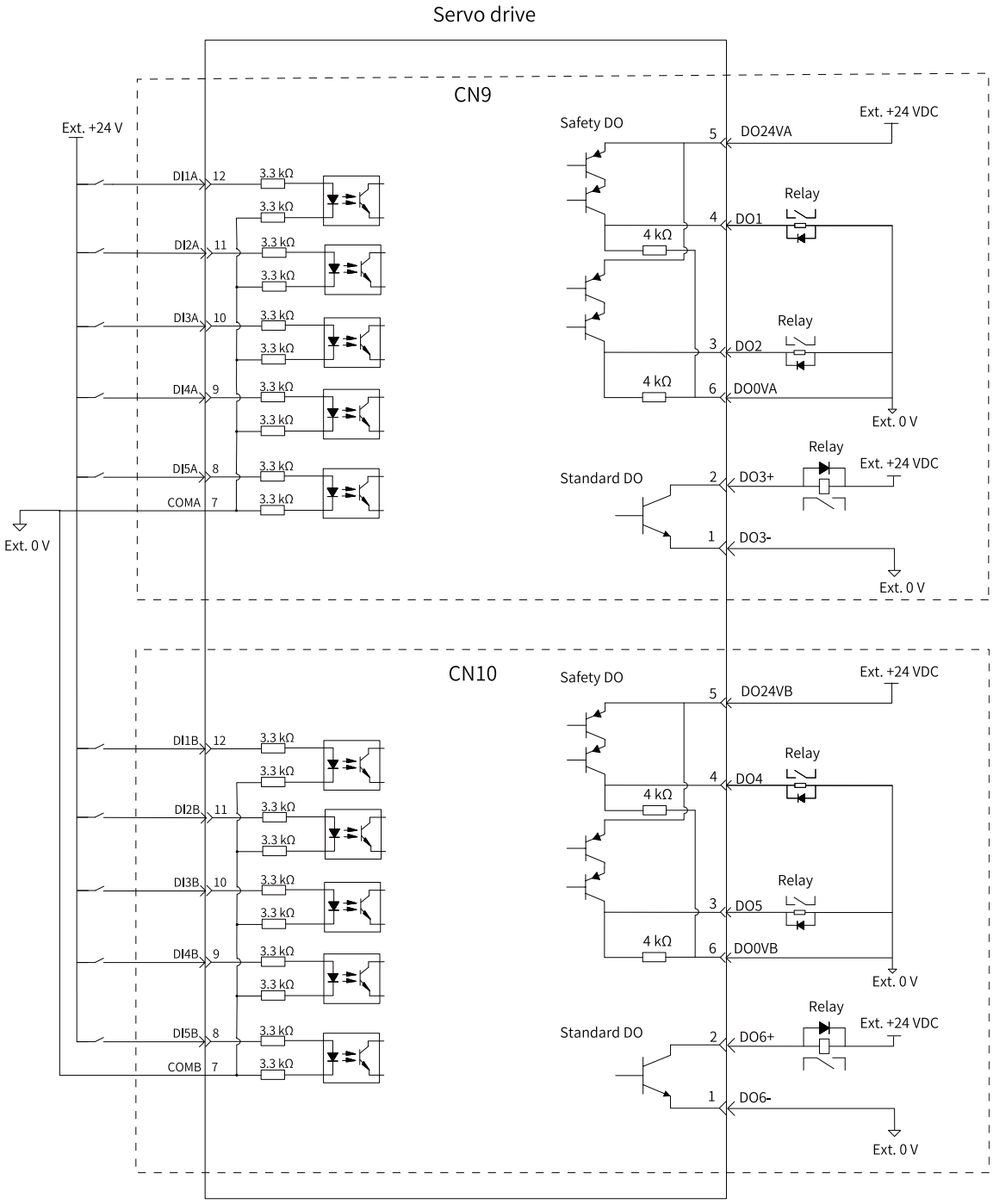
DI Wiring Requirements
Care must be taken in wiring to avoid introducing 24 V and DI short circuit failures. The following recommended method or method with equivalent effect may be used. Do as follows: • Insert 0 V between 24 V and DI signal line using a flat cable. • Use shielded wires for 24 V and DI respectively, with the shield connected to PE.
Care must be taken in wiring to avoid introducing short circuit failure between the dual channels (DIxA and DIxB) of the same DI. The following recommended method or method with equivalent effect may be used. Do as follows: • Insert 0 V between DIxA and DIxB signal lines using a flat cable. • Use shielded wires for DIxA and DIxB respectively, with the shield connected to PE.
Care must be taken in wiring to avoid introducing short circuit failure between different DIs (DIx and DIy). The following recommended method or method with equivalent effect may be used. Do as follows: • Insert 0 V between 24 V and DI signal line using a flat cable. • Use shielded wires for DIx and DIy respectively, with the shield connected to PE.

DO Wiring Requirements
Care must be taken in wiring to avoid introducing 24 V and DO short circuit failures. The following recommended method or method with equivalent effect may be used. Do as follows: • Insert 0 V between 24 V and DO signal wires using a flat cable. • Use shielded wires for 24 V and DO respectively, with the shield connected to PE.
Care must be taken in wiring to avoid introducing short circuit failure between different DOs (DOx and DOy). The following recommended method or method with equivalent effect may be used. Do as follows: • Insert 0 V between DOx and DOy signal lines using a flat cable. • Use shielded wires for DOx and DOy respectively, with the shield connected to PE.

Note

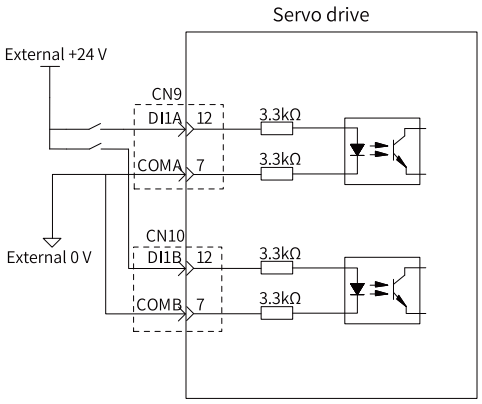
For basic information about DI/DO, see *" Basic DI information" on page 1170* and *" Basic DO information" on page 1171*.

Wiring diagram of the CN9/CN10 system



Safety digital input

The circuits for DI1 to DI5 are the same. When DI1A and DI1B are connected at the same time, a safety DI is formed. The following description takes the DI1 circuit as an example.

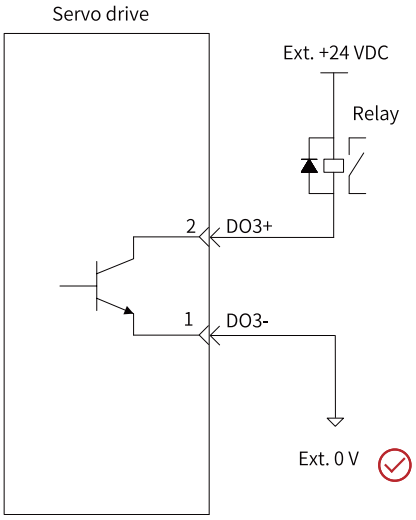


The safety DI is a source-type input. Perform wiring according to the characteristics of the load circuit.

Common digital output

The circuits for DO3 and DO6 the same. The following description takes the DO3 circuit as an example.

- **When the host controller provides relay input:**
  - **Correct wiring:**

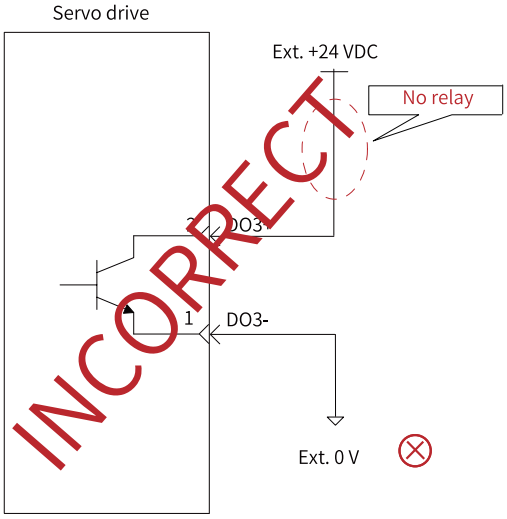


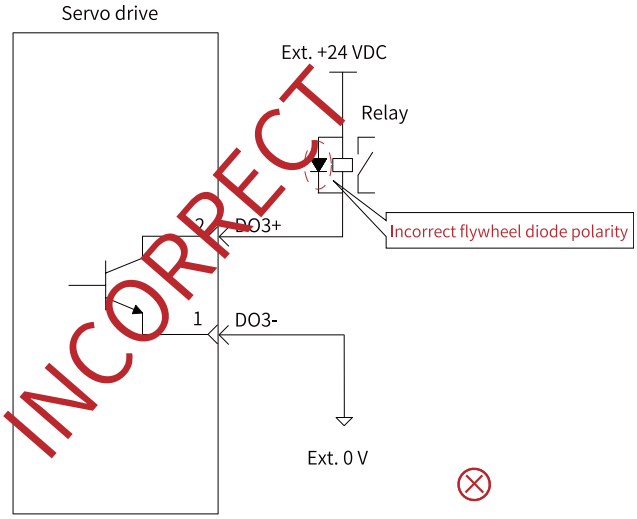
Note

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

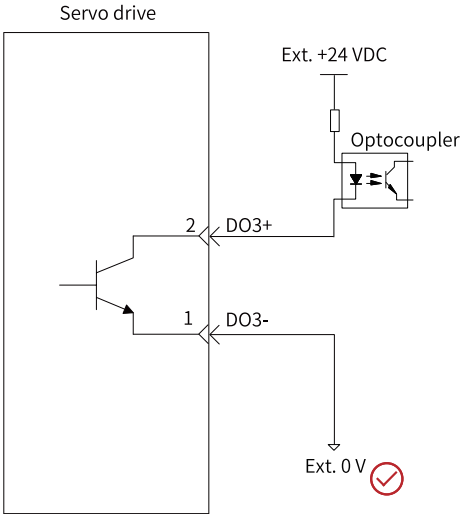
For the external voltage and current range of the DO, see *" Basic DO information" on page 1171*.

  - **Incorrect wiring:**

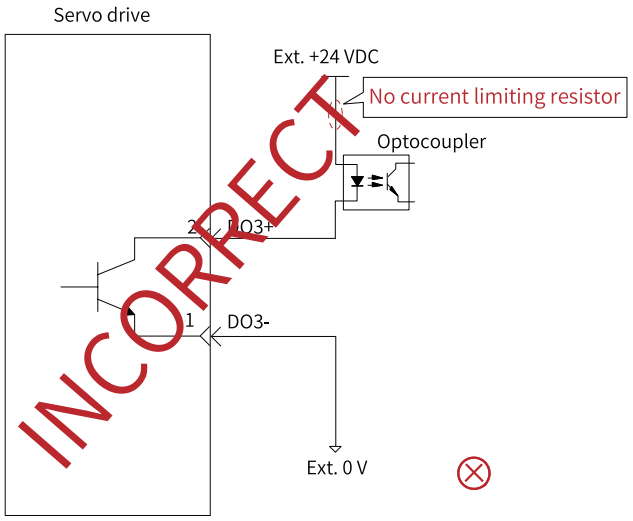




- **When the host controller adopts optocoupler input:**
  - **Correct wiring:**



  - **Incorrect wiring:**

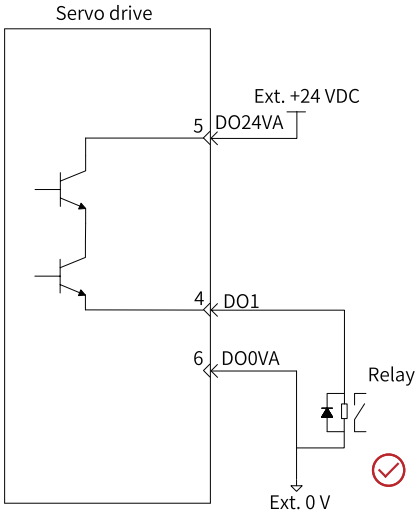


Safety digital output

The circuits for DO1, DO2, DO4, and DO5 are the same. The following description takes the DO1 circuit as an example.

The safety DO is a drain output. Please make reasonable wiring according to the characteristics of the load circuit.

- When the host controller provides relay input:
  - **Correct wiring:**

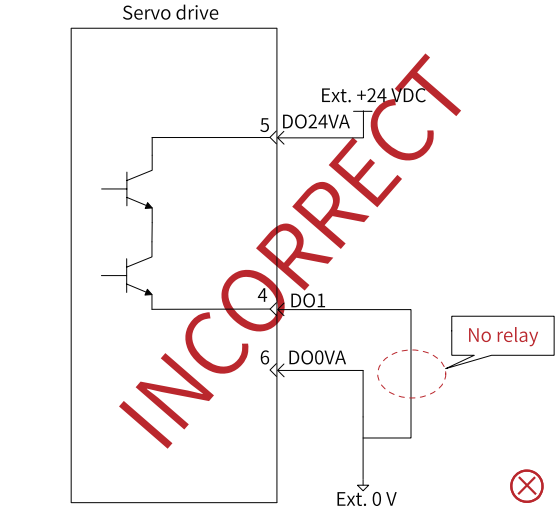


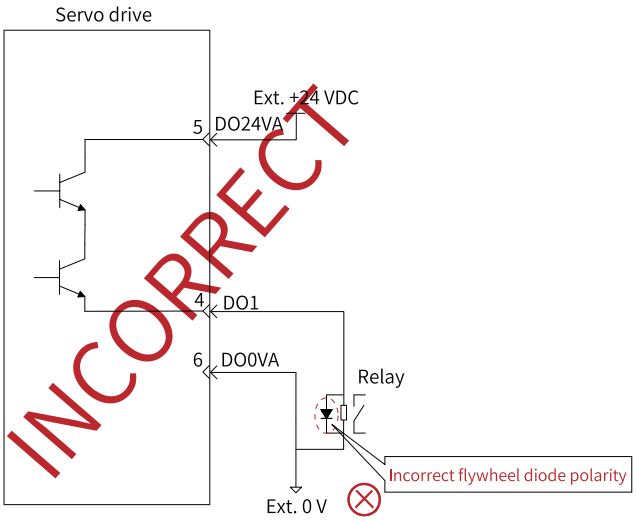
Note

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

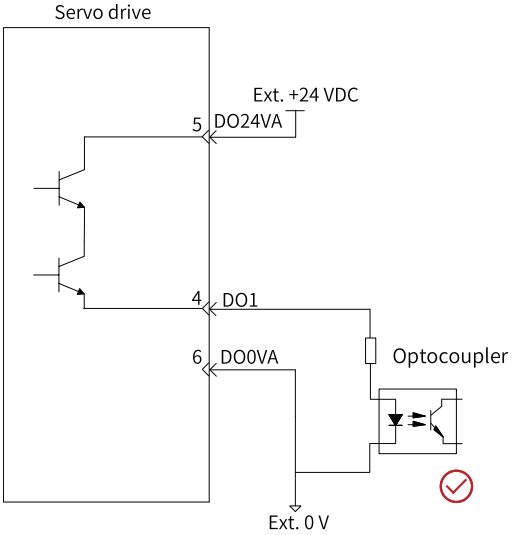
For the external voltage and current range of the DO, see *" Basic DO information" on page 1171*.

  - **Incorrect wiring:**



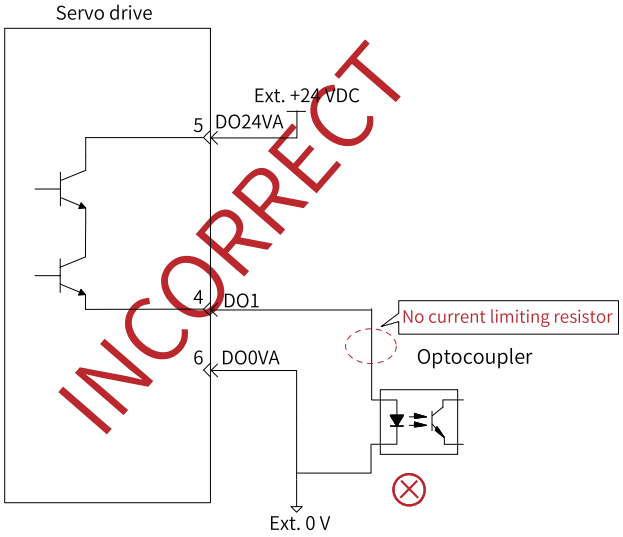


- **When the host controller adopts optocoupler input:**
  - **Correct wiring:**



Minimum current limiting resistor resistance R = (External power supply specification 24-0.75-0.75-Vf specification of optocoupler)/If specification of optocoupler.

- **Incorrect wiring:**



13.2 FSoE Connection and Setting

The hardware connection with Beckhoff safety master station is shown in *"Figure 13-2" on page 1178* . Various topologies such as ring and linear topologies can be achieved.

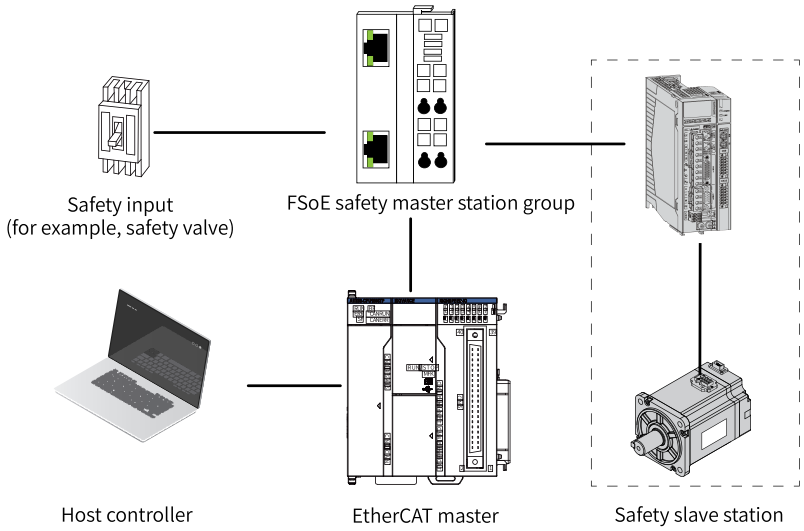


Figure 13-2 System network diagram

Note

Recommended master model: The safety drives can be used together with masters that support EL6900/EL6910. All Beckhoff PLCs support the safety drives.

13.3 FAQ About Encoder Configuration

Alarm 740.0

Alarm cause: The encoder communication has experienced prolonged communication timeout.

Possible cause	Troubleshooting method		Solution
Incorrect wiring	If this alarm occurs, check whether the value of H30.16 is abnormal (excessively high).	Check the encoder guide and the drive interface guide to confirm if the wiring is correct.	Correct the wiring accordingly.
Incorrect encoder interface		Check whether H00.41 displays the corresponding encoder interface.	Use H32.01 to switch the encoder interface.
A cable breaks		Check for open circuits in the cable, which can be tested by using a multimeter.	Replace faulty cables with serviceable cables.
Damaged encoder		Check whether the encoder is damaged.	Replace the damaged encoder with a serviceable encoder.
Check whether H00.00 is set improperly.		Check whether H00.00 (Speed reference selection) is set correctly.	Select a proper encoder type.

Alarm 740.2

Alarm cause: An error occurred during encoder communication.

Possible cause	Troubleshooting method	Solution
If alarm 740.0 does not occur at the same time, the issue may be caused by interference or excessive communication time exceeding one current loop cycle, resulting in a communication timeout.	Confirm that parameter H0b.28 is not set to 0, and that the values of H30.16 to H30.18 are not 0. Note: H0b.28 can store the communication status upon fault occurrence, while H30.16 to H30.18 count the number of faults per single communication error. Thus, these parameters can help locate the fault cause.	1 .Check whether H00.00 (Motor SN) is set properly. 2 .Check whether encoder cables are connected properly. 3 .Check whether the servo drive and motor are grounded properly. You can wind a magnetic ring on the encoder cable to reduce interference.
Encoder fault causing stop bit error.	Check the encoder.	Resolve the encoder fault or replace the encoder with a serviceable encoder.
Interference causing CRC error.	EMC solution (refer to the EMC troubleshooting guide for details).	EMC solution (refer to the EMC troubleshooting guide for details).
CRC error caused by incorrect encoder data length setting.	Check the encoder guide to confirm the correct encoder data length.	Set the encoder data length in H00.43 and H00.44 correctly.
After enabling BiSS-C error bit status detection, if multiple abnormal status bits are consecutively detected, an alarm is triggered. For details, see alarm 740.7.	For details, see alarm 740.7.	For details, see alarm 740.7.

Alarm 208.2

Alarm cause: The encoder communication time is excessively long.

Possible cause	**Troubleshooting method**	Solution	
The value of H01.59 is excessively small.	Check if the value of H01.59 is excessively small.	Increase the value of H01.59 (Bus encoder data transmission compensation time).	If the above measures do not solve the issue when the interruption frequency of the current loop is 16000 Hz, reduce the interruption frequency of the current loop to 8000 Hz.
The encoder cable is excessively long.	Check the cable length of the encoder.	Shorten the encoder cable length.	
The communication baud rate is excessively low.	Check the communication baud rate.	Increase the communication frequency in H34.08.	

Alarm 740.9

Alarm cause: The actual encoder data transmission time exceeds the time of one FPGA scheduling.

Possible cause	Troubleshooting method	Solution	
H01.59 is set to an excessively high value.	Check if the value of H01.59 is excessively large.	Reduce the value of H01.59 appropriately.	If the issue cannot be resolved at an interruption frequency of 16000 Hz, reduce the interruption frequency of the current loop to 8000 Hz in H01.60.
The encoder data bit is excessively long.	Calculate the data transmission time based on the encoder data bits and baud rate, and check whether it exceeds the time of one FPGA scheduling (H01.60).	Replace it with an encoder with lower number of bits.	
The communication baud rate is excessively low.		Increase the communication baud rate.	

Alarm 770.3

Alarm cause In fully closed-loop mode, the encoder communication has experienced prolonged communication timeout.

Possible cause	Troubleshooting method	Solution
Same as 740.0	If this alarm occurs, check if the value of H0F.55 is abnormal (too large). Other methods are the same as 740.0.	Same as 740.0.

Alarm 770.7

Alarm cause: Encoder communication error in fully closed-loop mode.

Possible cause	Troubleshooting method	Solution
If alarm 740.0 does not occur at the same time, the issue may be caused by interference or excessive communication time exceeding one current loop cycle, resulting in a communication timeout.	Check whether the value of parameter H0F.40 is not 0, and whether values of H0F.55 to H0F.57 are not 0. Note: H0F.40 can store the communication status upon fault occurrence, while H0F.55 to H0F.57 count the number of faults per single communication error. Thus, these parameters can help locate the fault cause.	1 .Check whether H00.00 (Motor SN) is set properly. 2 .Check whether encoder cables are connected properly. 3 .Check whether the servo drive and motor are grounded properly. You can wind a magnetic ring on the encoder cable to reduce interference.
Encoder fault causing stop bit error.	Check the encoder.	Resolve the encoder fault or replace the encoder with a serviceable encoder.
Interference causing CRC error.	EMC solution (refer to the EMC troubleshooting guide for details).	EMC solution (refer to the EMC troubleshooting guide for details).
CRC error caused by incorrect encoder data length setting.	Check the encoder guide to confirm the correct encoder data length.	Set a proper encoder data length in H0F.30 and H0F.31.

Alarm 770.8

Alarm cause: In fully closed-loop condition, the actual encoder data transmission time exceeds the time of one FPGA scheduling.

<table>
<tr><th>Possible cause</th><th>Troubleshooting method</th><th colspan="2">Solution</th></tr>
<tr><td>H01.59 is set to an excessively high value.</td><td>Check the value of H01.59.</td><td>Reduce the value of H01.59.</td><td rowspan="3">If the issue cannot be resolved at an interruption frequency of 16000 Hz, reduce the interruption frequency of the current loop to 8000 Hz in H01.60.</td></tr>
<tr><td>The encoder data bit is excessively long.</td><td rowspan="2">Calculate the data transmission time based on the encoder data bits and baud rate, and check whether it exceeds the time of one FPGA scheduling (H01.60).</td><td>Replace it with an encoder with a lower number of bits.</td></tr>
<tr><td>The communication baud rate is excessively low.</td><td>Increase the baud rate.</td></tr>
</table>

Alarm 740.7

Alarm cause:

The status bit feedback from BiSS-C or SSI is abnormal.

Possible cause	Troubleshooting method	Solution
Parameters are set improperly.	Refer to *" BiSS-C error bit detection" on page 1181*to confirm the definition and settings of the function parameters.	Correct the parameter settings.
The encoder itself reported an incorrect status bit.	Check the status bit feedback from the encoder.	Replace the damaged encoder with a serviceable encoder.

BiSS-C error bit detection

Parameter description

On the primary encoder, the fault detection function can be implemented using the F0 and F1 alarm index bits in the standard frame format. Related parameters:

Parameter	Description
H00.44	Defines the length of the status word configured based on the BiSS-C/SSI protocol.
H0A.88	bit0: Defines whether to enable the original BiSS-C data alarm function, which is applicable only to BiSS-C encoders.
H0A.89	Correct state of preset BiSS-C data. An alarm will be triggered if the actual detected value is inconsistent with H0A.89.

Description

- After the error bit detection function is enabled, the system can report alarm 740.7 only if the configuration is correct.
- When the error bit detection function is enabled, it can determine whether the encoder is in an alarm state.
- If the detected error bit status differs from the preset status, bit 7 of parameter H0b.28 will be set.
- If 50 consecutive error bit data anomalies are detected, alarm 740.2 will be triggered.

For details about troubleshooting, see chapter "Troubleshooting Common Encoder Configuration Errors".

13.4 DI/DO Function Assignment

Param.	Name	Function	Description	Description
Description of DI signals				
FunIN.1	S-ON	Servo ON	Disabled: Servo motor disabled Enabled: Servo motor enabled	The corresponding terminal logic must be level-triggered. The change of the corresponding DI/VDI or terminal logic is activated at next power-on.
FunIN.2	ALM-RST	Alarm reset signal	Inactive: Disabled Active: Enabled	“Edge-triggered” will be applied even if “level-triggered” is selected. To reset No. 1 and NO.2 resettable faults, switch off the S-ON signal first. The servo drive may, depending on the alarm type, continue operating after reset.
FunIN.5	DIR-SEL	Multi-reference direction	Inactive: Reference direction by default Valid: Reverse reference direction	The corresponding terminal logic is recommended to be level-triggered.
FunIN.6	CMD1	Multi-reference switchover CMD1	Used to select one from the 16 references.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.7	CMD2	Multi-reference switchover CMD2	Used to select one from the 16 references.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.8	CMD3	Multi-reference switchover CMD3	Used to select one from the 16 references.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.9	CMD4	Multi-reference switchover CMD4	Used to select one from the 16 references.	The corresponding terminal logic is recommended to be level-triggered.

Param.	Name	Function	Description	Description
FunIN.14	P-OT	Positive limit switch	Enabled: Forward drive inhibited Disabled: Forward drive permitted	Overtravel prevention applies when the machine moves beyond the limit. It is recommended that the corresponding terminal logic is level-triggered.
FunIN.15	N-OT	Negative limit switch	Overtravel prevention applies when the load moves beyond the limit. Active: Reverse drive inhibited Inactive: Reverse drive allowed	The corresponding terminal logic is recommended to be level-triggered.
FunIN.16	P-CL	Positive external torque limit	The torque limit source is switched based on H07.07 (Torque limit source). H07.07 = 1: Active: Positive external torque limit activated Inactive: Positive internal torque limit activated	The corresponding terminal logic is recommended to be level-triggered.
FunIN.17	N-CL	Negative external torque limit	The torque limit source is switched based on H07.07 (Torque limit source). H07.07 = 1: Active: Negative external torque limit activated Inactive: Negative internal torque limit activated	The corresponding terminal logic is recommended to be level-triggered.
FunIN.18	JOGCMD+	Forward jog	Active: Input based on command Inactive: Command input stopped	The corresponding terminal logic is recommended to be level-triggered.
FunIN.19	JOGCMD-	Jog in the reverse direction	Active: Input in reverse to the command Inactive: Command input stopped	The corresponding terminal logic is recommended to be level-triggered.
FunIN.24	GEAR_SEL	Electronic gear ratio switchover	Inactive: Electronic gear ratio 1 Valid: Electronic gear ratio 2	The corresponding terminal logic is recommended to be level-triggered.
FunIN.28	PosInSen	Multi-position reference enable	Disabled: The reference is ineffective. Enabled: The reference is enabled.	The corresponding terminal logic is recommended to be level-triggered.

Param.	Name	Function	Description	Description
FunIN.31	HomeSwitch	Home switch	Inactive: The switch is not triggered Enabled: The switch is triggered.	The corresponding terminal logic must be level-triggered. Allocate this function to the high-speed DI terminal. If the logic is set to 2 (rising edge active), the servo drive forcibly changes it to 1 (active high). If the logic is set to 3 (falling edge active), the servo drive forcibly changes it to 0 (active low). If the logic is set to 4 (both rising edge and falling edge active), the servo drive forcibly changes it to 0 (low level active).
FunIN.34	Emergence Stop	Emergency stop	Enabled: Position lock is applied after stop at zero speed. Invalid: Current running state unaffected	The corresponding terminal logic is recommended to be level-triggered.
FunIN.36	V_LmtSel	Internal speed limit source	Inactive: H07.19 used as positive/ negative internal speed limit Active: H07.20 used as positive/ negative internal speed limit	The corresponding terminal logic is recommended to be level-triggered.
FunIN.38	TouchProbe1	Touch probe 1	Disabled: Touch probe is not triggered. Enabled: Touch probe is triggerable.	The touch probe logic is related only to the touch probe function (60B8h).
FunIN.39	TouchProbe2	Touch probe 2	Disabled: Touch probe is not triggered. Enabled: Touch probe is triggerable.	The touch probe logic is related only to the touch probe function (60B8h).
FunIN.40	Multi-speed	Multi-speed enable	Disabled: The internal multi-speed reference is ineffective. Enabled: The internal multi-speed reference is enabled.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.46	PrEnable	Process segment enable	Inactive: Stop the process segment Active: Start the process segment	The corresponding terminal logic is recommended to be level-triggered.
FunIN.47	PrCMD1	Process segment command switchover 1	Used to switch among 16 process segments.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.48	PrCMD2	Process segment command switchover 2	Used to switch among 16 process segments.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.49	PrCMD3	Process segment command switchover 3	Used to switch among 16 process segments.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.50	PrCMD4	Process segment command switchover 4	Used to switch among 16 process segments.	The corresponding terminal logic is recommended to be level-triggered.

Param.	Name	Function	Description	Description
FunIN.51	PrEvent1	Event trigger process segment 1	The process segment A is triggered by the rising edge. The process segment B is triggered by the falling edge.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.52	PrEvent2	Event trigger process segment 2	The process segment A is triggered by the rising edge. The process segment B is triggered by the falling edge.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.53	PrEvent3	Event trigger process segment 3	The process segment A is triggered by the rising edge. The process segment B is triggered by the falling edge.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.54	PrEvent4	Event trigger process segment 4	The process segment A is triggered by the rising edge. The process segment B is triggered by the falling edge.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.55	PrSuspend	Process segment pause	Inactive: Continue the process segment (when the process segment is enabled). Active: The process segment is paused.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.56	GantryTrqAlignEnable	Gantry torque alignment	Inactive: Disabled Active: Enabled	-
FunIN.57	Gantry-DI-AlignClear	Gantry DI alignment enable	Inactive: Disabled Active: Enabled	-
FunIN.58	Gantry-DI-AlignEnable	Gantry DI alignment cleared	Inactive: Disabled Active: Enabled	-
FunIN.59	GantrySyncEnable	Gantry synchronization enable	Inactive: Disabled Active: Enabled	-
Description of DO signals				
FunOUT.1	S-RDY	Ready to switch on	The servo drive is in ready state and can receive the S-ON signal. Inactive: The servo drive not ready. Active: The servo drive is ready.	-
FunOUT.2	TGON	Motor rotation signal	Inactive. Absolute value of filtered motor speed is lower than the setpoint of H06.16. Active. Absolute value of filtered motor speed reaches the setpoint of H06.16.	-
FunOUT.5	COIN	Positioning completed	Inactive: Positioning not completed Active: Positioning completed	-

Param.	Name	Function	Description	Description
FunOUT.6	NEAR	Target position approach	Inactive: The positioning deviation is excessive. Active: The positioning deviation is slight.	-
FunOUT.9	BK	Brake output signal	Active: Brake signal output by the drive Inactive: Brake signal not output	-
FunOUT.10	WARN	Warning	Inactive: No alarm occurred on the servo drive or the alarm has been reset Active: Alarm occurred on the servo drive	-
FunOUT.11	ALM	Fault	The servo drive is faulty. Inactive: No fault occurred on the servo drive or the fault has been reset.	-
FunOUT.22	CmdOk	Internal command completed	Inactive: Internal command transmission not completed Active: Internal command transmission completed	-
FunOUT.24	MC_OK	Internal motion completed	Inactive: Internal command transmission or positioning not done Active: Command transmission and positioning done	-
FunOUT.25	CMP	Comparison output DO	Inactive: The servo drive did not pass the target position comparison point. Active: Servo drive passing the target position comparison point	-
FunOUT.26	LoopState	Closed loop state	0: Half closed loop. Position feedback signals come from the built-in encoder of the servo motor. 1: Fully closed loop. Position feedback signals come from the full closed-loop external encoder.	-
FunOUT.27	LEFTLIMIT	Left limit	Inactive: The servo drive is not at the left limit. Active: The servo drive is at the left limit.	This function is supported only by Inovance DDL communication read head.
FunOUT.28	RIGHTLIMIT	Right limit	Inactive: The servo drive is not at the right limit. Active: The servo drive is at the right limit.	This function is supported only by Inovance DDL communication read head.

Param.	Name	Function	Description	Description
FunOUT.31	Communication-forced DO		See *"Table 13-3 Communication-forced DO" on page 1187*	-
FunOUT.32	EDM	EDM output	Active: STO function triggered Inactive: STO function not triggered	The EDM outputs active signals only when both the 24 V input voltages for STO1 and STO2 are disconnected.
FunOUT.33	GantryAlignStatus	Gantry alignment	Inactive: Alignment not completed Active: Alignment completed	-

Table 13–3 Communication-forced DO

Type	Data	Description
bit0	0	DO1 status unchanged
	1	No output from DO1
bit1	0	DO2 status unchanged
	1	No output

13.5 DIDO Function Assignment [Functional Safety N]

Table 13–4 DI Function Assignment

Value	Name	Function Name	Description
01	STO command	STO trigger command	0: STO active 1: STO deselected
02	SBC command	SBC trigger command	0: SBC active 1: SBC deselected
03	SS1 command	SS1 trigger command	0: SS1 active 1: SS1 deselected
04	SS2 command	SS2 trigger command	0: SS2 active 1: SS2 deselected
05	SLS1 command	SLS1 trigger command	0: SLS1 active 1: SLS1 deselected
06	SLS2 command	SLS2 trigger command	0: SLS2 active 1: SLS2 deselected
07	SLS3 command	SLS3 trigger command	0: SLS3 active 1: SLS3 deselected
08	SLS4 command	SLS4 trigger command	0: SLS4 active 1: SLS4 deselected
09	SDIp command	SDIp trigger command	0: Active, forward rotation prohibited 1: Canceled, forward rotation allowed

Value	Name	Function Name	Description
10	SDIn command	SDIn trigger command	0: Active, reverse rotation prohibited 1: Canceled, reverse rotation allowed
11	ACK command	ACK trigger command	0: ACK deselected 1: ACK active

Table 13–5 DO Function Assignment

Value	Name	Function Name	Description
01	STO Active	STO active	0: Normal state 1: STO state
02	SBC Active	SBC active	0: Normal state 1: SBC state
03	SS1 Active	SS1 active	0: SS1 inactive 1: SS1 stop state
04	SS2 Active	SS2 active	0: SS2 inactive 1: SS2 stop state
05	SLS1 Active	SLS1 active	0: Normal state 1: SLS1 monitoring state
06	SLS2 Active	SLS2 active	0: Normal state 1: SLS2 monitoring state
07	SLS3 Active	SLS3 active	0: Normal state 1: SLS3 monitoring state
08	SLS4 Active	SLS4 active	0: Normal state 1: SLS4 monitoring state
09	SDIp Status	SDIp state	0: Inactive, motor is not rotating forward 1: Active, motor is rotating forward
10	SDIn Status	SDIn state	0: Inactive, motor is not rotating reversely 1: Active, motor is rotating reversely
11	SOS Active	SOS active	0: SOS inactive 1: SOS active
12	SSM Active	SSM active	0: Out of SSM limit 1: Within SSM limit
13	SS1-r Active	SS1-r active	0: SS1-r inactive 1: SS1-r active state
14	SS2-r Active	SS2-r active	0: SS2-r inactive 1: SS2-r active

Note

The DI/DO function can only be used in the local mode. This function is masked automatically in the bus mode, with the DI/DO hardware circuit failure not detected.

13.6 Service and Support

Should you encounter a safety accident during the use or operation of the product, or face challenges in operating and maintaining the equipment, which remain unresolved after the relevant documentation is consulted, we provide multiple channels to ensure prompt resolution:

- Channel #1: Contact service@inovance.com.
- Channel #2: Visit https://www.inovance.com/global to access document downloads, after-sales support, spare parts ordering, repair applications, and authenticity verification services.
- Channel #3: Download My Inovance app (https://zshc-eu.inovance.com/download-pc/) where you can access products info and documentation, and query product parameters.

We are committed to providing you with quick and professional technical support, and we look forward to your satisfaction and trust.

Copyright © Shenzhen Inovance Technology Co., Ltd.

PS00021316B00

Shenzhen Inovance Technology Co., Ltd.

www.inovance.com

Add.: Inovance Headquarters Tower, High-tech Industrial Park,
Guanlan Street, Longhua New District,
Shenzhen 518000, P.R. China

Tel: (0755) 2979 9595 Fax: (0755) 2961 9897

Suzhou Inovance Technology Co., Ltd.

www.inovance.com

Add.: No. 52, Tian E Dang Road, Wuzhong District, 215104,
Suzhou City, Jiangsu Province, P.R. China

Tel: (0512) 6637 6666 Fax: (0512) 6285 6720