INOVANCE

Advancing industrial technology,
for a better world



SV680P-INT Series Servo Drive

User Guide

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

Data code PS00021321B00

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 SV680P-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 series offers a power range of 0.05 kW to 7.5 kW and support for Modbus RTU and CANopen communication protocols. 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 types of safety functions. 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.

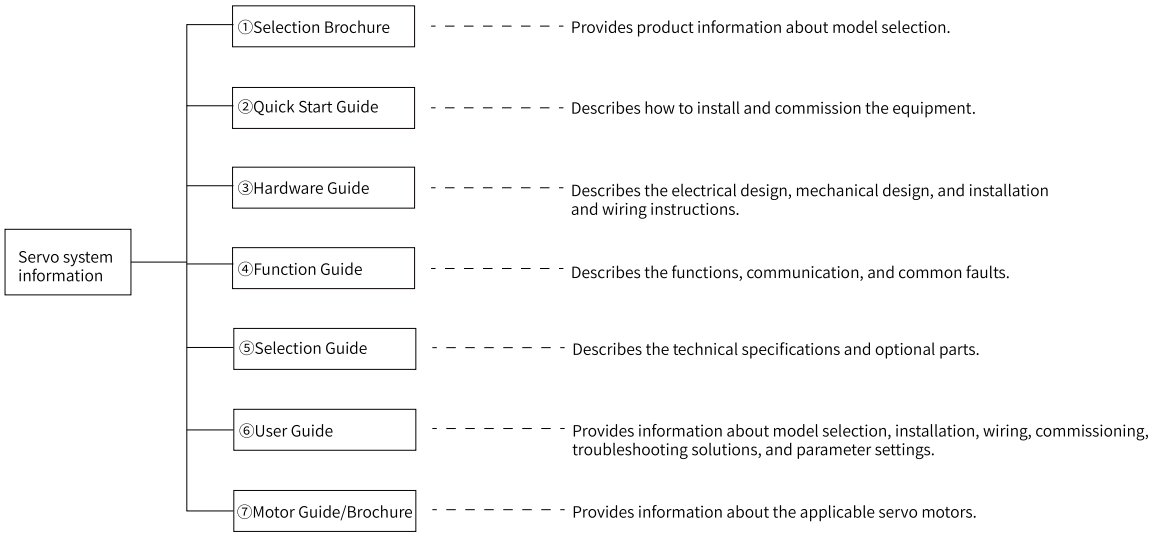
This guide provides information about selection, installation, commissioning, functions, troubleshooting, and parameters of the equipment.

Note

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

More data

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



No.	Name	Code	Description
①	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.
②	SV680P-INT Series Servo Quick Start Guide	PS00021323	Introduces product models, installation, and quick commissioning.
③	SV680P-INT Series Servo Drive Hardware Guide	PS00021324	Describes the installation and wiring of the drive, including pre-installation preparation, unpacking and handling, mechanical installation, and electrical installation.
④	SV680P-INT Series Servo Drive Function Guide	PS00021322	Describes the functions and parameters of the product, including function overview, basic servo functions, tuning instructions, and parameter descriptions.
⑤	SV680P-INT series servo drive selection guide	PS00021325	Provides information about product selection, including the list of supporting components, technical data on the drive and motor, and cable selection guide.
⑥	SV680P-INT Series Servo Drive User Guide (current guide)	PS00021321	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 (SV680PT1R4I-GINT, SV680PT2R3I-GINT, SV680PT1R4S-GINT, and SV680PT2R3S-GINT). • Motor data. • Adapter content to section "Plug-in Kit". • Section "Motor Product Information". • Section "Voltage Injection Auto-tuning". **Updated:** • Removed content about N-type models. • Made structural optimization. • Updated section "Installation Environment". • Updated section "Fuse (CE)". • Updated section "Fuse (UL)". • Update section "Circuit Breaker (CE)". • Update section "Circuit Breaker (UL)". • Updated the list of applicable cables. • Updated section "Magnetic Pole Auto-tuning". • Updated section "Auto-tuning Process". • Updated section "STune". • Deleted Fuse and circuit breaker requirements from protective devices. • Updated section "Braking Resistor". • Updated section "MS1H4-40B30CD-A6/S63*R-INT". • Updated section"MS1H4-75B30CD-A6/S63*R-INT". • 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 "Speed Reference Input": Added content about speed analog in dead zone with linearization mode. • Updated section "Torque Reference Input": Added content about torque analog in dead zone with linearization mode. • Updated section "Certifications, Directives, and Standards": Updated the functional safety certifications. • Updated section "Routine Maintenance Checklist": Added the brake circuit to the routine checklist. • Updated section "Installing the Motor Management Library": Updated the overload thermal threshold current in Motor overload protection method 3. • Updated the description of parameter H32.73. • Updated section "Guided Commissioning": Updated content about encoder tuning and configuration.
December 2024	A01	**Added:** Section "Conformance Certification". **Updated:** • The communication cable diagram. • The electrical wiring diagrams [P] and [N]. • Table "Recommended main circuit cables" in section "Cable Specifications".
November 2024	A00	Initial release.

Access to the guide

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

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

Warranty

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

Even within the warranty period, maintenance will 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
- Secondary damage caused by force majeure (natural disaster, earthquake, 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 22

1.1 General Safety Instructions 22

1.2 Industrial Information Security 27

1.3 Certifications, Directives, and Standards 28

1.4 Terms and Abbreviations 29

1.5 Safety Parameters 29

2 Model Selection 31

2.1 Model Selection [Standard Models] 31

2.1.1 List of Models (Compatible with MS1-R-INT Series Servo Motor) 31

2.1.2 Model Selection (Compatible with MS1-R-INT Series Servo Motor with Battery-free Encoder) 34

2.1.3 List of Motor Model Selection (Compatible with LMC Linear Module) 37

2.1.4 List of Motor Model Selection (Compatible with MP Series Torque Motor) 38

2.1.5 List of Motor Model Selection (Compatible with ISM Series Torque Motor) 38

2.2 Selection List [Functional Safety] 38

3 Product Information 42

3.1 Drive 42

3.1.1 Model and Nameplate 42

3.1.2 Components [Standard Model] 44

3.1.3 Components [Backup Power Supply Model] 46

3.1.4 Components [Functional Safety Models] 48

3.2 MS1-R-INT Series Servo Motor 51

3.2.1 Models and Nameplate 51

3.2.2 Components 52

3.3 MS1-R Series Servo Motor with Battery-free Encoder 54

3.3.1 Models and Nameplate 54

3.3.2 Components 55

3.4 ISM Series Torque Motor 56

3.4.1 Model description 56

3.4.2 Components 56

3.5 MP Series Torque Motor 58

3.5.1 Model Description 58
3.5.2 Components 59
3.6 LMC Linear Module 62
3.6.1 Model description 62
3.6.2 Components 63
4 System Connection 64
4.1 System Composition 64
4.2 System Connection Diagram 65
5 Installation 66
5.1 Installation Instructions 66
5.2 Pre-installation Preparation 67
5.2.1 Requirements on Installation Personnel 67
5.2.2 Installation Environment 68
5.2.3 Clearance Requirements 69
5.2.4 Installation Dimensions [Standard Model] 71
5.2.5 Installation Dimensions [Backup Power Supply Model] 73
5.2.6 Installation Dimensions [Functional Safety Models] 75
5.2.7 Requirements on Optional Parts 77
5.2.7.1 Instructions for Installing the Fuse and Circuit Breaker 77
5.2.7.2 Instructions for Installing the AC Input Reactor 77
5.2.7.3 Instructions for Installing the EMC Filter 77
5.2.7.4 Instructions for Installing Magnetic Ring and Ferrite Clamp 78
5.2.8 Cable installation requirements 80
5.3 Unpacking and Handling 80
5.4 Mechanical Installation 83
5.4.1 Pre-installation Check 83
5.4.2 Mounting the Drive 83
5.4.3 Installing the Motor 84
5.4.4 Post-Installation Inspection 86
6 Wiring 88
6.1 Wiring Precautions 88
6.1.1 Safety Precautions 88
6.1.2 Interference Resistance 88
6.1.3 Instructions for Use of Cables 89
6.2 Electrical Wiring Diagram 90
6.3 Introduction to Main Circuit Terminals 91

6.3.1 Terminal Layout 91
6.3.2 Wiring Precautions and Requirements 92
6.3.3 Cable Model Requirements 94
6.3.4 Cable Specifications 95
6.3.4.1 Cable Specifications (CE) 95
6.3.4.2 Cable Specifications (UL) 98
6.3.5 Wiring Examples 101
6.3.5.1 Wiring Example of the Power Supply 101
6.3.5.2 Wiring of the Grounding Cable 103
6.4 Control Terminal CN1 106
6.4.1 Terminal Layout 106
6.4.2 Wiring Precautions 108
6.4.3 Cable Specifications and Model Requirements 108
6.4.4 Wiring Examples 109
6.4.4.1 DI/DO Signals 109
6.4.4.2 Encoder Frequency-Division Output Signals 112
6.4.4.3 AI/AO Signals 113
6.4.4.4 Position Reference Input Signals 114
6.5 CN2 Encoder Terminal 121
6.5.1 Terminal Arrangement 121
6.5.2 Wiring Precautions and Requirements 122
6.5.3 Cable Requirements 123
6.5.4 Wiring Examples 123
6.5.4.1 Communication with the Master Encoder 123
6.5.4.2 Communication with the Second Encoder 124
6.5.5 Adapters of Power Cables and Encoder Cables 125
6.6 Communication Terminals CN3 and CN4 125
6.6.1 Terminal Layout 125
6.6.2 Wiring Precautions and Requirements 126
6.6.3 Wiring Examples 130
6.6.3.1 CAN Communication Connection Examples 130
6.6.3.2 Wiring example of RS485 communication 131
6.7 Communication Terminal CN5 133
6.8 STO Safety Terminal (CN6) 134
6.8.1 Terminal layout 134
6.8.2 Wiring Precautions and Requirements 135
6.9 CN2 Encoder Terminal 136
6.9.1 Terminal layout 136

6.9.2 Wiring Examples....137
6.9.2.1 Communication with the First Encoder....137
6.9.2.2 Communication with the Second Encoder....139
6.9.2.3 Connecting with the Hall Sensor....140
6.10 Description of Brake and PTC Input Terminal (CN8)....141
6.10.1 Terminal Arrangement....141
6.10.2 Wiring Precautions and Requirements....141
6.10.3 Wiring Examples....142
6.10.3.1 PTC Wiring Example....142
6.10.3.2 Brake Wiring Examples....143
6.11 Expansion Safety Function Terminals CN9 and CN10....144
6.12 CN11 24V Terminal....152
6.13 Grounding....153
6.13.1 Grounding Requirement (CE)....153
6.13.2 Grounding Requirements (UL)....154
6.13.3 Wiring Precautions....154
6.13.4 Wiring Examples....154
6.13.4.1 Single-Drive Grounding....154
6.13.4.2 Multi-Drive Grounding....155
6.13.4.3 Grounding of the Control Cabinet System....155
6.14 Wiring of Options....156
6.14.1 Wiring of the Braking Resistor....156
6.14.2 Wiring of the Power Supply Filter....157
6.14.3 Wiring of Surge Protection Device....158
6.14.3.1 Wiring Precautions and Requirements....158
6.14.3.2 Wiring Example....158
6.15 Post-wiring Inspection....160
6.16 Solutions to Common EMC Problems....161
6.16.1 Residual Current Device Malfunction....161
6.16.2 Harmonic Suppression....161
6.16.3 Control Circuit Interference....162
6.16.3.1 High-speed Pulse Interference....162
6.16.3.2 Control Circuit Wiring Interference....162
6.16.3.3 Common I/O Signal Interference....162
6.16.4 Communication Interference....163
7 Commissioning Tools....164
7.1 Keypad....164

7.1.1 Keypad Display 164
7.1.2 Description 174
7.1.3 Parameter Setting 175
7.2 Commissioning Software 180
7.2.1 Install 180
7.2.2 Connection 183
7.2.3 Common Software Functions 186
8 Commissioning and Operation 190
8.1 Commissioned Objects 190
8.2 Commissioning Process 191
8.3 Pre-operation Inspection 191
8.4 Power-on 192
8.5 Installing the Motor Management Library 193
8.5.1 Installation Procedure 193
8.5.2 Encoder Configuration 200
8.5.2.1 Encoder Parameter Configuration Process 200
8.5.2.2 BiSS-C Encoder 200
8.5.2.3 SSI Encoder 203
8.5.2.4 EnDat 2.2 Encoder 206
8.5.2.5 FAQ About Encoder Configuration 209
8.6 Magnetic Pole Auto-tuning 212
8.6.1 Auto-tuning Process 215
8.6.2 Pre-positioning Auto-tuning 216
8.6.3 Inching Auto-tuning 216
8.6.4 Closed-Loop Pre-positioning Auto-tuning 218
8.6.5 Position Lock Auto-tuning 220
8.6.6 Hall auto-tuning 222
8.6.7 Voltage Injection Auto-tuning 223
8.7 Jog 224
8.8 Commissioning 227
8.9 Enable operation 239
8.10 Servo Drive Stop 246
8.11 Quick Transfer of Motor Parameters 251
9 Tuning 253
9.1 Overview 253

9.2 Current Loop Tuning 254
9.3 Inertia Auto-tuning 257
9.3.1 Offline inertia auto-tuning 257
9.3.2 Online inertia auto-tuning 260
9.4 Automatic Gain Tuning 261
9.4.1 STune 261
9.4.2 ETune 267
9.5 Manual Gain Tuning 274
9.5.1 Basic Parameters 274
9.5.2 Gain Switchover 277
9.5.3 Position reference filter 282
9.5.4 Feedforward gain 282
9.5.5 Pseudo Differential Feedforward Control 285
9.5.6 Torque Disturbance Observer 286
9.5.7 Speed Observer 287
9.5.8 Model Tracking 289
9.5.9 Friction Compensation 291
9.5.10 Encoder scale fluctuation suppression 292
9.5.11 Motor Cogging Torque Ripple Compensation 294
9.6 Parameter Tuning in Different Control Modes 296
9.6.1 Parameter Tuning in Speed Control Mode 296
9.6.2 Parameter Tuning in Position Control Mode 296
9.6.3 Parameter Tuning in Torque Control Mode 298
9.7 Vibration Suppression 298
9.7.1 Mechanical Resonance Suppression 299
9.7.2 Low-frequency resonance suppression at the mechanical end 305
9.8 Mechanical Characteristic Analysis 307
9.9 High-Performance Tuning 309
10 Function Overview 312
11 Basic Functions of the Servo Drive 316
11.1 Setting and Display of Operation Modes 317
11.2 Conversion Factors 317
11.3 Servo Drive States 319
11.3.1 Control Word 6040h 322
11.3.2 Status Word 6041h 323
11.4 Process Segment Mode 324

11.4.1 Mode Triggering....325
11.4.2 Related Parameters....327
11.4.3 Operation Modes....330
11.4.4 DO and Sequence....340
11.5 Profile Position (PP) Mode....340
11.5.1 Function block diagram....341
11.5.2 Configuration block diagram....341
11.5.3 Recommended configuration....343
11.5.4 Related parameters....344
11.5.5 Related Function Settings....347
11.6 Profile Velocity (PV) Mode....349
11.6.1 Function block diagram....349
11.6.2 Configuration block diagram....349
11.6.3 Recommended configuration....349
11.6.4 Related parameters....350
11.6.5 Related Function Settings....352
11.7 Profile Torque (PT) Mode....354
11.7.1 Function block diagram....354
11.7.2 Configuration block diagram....354
11.7.3 Recommended configuration....354
11.7.4 Related parameters....355
11.7.5 Related Function Settings....357
11.8 Homing Mode (HM)....359
11.8.1 Function block diagram....360
11.8.2 Configuration block diagram....360
11.8.3 Recommended configuration....360
11.8.4 Related parameters....361
11.8.5 Related Function Settings....363
11.8.6 Homing Operation....365
11.9 Position Control Mode....382
11.9.1 Function block diagram....384
11.9.2 Position reference input....384
11.9.3 Reference Frequency Division/Multiplication (Electronic Gear Ratio)....403
11.9.4 Position Reference Filter....408
11.9.5 Position Deviation Clearance....409
11.9.6 Frequency Division Output....411
11.9.7 Motion Control Completed, Internal Command Completed, Positioning Completed, Proximity....413

11.10 Speed Control Mode 420
11.10.1 Function block diagram 421
11.10.2 Speed Reference Input 421
11.10.3 Ramp Function 436
11.10.4 Zero Clamp 437
11.10.5 Speed Reference Limit 438
11.10.6 Speed-Related DO 439
11.11 Torque Control Mode 443
11.11.1 Function block diagram 444
11.11.2 Torque Reference Input 445
11.11.3 Torque reference filter 452
11.11.4 Torque Reference Limit 453
11.11.5 Speed Limit in Torque Control 460
11.11.6 Torque reached output 463
11.12 Hybrid Control Mode 464
11.13 Interpolated position (IP) mode 466
11.13.1 Function Block Diagram 467
11.13.2 Configuration Block Diagram 467
11.13.3 Recommended Configuration 468
11.13.4 Related parameters 468
11.13.5 Related Function Settings 470
11.14 Homing 471
11.15 Interrupt Positioning 484
12 Common Functions 488
12.1 Absolute System 488
12.1.1 Overview 488
12.1.2 Related Parameters 489
12.1.3 Precautions for Using the Battery Box 496
12.2 Full Closed-loop 496
12.2.1 Fully Closed-loop Parameter Settings 497
12.2.2 Encoder Parameter Settings 501
12.2.2.1 BiSS-C encoder 501
12.2.2.2 SSI encoder 502
12.2.2.3 EnDat Encoder 504
12.2.3 Enabling Fully Closed-loop Settings 505
12.3 Software Limit 507
12.4 Software reset 509

12.5 Motor Protection 510
12.6 DI filter time 512
12.7 Communication-forced DO 513
12.8 Position comparison 514
12.9 Black Box 523
12.10 Touch Probe Function 526
12.11 SEMI F47 Voltage Drop 531
12.12 Accuracy Compensation 533
12.12.1 Accuracy Compensation Function 533
12.12.2 Application Cases 539
12.13 Quadrant Friction Compensation 552
12.14 Backlash compensation instruction 554
13 Gantry Synchronization 556
13.1 Wiring 556
13.2 Gantry Commissioning Solutions 559
13.3 Gantry Commissioning Process 562
13.4 Single-axis Commissioning 563
13.5 Dual-axis Gantry Commissioning Instructions 563
13.5.1 Commissioning procedure for gantry synchronization control scheme 1 564
13.5.2 Commissioning procedure for gantry synchronization control scheme 2 570
13.6 Gantry Applications in Fully-closed Mode 571
13.7 Flexible gantry homing trajectory 572
14 Safety Functions [Functional Safety Models] 587
14.1 Overview 587
14.1.1 List of Safety Functions 587
14.1.2 Precautions 588
14.1.3 General 592
14.2 Software Parameter Configuration 593
14.3 Safety DI/DO Function 595
14.3.1 Safety DI Function 595
14.3.2 Safety DO Function 597
14.4 STO 598
14.4.1 Overview 598

14.4.2 STO Triggered by Local Mode 598
14.4.3 Sequence Diagram 602
14.5 Safe Brake Control (SBC) 604
14.5.1 Overview 604
14.5.2 SBC Triggered by Local Mode 604
14.5.3 Sequence Diagram 609
14.6 Safe Stop 1 (SS1) 611
14.6.1 Overview 611
14.6.2 SS1 Triggered by Local Mode 611
14.6.3 Sequence Diagram 616
14.7 Safe Stop 2 (SS2) 618
14.7.1 Overview 618
14.7.2 SS2 Triggered by Local Mode 618
14.7.3 Sequence Diagram 622
14.8 Safe Operating Stop (SOS) 624
14.8.1 Overview 624
14.8.2 SOS Triggered by Local Mode 624
14.8.3 Sequence Diagram 626
14.9 Safety-limited Speed (SLS) 626
14.9.1 Overview 626
14.9.2 SLS Triggered by Local Mode 627
14.9.3 Sequence Diagram 632
14.10 Safe Direction (SDI) 633
14.10.1 Overview 633
14.10.2 SDI Triggered in Local Mode 633
14.10.3 Sequence Diagram 638
14.11 Safe Speed Monitor (SSM) 640
14.11.1 Overview 640
14.11.2 SSM Triggered Locally 640
14.11.3 Sequence Diagram 642
14.12 STO Response Time 643
14.12.1 Response Time for Triggering Safety Functions in Local Mode 643
14.13 Fault reset 643
14.14 Commissioning and Operation 644
14.14.1 Pre-operation Inspection 644
14.14.2 Trial Run 644
14.14.3 Verification and validation 645

15 STO Integration 649
15.1 Overview 649
15.2 Functions and Monitoring 650
15.3 Fault Reset 652
15.4 Safety Function Response Time 653
15.5 Acceptance and Verification 653
16 Communication 656
16.1 Modbus RTU 656
16.1.1 Communication Overview 656
16.1.1.1 Modbus communication specifications 656
16.1.1.2 Modbus Protocol 656
16.1.2 Hardware Configuration 656
16.1.2.1 Terminal Layout 656
16.1.2.2 Wiring example of RS485 communication 657
16.1.3 Communication Transmission Mode 659
16.1.4 Communication data frame structure 659
16.1.5 Communication parameters 666
16.2 CANopen Communication 666
16.2.1 Communication Overview 666
16.2.1.1 Communication Technical Data 666
16.2.1.2 Protocol Description 667
16.2.2 Hardware Configuration 668
16.2.2.1 Terminal Layout 668
16.2.2.2 CAN Communication Connection Examples 668
16.2.3 Communication Transmission Mode 669
16.2.4 Communication Data Frame Structure 670
16.2.4.1 Network Management (NMT) System 670
16.2.4.2 Service data object (SDO) 675
16.2.4.3 Process Data Object (PDO) 675
16.2.4.4 Synchronization (SYNC) Object 679
16.2.4.5 Emergency (EMCY) Object Service 681
16.2.4.6 SDO Transmission Message 682
16.2.4.7 SDO Transmission Framework 684
16.2.5 Communication Parameters 685
16.3 Communication Configuration Examples 686
16.3.1 CANopen Communication Configuration Examples 686
16.3.1.1 Connecting SV680P-INT to Schneider 3S Master 686

16.3.1.2 Connecting SV680P-INT to Beckhoff CANopen Master....701
16.3.1.3 Connecting SV680P-INT to Inovance H3U CANopen Master....712
16.3.1.4 Connecting SV680P-INT to Inovance EASY CANope Master....720
17 Parameter Descriptions....727
17.1 H00 Servo Motor Parameters....727
17.2 H01 Drive Parameters....735
17.3 H02 Basic Control Parameters....739
17.4 H03 Terminal Input Parameters....750
17.5 H04 Terminal Output Parameters....763
17.6 H05 Position Control Parameters....773
17.7 H06 Speed Control Parameters....794
17.8 H07 Torque Control Parameters....809
17.9 H08 Gain Parameters....818
17.10 H09 Auto-tuning Parameters....834
17.11 H0A Fault and Protection Parameters....852
17.12 H0b Monitoring Parameters....871
17.13 H0C Fault and Protection Parameters 2....888
17.14 H0d Auxiliary Function Parameters....890
17.15 H0E Communication Function Parameters....895
17.16 H0F Fully Closed-loop Parameters....902
17.17 H11 Multi-position Parameters....915
17.18 H12 Multi-speed Parameters....935
17.19 H14 Gantry Synchronization Parameters....957
17.20 H15 Machine Tool Parameters....968
17.21 H17 VDI/DO Parameters....972
17.22 H18 Position Comparison Output Parameters....1001
17.23 H19 Target Position Parameters....1006
17.24 H1E Oscilloscope Variables....1036
17.25 H1F Software Tool Parameters....1040
17.26 H21 Current Loop Gain Switchover Parameters....1041
17.27 H22 Process Segment Parameters....1042
17.28 H23 Process Segment Parameters....1055

17.29 H30 Variables Read Through Communication....1062
17.30 H31 References Set Through Communication....1066
17.31 H32 Direct Drive Parameters....1067
17.32 H33 Compensation Parameters....1085
17.33 H34 Servo Motor Parameters 2....1100
17.34 H3A Servo Version Number Parameters....1102
17.35 1000h Object Dictionary....1104
17.36 6000h Object Dictionary....1123
18 Safety Parameters....1148
18.1 H02 Basic Control Parameters....1148
18.2 H0A Fault and Protection Parameters....1148
18.3 H20 Functional Safety Parameters....1149
19 Troubleshooting....1168
19.1 Fault Levels and Display....1168
19.2 Fault Reset....1169
19.3 Troubleshooting....1169
19.3.1 List of Fault Codes....1169
19.3.2 List of Alarm Codes....1178
19.3.3 Description of Fault Codes....1180
19.3.3.1 Troubleshooting Faults....1180
19.3.3.2 Internal Faults....1267
19.3.4 Description of Alarm Codes....1268
20 Maintenance....1289
20.1 Maintenance Period....1289
20.2 Daily Maintenance and Inspection....1290
20.2.1 Routine Maintenance Items....1290
20.2.2 Periodic Inspection Items....1290
20.3 Replacing Components....1291
20.3.1 Replacing the Drive....1291
20.3.2 Replacing the Motor Flat Key....1292
21 Servo Technical Specifications....1294
21.1 Electrical Specifications....1294
21.2 Technical Specifications....1298

21.3 Communication Specifications 1300
21.4 Dynamic Brake Characteristic Curve 1302
21.5 Load Moment of Inertia 1304
21.6 Product Dimensions 1305
22 Motor Technical Specifications 1306
22.1 MS1-R-INT Series Servo Motor 1306
22.1.1 General Specifications 1306
22.1.1.1 Mechanical Characteristics 1306
22.1.1.2 Overload Characteristics 1309
22.1.1.3 Derating Characteristics 1312
22.1.1.4 Temperature Curve of the Oil Seal 1312
22.1.1.5 Load Moment of Inertia 1312
22.1.2 Model Selection (MS1-R-INT Series Servo Motor) 1313
22.1.2.1 Selection Precautions 1313
22.1.2.2 Low Inertia and Small Capacity (MS1H1) 1314
22.1.2.2.1 MS1H1-05B30CB-A6/S63*R-INT 1314
22.1.2.2.2 MS1H1-10B30CB-A6/S63*R-INT 1315
22.1.2.2.3 MS1H1-20B30CB-A6/S63*R-INT 1316
22.1.2.2.4 MS1H1-40B30CB-A6/S63*R-INT 1317
22.1.2.2.5 MS1H1-55B30CB-A6/S63*R-INT 1318
22.1.2.2.6 MS1H1-75B30CB-A6/S63*R-INT 1319
22.1.2.2.7 MS1H1-10C30CB-A6/S63*R-INT 1320
22.1.2.3 Low Inertia and Medium Capacity (MS1H2) 1321
22.1.2.3.1 MS1H2-10C30CB-A6/S63*R-INT 1321
22.1.2.3.2 MS1H2-10C30CD-A6/S63*R-INT 1322
22.1.2.3.3 MS1H2-15C30CB-A6/S63*R-INT 1323
22.1.2.3.4 MS1H2-15C30CD-A6/S63*R-INT 1324
22.1.2.3.5 MS1H2-20C30CB-A6/S63*R-INT 1325
22.1.2.3.6 MS1H2-20C30CD-A6/S63*R-INT 1326
22.1.2.3.7 MS1H2-25C30CB-A6/S63*R-INT 1327
22.1.2.3.8 MS1H2-25C30CD-A6/S63*R-INT 1328
22.1.2.3.9 MS1H2-30C30CB-A6/S63*R-INT 1329
22.1.2.3.10 MS1H2-30C30CD-A6/S63*R-INT 1330
22.1.2.3.11 MS1H2-40C30CB-A6/S63*R-INT 1331
22.1.2.3.12 MS1H2-40C30CD-A6/S63*R-INT 1332
22.1.2.3.13 MS1H2-50C30CB-A6/S63*R-INT 1333
22.1.2.3.14 MS1H2-50C30CD-A6/S63*R-INT 1334
22.1.2.4 Medium Inertia and Medium Capacity (MS1H3) 1335
22.1.2.4.1 MS1H3-85B15CB-A6/S63*R-INT 1335
22.1.2.4.2 MS1H3-85B15CD-A6/S63*R-INT 1336
22.1.2.4.3 MS1H3-13C15CB-A6/S63*R-INT 1337

22.1.2.4.4 MS1H3-13C15CD-A6/S63*R-INT 1338
22.1.2.4.5 MS1H3-18C15CB-A6/S63*R-INT 1339
22.1.2.4.6 MS1H3-18C15CD-A6/S63*R-INT 1340
22.1.2.4.7 MS1H3-29C15CB-A6/S63*R-INT 1341
22.1.2.4.8 MS1H3-29C15CD-A6/S63*R-INT 1342
22.1.2.4.9 MS1H3-44C15CB-A6/S63*R-INT 1344
22.1.2.4.10 MS1H3-44C15CD-A6/S63*R-INT 1345
22.1.2.4.11 MS1H3-55C15CD-A6/S63*R-INT 1346
22.1.2.4.12 MS1H3-75C15CD-A6/S63*R-INT 1347
22.1.2.5 Medium Inertia and Small Capacity (MS1H4) 1348
22.1.2.5.1 MS1H4-05B30CB-A6/S63*R-INT 1348
22.1.2.5.2 MS1H4-10B30CB-A6/S63*R-INT 1350
22.1.2.5.3 MS1H4-20B30CB-A6/S63*R-INT 1351
22.1.2.5.4 MS1H4-40B30CB-A6/S63*R-INT 1353
22.1.2.5.5 MS1H4-40B30CD-A6/S63*R-INT 1354
22.1.2.5.6 MS1H4-55B30CB-A6/S63*R-INT 1355
22.1.2.5.7 MS1H4-75B30CB-A6/S63*R-INT 1356
22.1.2.5.8 MS1H4-75B30CD-A6/S63*R-INT 1357
22.1.2.5.9 MS1H4-10C30CB-A6/S63*R-INT 1358
22.2 MS1-R Series Servo Motor with Battery-free Encoder 1359
22.2.1 General Specifications 1359
22.2.1.1 Mechanical Characteristics 1359
22.2.1.2 Overload Characteristics 1362
22.2.1.3 Derating Characteristics 1364
22.2.1.4 Temperature Curve of the Oil Seal 1364
22.2.1.5 Load Moment of Inertia 1364
22.2.2 Model Selection (MS1-R-INT Series Servo Motor with Battery-free Encoder) 1365
22.2.2.1 Selection Instructions 1365
22.2.2.2 Low Inertia and Small Capacity (MS1H1) 1366
22.2.2.2.1 MS1H1-05B30CB-V63*R-INT 1366
22.2.2.2.2 MS1H1-10B30CB-V63*R-INT 1367
22.2.2.2.3 MS1H1-20B30CB-V63*R-INT 1368
22.2.2.2.4 MS1H1-40B30CB-V63*R-INT 1370
22.2.2.2.5 MS1H1-55B30CB-V631R-INT 1371
22.2.2.2.6 MS1H1-75B30CB-V63*R-INT 1372
22.2.2.2.7 MS1H1-10C30CB-V63*R-INT 1373
22.2.2.3 Low Inertia and Medium Capacity (MS1H2) 1374
22.2.2.3.1 MS1H2-10C30CB-V63*R-INT 1374
22.2.2.3.2 MS1H2-10C30CD-V63*R-INT 1375
22.2.2.3.3 MS1H2-15C30CB-V63*R-INT 1376
22.2.2.3.4 MS1H2-15C30CD-V63*R-INT 1377
22.2.2.3.5 MS1H2-20C30CB-V63*R-INT 1378
22.2.2.3.6 MS1H2-20C30CD-V63*R-INT 1379

22.2.2.3.7 MS1H2-25C30CB-V63*R-INT 1380
22.2.2.3.8 MS1H2-25C30CD-V63*R-INT 1381
22.2.2.3.9 MS1H2-30C30CB-V63*R-INT 1382
22.2.2.3.10 MS1H2-30C30CD-V63*R-INT 1383
22.2.2.3.11 MS1H2-40C30CB-V63*R-INT 1384
22.2.2.3.12 MS1H2-40C30CD-V63*R-INT 1385
22.2.2.3.13 MS1H2-50C30CB-V63*R-INT 1386
22.2.2.3.14 MS1H2-50C30CD-V63*R-INT 1387
22.2.2.4 Medium Inertia and Medium Capacity (MS1H3) 1388
22.2.2.4.1 MS1H3-85B15CB-V63*R-INT 1388
22.2.2.4.2 MS1H3-85B15CD-V63*R-INT 1389
22.2.2.4.3 MS1H3-13C15CB-V63*R-INT 1390
22.2.2.4.4 MS1H3-13C15CD-V63*R-INT 1391
22.2.2.4.5 MS1H3-18C15CB-V63*R-INT 1392
22.2.2.4.6 MS1H3-18C15CD-V63*R-INT 1393
22.2.2.4.7 MS1H3-29C15CB-V63*R-INT 1394
22.2.2.4.8 MS1H3-29C15CD-V63*R-INT 1395
22.2.2.4.9 MS1H3-44C15CB-V63*R-INT 1396
22.2.2.4.10 MS1H3-44C15CD-V63*R-INT 1397
22.2.2.4.11 MS1H3-55C15CD-V63*R-INT 1398
22.2.2.4.12 MS1H3-75C15CD-V63*R-INT 1399
22.2.2.5 Medium Inertia and Small Capacity (MS1H4) 1400
22.2.2.5.1 MS1H4-05B30CB-V63*R-INT 1400
22.2.2.5.2 MS1H4-10B30CB-V63*R-INT 1403
22.2.2.5.3 MS1H4-20B30CB-V63*R-INT 1405
22.2.2.5.4 MS1H4-40B30CB-V63*R-INT 1406
22.2.2.5.5 MS1H4-55B30CB-V631R-INT 1407
22.2.2.5.6 MS1H4-75B30CB-V63*R-INT 1408
22.2.2.5.7 MS1H4-10C30CB-V63*R-INT 1409
23 Options 1411
23.1 Cables 1411
23.1.1 Power Cable 1411
23.1.2 Encoder cable 1414
23.1.3 Communication cable 1417
23.1.4 Connector Kits 1418
23.1.5 Description of Cable Terminals 1420
23.2 Peripheral Electrical Components 1421
23.2.1 List of Peripheral Electrical Components 1421
23.2.2 Fuse (CE) 1421
23.2.3 Fuse (UL) 1423
23.2.4 Electromagnetic Contactor 1424
23.2.5 Circuit Breaker (CE) 1424

23.2.6 Circuit Breaker (UL) 1426
23.2.7 AC Input Reactor 1427
23.2.8 EMC Filter 1429
23.2.9 Magnetic Ring and Magnetic Buckle 1431
23.3 Shield Bracket 1433
23.4 Absolute Encoder Batteries 1433
23.5 Braking Resistor 1434
24 Certification and Standard Requirements 1446
24.1 CE Certification 1446
24.1.1 Requirements for Compliance with EMC 1446
24.1.2 Requirements for Compliance with Low Voltage Directive 1447
24.2 UL/cUL certification 1448
24.3 KC Certification 1450
24.4 UKCA Certification 1450
24.5 Functional Safety Certification 1451
25 Appendix 1452
25.1 DI/DO Function Assignment 1452
25.2 DIDO Function Assignment [safety parameter configuration] 1460
25.3 Service and Support 1462

1 Fundamental Safety Instructions

1.1 General Safety Instructions

Safety disclaimer

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

Safety levels and definitions

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

Safety Instructions

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

Unpacking
 • Do not install the product in the case of any damage, rust, or signs of use on the product or accessories upon unpacking. • Do not install the product in the case of water seepage into the product or missing or damaged components upon unpacking. • Do not install the product in the case of any discrepancy between the product you received and the product name on the packing list.
 • Check whether the packing is intact and whether there is damage, water seepage, dampness, and deformation before unpacking. • Unpack the package by following the unpacking sequence. Do not strike the package violently. • Check for damage, rust, or dents on the surfaces of the product and accessories upon unpacking. • After unpacking, check the contents against the packing list to ensure that the equipment and accessories are in the correct quantities, and that all documentation is complete.

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

Installation

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 Model Selection

2.1 Model Selection [Standard Models]

2.1.1 List of Models (Compatible with MS1-R-INT Series Servo Motor)

Motor with 26-bit encoder

Servo motor				Servo drive SV680-INT (standard model)			
Models without brake	Models with brake	Flange size (mm)	Capacity (kW)	Voltage class (V)	Size	Recommended model	No.
Ratings of MS1H1 (n_N= 3000 rpm, n_{max}=7000 rpm) series motors							
MS1H1-05B30CB-A6/ S630R-INT	MS1H1-05B30CB-A6/S632R-INT	40	0.05	Single-phase/ Three-phase 200V	A	S1R6	00002
MS1H1-10B30CB-A6/ S630R-INT	MS1H1-10B30CB-A6/S632R-INT	40	0.1	Single-phase/ Three-phase 200V			
MS1H1-20B30CB-A6/ S631R-INT	MS1H1-20B30CB-A6/S634R-INT	60	0.2	Single-phase/ Three-phase 200V			
MS1H1-40B30CB-A6/ S631R-INT	MS1H1-40B30CB-A6/S634R-INT	60	0.4	Single-phase/ Three-phase 200V		S2R8	00003
MS1H1-55B30CB-A6/ S631R-INT	-	80	0.55	Single-phase/ Three-phase 200V	C	S5R5	00005
MS1H1-75B30CB-A6/ S631R-INT	MS1H1-75B30CB-A6/S634R-INT	80	0.75	Single-phase/ Three-phase 200V		S5R5	00005
MS1H1-10C30CB-A6/ S631R-INT	MS1H1-10C30CB-A6/S634R-INT	80	1.0	Single-phase/ Three-phase 200V	C	S7R6	00006
Ratings of MS1H2 (n_N= 3000 rpm, n_{max}= 6000 rpm) series motors							
MS1H2-10C30CB-A6/ S631R-INT	MS1H2-10C30CB-A6/S634R-INT	100	1.0	Single-phase/ Three-phase 200V	C	S7R6	00006
MS1H2-10C30CD-A6/ S631R-INT	MS1H2-10C30CD-A6/ S634R-INT	100	1.0	Three-phase 400 V		T3R5	10001
MS1H2-15C30CB-A6/ S631R-INT	MS1H2-15C30CB-A6/S634R-INT	100	1.5	Single-phase/ Three-phase 200V	D	S012	00007
MS1H2-15C30CD-A6/ S631R-INT	MS1H2-15C30CD-A6/ S634R-INT	100	1.5	Three-phase 400 V	C	T5R4	10002

Servo motor				Servo drive SV680-INT (standard model)			
Models without brake	Models with brake	Flange size (mm)	Capacity (kW)	Voltage class (V)	Size	Recommended model	No.
MS1H2-20C30CB-A6/S631R-INT	MS1H2-20C30CB-A6/S634R-INT	100	2.0	Three-phase 200 V	E	S018	00008
MS1H2-20C30CD-A6/S631R-INT	MS1H2-20C30CD-A6/S634R-INT	100	2.0	Three-phase 400 V	D	T8R4	10003
MS1H2-25C30CB-A6/S631R-INT	MS1H2-25C30CB-A6/S634R-INT	100	2.5	Three-phase 200 V	E	S022	00009
MS1H2-25C30CD-A6/S631R-INT	MS1H2-25C30CD-A6/S634R-INT	100	2.5	Three-phase 400 V	D	T012	10004
MS1H2-30C30CB-A6/S631R-INT	MS1H2-30C30CB-A6/S634R-INT	130	3.0	Three-phase 200 V	E	S022	00009
MS1H2-30C30CD-A6/S631R-INT	MS1H2-30C30CD-A6/S634R-INT	130	3.0	Three-phase 400 V	D	T012	10004
MS1H2-40C30CB-A6/S631R-INT	MS1H2-40C30CB-A6/S634R-INT	130	4.0	Three-phase 200 V	E	S027	00010
MS1H2-40C30CD-A6/S631R-INT	MS1H2-40C30CD-A6/S634R-INT	130	4.0	Three-phase 400 V		T017	10005
MS1H2-50C30CB-A6/S631R-INT	MS1H2-50C30CB-A6/S634R-INT	130	5.0	Three-phase 200 V		S027	00010
MS1H2-50C30CD-A6/S631R-INT	MS1H2-50C30CD-A6/S634R-INT	130	5.0	Three-phase 400 V		T021	10006
Ratings of MS1H3 (n_N=1500 rpm, n_{max}= 4500 rpm) series motors							
MS1H3-85B15CB-A6/S631R-INT	MS1H3-85B15CB-A6/S634R-INT	130	0.85	Single-phase/ Three-phase 200V	C	S7R6	00006
MS1H3-85B15CD-A6/S631R-INT	MS1H3-85B15CD-A6/S634R-INT	130	0.85	Three-phase 400 V		T3R5	10001
MS1H3-13C15CB-A6/S631R-INT	MS1H3-13C15CB-A6/S634R-INT	130	1.3	Single-phase/ Three-phase 200V	D	S012	00007
MS1H3-13C15CD-A6/S631R-INT	MS1H3-13C15CD-A6/S634R-INT	130	1.3	Three-phase 400 V	C	T5R4	10002
MS1H3-18C15CB-A6/S631R-INT	MS1H3-18C15CB-A6/S634R-INT	130	1.8	Three-phase 200 V	E	S018	00008
MS1H3-18C15CD-A6/S631R-INT	MS1H3-18C15CD-A6/S634R-INT	130	1.8	Three-phase 400 V	D	T8R4	10003
MS1H3-29C15CB-A6/S631R-INT	MS1H3-29C15CB-A6/S634R-INT	180	2.9	Three-phase 200 V	E	S022	00009
MS1H3-29C15CD-A6/S631R-INT	MS1H3-29C15CD-A6/S634R-INT	180	2.9	Three-phase 400 V	D	T012	10004
MS1H3-44C15CB-A6/S631R-INT	MS1H3-44C15CB-A6/S634R-INT	180	4.4	Three-phase 200 V	E	S027	00010

Servo motor				Servo drive SV680-INT (standard model)			
Models without brake	Models with brake	Flange size (mm)	Capacity (kW)	Voltage class (V)	Size	Recommended model	No.
MS1H3-44C15CD-A6/ S631R-INT	MS1H3-44C15CD-A6/ S634R-INT	180	4.4	Three-phase 400 V	E	T017	10005
MS1H3-55C15CD-A6/ S631R-INT	MS1H3-55C15CD-A6/ S634R-INT	180	5.5	Three-phase 400 V		T021	10006
MS1H3-75C15CD-A6/ S631R-INT	MS1H3-75C15CD-A6/ S634R-INT	180	7.5	Three-phase 400 V		T026	10007
Ratings of MS1H4 (n_N= 3000 rpm, n_{max}=7000 rpm) series motors							
MS1H4-05B30CB-A6/ S630R-INT	MS1H4-05B30CB-A6/S632R-INT	40	0.05	Single-phase/ Three-phase 200V	A	S1R6	00002
MS1H4-10B30CB-A6/ S630R-INT	MS1H4-10B30CB-A6/S632R-INT	40	0.1	Single-phase/ Three-phase 200V		S1R6	00002
MS1H4-05B30CB-A6/ S631R-INT	MS1H4-05B30CB-A6/S634R-INT	40	0.05	Single-phase/ Three-phase 200V		S1R6	00002
MS1H4-10B30CB-A6/ S631R-INT	MS1H4-10B30CB-A6/S634R-INT	40	0.1	Single-phase/ Three-phase 200V		S1R6	00002
MS1H4-20B30CB-A6/ S631R-INT	MS1H4-20B30CB-A6/S634R-INT	60	0.2	Single-phase/ Three-phase 200V		S1R6	00002
MS1H4-40B30CB-A6/ S631R-INT	MS1H4-40B30CB-A6/S634R-INT	60	0.4	Single-phase/ Three-phase 200V		S2R8	00003
MS1H4-40B30CD-A6/ S631R-INT	MS1H4-40B30CD-A6/ S634R-INT	60	0.4	Three-phase 400 V	B	T1R4	10029
MS1H4-55B30CB-A6/ S631R-INT	-	80	0.55	Single-phase/ Three-phase 200V	C	S5R5	00005
MS1H4-75B30CB-A6/ S631R-INT	MS1H4-75B30CB-A6/S634R-INT	80	0.75	Single-phase/ Three-phase 200V		S5R5	00005
MS1H4-75B30CD-A6/ S631R-INT	MS1H4-75B30CD-A6/ S634R-INT	80	0.75	Three-phase 400 V	B	T2R3	10031
MS1H4-10C30CB-A6/ S631R-INT	MS1H4-10C30CB-A6/S634R-INT	80	1.0	Single-phase/ Three-phase 200V	C	S7R6	00006

Note

Models of drives:

- S: 200 V voltage class
- T: 400 V voltage class
- 1R6: 1.6 A rated output current, 2R8: 2.8 A rated output current..., 026: 26 A rated output current, 027: 27 A rated output current

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

Servo motor				Servo drive SV680-INT series			
Model without brake	Model with brake	Frame size (mm)	Capacity (kW)	Voltage class	Size	Recommended model	No.
Ratings of MS1H1 (n_N= 3000 rpm, n_{max}=7000 rpm) series motors							
MS1H1-05B30CB-V630R-INT	MS1H1-05B30CB-V632R-INT	40	0.55	Single-phase/ Three-phase 200 V	A	S1R6	00002
MS1H1-10B30CB-V630R-INT	MS1H1-10B30CB-V632R-INT	40	0.1	Single-phase/ Three-phase 200 V			
MS1H1-20B30CB-V631R-INT	MS1H1-20B30CB-V634R-INT	60	0.2	Single-phase/ Three-phase 200 V			
MS1H1-40B30CB-V631R-INT	MS1H1-40B30CB-V634R-INT	60	0.4	Single-phase/ Three-phase 200 V		S2R8	00003
MS1H1-55B30CB-V631R-INT	-	80	0.55	Single-phase/ Three-phase 200 V	C	S5R5	00005
MS1H1-75B30CB-V631R-INT	MS1H1-75B30CB-V634R-INT	80	0.75	Single-phase/ Three-phase 200 V		S5R5	00005
MS1H1-10C30CB-V631R-INT	MS1H1-10C30CB-V634R-INT	80	1.0	Single-phase/ Three-phase 200 V	C	S7R6	00006
Ratings of MS1H2 (n_N= 3000 rpm, n_{max}= 6000 rpm) series motors							
MS1H2-10C30CB-V631R-INT	MS1H2-10C30CB-V634R-INT	100	1.0	Single-phase/ Three-phase 200 V	C	S7R6	00006
MS1H2-10C30CD-V631R-INT	MS1H2-10C30CD-V634R-INT	100	1.0	Three-phase 400 V		T3R5	10001

Servo motor				Servo drive SV680-INT series			
Model without brake	Model with brake	Frame size (mm)	Capacity (kW)	Voltage class	Size	Recommended model	No.
MS1H2-15C30CB-V631R-INT	MS1H2-15C30CB-V634R-INT	100	1.5	Single-phase/ Three-phase 200 V	D	S012	00007
MS1H2-15C30CD-V631R-INT	MS1H2-15C30CD-V634R-INT	100	1.5	Three-phase 400 V	C	T5R4	10002
MS1H2-20C30CB-V631R-INT	MS1H2-20C30CB-V634R-INT	100	2.0	Three-phase 200 V	E	S018	00008
MS1H2-20C30CD-V631R-INT	MS1H2-20C30CD-V634R-INT	100	2.0	Three-phase 400 V	D	T8R4	10003
MS1H2-25C30CB-V631R-INT	MS1H2-25C30CB-V634R-INT	100	2.5	Three-phase 200 V	E	S022	00009
MS1H2-25C30CD-V631R-INT	MS1H2-25C30CD-V634R-INT	100	2.5	Three-phase 400 V	D	T012	10004
MS1H2-30C30CB-V631R-INT	MS1H2-30C30CB-V634R-INT	130	3.0	Three-phase 200 V	E	S022	00009
MS1H2-30C30CD-V631R-INT	MS1H2-30C30CD-V634R-INT	130	3.0	Three-phase 400 V	D	T012	10004
MS1H2-40C30CB-V631R-INT	MS1H2-40C30CB-V634R-INT	130	4.0	Three-phase 200 V	E	S027	00010
MS1H2-40C30CD-V631R-INT	MS1H2-40C30CD-V634R-INT	130	4.0	Three-phase 400 V		T017	10005
MS1H2-50C30CB-V631R-INT	MS1H2-50C30CB-V634R-INT	130	5.0	Three-phase 200 V		S027	00010
MS1H2-50C30CD-V631R-INT	MS1H2-50C30CD-V634R-INT	130	5.0	Three-phase 400 V		T021	10006
Ratings of MS1H3 (n_N=1500 rpm, n_{max}= 4500 rpm) series motors							
MS1H3-85B15CB-V631R-INT	MS1H3-85B15CB-V634R-INT	130	0.85	Single-phase/ Three-phase 200 V	C	S7R6	00006
MS1H3-85B15CD-V631R-INT	MS1H3-85B15CD-V634R-INT	130	0.85	Three-phase 400 V		T3R5	10001
MS1H3-13C15CB-V631R-INT	MS1H3-13C15CB-V634R-INT	130	1.3	Single-phase/ Three-phase 200 V	D	S012	00007
MS1H3-13C15CD-V631R-INT	MS1H3-13C15CD-V634R-INT	130	1.3	Three-phase 400 V	C	T5R4	10002
MS1H3-18C15CB-V631R-INT	MS1H3-18C15CB-V634R-INT	130	1.8	Three-phase 200 V	E	S018	00008
MS1H3-18C15CD-V631R-INT	MS1H3-18C15CD-V634R-INT	130	1.8	Three-phase 400 V	D	T8R4	10003
MS1H3-29C15CB-V631R-INT	MS1H3-29C15CB-V634R-INT	180	2.9	Three-phase 200 V	E	S022	00009

Servo motor				Servo drive SV680-INT series			
Model without brake	Model with brake	Frame size (mm)	Capacity (kW)	Voltage class	Size	Recommended model	No.
MS1H3-29C15CD-V631R-INT	MS1H3-29C15CD-V634R-INT	180	2.9	Three-phase 400 V	D	T012	10004
MS1H3-44C15CB-V631R-INT	MS1H3-44C15CB-V634R-INT	180	4.4	Three-phase 200 V	E	S027	00010
MS1H3-44C15CD-V631R-INT	MS1H3-44C15CD-V634R-INT	180	4.4	Three-phase 400 V	E	T017	10005
MS1H3-55C15CD-V631R-INT	MS1H3-55C15CD-V634R-INT	180	5.5	Three-phase 400 V		T021	10006
MS1H3-75C15CD-V631R-INT	MS1H3-75C15CD-V634R-INT	180	7.5	Three-phase 400 V		T026	10007
Ratings of MS1H4 (n_N= 3000 rpm, n_{max}=7000 rpm) series motors							
MS1H4-05B30CB-V630R-INT	MS1H4-05B30CB-V632R-INT	40	0.05	Single/Three-phase 200 V	A	S1R6	00002
MS1H4-05B30CB-V631R-INT	MS1H4-05B30CB-V634R-INT	40	0.05	Single/Three-phase 200 V			
MS1H4-10B30CB-V630R-INT	MS1H4-10B30CB-V632R-INT	40	0.1	Single/Three-phase 200 V			
MS1H4-10B30CB-V631R-INT	MS1H4-10B30CB-V634R-INT	40	0.1	Single/Three-phase 200 V			
MS1H4-20B30CB-V631R-INT	MS1H4-10B30CB-V634R-INT	60	0.2	Single-phase/ Three-phase 200 V			
MS1H4-40B30CB-V631R-INT	MS1H4-40B30CB-V634R-INT	60	0.4	Single-phase/ Three-phase 200 V		S2R8	00003
MS1H4-55B30CB-V631R-INT	-	80	0.55	Single-phase/ Three-phase 200 V	C	S5R5	00005
MS1H4-75B30CB-V631R-INT	MS1H4-75B30CB-V634R-INT	80	0.75	Single-phase/ Three-phase 200 V		S5R5	00005
MS1H4-10C30CB-V631R-INT	MS1H4-10C30CB-V634R-INT	80	1.0	Single-phase/ Three-phase 200 V	C	S7R6	00006

Note

- Models of drives:
  - S: 200 V voltage class
  - T: 400 V voltage class
  - 1R6: Rated output current = 1.6 A; 2R8 - Rated output current = 2.8 A…; 026 - Rated output current = 26 A; 027 - Rated output current = 27 A
- Servo motors match different series of servo drives. The maximum speed and maximum torque output of the motor vary slightly. See the servo drive selection guide for details.
- Servo motors designed to work with 23-bit (V3) or 26-bit (V6) encoders have the same dimensions.
- The MS1-R series motors equipped with the V6/V3/A6/A3 encoders have the same dimensions.

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

Motor model	Servo drive model SV680-INT series	Power cable length (m)				
		3	5	8	10	12
LMC88100Y1-INT LMC88-130Y1-INT LMC88-185Y1-INT LMC88-240Y1-INT	S5R5	S6-L-M160-3.0-TTS-2-INT	S6-L-M160-5.0-TTS-2-INT	S6-L-M160-8.0-TTS-2-INT	S6-L-M160-10.0-TTS-2-INT	S6-L-M160-12.0-TTS-2-INT
LMC118-130Y1-INT LMC118-185Y1-INT	S5R5	S6-L-M160-3.0-TTS-2-INT	S6-L-M160-5.0-TTS-2-INT	S6-L-M160-8.0-TTS-2-INT	S6-L-M160-10.0-TTS-2-INT	S6-L-M160-12.0-TTS-2-INT
LMC118-240Y2-INT	S7R6	S6-L-M160-3.0-TTS-2-INT	S6-L-M160-5.0-TTS-2-INT	S6-L-M160-8.0-TTS-2-INT	S6-L-M160-10.0-TTS-2-INT	S6-L-M160-12.0-TTS-2-INT
LMC118-185Y3-INT LMC118-355Y3-INT	S012	S6-L-M150-3.0-TTS-2-INT	S6-L-M150-5.0-TTS-2-INT	S6-L-M150-8.0-TTS-2-INT	S6-L-M150-10.0-TTS-2-INT	S6-L-M150-12.0-TTS-2-INT
LMC168-185Y1-INT	S5R5	S6-L-M160-3.0-TTS-2-INT	S6-L-M160-5.0-TTS-2-INT	S6-L-M160-8.0-TTS-2-INT	S6-L-M160-10.0-TTS-2-INT	S6-L-M160-12.0-TTS-2-INT
LMC168-130Y2-INT LMC168-240Y2-INT	S7R6	S6-L-M160-3.0-TTS-2-INT	S6-L-M160-5.0-TTS-2-INT	S6-L-M160-8.0-TTS-2-INT	S6-L-M160-10.0-TTS-2-INT	S6-L-M160-12.0-TTS-2-INT
LMC168-185Y3-INT LMC168-240Y4-INT	S012	S6-L-M150-3.0-TTS-2-INT	S6-L-M150-5.0-TTS-2-INT	S6-L-M150-8.0-TTS-2-INT	S6-L-M150-10.0-TTS-2-INT	S6-L-M150-12.0-TTS-2-INT
LMC188-240Y2-INT	S7R6	S6-L-M160-3.0-TTS-2-INT	S6-L-M160-5.0-TTS-2-INT	S6-L-M160-8.0-TTS-2-INT	S6-L-M160-10.0-TTS-2-INT	S6-L-M160-12.0-TTS-2-INT
LMC188-355Y3-INT LMC188-240Y4-INT	S012	S6-L-M150-3.0-TTS-2-INT	S6-L-M150-5.0-TTS-2-INT	S6-L-M150-8.0-TTS-2-INT	S6-L-M150-10.0-TTS-2-INT	S6-L-M150-12.0-TTS-2-INT
LMC188-355Y6-INT	S021	S6-L-M040-3.0-TTS-2-INT	S6-L-M040-5.0-TTS-2-INT	S6-L-M040-8.0-TTS-2-INT	S6-L-M040-10.0-TTS-2-INT	S6-L-M040-12.0-TTS-2-INT
LMC228-240Y4-INT	S012	S6-L-M150-3.0-TTS-2-INT	S6-L-M150-5.0-TTS-2-INT	S6-L-M150-8.0-TTS-2-INT	S6-L-M150- 10.0-TTS-2-INT	S6-L-M150- 12.0-TTS-2-INT
LMC228-290Y5-INT	S017	S6-L-M040-3.0-TTS-2-INT	S6-L-M040-5.0-TTS-2-INT	S6-L-M040-8.0-TTS-2-INT	S6-L-M040- 10.0-TTS-2-INT	S6-L-M040- 12.0-TTS-2-INT

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

Motor model	Servo drive SV680-INT series	Extension power cable length (3 m)	Extension power cable length (5 m)	Extension power cable length (10 m)
MP1-112F10AB-U313X-INT	S2R8	S6-L-M110-3.0-T-INT	S6-L-M110-5.0-T-INT	S6-L-M110-10.0-T-INT
MP1-140S10BB-U323X-INT	S012	S6-L-M110-3.0-T-INT	S6-L-M110-5.0-T-INT	S6-L-M110-10.0-T-INT
MP1-175S11BB-U333X-INT	S012	S6-L-M110-3.0-T-INT	S6-L-M110-5.0-T-INT	S6-L-M110-10.0-T-INT
MP1-220S15BB-U323X-INT	S012	S6-L-M0BD-3.0-INT	S6-L-M0BD-5.0-INT	S6-L-M0BD-10.0-INT
MP1-220S30BD-U323X-INT	T021	S6-L-M0BD-3.0-INT	S6-L-M0BD-5.0-INT	S6-L-M0BD-10.0-INT
MP1-220S30BD-U323L-C-INT	T026	S6-L-M0BD-3.0-INT	S6-L-M0BD-5.0-INT	S6-L-M0BD-10.0-INT

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

Motor model	Servo drive SV680-INT series	Extension power cable length (3 m)	Extension power cable length (5 m)	Extension power cable length (10 m)
ISMT1-160F12AB-A113X-INT	S2R8	S6-L-M110-3.0-T-INT	S6-L-M110-5.0-T-INT	S6-L-M110-10.0-T-INT
ISMT1-160F12AB-A133X-INT				
ISMT1-160F45AB-A133X-INT				

2.2 Selection List [Functional Safety]

Table 2–1 Functional safety drives and compatible functional safety motors

Drive				Motor				
Voltage Class	Size	Recommended Drive Model	H01.10 No.	Motor without Brake	Motor with Brake	Flange Size (mm)	Capacity (kW)	Built-in Safety Encoder
Ratings of MS1H1 (n_N= 3000 rpm, n_{max}=7000 rpm) series motors								
Single-phase/Three-phase 200 V	A	S1R6	00002	MS1H1-05B30CB-S630R-INT	MS1H1-05B30CB-S632R-INT	40	0.05	EA33H6-B26M16-TH5N1T
				MS1H1-10B30CB-S630R-INT	MS1H1-10B30CB-S632R-INT	40	0.1	EA33H6-B26M16-TH5N1T
				MS1H1-20B30CB-S631R-INT	MS1H1-20B30CB-S634R-INT	60	0.2	EA45H8-B26M16-TH5N1T
Single-phase/Three-phase 200 V		S2R8	00003	MS1H1-40B30CB-S631R-INT	MS1H1-40B30CB-S634R-INT	60	0.4	EA45H8-B26M16-TH5N1T
Single-phase/Three-phase 200 V	C	S5R5	00005	MS1H1-55B30CB-S631R-INT	-	80	0.55	EA45H8-B26M16-TH5N1T
Single-phase/Three-phase 200 V		S5R5	00005	MS1H1-75B30CB-S631R-INT	MS1H1-75B30CB-S634R-INT	80	0.75	EA45H8-B26M16-TH5N1T

Drive				Motor				
Voltage Class	Size	Recommended Drive Model	H01.10 No.	Motor without Brake	Motor with Brake	Flange Size (mm)	Capacity (kW)	Built-in Safety Encoder
Single-phase/Three-phase 200 V	C	S7R6	00006	MS1H1-10C30CB-S631R-INT	MS1H1-10C30CB-S634R-INT	80	1.0	EA45H8-B26M16-TH5N1T
Ratings of MS1H2 (n_N= 3000 rpm, n_{max}= 6000 rpm) series motors								
Single-phase/Three-phase 200 V	C	S7R6	00006	MS1H2-10C30CB-S631R-INT	MS1H2-10C30CB-S634R-INT	100	1.0	EA79R8-B26M16-TH5Y3-FS
Three-phase 400		T3R5	10001	MS1H2-10C30CD-S631R-INT	MS1H2-10C30CD-S634R-INT	100	1.0	EA79R8-B26M16-TH5Y3-FS
Single-phase/Three-phase 200 V	D	S012	00007	MS1H2-15C30CB-S631R-INT	MS1H2-15C30CB-S634R-INT	100	1.5	EA79R8-B26M16-TH5Y3-FS
Three-phase 400 V	C	T5R4	10002	MS1H2-15C30CD-S631R-INT	MS1H2-15C30CD-S634R-INT	100	1.5	EA79R8-B26M16-TH5Y3-FS
Three-phase 200 V	E	S018	00008	MS1H2-20C30CB-S631R-INT	MS1H2-20C30CB-S634R-INT	100	2.0	EA79R8-B26M16-TH5Y3-FS
Three-phase 400 V	D	T8R4	10003	MS1H2-20C30CD-S631R-INT	MS1H2-20C30CD-S634R-INT	100	2.0	EA79R8-B26M16-TH5Y3-FS
Three-phase 200 V	E	S022	00009	MS1H2-25C30CB-S631R-INT	MS1H2-25C30CB-S634R-INT	100	2.5	EA79R8-B26M16-TH5Y3-FS
Three-phase 400 V	D	T012	10004	MS1H2-25C30CD-S631R-INT	MS1H2-25C30CD-S634R-INT	100	2.5	EA79R8-B26M16-TH5Y3-FS
Three-phase 200 V	E	S022	00009	MS1H2-30C30CB-S631R-INT	MS1H2-30C30CB-S634R-INT	130	3.0	EA79R8-B26M16-TH5Y3-FS
Three-phase 400 V	D	T012	10004	MS1H2-30C30CD-S631R-INT	MS1H2-30C30CD-S634R-INT	130	3.0	EA79R8-B26M16-TH5Y3-FS
Three-phase 200 V	E	S027	00010	MS1H2-40C30CB-S631R-INT	MS1H2-40C30CB-S634R-INT	130	4.0	EA79R8-B26M16-TH5Y3-FS
Three-phase 400 V		T017	10005	MS1H2-40C30CD-S631R-INT	MS1H2-40C30CD-S634R-INT	130	4.0	EA79R8-B26M16-TH5Y3-FS
Three-phase 200 V		S027	00010	MS1H2-50C30CB-S631R-INT	MS1H2-50C30CB-S634R-INT	130	5.0	EA79R8-B26M16-TH5Y3-FS
Three-phase 400 V		T021	10006	MS1H2-50C30CD-S631R-INT	MS1H2-50C30CD-S634R-INT	130	5.0	EA79R8-B26M16-TH5Y3-FS
Ratings of MS1H3 (n_N=1500 rpm, n_{max}= 4500 rpm) series motors								
Single-phase/Three-phase 200 V	C	S7R6	00006	MS1H3-85B15CB-S631R-INT	MS1H3-85B15CB-S634R-INT	130	0.85	EA79R8-B26M16-TH5Y3-FS
Three-phase 400 V		T3R5	10001	MS1H3-85B15CD-S631R-INT	MS1H3-85B15CD-S634R-INT	130	0.85	EA79R8-B26M16-TH5Y3-FS

Drive				Motor				
Voltage Class	Size	Recommended Drive Model	H01.10 No.	Motor without Brake	Motor with Brake	Flange Size (mm)	Capacity (kW)	Built-in Safety Encoder
Single-phase/Three-phase 200 V	D	S012	00007	MS1H3-13C15CB-S631R-INT	MS1H3-13C15CB-S634R-INT	130	1.3	EA79R8-B26M16-TH5Y3-FS
Three-phase 400 V	C	T5R4	10002	MS1H3-13C15CD-S631R-INT	MS1H3-13C15CD-S634R-INT	130	1.3	EA79R8-B26M16-TH5Y3-FS
Three-phase 200 V	D	S018	00008	MS1H3-18C15CB-S631R-INT	MS1H3-18C15CB-S634R-INT	130	1.8	EA79R8-B26M16-TH5Y3-FS
Three-phase 400 V	D	T8R4	10003	MS1H3-18C15CD-S631R-INT	MS1H3-18C15CD-S634R-INT	130	1.8	EA79R8-B26M16-TH5Y3-FS
Three-phase 200 V	E	S022	00009	MS1H3-29C15CB-S631R-INT	MS1H3-29C15CB-S634R-INT	180	2.9	EA79R8-B26M16-TH5Y3-FS
Three-phase 400 V		T012	10004	MS1H3-29C15CD-S631R-INT	MS1H3-29C15CD-S634R-INT	180	2.9	EA79R8-B26M16-TH5Y3-FS
Three-phase 200 V	E	S027	00010	MS1H3-44C15CB-S631R-INT	MS1H3-44C15CB-S634R-INT	180	4.4	EA79R8-B26M16-TH5Y3-FS
Three-phase 400 V	E	T017	10005	MS1H3-44C15CD-S631R-INT	MS1H3-44C15CD-S634R-INT	180	4.4	EA79R8-B26M16-TH5Y3-FS
Three-phase 400 V		T021	10006	MS1H3-55C15CD-S631R-INT	MS1H3-55C15CD-S634R-INT	180	5.5	EA79R8-B26M16-TH5Y3-FS
Three-phase 400 V		T026	10007	MS1H3-75C15CD-S631R-INT	MS1H3-75C15CD-S634R-INT	180	7.5	EA79R8-B26M16-TH5Y3-FS
Ratings of MS1H4 (n_N= 3000 rpm, n_{max}=7000 rpm) series motors								
Single-phase/Three-phase 200 V	A	S1R6	00002	MS1H4-05B30CB-S630R-INT	MS1H4-05B30CB-S632R-INT	40	0.05	EA33H6-B26M16-TH5N1T
Single-phase/Three-phase 200 V		S1R6	00002	MS1H4-10B30CB-S630R-INT	MS1H4-10B30CB-S632R-INT	40	0.1	EA33H6-B26M16-TH5N1T
Single-phase/Three-phase 200 V		S1R6	00002	MS1H4-05B30CB-S631R-INT	MS1H4-05B30CB-S634R-INT	40	0.05	EA33H6-B26M16-TH5N1T
Single-phase/Three-phase 200 V		S1R6	00002	MS1H4-10B30CB-S631R-INT	MS1H4-10B30CB-S634R-INT	40	0.1	EA33H6-B26M16-TH5N1T
Single-phase/Three-phase 200 V		S1R6	00002	MS1H4-20B30CB-S631R-INT	MS1H4-20B30CB-S634R-INT	60	0.2	EA45H8-B26M16-TH5N1T
Single-phase/Three-phase 200 V		S2R8	00003	MS1H4-40B30CB-S631R-INT	MS1H4-40B30CB-S634R-INT	60	0.4	EA45H8-B26M16-TH5N1T

Drive				Motor				
Voltage Class	Size	Recommended Drive Model	H01.10 No.	Motor without Brake	Motor with Brake	Flange Size (mm)	Capacity (kW)	Built-in Safety Encoder
Single-phase/Three-phase 200 V	C	S5R5	00005	MS1H4-55B30CB-S631R-INT	-	80	0.55	EA45H8-B26M16-TH5N1T
Single-phase/Three-phase 200 V		S5R5	00005	MS1H4-75B30CB-S631R-INT	MS1H4-75B30CB-S634R-INT	80	0.75	EA45H8-B26M16-TH5N1T
Single-phase/Three-phase 200 V	C	S7R6	00006	MS1H4-10C30CB-S631R-INT	MS1H4-10C30CB-S634R-INT	80	1.0	EA45H8-B26M16-TH5N1T

Note

Safety functions SS1-r/SLS/SSM/SOS/SS2/SDI require the use of a safety motor, while safety functions SS1-t/STO/SBC do not.

3 Product Information

3.1 Drive

3.1.1 Model and Nameplate

Model description

SV680 ① P ② S ③ 2R8 ④ I ⑤ - GINT ⑥

① **Product series** SV680: SV680 universal servo drive	④ **Rated output current**		⑤ **Model specification** I: Standard type S: Functional safety type
② **Product type** P: Pulse type + CANopen communication type	S: 200 V	1R6: 1.6 A 2R8: 2.8 A 5R5: 5.5 A 7R6: 7.6 A 012: 12.0 A 018: 18.0 A 022: 22.0 A 027: 27.0 A	⑥ **Model specification** GINT: General (international version) PINT: Backup power supply type* (international version)
③ **Voltage class** S: 200 V T: 400 V	T: 400 V	1R4: 1.4 A 2R3: 2.3 A 3R5: 3.5 A 5R4: 5.4 A 8R4: 8.4 A 012: 12.0 A 017: 17.0 A 021: 21.0 A 026: 26.0 A	

Note

*: Backup power supply provides power to the control circuit when the main circuit is not powered, maintaining functions such as programming, connecting to backend configuration parameters, and communication.

Nameplate description

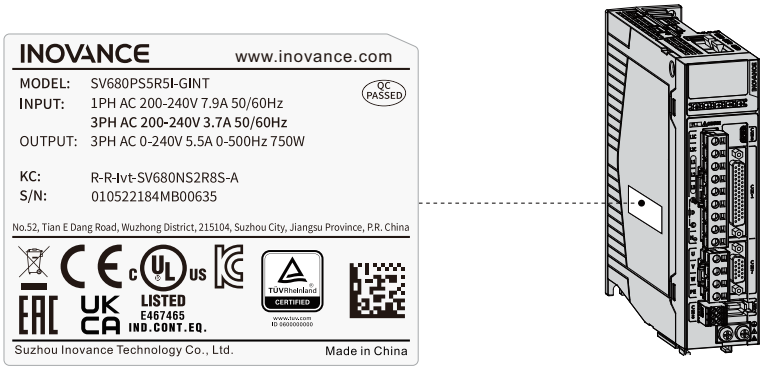


Figure 3-1 Diagram of nameplate descriptions (standard model)

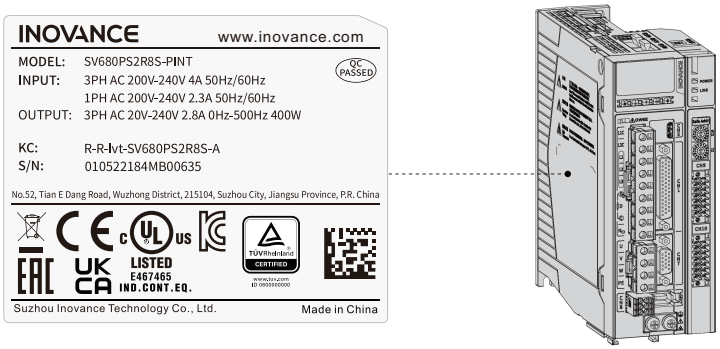


Figure 3-2 Diagram of nameplate descriptions (functional safety model)

Description of production serial number

01050202 4 S 7 00001
① ② ③ ④ ⑤

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

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

3.1.2 Components [Standard Model]

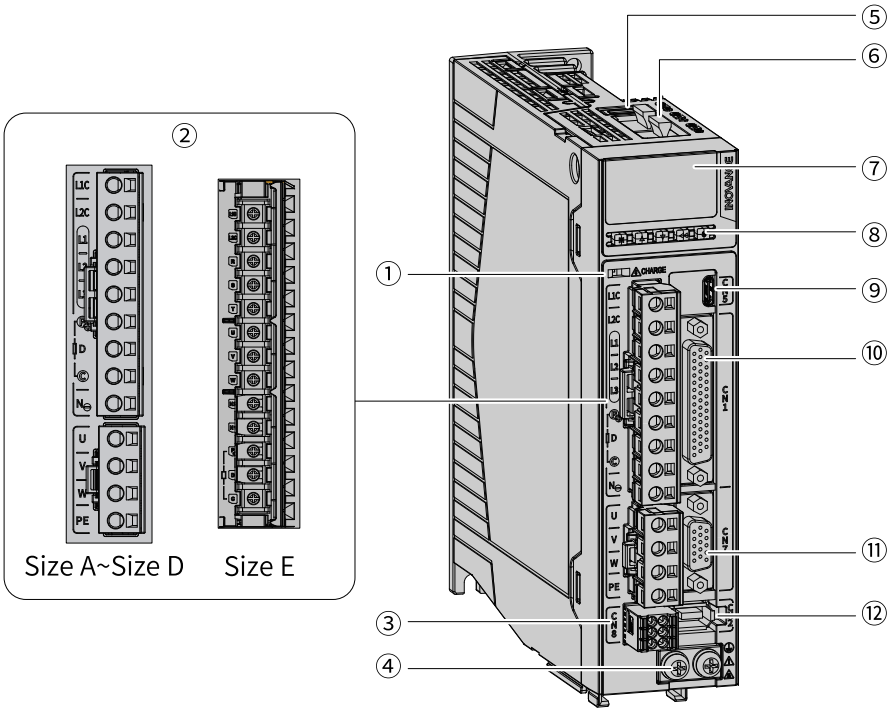


Figure 3-3 Components of servo drives

Table 3–1 Components of the servo drive

No.	Component		Description
①	CHARGE (bus voltage indicator)		Indicates the bus capacitor with charges. When this indicator is on, it indicates that electric charge may still exist in the internal capacitor of the servo unit even if the main circuit power supply is off. To prevent electric shock, do not touch the power supply terminals when this indicator turns on.
② (Size A to size D)	Main circuit terminals	L1C and L2C control circuit power input terminals	Provides power supply to the control circuit as per the rated voltage class on the nameplate
		Main circuit power input terminal [1]	Connect this terminal to the power supply for the main circuit of the drive as per the rated voltage on the nameplate.
		$P_{\oplus}$, D, and C (terminals for connecting an external braking resistor)[2]	Remove the jumper bar between terminals $P_{\oplus}$ and D before connecting an external braking resistor between terminals $P_{\oplus}$ and C.
		$P_{\oplus}$, $N_{\ominus}$ (servo bus terminal)	Used by the common DC bus for multiple drives.
		U, V, W, PE (terminals for connecting the servo motor)	Connects the U, V, and W phases and grounding terminal of the motor.

No.	Component		Description
② (Size E)	Main circuit terminals	L1C and L2C control circuit power input terminals	Provides power supply to the control circuit as per the rated voltage class on the nameplate
		R, S, T (main circuit power input terminals)	Connect this terminal to the power supply for the main circuit of the drive as per the rated voltage on the nameplate.
		$P_{\oplus}$, D, C (external braking resistor terminal)	Remove the jumper bar between terminals $P_{\oplus}$ and D before connecting an external braking resistor between terminals $P_{\oplus}$ and C.
		N2 and N1 (terminals for connecting an external reactor)	N1 is shorted to N2 with a jumper by default. To suppress power supply harmonics, remove the jumper and connect an external DC reactor between N1 and N2.
		U, V, W (terminals for connecting the servo motor)	Used to connect U, V, and W phases of the motor.
③	CN8 (brake and PTC input terminal)		Used for wiring of the brake and PTC.
④	Servo drive grounding terminal		Connected to the grounding terminal of the power supply for grounding purpose
⑤	CN6 (STO safety function terminal)		Connected to external functional safety signal for functional safety purpose
⑥	CN3, CN4 communication terminals		Connected to Modbus RTU and CANopen host controllers in parallel.
⑦	LED display		The 5-digit 8-segment LED display is used to show operating state and parameter setting of the drive.
⑧	Key operator		M: Used to switch parameters in sequence. ▲: Increases the value of the blinking digit. ▼: Decreases the value of the blinking digit. ◀◀: Shifts the blinking bit leftwards (Hold down: Turns to the next page when the displayed number exceeds five digits) S: Saves modifications and enters the next menu.
⑨	CN5 (communication terminal)		This terminal only supports online upgrade and software tool commissioning, which can be performed only when the drive is energized. In USB mode, the terminal only supports download and upload of parameters, and drive firmware update. The terminal uses USB power supply. If there is a fault that cannot be completely reset, disconnect the USB power supply and drive control power, and then power on again.
⑩	CN1 (control terminal)		Used for reference input signals and other I/O signals.
⑪	CN7 (encoder feedback terminal)		Supports communication-type encoders and pulse-type encoders. Supports gantry synchronization.
⑫	CN2 (encoder feedback terminal)		Supports communication-type encoders. Supports gantry synchronization.

Note

- [1] When the main circuit power input terminals of drives with a voltage class of 200 V are L1, L2, L3, or any two among L1, L2, and L3 in case of single-phase power supplies. The main circuit power input terminals of drives with a voltage class of 400 V are R, S, and T.
- [2] The built-in braking resistor or jumper bar is not available in models S1R6 and S2R8. If an external braking resistor is needed for S1R6 and S2R8 models, connect it between terminals P⊕ and C.

3.1.3 Components [Backup Power Supply Model]

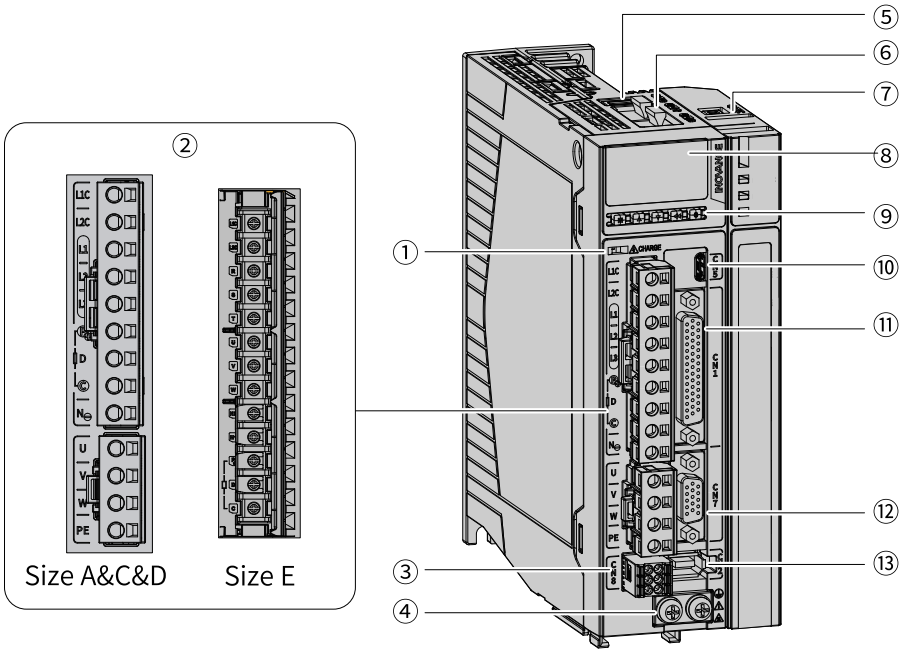


Figure 3-4 Components of servo drives

Table 3–2 Components of the servo drive

No.	Component		Description
①	CHARGE (bus voltage indicator)		Indicates the bus capacitor with charges. When this indicator is on, it indicates that electric charge may still exist in the internal capacitor of the servo unit even if the main circuit power supply is off. To prevent electric shock, do not touch the power supply terminals when this indicator turns on.
② (Sizes A, C, and D)	Main circuit terminals	L1C and L2C control circuit power input terminals	Provides power supply to the control circuit as per the rated voltage class on the nameplate
		Main circuit power input terminal [1]	Connect this terminal to the power supply for the main circuit of the drive as per the rated voltage on the nameplate.
		P⊕, D, and C (terminals for connecting an external braking resistor)[2]	Remove the jumper bar between terminals P⊕ and D before connecting an external braking resistor between terminals P⊕ and C.
		P⊕, N⊖ (servo bus terminal)	Used by the common DC bus for multiple drives.
		U, V, W, PE (terminals for connecting the servo motor)	Used to connect the U, V, and W phases and grounding terminal of the motor.

No.	Component		Description
② (Size E)	Main circuit terminals	L1C and L2C control circuit power input terminals	Provides power supply to the control circuit as per the rated voltage class on the nameplate
		R, S, T (main circuit power input terminals)	Connect this terminal to the power supply for the main circuit of the drive as per the rated voltage on the nameplate.
		$P_{\oplus}$, D, C (external braking resistor terminal)	Remove the jumper bar between terminals $P_{\oplus}$ and D before connecting an external braking resistor between terminals $P_{\oplus}$ and C.
		N2 and N1 (terminals for connecting an external reactor)	N1 is shorted to N2 with a jumper by default. To suppress power supply harmonics, remove the jumper and connect an external DC reactor between N1 and N2.
		U, V, W (terminals for connecting the servo motor)	Used to connect U, V, and W phases of the motor.
③	CN8 (brake and PTC input terminal)		Used for wiring of the brake and PTC.
④	Servo drive grounding terminal		Connected to the grounding terminal of the power supply for grounding purpose
⑤	CN6 (STO safety function terminal)		Connected to external functional safety signal for functional safety purpose
⑥	CN3, CN4 communication terminals		Connected to Modbus RTU and CANopen host controllers in parallel.
⑦	CN11 (24 V backup power input terminal)		When the main circuit is not powered, the control circuit is powered to maintain functions such as programming, connection to software tool parameters, and communication.
⑧	LED display		The 5-digit 8-segment LED display is used to show operating state and parameter setting of the drive.
⑨	Key operator		M: Used to switch parameters in sequence. ▲: Increases the value of the blinking digit. ▼: Decreases the value of the blinking digit. ◀◀: Shifts the blinking bit leftwards (Hold down: Turns to the next page when the displayed number exceeds five digits) S: Saves modifications and enters the next menu.
⑩	CN5 (communication terminal)		This terminal only supports online upgrade and software tool commissioning, which can be performed only when the drive is energized. In USB mode, the terminal only supports download and upload of parameters, and drive firmware update. The terminal uses USB power supply. If there is a fault that cannot be completely reset, disconnect the USB power supply and drive control power, and then power on again.
⑪	CN1 (control terminal)		Used for reference input signals and other I/O signals.
⑫	CN7 (encoder feedback terminal)		Supports communication-type encoders and pulse-type encoders. Supports gantry synchronization.
⑬	CN2 (encoder feedback terminal)		Supports communication-type encoders. Supports gantry synchronization.

Note

- [1] When the main circuit power input terminals of drives with a voltage class of 200 V are L1, L2, L3, or any two among L1, L2, and L3 in case of single-phase power supplies. The main circuit power input terminals of drives with a voltage class of 400 V are R, S, and T.
- [2] The built-in braking resistor or jumper bar is not available in models S1R6 and S2R8. If an external braking resistor is needed for S1R6 and S2R8 models, connect it between terminals P⊕ and C.
- CN11 (24 V backup power input terminal): supported only by functional safety models and backup power supply models.

3.1.4 Components [Functional Safety Models]

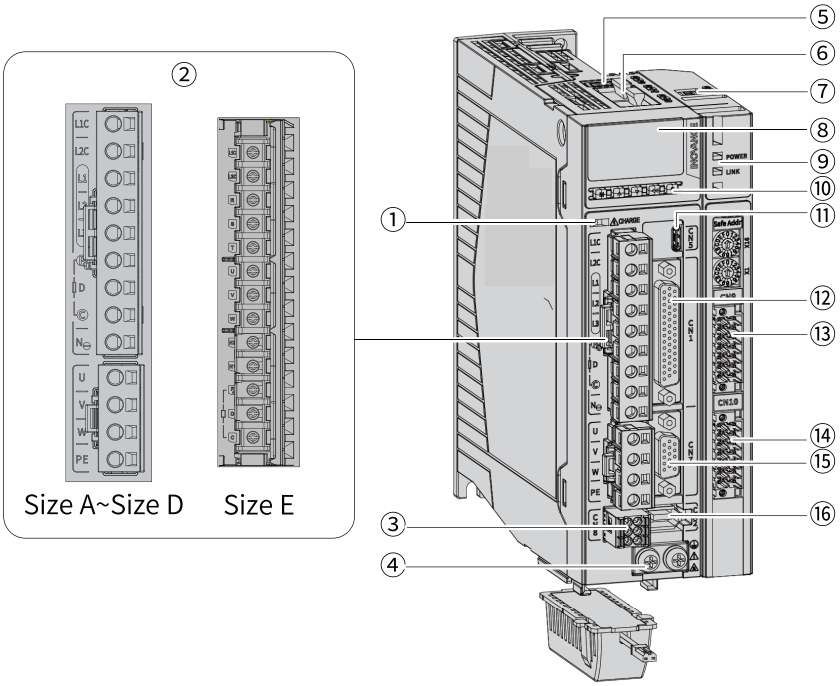


Figure 3-5 Components of servo drives

Table 3–3 Components of the servo drive

No.	Component		Description
①	CHARGE (bus voltage indicator)		Indicates the bus capacitor with charges. When this indicator is on, it indicates that electric charge may still exist in the internal capacitor of the servo unit even if the main circuit power supply is off. To prevent electric shock, do not touch the power supply terminals when this indicator turns on.
② (Size A to size D)	Main circuit terminals	L1C and L2C control circuit power input terminals	Provides power supply to the control circuit as per the rated voltage class on the nameplate
		Main circuit power input terminal [1]	Connect this terminal to the power supply for the main circuit of the drive as per the rated voltage on the nameplate.
		P⊕, D, and C (terminals for connecting an external braking resistor)[2]	Remove the jumper bar between terminals P⊕ and D before connecting an external braking resistor between terminals P⊕ and C.
		P⊕, N⊖ (servo bus terminal)	Used by the common DC bus for multiple drives.
		U, V, W, PE (terminals for connecting the servo motor)	Used to connect the U, V, and W phases and grounding terminal of the motor.
② (Size E)	Main circuit terminals	L1C and L2C control circuit power input terminals	Provides power supply to the control circuit as per the rated voltage class on the nameplate
		R, S, T (main circuit power input terminals)	Connect this terminal to the power supply for the main circuit of the drive as per the rated voltage on the nameplate.
		P⊕, D, C (external braking resistor terminal)	Remove the jumper bar between terminals P⊕ and D before connecting an external braking resistor between terminals P⊕ and C.
		N2 and N1 (terminals for connecting an external reactor)	N1 is shorted to N2 with a jumper by default. To suppress power supply harmonics, remove the jumper and connect an external DC reactor between N1 and N2.
		U, V, W (terminals for connecting the servo motor)	Used to connect U, V, and W phases of the motor.
③	CN8 (brake and PTC input terminal)		Used for wiring of the brake and PTC.
④	Servo drive grounding terminal		Connected to the grounding terminal of the power supply for grounding purpose
⑤	CN6 (STO safety function terminal)		Connected to external functional safety signal for functional safety purpose
⑥	CN3, CN4 communication terminals		Connected to Modbus RTU and CANopen host controllers in parallel.
⑦	CN11 (24 V backup power input terminal)		When the main circuit is not powered, the control circuit is powered to maintain functions such as programming, connection to software tool parameters, and communication.
⑧	LED display		The 5-digit 8-segment LED display is used to show operating state and parameter setting of the drive.
⑨	Power supply indicator of the safety module		Power: When the safety module is connected and the power supply is normal, the indicator is on. LINK: Safety communication status indicator Note: The P-model drive does not have FSoE, so this indicator is not on.

No.	Component	Description
⑩	Key operator	M: Switches parameters in sequence. ▲: Increases the value of the blinking bit. ▲: Decreases the value of the blinking bit. ◀◀: Shifts the blinking bit leftwards (Hold down: Turns to the next page when the displayed number exceeds five digits) S: Saves modifications and enters the next menu.
⑪	CN5 (communication terminal)	This terminal only supports online upgrade and software tool commissioning, which can be performed only when the drive is energized. In USB mode, the terminal only supports download and upload of parameters, and drive firmware update. The terminal uses USB power supply. If there is a fault that cannot be completely reset, disconnect the USB power supply and drive control power, and then power on again.
⑫	CN1 (control terminal)	Used for reference input signals and other I/O signals.
⑬	CN9 (safety module control terminal A)	Control terminal A of the safety module
⑭	CN10 (safety module control terminal B)	Command input and output terminal B of the safety module.
⑮	CN7 (encoder feedback terminal)	Supports communication-type encoders and pulse-type encoders. Supports gantry synchronization.
⑯	CN2 (encoder feedback terminal)	Supports communication-type encoders. Supports gantry synchronization.

Note

- [1] When the main circuit power input terminals of drives with a voltage class of 200 V are L1, L2, L3, or any two among L1, L2, and L3 in case of single-phase power supplies. The main circuit power input terminals of drives with a voltage class of 400 V are R, S, and T.
- [2] The built-in braking resistor or jumper bar is not available in models S1R6 and S2R8. If an external braking resistor is needed for S1R6 and S2R8 models, connect it between terminals P⊕ and C.

3.2 MS1-R-INT Series Servo Motor

3.2.1 Models and Nameplate

Model

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

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

Note

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

Nameplate description

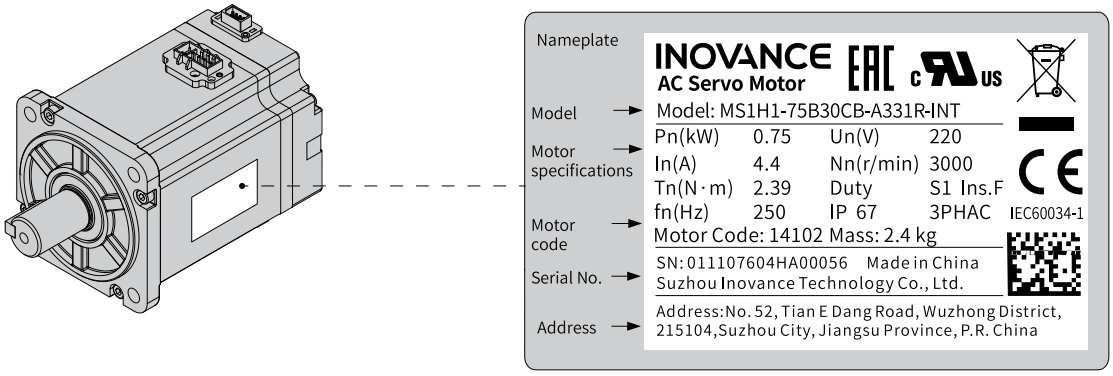


Figure 3-6 Model and Nameplate

3.2.2 Components

Motor (40-flange)

- **Terminal-type servo motor**

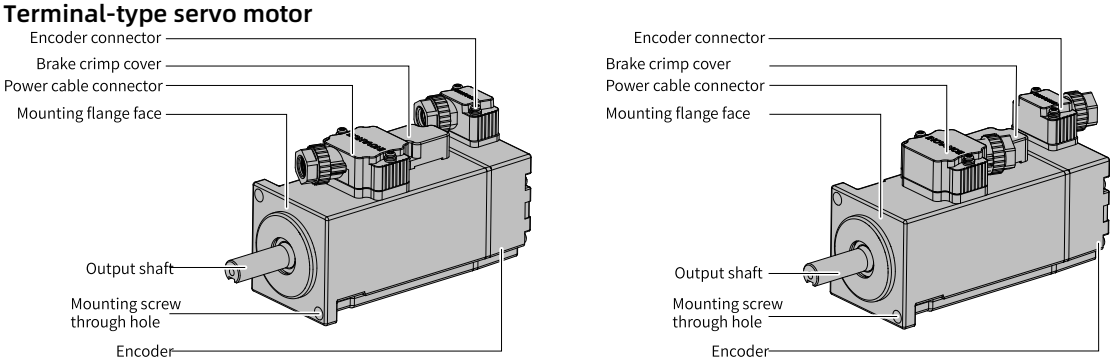


Figure 3-7 Components of terminal-type servo motors (Left: motor with front cable outlet; Right: motor with rear cable outlet)

- **Flying leads type servo motors**

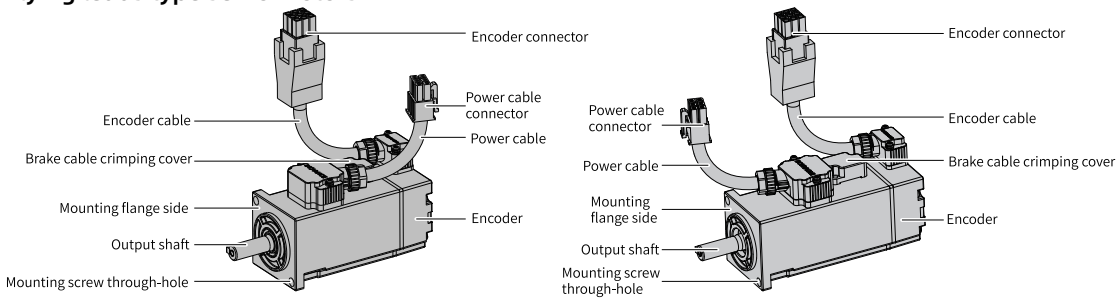


Figure 3-8 Components of the flying leads motor (left: 50 W flying leads motor, right: 100 W flying leads motor)

Note

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

Motor (60- and 80-flange)

- **Terminal-type servo motor**

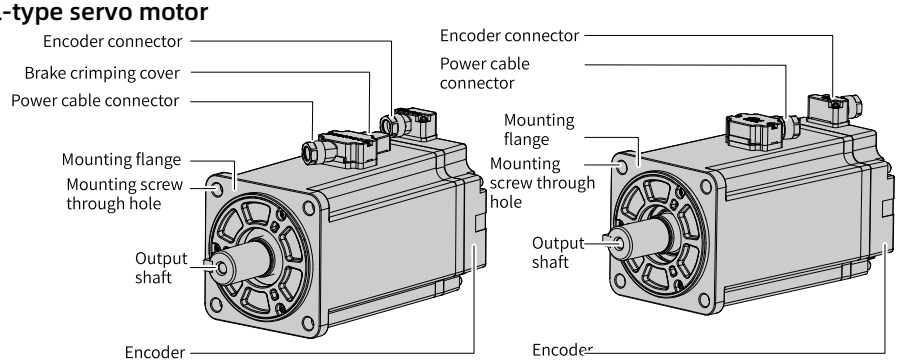


Figure 3-9 Components of terminal-type servo motors (Left: motor with front cable outlet; Right: motor with rear cable outlet)

- **Flying leads type servo motors**

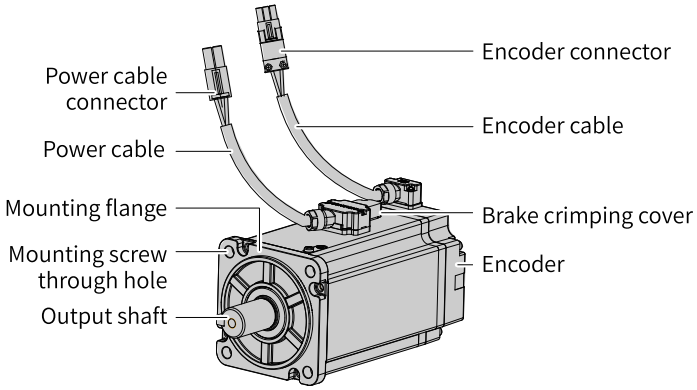


Figure 3-10 Components of the flying leads motor (front cable outlet as standard)

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

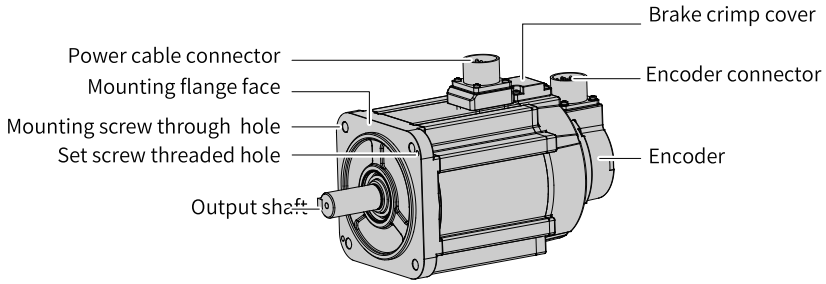


Figure 3-11 Components of servo drives in frame sizes 100/130/180

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

3.3.1 Models and Nameplate

Model Description

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

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

Note

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

Nameplate description

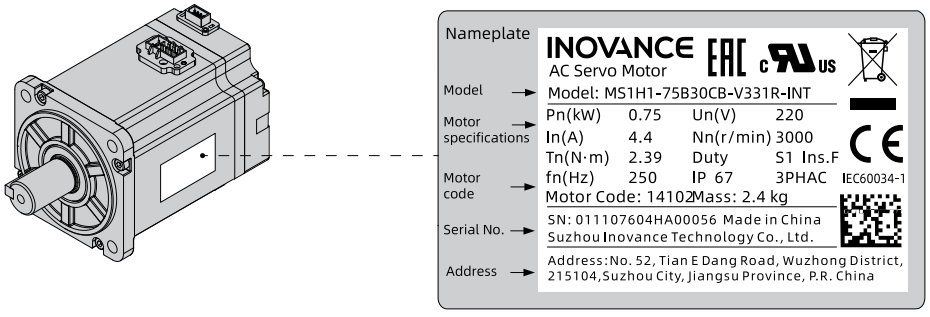


Figure 3-12 Model and Nameplate

3.3.2 Components

Motor (frame sizes 40/60/80)

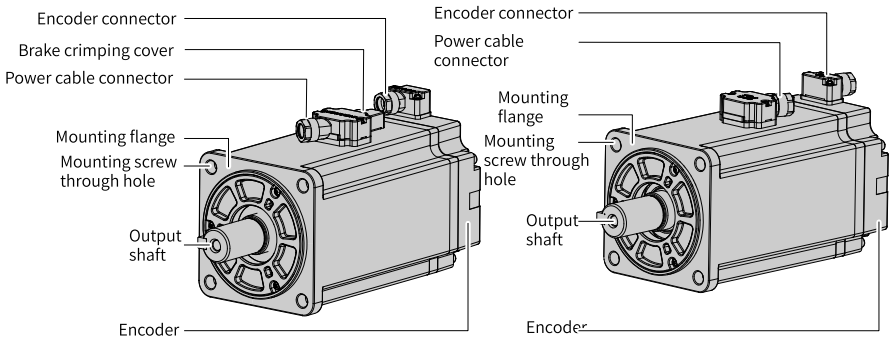


Figure 3-13 Components of servo drives in frame sizes 40/60/80 (Left: motor with front cable outlet; Right: motor with rear cable outlet)

Note

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

Motor (frame sizes 100/ 130/180)

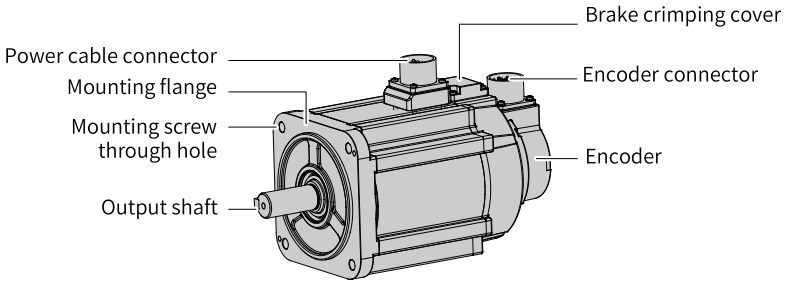


Figure 3-14 Components of servo drives in frame sizes 100/130/180

3.4 ISM Series Torque Motor

3.4.1 Model description

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

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

3.4.2 Components

ISMT1-160F12AB-A133X-INT

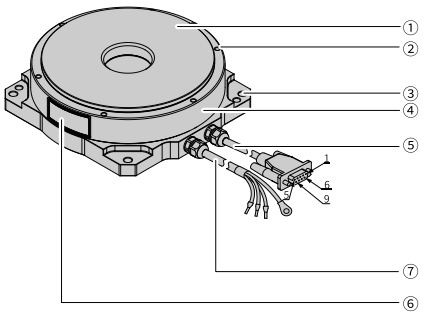
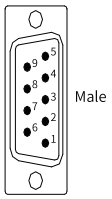


Figure 3-15 Components of ISMT1-160F12AB-A133X-INT

Table 3–4 Motor Components

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


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

ISMT1-160F45AB-A133X-INT

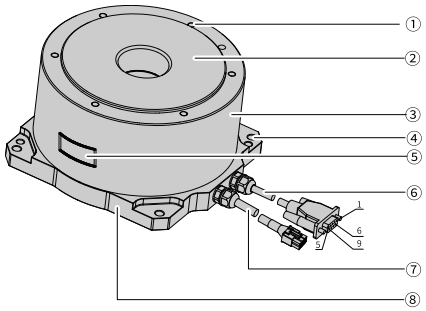
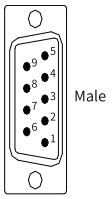


Figure 3-16 Components of ISMT1-160F45AB-A133X-INT

Table 3–5 Motor Components

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

<table>
<tr><th>No.</th><th>Component</th><th>Description</th></tr>
<tr><td>⑥</td><td>Signal cable</td><td>
<table>
<tr><td>Pin No.</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>Pin assign-ment</td><td>PS+</td><td>PS-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Pin No.</td><td>6</td><td>7</td><td>8</td><td colspan="2">9</td></tr>
<tr><td>Pin assign-ment</td><td>-</td><td>+5 V</td><td>GND</td><td colspan="2">-</td></tr>
</table>


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

3.5 MP Series Torque Motor

3.5.1 Model Description

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

① **Product family** M: Motor	⑥ **Maximum output torque (N·m)** One letter and two digits A: x 1 B: x 10 C: x 100 D: x 1000 E: x 10000 Example: 12 A: 12 N·m	⑨ **Installation accuracy** The mechanical deviation is lower than this value in both the axial and radial directions. 0: 3 μm max. 1: 5 μm max. 2: 10 μm max. 3: 30 μm max.
② **Product Type** P: Precision torque (direct-drive) motor		
③ **Product code** 1: 1st generation 2: 2nd generation		
④ **Frame size** 112: 112 mm diameter 140: 140 mm diameter 160: 160 mm diameter 175: 175 mm diameter 220: 220 mm diameter	⑦ **Voltage class (V)** B: 200 V D: 400 V	⑩ **Connector type** 1: Metal aviation connector 2: Cable gland - straight entry 3 m (U-type terminal) 3: Cable gland - straight entry 0.3 m (6-pin plastic terminal) 4: Cable gland - straight entry 3 m (U-type terminal)

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

3.5.2 Components

MP1-175S11BB-U333X-INT

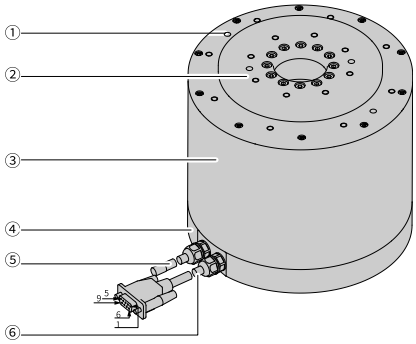


Figure 3-17 Components of MP1-175S11BB-U333X-INT

Table 3–6 Motor components

No.	Name	Remarks
①	Positioning pin hole of motor turntable	Used for mounting the turntable.
②	Mounting flange of the turntable	Used to install the flange to the turntable on the load end.
③	Turntable	DDR motor rotor
④	Stator	DDR motor stator
⑤	Power cable	Conductor color: White / Black / Red / Yellow-green Description: U / V / W / Grounding
⑥	Signal cable	Pin No. 1: Pin assignment PS+ Pin No. 2: PS- Pin No. 3: - Pin No. 4: - Pin No. 5: - Pin No. 6: - Pin No. 7: +5V Pin No. 8: GND Pin No. 9: - Male

MP1-112F10AB-U313X-INT

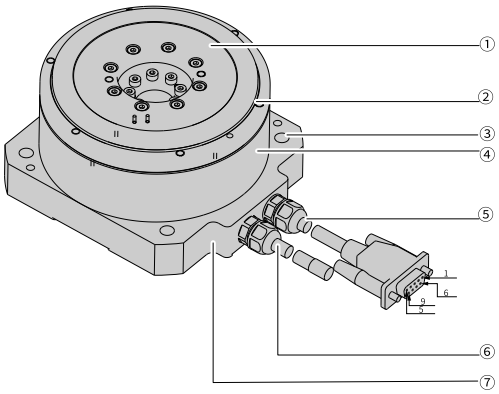
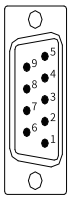


Figure 3-18 Components of MP1-112F10AB-U313X-INT

Table 3–7 Motor components

<table>
<tr><th>No.</th><th>Name</th><th>Remarks</th></tr>
<tr><td>①</td><td>Mounting flange of the turntable</td><td>Used to install the flange to the turntable on the load end.</td></tr>
<tr><td>②</td><td>Positioning pin hole of motor turntable</td><td>Used for mounting the turntable.</td></tr>
<tr><td>③</td><td>Positioning pin hole for stator</td><td>Used for mounting the stator.</td></tr>
<tr><td>④</td><td>Turntable</td><td>DDR motor rotor</td></tr>
<tr><td>⑤</td><td>Signal cable</td><td>
<table>
<tr><td>Pin No.</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>Pin assign-ment</td><td>PS+</td><td>PS-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Pin No.</td><td>6</td><td>7</td><td>8</td><td colspan="2">9</td></tr>
<tr><td>Pin assign-ment</td><td>-</td><td>+5V</td><td>GND</td><td colspan="2">-</td></tr>
</table>


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

MP1-220S30BD-U323L-INT

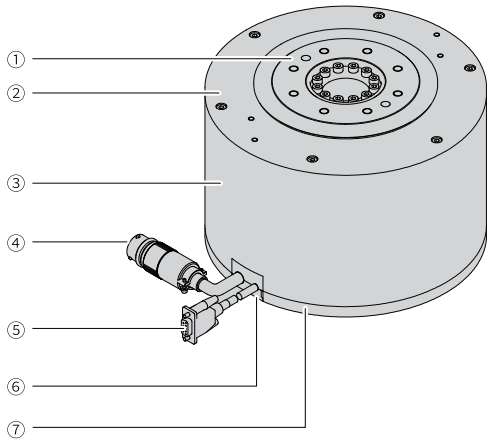
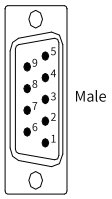


Figure 3-19 Components of MP1-220S30BD-U323L-INT

Table 3–8 Motor components

<table>
<tr><th>No.</th><th>Name</th><th>Remarks</th></tr>
<tr><td>①</td><td>Load mounting flange</td><td>Used to install the mounting flange on the load end.</td></tr>
<tr><td>②</td><td>Front end cover</td><td>Front end cover of the DDR motor stator</td></tr>
<tr><td>③</td><td>Enclosure</td><td>Stator enclosure of the DDR motor</td></tr>
<tr><td>④</td><td>Power cable</td><td>
<table>
<tr><td>Conductor color</td><td>White</td><td>Black</td><td>Red</td><td>Yellow-green</td></tr>
<tr><td>Description</td><td>U</td><td>V</td><td>W</td><td>Ground-ing</td></tr>
</table>
</td></tr>
<tr><td>⑤</td><td>Signal cable</td><td>
<table>
<tr><td>Pin No.</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>Pin assign-ment</td><td>PS+</td><td>PS-</td><td>-</td><td>PTC+</td><td>P-T-C-</td></tr>
<tr><td>Pin No.</td><td>6</td><td>7</td><td>8</td><td colspan="2">9</td></tr>
<tr><td>Pin assign-ment</td><td>-</td><td>+5V</td><td>GND</td><td colspan="2">-</td></tr>
</table>


</td></tr>
<tr><td>⑥</td><td>Crimping block</td><td>Cable limit parts</td></tr>
<tr><td>⑦</td><td>Frame size</td><td>DDR motor mounting base</td></tr>
</table>

3.6 LMC Linear Module

3.6.1 Model description

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

① Product family

LM: Linear module

② Product type

C: Compact

③ Product iteration

1: First generation

2: Second generation

④ Flange size

A: 110 mm

B: 140 mm

C: 170 mm

D: 210 mm

E: 88 mm

F: 118 mm

G: 168 mm

H: 188 mm

K: 228 mm

L: 120 mm

⑤ Number of rotors

1: 1

2: 2

⑥ Color

1: Natural color

2: Black

⑩ Feedback type

1: 0.1 μm grating

2: 0.5 μm grating

3: 1 μm grating

4: 1 μm magnetic grating

5: Inovance communication-type absolute optical scale

6: Inovance communication-type magnetic scale

7: Inovance communication-type incremental optical scale

8: Others

9: Third-party RU2 series incremental grating with a resolution of 0.1 μm

A: third-party RU2 series incremental grating with a resolution of 0.5 μm

B: Third-party RU2 series incremental grating with a resolution of 1 μm

C: Third-party ABS series BiSS-C absolute grating with a resolution of 0.05 μm

D: Third-party ABS series BiSS-C absolute grating with a resolution of 0.1 μm

E: Third-party ABS series BiSS-C absolute grating with a resolution of 0.5 μm

F: Inovance ELOI series TTL incremental grating with a resolution of 0.05 μm

G: Inovance ELOI series TTL incremental grating with a resolution of 0.1 μm

H: Inovance ELOI series TTL incremental grating with a resolution of 0.5 μm

J: Inovance ELOI series TTL incremental grating with a resolution of 1 μm

⑬ Optoelectronic switch

Q: No optoelectronic switch

N: NPN type

P: PNP type

⑭ Guideway brand

1: THK

2: HIWIN

3: WON

4: SBC

⑮ Drag chain, side protective plate, and centralized lubrication system

0: Not equipped with a drag chain, a side protective plate, or a centralized lubrication system

1: Equipped with a vertical drag chain, without a side protective plate or a centralized lubrication system

2: Not equipped a drag chain or a centralized lubrication system, but with a side protective plate

3: Equipped with a vertical drag chain, a side protective plate, but without a centralized lubrication system

4: Not equipped with a drag chain or a side protective plate, but with a centralized lubrication system

5: Equipped with a vertical drag chain and a centralized lubrication system, but with a side protective plate

6: Not equipped with a drag chain, but with a side protective plate and a centralized lubrication system

7: Equipped with a vertical drag chain, a side protective plate, and a centralized lubrication system

⑦ **Itinerary** 0500: Active travel of 500 mm for single-rotor motors and 500 mm for multi-rotor motors	⑪ **Cable length** 003: 0.3 m 030: 3 m	⑯ **Design type** N: Normal R: Right mirror L: Left mirror
⑧ **Motor code** PXX: For details, see the motor code comparison table.	⑫ **Drive and Hall sensor** G: Without a Hall sensor, but with an SV680-INT P-type drive (200 V input) K: With a Hall sensor and an SV680-INT P-type drive (200 V input) M: Without a Hall sensor, but with an SV680-INT P-type drive (400 V input) P: With a Hall sensor and an SV680-INT P-type drive (400 V input)	⑰ **Design date** 221227: Date of the initial plan
⑨ **Motor wiring** 1: Y1 2: Y2 3: Y3 4: Y4 5: Y5 6: Y6		⑱ **Model/Type** INT: International version

3.6.2 Components

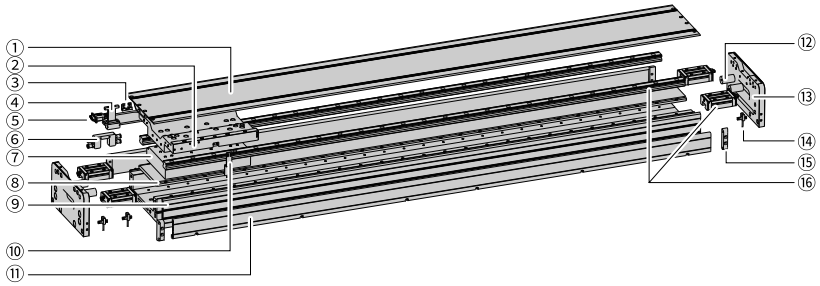


Figure 3-20 Components of LMC series linear motor

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

4 System Connection

4.1 System Composition

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



Observe the following precautions when connecting the external braking resistor:

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

4.2 System Connection Diagram

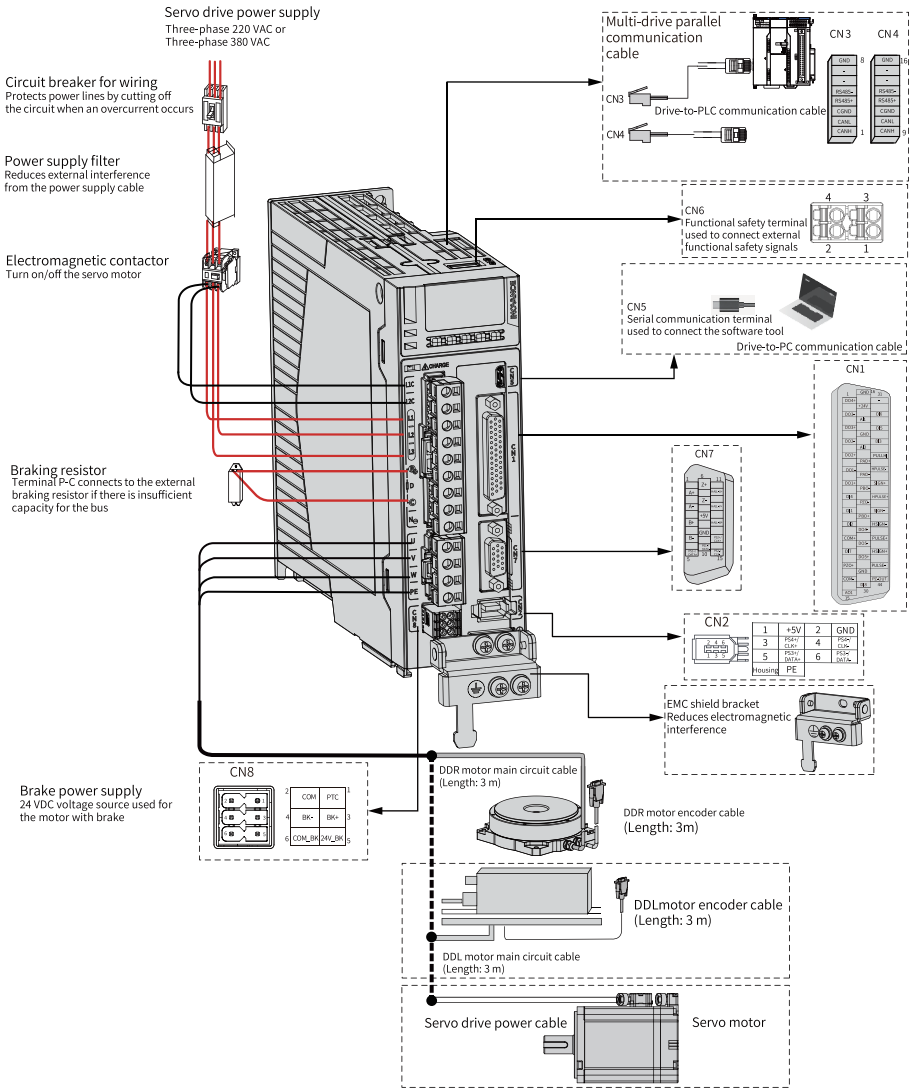


Figure 4-1 Motor system wiring diagram

Note

- CN2 is used as the encoder terminal when an Inovance rotary servo motor is connected. CN7 is used when a direct drive or purchased motor is connected.
- When an external braking resistor is required, remove the jumper bar between P⊕ and D, and connect the braking resistor between P⊕ and C. If an external braking resistor is not required, do not remove the jumper bar between P⊕ and D. Only Size A does not come with a built-in resistor or jumper bar between P⊕ and D as standard. Before use, ensure that the braking resistor parameters H02.25, H02.26, and H02.27 are set correctly.

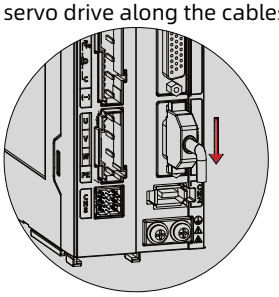
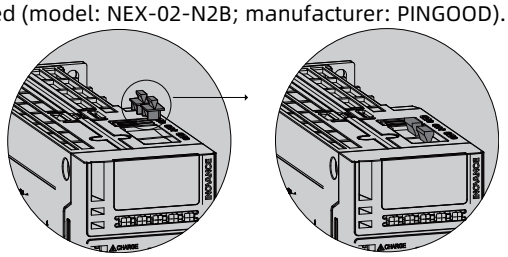
5 Installation

5.1 Installation Instructions

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

Table 5–1 Installation precautions

Item	Description
Method	• Install the servo drive vertically and upward to facilitate heat dissipation. For installation of multiple drives inside the cabinet, install them side by side. For dual-row installation, install an air guide plate. • Make sure the drive is installed vertically to the wall. Cool the drive down with natural convection or a cooling fan. Secure the servo drive to the mounting surface through two to four mounting holes. The number of mounting holes depends on the capacity of the servo drive. • Install the servo drive vertically to the wall, with its front (actual mounting face) facing the operator. • The mounting bracket (if needed) must be made of incombustible materials.
Cooling	As shown in *"5.2.3 Clearance Requirements" on page 69*, reserve sufficient space around the drive to ensure a good heat dissipation through the cooling fan or natural convection. Take the heat dissipated by other devices inside the cabinet into consideration. Install a cooling fan to the upper part of the servo drive to avoid excessive temperature rise in a certain area, keeping an even temperature inside the control cabinet.
Protective grounding	Ground the grounding terminal properly. Failure to comply may result in electric shock or malfunction due to interference.

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

5.2 Pre-installation Preparation

5.2.1 Requirements on Installation Personnel

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

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

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

- Familiar with this manual especially all the safety precautions

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

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

Danger

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

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

5.2.2 Installation Environment

Table 5–2 Environment requirements

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

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

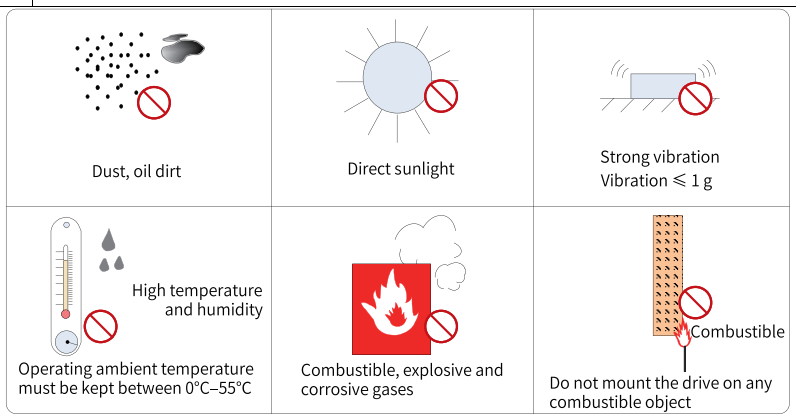


Figure 5-1 Environment requirements

5.2.3 Clearance Requirements

Clearance for side-by-side installation

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

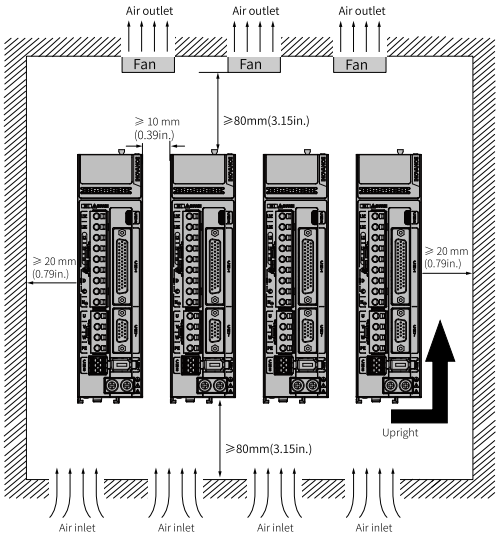


Figure 5-2 Clearance for side-by-side installation

Compact installation

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

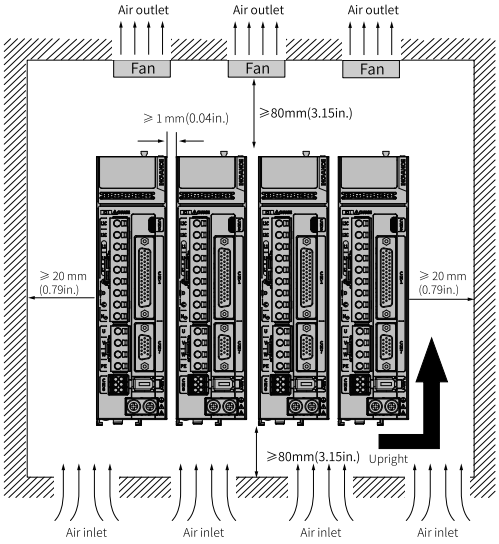


Figure 5-3 Clearance for compact installation

Close installation

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

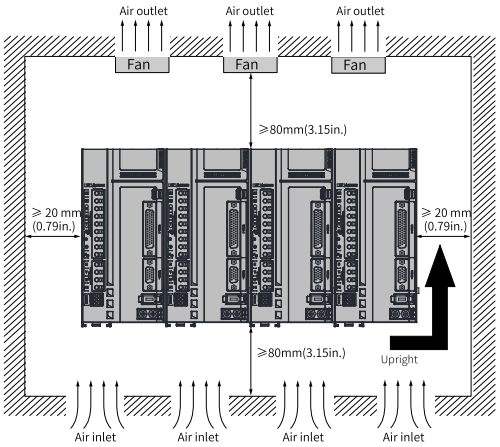


Figure 5-4 Close installation

5.2.4 Installation Dimensions [Standard Model]

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

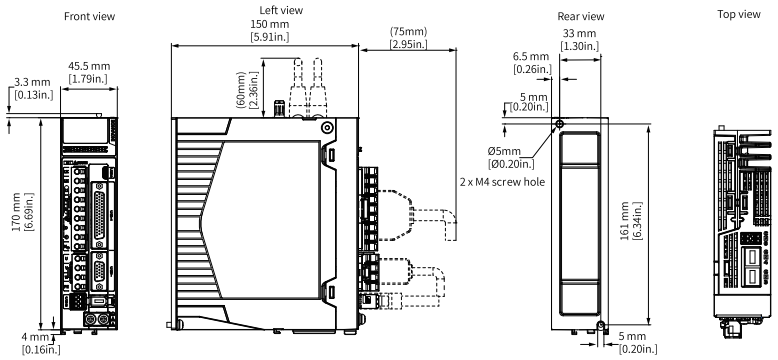


Figure 5-5 Dimensions of servo drives in size A

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

Weight: 0.96 kg

Drives in size E (rated power: 0.4 kW to 0.75 kW)

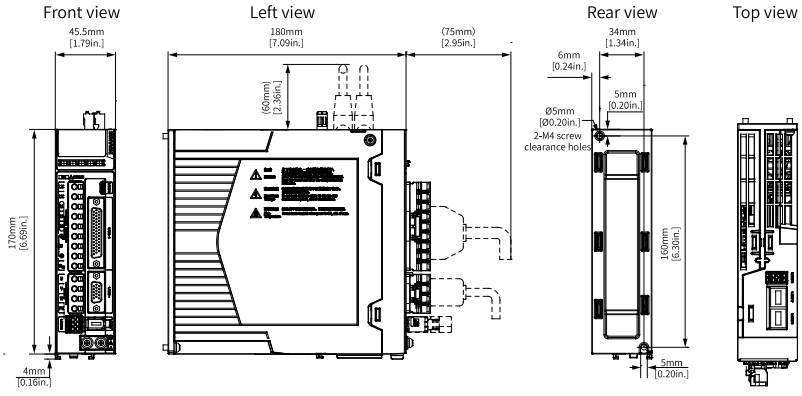


Figure 5-6 Dimensions of servo drives in size B

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

Weigh: 1.2 kg

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

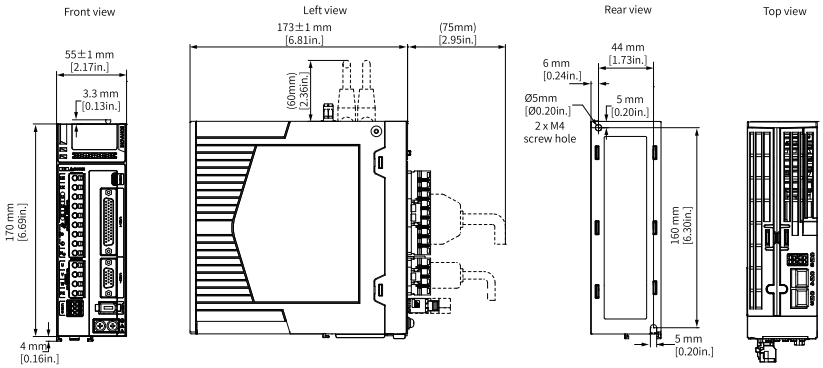


Figure 5-7 Dimension drawing of servo drives in Size C

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

Weigh: 1.3 kg

Servo drives in size D (rated power: 1.5 kW to 3.0 kW)

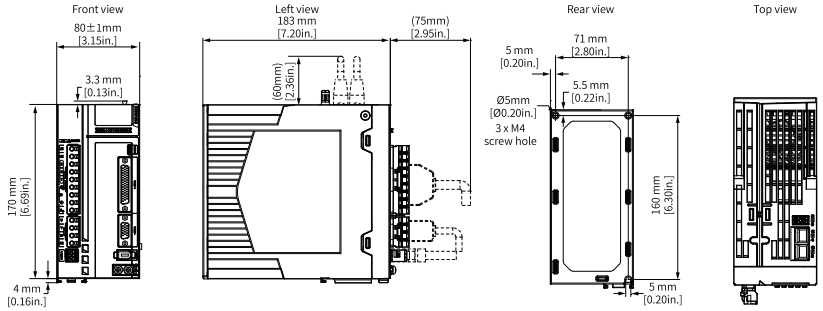


Figure 5-8 Dimension drawing of servo drives in Size D

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

Weigh: 1.8 kg

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

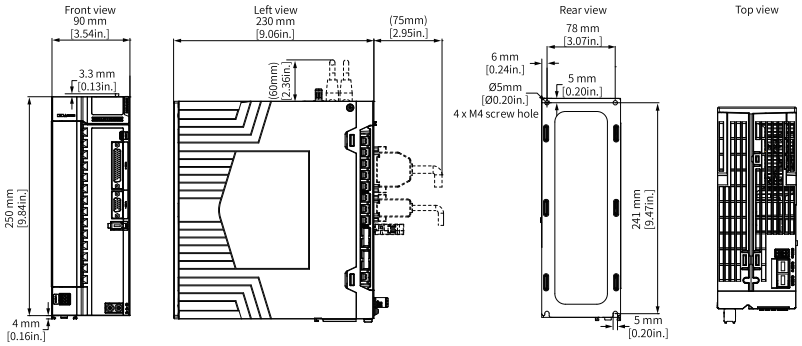


Figure 5-9 Dimension drawing of servo drives in Size E

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

Weigh: 3.6 kg

5.2.5 Installation Dimensions [Backup Power Supply Model]

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

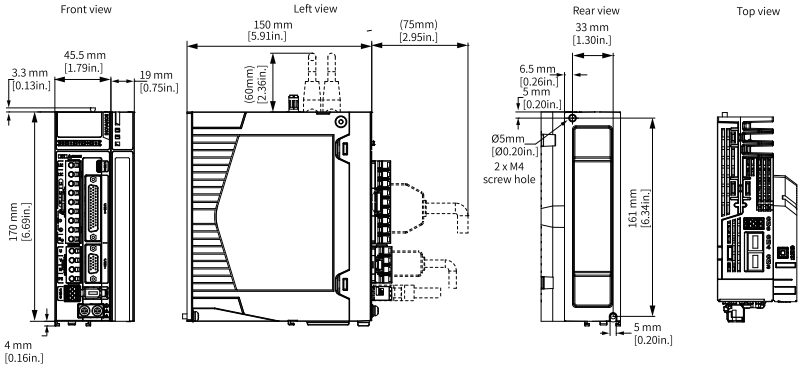


Figure 5-10 Dimensions of servo drives in size A

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

Weigh: 1.11 kg

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

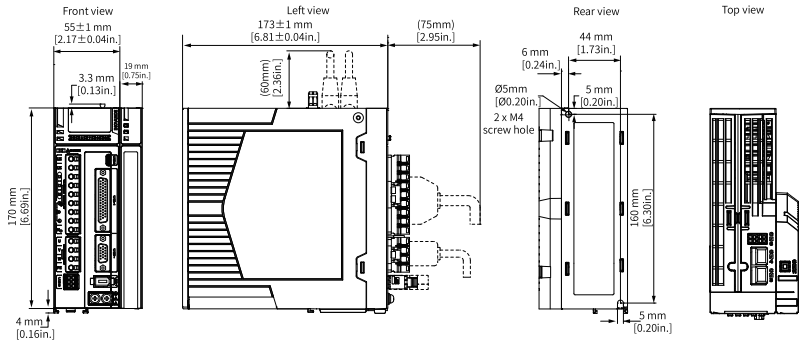


Figure 5-11 Dimension drawing of servo drives in Size C

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

Weight: 1.45 kg

Servo drives in size D (rated power: 1.5 kW to 3.0 kW)

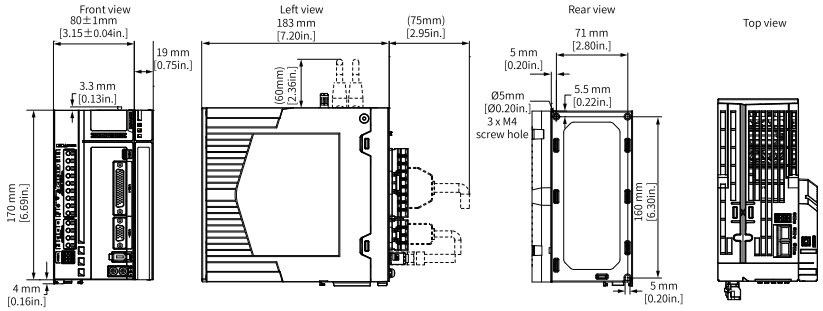


Figure 5-12 Dimension drawing of servo drives in Size D

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

Weigh: 1.95kg

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

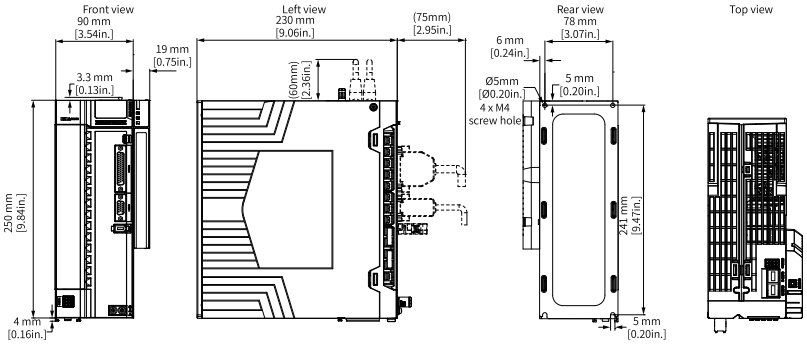


Figure 5-13 Dimension drawing of servo drives in Size E

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

Weigh: 3.75kg

5.2.6 Installation Dimensions [Functional Safety Models]

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

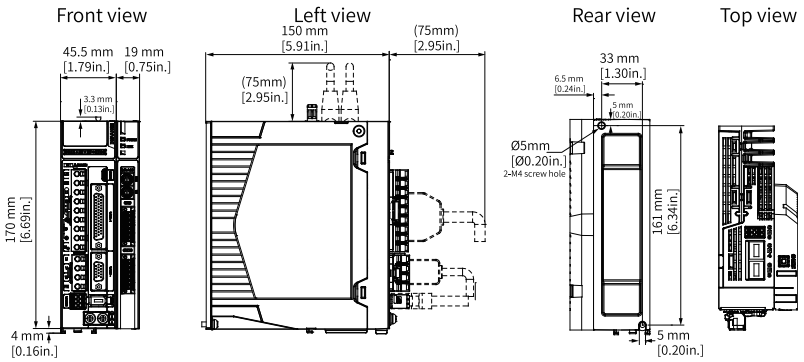


Figure 5-14 Dimensions of servo drives in size A

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

Weigh: 1.11 kg

Drives in size E (rated power: 0.4 kW to 0.75 kW)

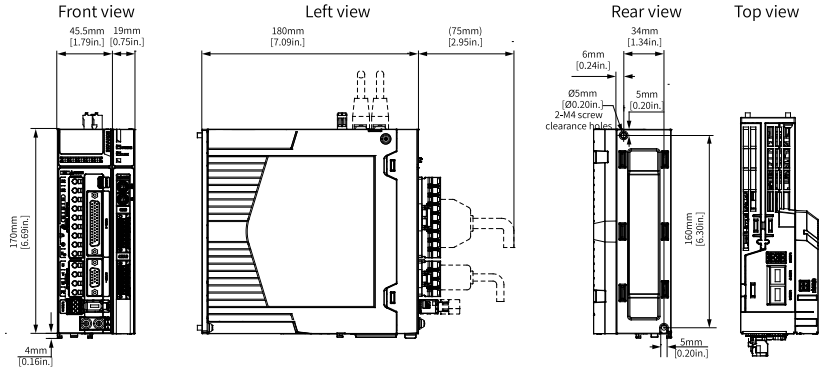


Figure 5-15 Dimensions of servo drives in size B

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

Weigh: 1.3 kg

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

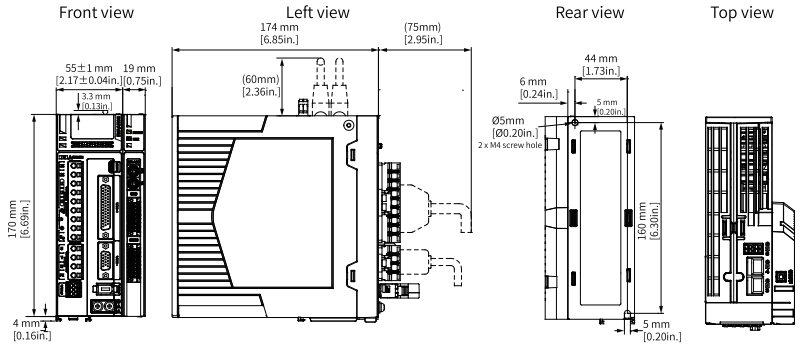


Figure 5-16 Dimension drawing of servo drives in Size C

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

Weight: 1.45 kg

Servo drives in size D (rated power: 1.5 kW to 3.0 kW)

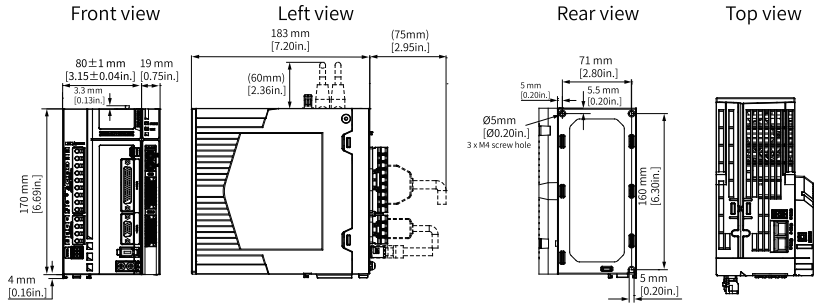


Figure 5-17 Dimension drawing of servo drives in Size D

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

Weigh: 1.95kg

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

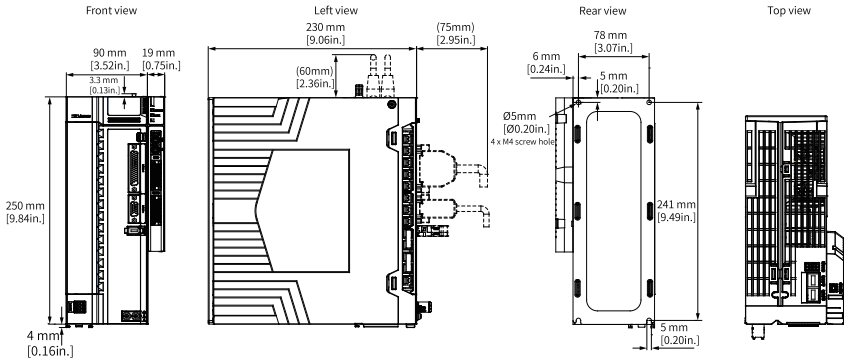


Figure 5-18 Dimension drawing of servo drives in Size E

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

Weigh: 3.75kg

5.2.7 Requirements on Optional Parts

5.2.7.1 Instructions for Installing the Fuse and Circuit Breaker

Caution

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

5.2.7.2 Instructions for Installing the AC Input Reactor

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

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

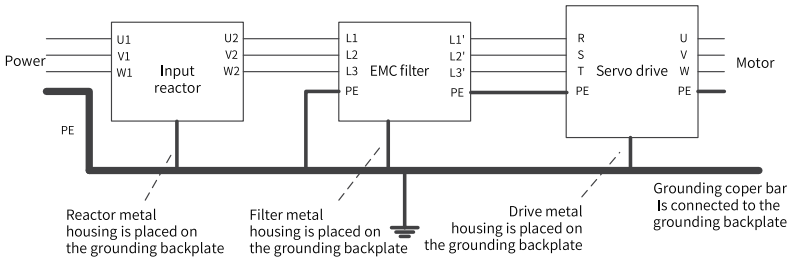


Figure 5-19 Connection of the AC input reactor

5.2.7.3 Instructions for Installing the EMC Filter

Note

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

The following figure shows the connection of the EMC filter.

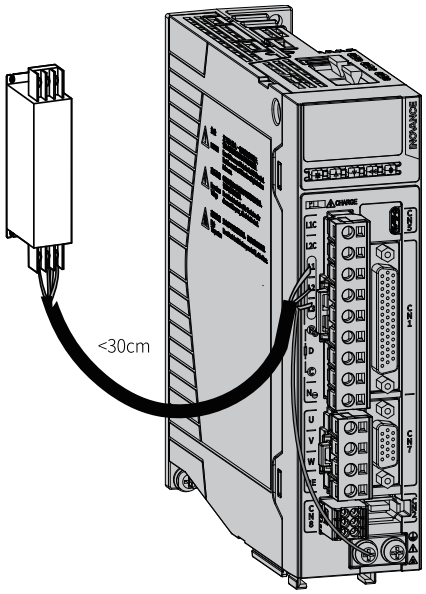


Figure 5-20 Connection of the EMC filter

5.2.7.4 Instructions for Installing Magnetic Ring and Ferrite Clamp

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

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

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

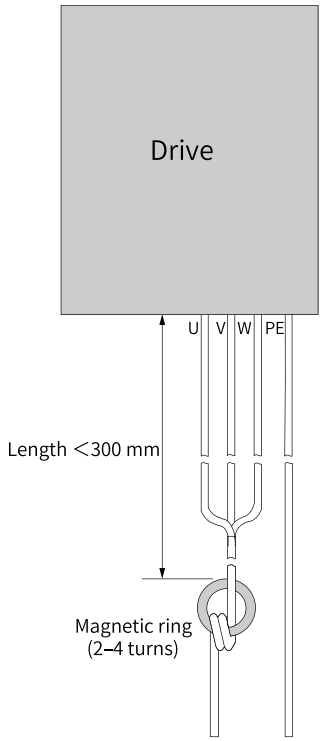


Figure 5-21 Installing the magnetic ring

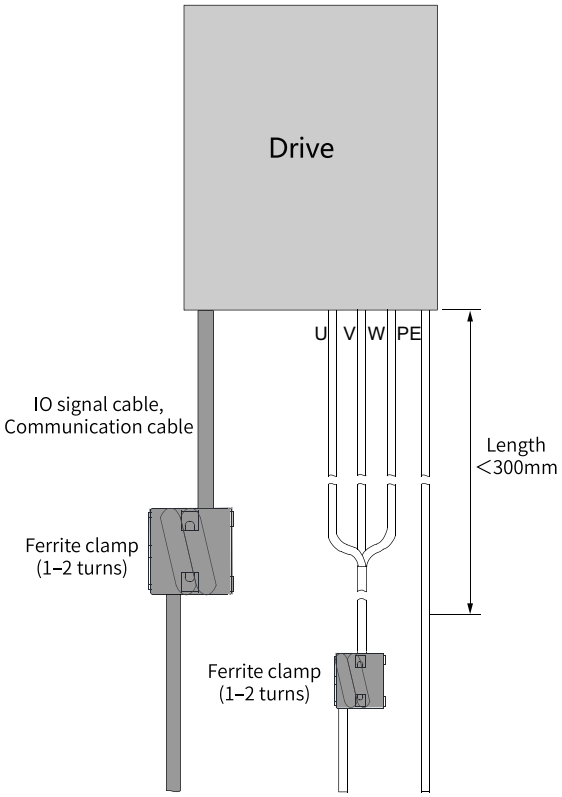


Figure 5-22 Installing the ferrite clamp

Instructions for installing the shield bracket

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

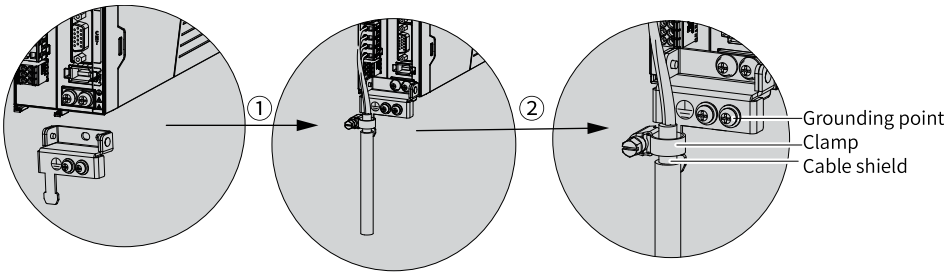


Figure 5-23 Installation of the shield bracket

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

5.2.8 Cable installation requirements

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

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

5.3 Unpacking and Handling

Check the following items upon unpacking.

Item	Description
Check whether the product complies with your order.	Check whether the servo drive model and specifications comply with your order. See the dimensions of the packing box for standard models in *"Table 5-4" on page 81* and functional safety models in *"Table 5-4" on page 81*. The deliverables include the product, cushion, carton box, and screw bag, as shown in *"Figure 5-24" on page 81* .
Check whether the product is intact.	Check whether the product delivered is in good condition. If the product is not intact, contact Inovance or your supplier immediately.

Table 5–3 Outer packaging box dimensions for the drive (standard model)

Size	Model	Outer width (mm)	Outer height (mm)	Outer depth (mm)	Weight (kg)
A	S1R6, S2R8	240	193	85	1.13
B	T1R4, T2R3	230	223	95	1.2
C	S5R5, S7R6, T3R5, T5R4	230	223	95	1.5
D	S012, T8R4, and T012	240	223	125	2.0
E	S018, S022, S027, T017, T021, and T026	325	285	145	3.9

Table 5–4 Outer packaging box dimensions for the drive (functional safety model)

Size	Model	Outer width (mm)	Outer height (mm)	Outer depth (mm)	Weight (kg)
A	S1R6, S2R8	240	193	105	1.28
B	T1R4, T2R3	230	223	105	1.30
C	S5R5, S7R6, T3R5, T5R4	230	223	105	1.65
D	S012, T8R4, and T012	240	223	145	2.15
E	S018, S022, S027, T017, T021, and T026	325	285	165	4.05

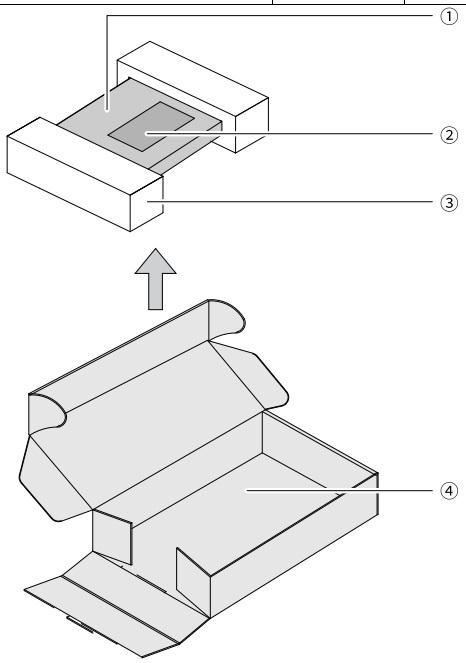


Figure 5-24 Components inside the packing box

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

Table 5–5 Terminal accessory kit

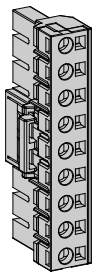
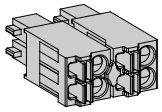
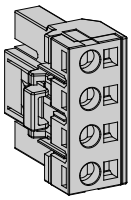
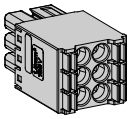
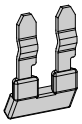
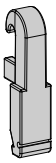
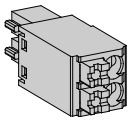
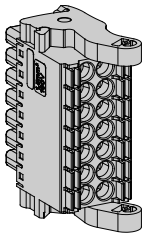
Diagram	Name	Applicable model
	Plug-in terminal block-plug-spring clamp wiring-9P-black-with safety lock	All models
	Pluggable terminal block - Connector - Spring clamp wiring - 2 × 2P - Black-printing on both sides	All models

Diagram	Name	Applicable model
	Plug-in terminal block-plug-spring clamp wiring-4P-black	All models
	Pluggable terminal block - Connector - Spring clamp wiring-/-3.5 mm - 2 × 3P - Black - 180° - Screen printed - RoHS	All models
	Jumper bar-16A-pluggable bridge	All models
-	Labels-labels for servo drive terminals	All models
	Plastic parts-plug wiring key-for use with servo drive power plug	All models
	Pluggable terminal block - Connector - Spring clamp-type wiring -/-3.5 mm - 1 × 2P - Orange - 180° - RoHS	Standby power supply type Functional safety type
	Pluggable terminal block - Connector - Spring clamp wiring-/-3.5 mm - 2 × 7P - Black - 180° outlet - Push rod at both sides - RoHS	Functional safety type
	Pluggable terminal block - Connector - Spring clamp wiring - NA - 3.5 mm - 2 × 7P - Black - 180° outlet - Push rod at both sides - RoHS	Functional safety type

Caution

The terminal accessories package list of SV680-INT is subject to the actual products.

If you need to purchase the terminal accessory kit separately, contact Inovance. For the material code of the accessory kit for each model, see *"Table 5-6" on page 82*.

Table 5-6 Part number of the accessory package for each model

Material code	Name
Standard model	
98050921	Accessories (sale)-S6-C70-SV680P size A terminal accessory kit
98050922	Accessories (sale)-S6-C58-SV680P size B&C&D terminal accessory kit
98050923	Complete accessories (sale)-S6-C71-SV680P size E terminal accessory package
Functional safety type	
98050838	Accessories (sale) - S6-C158- SV680P size A terminal accessory kit (functional safety)
98050836	Accessories (sale) - S6-C159- Terminal accessory kit for SV680P drives in size B/C/D (functional safety)
98050834	Accessories (sale)- S6-C160-SV680P size E terminal accessory kit (functional safety)

5.4 Mechanical Installation

5.4.1 Pre-installation Check

Table 5–7 Pre-inspection checklist

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

5.4.2 Mounting the Drive

The drive supports backplate mounting only.

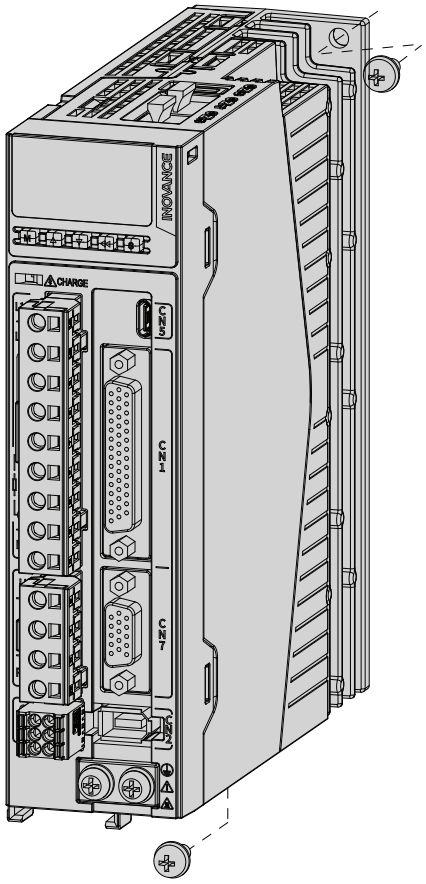


Figure 5-25 Backplate mounting diagram

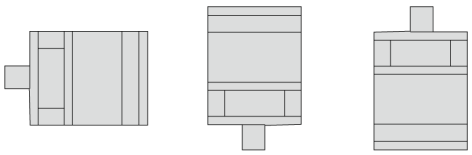
Note

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

5.4.3 Installing the Motor

Installation direction

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



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

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

Heat dissipation

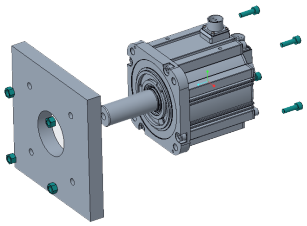
The MS1 series motor is naturally cooled. The internal heat is consumed through heat conduction, heat radiation, and natural convection. A heatsink is used for heat conduction. For details, see *"Installation instructions" on page 84*. To ensure adequate heat dissipation, keep at least 100 mm spacing between adjacent parts on three sides.

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

Installation instructions

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

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



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

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

- For vertical mounting with the shaft extension upwards, ensure that no liquid enters the upper bearing.
- When using a motor with oil seal, lower the oil level until it is below the lip of the oil seal.
- To prevent excessive wear of the oil seal, leave a small amount of oil on the lip for lubrication.
- The motor must be installed on a flat, vibration-free, distortion-resistant support flange surface.
- Use hexagon socket screws with strength grade of at least 8.8.
- When tightening the fixing screws, prevent the screws from deforming.
- Obey the recommended tightening torque values of motor flange fixing screws. See table *"Table 5-8 Recommended tightening torques for fixing screws" on page 85*.
- For motors with a flange of 180 mm or above, remove or tighten the lifting lugs after the motor is mounted.

Table 5–8 Recommended tightening torques for fixing screws

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

Note

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

Installing the brake motor

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

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

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

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

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

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

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

Note

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

Mechanical connection

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

- Use the threaded hole on the shaft extension.
- Heat up the transmission unit when necessary.
- Use a washer to protect the shaft extension center during disassembly.
- The motor with a keyway has been tested for half-key balance before delivery. If necessary, you can perform full balancing for the motor with transmission units.

Coupling

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

Conveyor connection

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

5.4.4 Post-Installation Inspection

Table 5–9 Checklist

No.	Description	Yes
1	Terminal screws are tightened to the specified torque and marked.	□
2	The servo drive and the external braking resistor are placed on incombustible objects.	□

No.	Description	Yes
3	There are no unwanted objects (such as cable terminals and metal chippings) that may cause short circuit of the signal cable and power cable inside or outside the servo drive.	□
4	The servo motor is installed properly. The motor shaft is connected to the machine securely.	□
5	The servo motor and the connected machine are in good condition and ready to run.	□
6	The connector of the main circuit cable is crimped and installed firmly.	□

6 Wiring

6.1 Wiring Precautions

6.1.1 Safety Precautions

Caution

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

Note

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

6.1.2 Interference Resistance

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

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

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

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

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

6.1.3 Instructions for Use of Cables

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

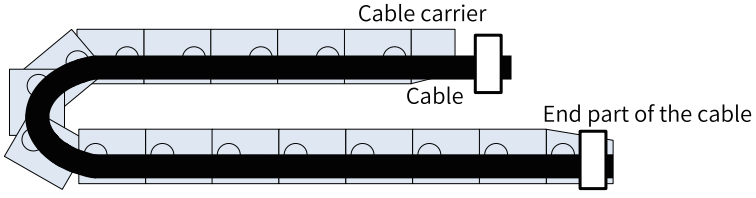


Figure 6-1 Cable drag chain

6.2 Electrical Wiring Diagram

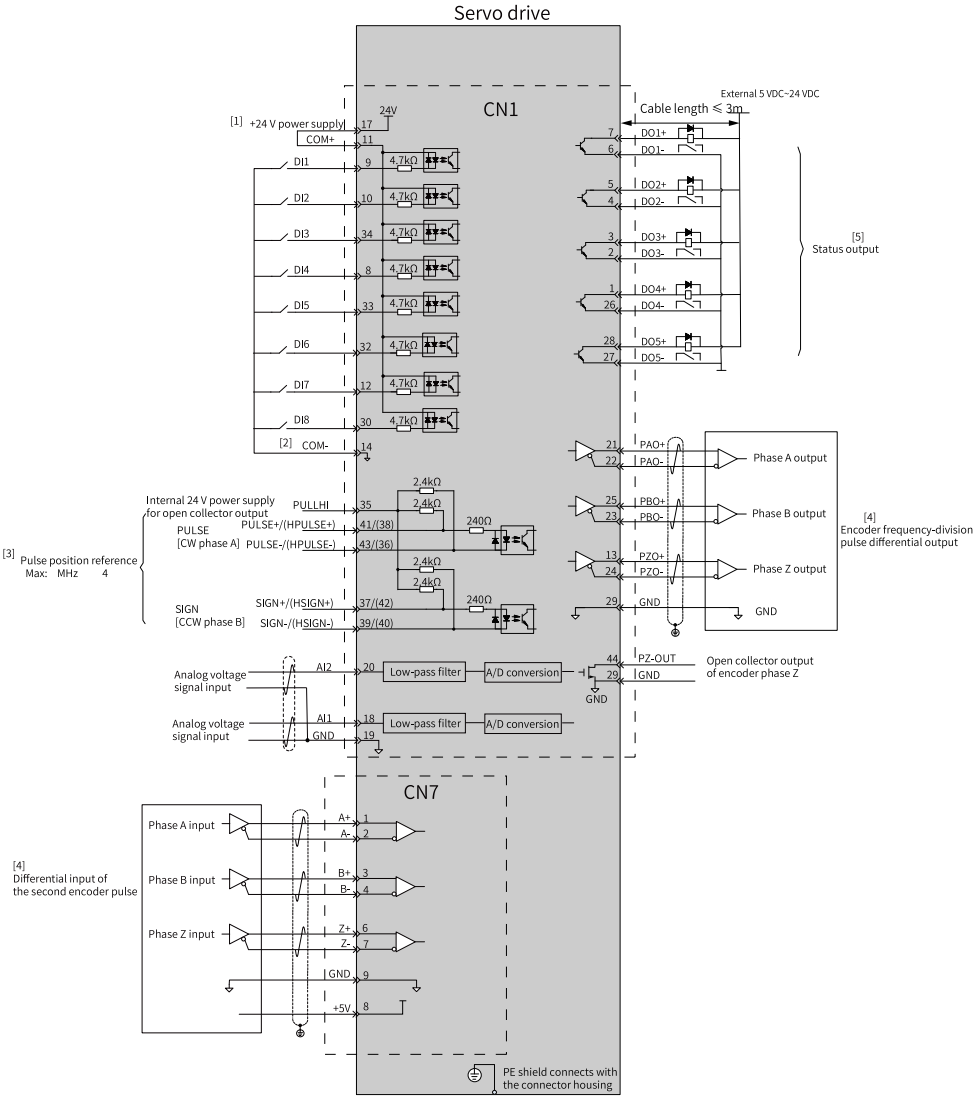


Figure 6-2 Electrical wiring diagram

Note

- indicates shielded twisted pairs.
- [1] The range of the internal +24 V power supply is 20 V to 30 V, with maximum operating current being 150 mA.
- [2] DI7 and DI8 are high-speed DIs that must be used according to their functions assigned. The DI can be powered by an external power supply. For details, see *" DI circuit" on page 109*.
- [3] Use the shielded twisted pairs for pulse terminals, with both ends of the shield connected to PE. Connect GND and signal GND of the host controller properly. Pins 41, 43, 37 and 39 or 38, 36, 42, and 40 can be used for both low-speed and high-speed pulses.
- [4] Use shielded twisted pairs as frequency-division output cables and full closed-loop input cables, with both ends of the cable shield connected to PE. Connect GND to the signal ground of the host controller properly.
- [5] Prepare the DO power supply (voltage range: 5 V to 24 V) yourself. The DO terminals support up to 30 VDC voltage and 50 mA current. When the host controller provides optocoupler input, install a current-limiting resistor. See details in *" DO circuit" on page 110*.

6.3 Introduction to Main Circuit Terminals

6.3.1 Terminal Layout

Servo drives in size A to size D (rated power: 0.2 kW to 3.0 kW)

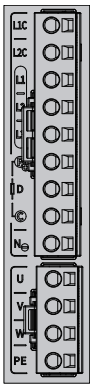


Figure 6-3 Main circuit terminal pin layout of drives in sizes A to D

Table 6–1 Description of main circuit terminal pins of drives in sizes A to D

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

Note

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

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

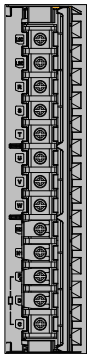


Figure 6-4 Main circuit terminal pin layout of servo drive in Size E

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

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

Note

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

6.3.2 Wiring Precautions and Requirements

Danger

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

Caution

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

Caution

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

Caution

- The DDR motor has been matched with the encoder adapter before delivery. Do not perform replacement on your own. Failure to comply may result in runaway, personal injury, or property damage.
- Connect the DDR motor power cables in the correct phase sequence. Failure to comply may result in runaway, resulting in personal injury or property damage.

Caution

- Ensure that the motor power cable is connected to the grounding terminal of the drive. Ensure that the cable is installed properly and securely. Failure to comply can result in motor malfunction or damage.
- Connect the screws on the power supply end to the screws on the motor output end. Failure to comply can result in a fire. Use the screws within the rated voltage range. Failure to comply can result in a fire.
- Keep the wiring length as short as possible. For the cable length and cross sectional area requirements, see the related requirements in the signal cable wiring precautions. Keep the power cable at least 30 cm away from the signal cable. Vibration or malfunction can occur on the signal cable due to noise interference.
- Cables of the standard specifications are recommended. If cables of other specifications need to be used, select the cables properly based on the rated current of the equipment and the ambinet environment. Use twisted pair cables or multi-conductor twisted pair cables for the encoder.
- Do not directly connect commercial power supply to the motor. Failure to comply can result in a fire or malfunction.

6.3.3 Cable Model Requirements

- Ensure the cable bending radius meets the related requirements (fixed cable ≥ 5D, flexible cable ≥ 10D) to prevent internal conductor breakage due to long-term bending.
- Use cables with a rated voltage above 600 VAC and rated temperature above 75°C. Under an ambient temperature of 30°C and normal cooling conditions, the permissible current density of the cable cannot exceed 8 A/mm² when the total current is below 50 A, or 5 A/mm² when the total current is above 50 A. In case of high ambient temperature or bundled cables, adjust the permissible current density (A/mm²) according to the following formula.
  Allowable current density = 8 × reduction coefficient of current-carrying conductor density × current correction coefficient

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

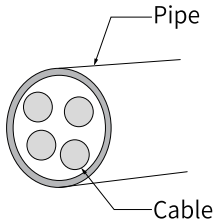


Table 6–3 Current carrying density derating coefficient of conductor

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

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

To comply with the EMC standards, use shielded cables. For details, see *"Figure 6-5" on page 95* .

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

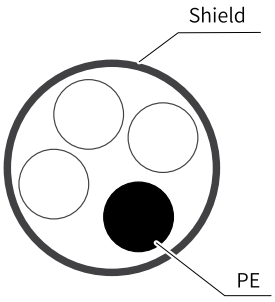


Figure 6-5 Recommended power cable types

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

6.3.4 Cable Specifications

6.3.4.1 Cable Specifications (CE)

Table 6–4 Recommended main circuit cables

Drive model			L1C, L2C		L1, L2, L3/R, S, T		P⊕, D, C, N⊖, N2, N1		U, V, W, PE		Grounding terminal	
Size	Model	Continuous input current of main circuit (A)	(mm^2)	AWG	(mm^2)	AWG	(mm^2)	AWG	(mm^2)	AWG	(mm^2)	AWG
Single-phase 200 V												
A	S1R6	2.3	2 x 0.75	18	3 x 0.75	18	2 x 0.75	18	4 x 0.52	20	3.33	12
	S2R8	4	2 x 0.75	18	3 x 0.75	18	2 x 0.75	18	4 x 0.52	20	3.33	12
C	S5R5	7.9	2 x 0.75	18	3 x 0.75	18	2 x 0.75	18	4 x 0.52	20	3.33	12
	S7R6	9.6	2 x 0.75	18	3 x 1.31	16	2 x 0.75	18	4 x 0.52	20	3.33	12
D	S012	12.8	2 x 0.75	18	3 x 1.31	16	2 x 0.75	18	4 x 1.31	16	3.33	12
Three-phase 200 V												
A	S1R6	1.1	2 x 0.75	18	3 x 0.75	18	2 x 0.75	18	4 x 0.52	20	3.33	12
	S2R8	2.3	2 x 0.75	18	3 x 0.75	18	2 x 0.75	18	4 x 0.52	20	3.33	12
C	S5R5	4.4	2 x 0.75	18	3 x 0.75	18	2 x 0.75	18	4 x 0.52	20	3.33	12
	S7R6	5.1	2 x 0.75	18	3 x 0.75	18	2 x 0.75	18	4 x 0.52	20	3.33	12
D	S012	8	2 x 0.75	18	3 x 1.31	16	2 x 0.75	18	4 x 1.31	16	3.33	12

Drive model			L1C, L2C		L1, L2, L3/R, S, T		P ⊕ , D, C, N ⊖ , N2, N1		U, V, W, PE		Grounding terminal	
Size	Model	Continuous input current of main circuit (A)	(mm^2)	AWG	(mm^2)	AWG	(mm^2)	AWG	(mm^2)	AWG	(mm^2)	AWG
E	S018	8.7	2 x 0.75	18	3 x 2.08	14	2 x 0.75	18	4 x 2.08	14	3.33	12
	S022	11	2 x 0.75	18	3 x 2.08	14	2 x 0.75	18	4 x 2.08	14	3.33	12
	S027	23.8	2 x 0.75	18	3 x 3.33	12	2 x 0.75	18	4 x 3.33	12	3.33	12
Three-phase 400 V												
B	T1R4	1.0	2 x 0.75	18	3 x 0.75	18	2 x 0.75	18	4 x 0.52	20	3.33	12
	T2R3	1.8	2 x 0.75	18	3 x 0.75	18	2 x 0.75	18	4 x 0.52	20	3.33	12
C	T3R5	2.4	2 x 0.75	18	3 x 0.75	18	2 x 0.75	18	4 x 0.52	20	3.33	12
	T5R4	3.6	2 x 0.75	18	3 x 0.75	18	2 x 0.75	18	4 x 0.52	20	3.33	12
D	T8R4	5.6	2 x 0.75	18	3 x 0.75	18	2 x 0.75	18	4 x 0.52	20	3.33	12
	T012	8	2 x 0.75	18	3 x 1.31	16	2 x 0.75	18	4 x 1.31	16	3.33	12
E	T017	12	2 x 0.75	18	3 x 2.08	14	2 x 0.75	18	4 x 2.08	14	3.33	12
	T021	16	2 x 0.75	18	3 x 2.08	14	2 x 0.75	18	4 x 2.08	14	3.33	12
	T026	21	2 x 0.75	18	3 x 3.33	12	2 x 0.75	18	4 x 3.33	12	3.33	12

Note

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

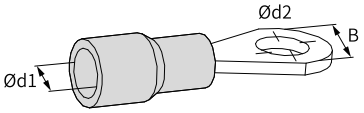
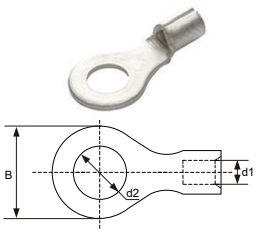
Table 6–5 Recommended cable specifications and models

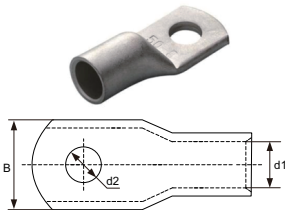
Type	Size	Outer diameter (mm)
Power cable	4 x 12AWG	12.2±0.4
	4 x 14AWG	10.5±0.3
	4 x 16AWG	9.5+0.4
	4 x 20AWG	6.5+0.2
Power cable shield	4 x 12AWG	12.9+0.4
	4 x 14AWG	11.2+0.4
	4 x 16AWG	10.1+0.4
	4 x 20AWG	6.5±0.2
Power cable + Brake cable	4 x 20AWG+2 x 24AWG	6.5±0.2
Brake cable	2 x 18AWG	5.8±0.2
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

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

Drive model			Recommended PVC cable model @ 40℃			
Size	Model	Continuous input current of main circuit (A)	U, V, W, PE	Recommended model of brake cable lug	Recommended model of grounding cable lug	Tightening torque (N·m)
Single-phase 200 V						
A	S1R6	2.3	GTVE10008	GTVE05008	TVR2-4	1.36
	S2R8	4				
C	S5R5	7.9				
	S7R6	9.6	GTVE15008	GTVE10008		
D	S012	12.8			TNR3.5-4	1.36
Three-phase 200 V						
A	S1R6	1.1	GTVE10008	GTVE05008	TVR2-4	1.36
	S2R8	2.3				
C	S5R5	4.4				
	S7R6	5.1				
D	S012	8.0			TNR3.5-4	1.36
E	S018	8.7			TNR5.5-4	1.36
	S022	11.0	GTVE15008	GTVE10008		
	S027	23.8	GTVE60010	GTVE60010	GTNR10-4	1.36
Three-phase 400 V						
B	T1R4	1.0	GTVE10008	GTVE05008	TVR2-4	1.36
	T2R3	1.8				
C	T3R5	2.4				
	T5R4	3.6				
D	T8R4	5.6			TNR3.5-4	1.36
	T012	8.0				
E	T017	12.0	TVR1.25-4	GTVE10008	TNR5.5-4	1.36
	T021	16.0	TVR2-4	GTVE10008		1.36
	T026	21.0	TVR5.5-4	GTVE60010	GTNR10-4	1.36

Table 6–7 Drawing and appearance of the grounding cable lug

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

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

6.3.4.2 Cable Specifications (UL)

Table 6–8 Recommended main circuit cables

Drive model			L1C, L2C		L1, L2, L3/R, S, T		P ⊕ , D, C, N ⊖ , N2, N1		U, V, W, PE		Grounding terminal	
Size	Model	Continuous input current of main circuit (A)	(mm^2)	AWG	(mm^2)	AWG	(mm^2)	AWG	(mm^2)	AWG	(mm^2)	AWG
Single-phase 200 V												
A	S1R6	2.3	2 × 2.08	14	3 × 2.08	14	2 × 0.75	18	4 × 0.52	20	3.33	12
	S2R8	4	2 × 2.08	14	3 × 2.08	14	2 × 0.75	18	4 × 0.52	20	3.33	12
C	S5R5	7.9	2 × 2.08	14	3 × 2.08	14	2 × 0.75	18	4 × 0.52	20	3.33	12
	S7R6	9.6	2 × 2.08	14	3 × 2.08	14	2 × 0.75	18	4 × 0.52	20	3.33	12
D	S012	12.8	2 × 2.08	14	3 × 2.08	14	2 × 0.75	18	4 × 1.31	16	3.33	12
Three-phase 200 V												
A	S1R6	1.1	2 × 2.08	14	3 × 2.08	14	2 × 0.75	18	4 × 0.52	20	3.33	12
	S2R8	2.3	2 × 2.08	14	3 × 2.08	14	2 × 0.75	18	4 × 0.52	20	3.33	12
C	S5R5	4.4	2 × 2.08	14	3 × 2.08	14	2 × 0.75	18	4 × 0.52	20	3.33	12
	S7R6	5.1	2 × 2.08	14	3 × 2.08	14	2 × 0.75	18	4 × 0.52	20	3.33	12
D	S012	8	2 × 2.08	14	3 × 2.08	14	2 × 0.75	18	4 × 1.31	16	3.33	12
E	S018	8.7	2 × 2.08	14	3 × 2.08	14	2 × 0.75	18	4 × 2.08	14	3.33	12
	S022	11	2 × 2.08	14	3 × 2.08	14	2 × 0.75	18	4 × 2.08	14	3.33	12
	S027	23.8	2 × 2.08	14	3 × 3.33	12	2 × 0.75	18	4 × 3.33	12	3.33	12
Three-phase 400 V												
B	T1R4	1.0	2 × 2.08	14	3 × 2.08	14	2 × 0.75	18	4 × 0.52	20	3.33	12
	T2R3	1.8	2 × 2.08	14	3 × 2.08	14	2 × 0.75	18	4 × 0.52	20	3.33	12
C	T3R5	2.4	2 × 2.08	14	3 × 2.08	14	2 × 0.75	18	4 × 0.52	20	3.33	12
	T5R4	3.6	2 × 2.08	14	3 × 2.08	14	2 × 0.75	18	4 × 0.52	20	3.33	12
D	T8R4	5.6	2 × 2.08	14	3 × 2.08	14	2 × 0.75	18	4 × 0.52	20	3.33	12
	T012	8	2 × 2.08	14	3 × 2.08	14	2 × 0.75	18	4 × 1.31	16	3.33	12
E	T017	12	2 × 2.08	14	3 × 2.08	14	2 × 0.75	18	4 × 2.08	14	3.33	12
	T021	16	2 × 2.08	14	3 × 2.08	14	2 × 0.75	18	4 × 2.08	14	3.33	12
	T026	21	2 × 2.08	14	3 × 3.33	12	2 × 0.75	18	4 × 3.33	12	3.33	12

Table 6–9 Recommended servo cable specifications and models

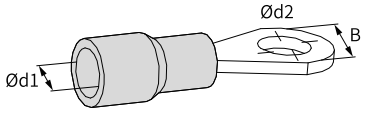
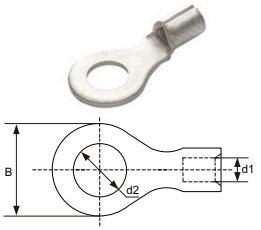
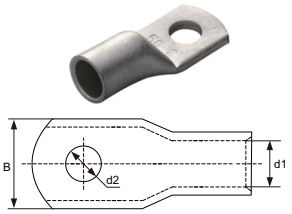
Cable type	Cable size	Outer diameter (mm)
Power cable	4 × 12 AWG	12.2 ± 0.4
	4 × 14 AWG	10.5 ± 0.3
	4 × 16 AWG	9.5 + 0.4
	4 × 20 AWG	6.5 + 0.2
Shielded power cable	4 × 12 AWG	12.9 + 0.4
	4 × 14 AWG	11.2 + 0.4
	4 × 16 AWG	10.1 + 0.4
	4 × 20 AWG	6.5 ± 0.2
Power cable + brake cable	4 × 20 AWG + 2 × 24 AWG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

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

Drive model			Recommended PVC cable model (at 40℃)			
Size	Model	Continuous input current of main circuit (A)	U, V, W, PE	Recommended model of brake cable lug	Recommended model of grounding cable lug	Tightening torque (N·m)
Single-phase 200 V						
A	S1R6	2.3	GTVE10008	GTVE05008	TVR2-4	1.36
	S2R8	4				
C	S5R5	7.9				
	S7R6	9.6	GTVE15008	GTVE10008		
D	S012	12.8			TNR3.5-4	1.36
Three-phase 200 V						
A	S1R6	1.1	GTVE10008	GTVE05008	TVR2-4	1.36
	S2R8	2.3				
C	S5R5	4.4				
	S7R6	5.1				
D	S012	8.0			TNR3.5-4	1.36
E	S018	8.7			TNR5.5-4	1.36
	S022	11.0	GTVE15008	GTVE10008		
	S027	23.8	GTVE60010	GTVE60010	GTNR10-4	1.36
Three-phase 400 V						
B	T1R4	1.0	GTVE10008	GTVE05008	TVR2-4	1.36
	T2R3	1.8				
C	T3R5	2.4				
	T5R4	3.6				
D	T8R4	5.6			TNR3.5-4	1.36
	T012	8.0				

Drive model			Recommended PVC cable model (at 40℃)			
Size	Model	Continuous input current of main circuit (A)	U, V, W, PE	Recommended model of brake cable lug	Recommended model of grounding cable lug	Tightening torque (N·m)
E	T017	12.0	TVR1.25-4	GTVE10008	TNR5.5-4	1.36
	T021	16.0	TVR2-4	GTVE10008		1.36
	T026	21.0	TVR5.5-4	GTVE60010	GTNR10-4	1.36

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

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

6.3.5 Wiring Examples

6.3.5.1 Wiring Example of the Power Supply

Using the single-phase 200 V model

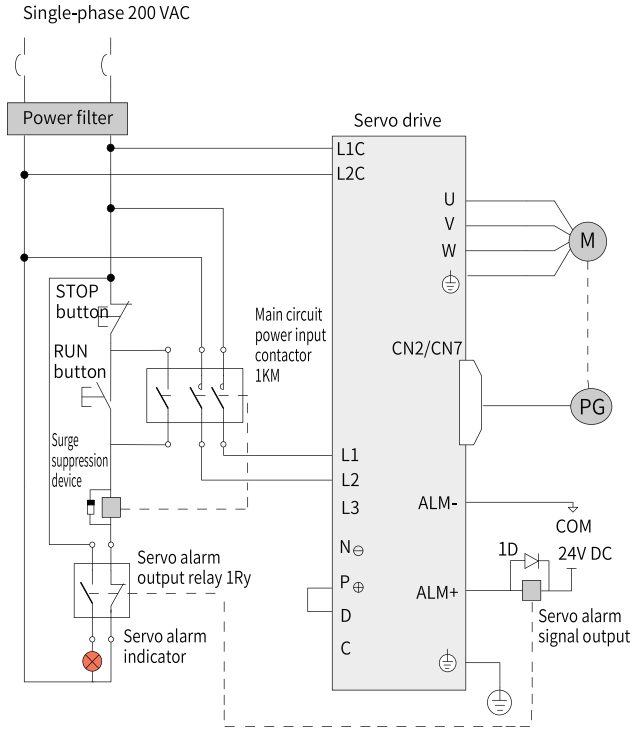


Figure 6-6 Main circuit wiring of single-phase 200 V model

Note

- 1KM: Electromagnetic contactor; 1Ry: Relay; 1D: Flywheel diode
- DO is set as alarm output (ALM+/-). When the drive alarms, the power supply will be cut off automatically. S1R6 or S2R8 is not configured with the built-in braking resistor. If the braking resistor is needed, remove the jumper bar between P⊕ and D and then connect an external braking resistor between terminals P⊕ and C.
- CN2 is used as the encoder terminal when an Inovance rotary servo motor is connected. CN7 is used as the encoder terminal when a direct drive motor or third-party motor is connected.

Using the three-phase 200 V model

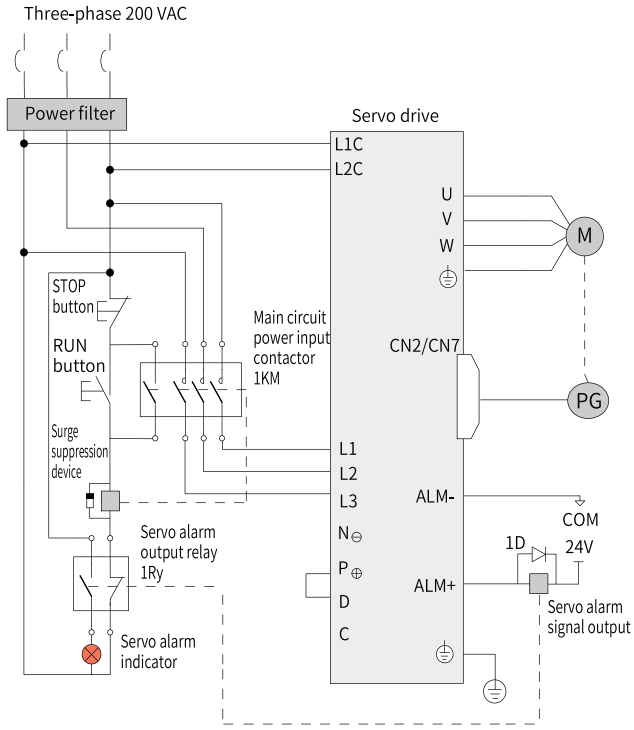


Figure 6-7 Main circuit wiring of three-phase 200 V model

Note

- 1KM: Electromagnetic contactor; 1Ry: Relay; 1D: Flywheel diode
- The DO is set as alarm output (ALM+/-). When the servo drive alarms, the power supply is cut off automatically and the alarm indicator lights up.
- CN2 is used as the encoder terminal when an Inovance rotary servo motor is connected. CN7 is used as the encoder terminal when a direct drive or purchased motor is connected.

Using the three-phase 400 V model

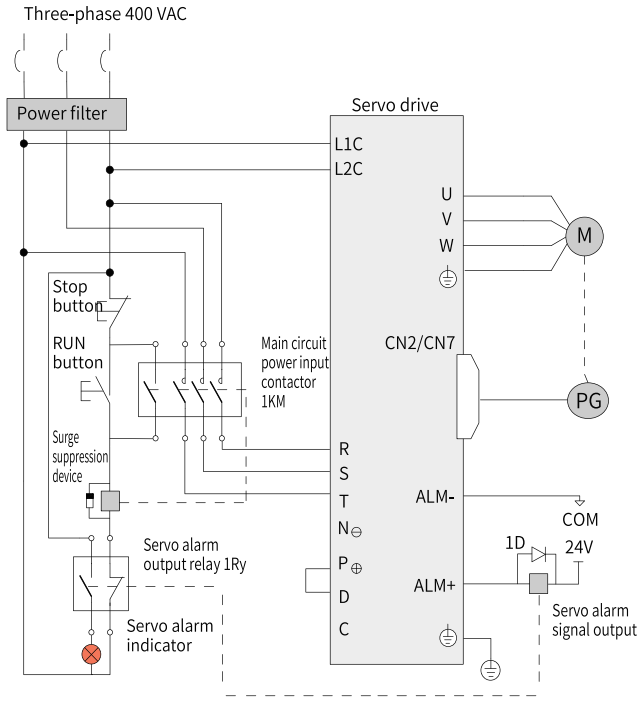


Figure 6-8 Main circuit wiring of three-phase 400 V model

Note

- 1KM: Electromagnetic contactor; 1Ry: Relay; 1D: Flywheel diode
- The DO is set as alarm output (ALM+/-). When the servo drive alarms, the power supply is cut off automatically and the alarm indicator lights up.
- CN2 is used as the encoder terminal when an Inovance rotary servo motor is connected. CN7 is used as the encoder terminal when a direct drive or third-party motor is connected.

6.3.5.2 Wiring of the Grounding Cable

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

Warning

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

Caution

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

Grounding requirements

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

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

Multi-drive grounding

Side-by-side installation of multiple drives:

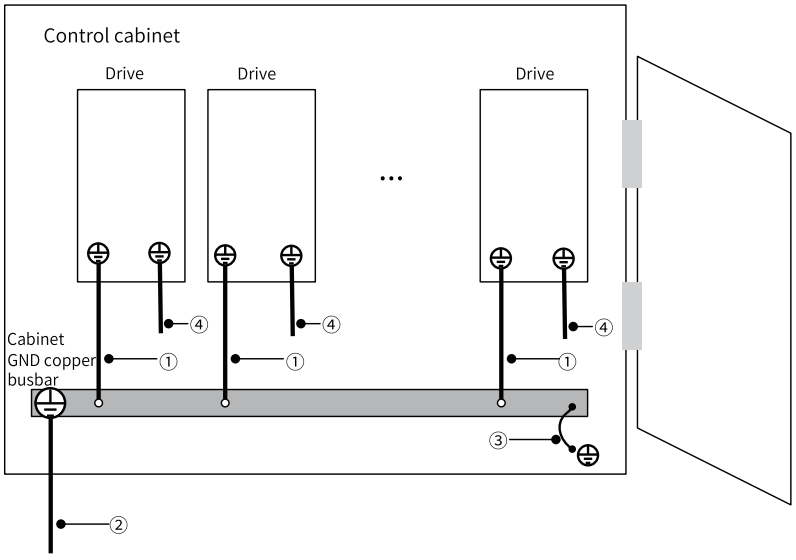


Table 6–12 Description for grounding of multiple drives installed in parallel

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

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

Grounding the control cabinet system

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

Table 6–13 Wiring requirements

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

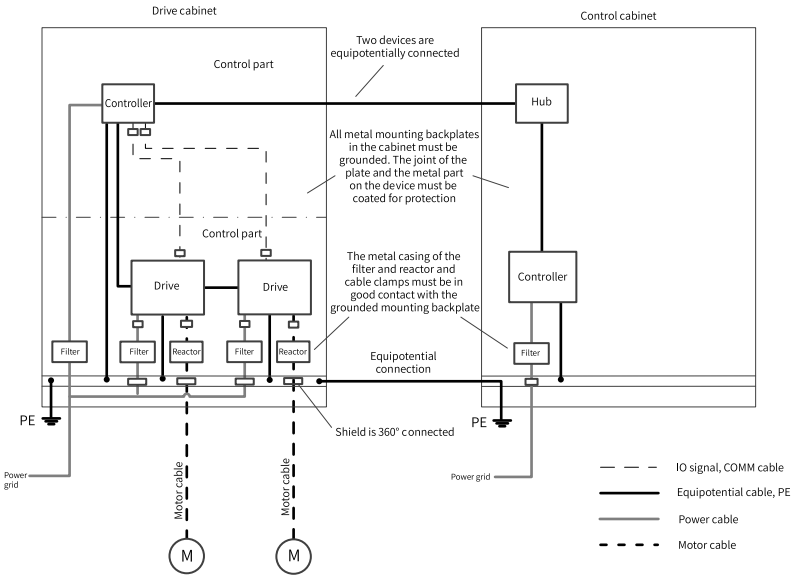


Figure 6-9 Recommended wiring for the control cabinet system

6.4 Control Terminal CN1

6.4.1 Terminal Layout

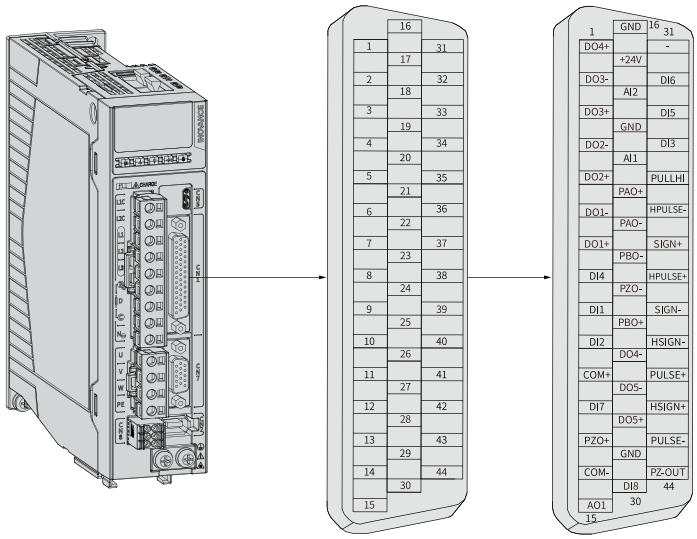


Figure 6-10 Control terminal layout

Note

- Terminal CN1: Plastic housing of the cable-side plug. Pin: male solder connector.
- Use shielded cables as signal cables and ground both ends of each shielded cable.

Table 6–14 Description of position reference input signals

Signal		Pin No.	Function
Position reference	PULSE+	41	Low-speed pulse reference input mode: • Differential drive input • OC Pulse input status: • Direction + Pulse • Phase A + B quadrature pulse • CW/CCW pulse
	PULSE–	43	
	SIGN+	37	
	SIGN–	39	
	PULLHI	35	
	HPULSE+	38	High-speed reference pulse input
	HPULSE–	36	
	HSIGN+	42	High-speed position reference symbols
	HSIGN–	40	

Table 6–15 Description of DI/DO signals

Signal		Default function	Pin No.	Function
General	DI1	P-OT	9	Positive limit switch
	DI2	N-OT	10	Negative limit switch
	DI3	INHIBIT	34	Position reference inhibited
	DI4	ALM-RST	8	Alarm reset (edge-triggered)
	DI5	S-ON	33	Enable servo
	DI6	-	32	-
	DI7	XintStart	12	Interrupt positioning enable
	DI8	HomeSwitch	30	Home switch
	+24 V		17	Internal 24 V power supply; voltage range: 20 V to 30 V; maximum output current: 150 mA (@25℃)
	COM-		14	
	COM+		11	Common terminal of DI terminals
	DO1+	S-RDY+	7	Ready to switch on
	DO1-	S-RDY-	6	
	DO2+	COIN+	5	Positioning completed
	DO2-	COIN-	4	
	DO3+	-	3	-
	DO3-	-	2	
	DO4+	ALM+	1	Fault output
	DO4-	ALM-	26	
	DO5+	HomeAttain+	28	HomeAttain
	DO5-	HomeAttain-	27	

Table 6–16 Specifications of encoder frequency-division output signals

Signal		Pin No.	Function	
General	PAO+	21	Phase A output signal	Phases A+B quadrature pulse output signal
	PAO-	22		
	PBO+	25	Phase B output signal	
	PBO-	23		
	PZO+	13	Phase Z output signal	Origin pulse output signal
	PZO-	24		
	PZ-OUT	44	Phase Z output signal	Origin pulse OC output signal
	GND	29	Home pulse open-collector output signal ground	
	PE	Housing	-	

Table 6–17 Specifications of AI/AO signals

Signal		Pin No.	Function
General	AO1	15	Analog output Voltage range: –10 V to +10 V
	GND	19	Common terminal of AI/AO
	AI1	20	Voltage-type AI1 16-bit Voltage range: –10 V to +10 V Maximum allowable voltage: ±12 V
	AI2	18	Voltage-type AI2 12bit Voltage range: –10 V to +10 V Maximum allowable voltage: ±12 V
	GND	16	Power ground
	PE	Housing	-

6.4.2 Wiring Precautions

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

Observe the following requirements when you wire the control circuit.

Caution

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

6.4.3 Cable Specifications and Model Requirements

Observe the requirements in EN 60204-1 when you connect control circuit cables.

I/O signal cable selection

Use shielded cables for I/O signal circuits to protect I/O signals from intense peripheral interference and noise. Use separate shielded cables for different analog signals. It is recommended to use shielded twisted pair (STP) cables for digital signals.

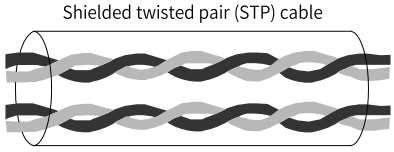


Figure 6-11 Shielded twisted pairs

Control cable specifications

Table 6–18 Recommended control cable specifications

Control terminal	Recommended connector Kit/material code	Recommended cable specifications (AWG)
CN1	DB44	24 to 30

6.4.4 Wiring Examples

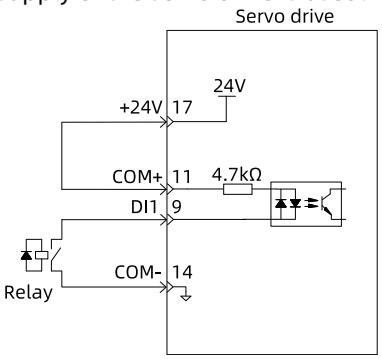
6.4.4.1 DI/DO Signals

DI circuit

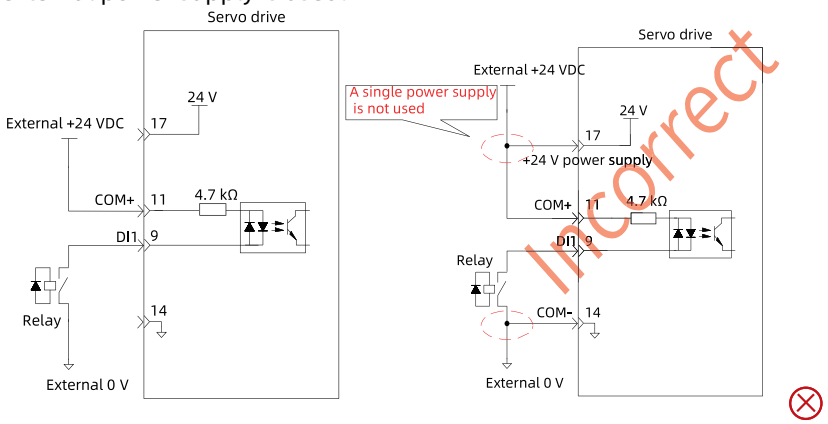
The following takes the DI1 circuit as an example. Other DI circuits are the same.

For the DI terminal layout, see *"Table 6-15 Description of DI/DO signals" on page 107*.

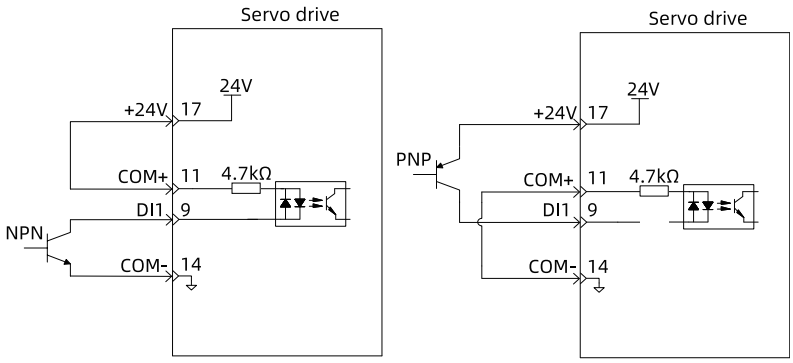
- When the host controller adopts relay output:
  - When the internal 24 V power supply of the servo drive is used:



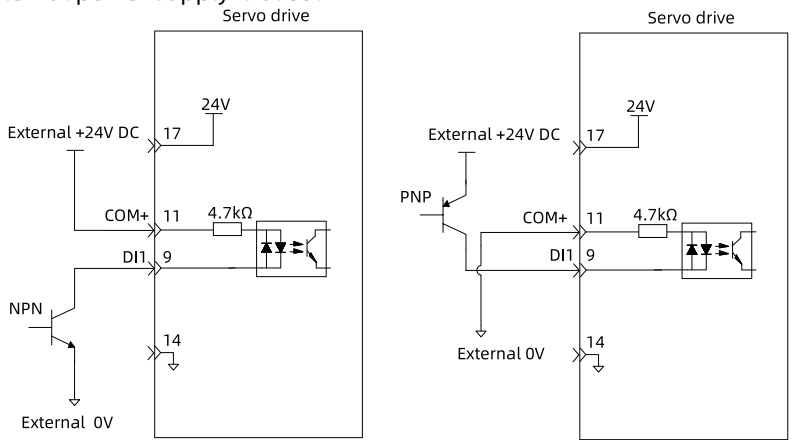
  - When the external power supply is used:



- When the host controller generates open-collector output:
  - When the internal 24 V power supply of the servo drive is used:



- When the external power supply is used:



Note

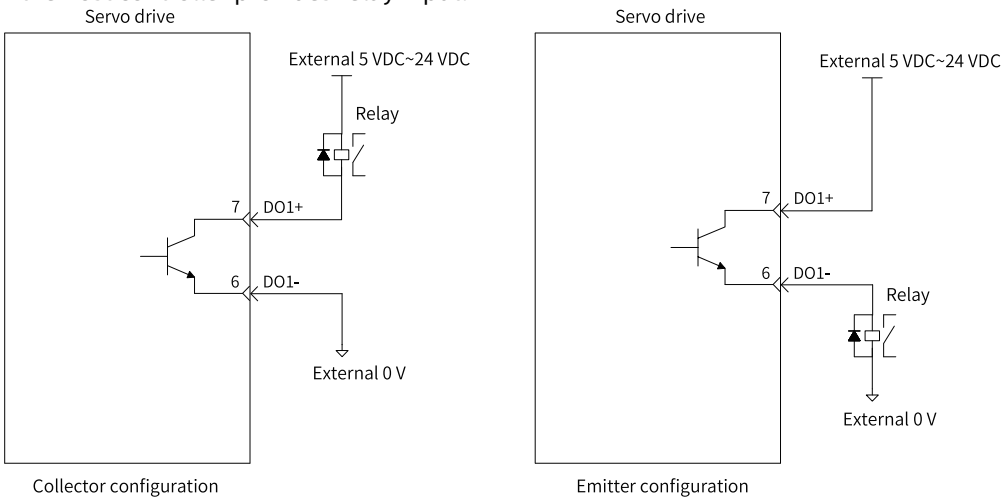
PNP and NPN input cannot be used together in the same circuit.

DO circuit

The following takes DO1 as an example. Other DO circuits are the same.

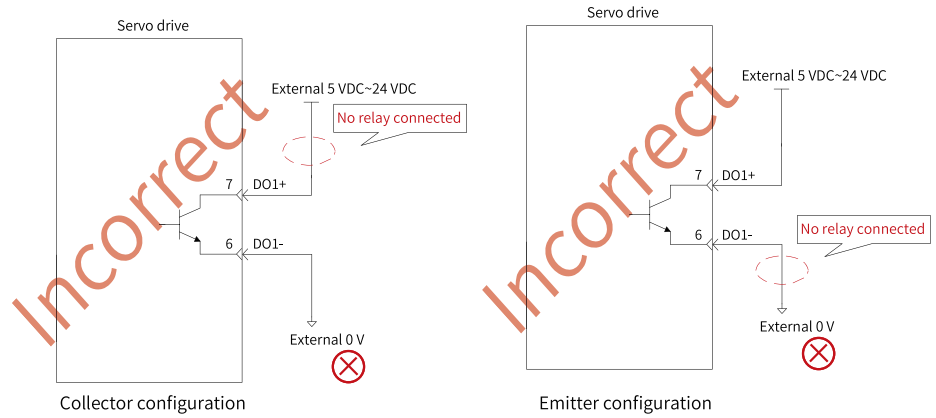
For the DO terminal layout, see *"Table 6-15 Description of DI/DO signals" on page 107*.

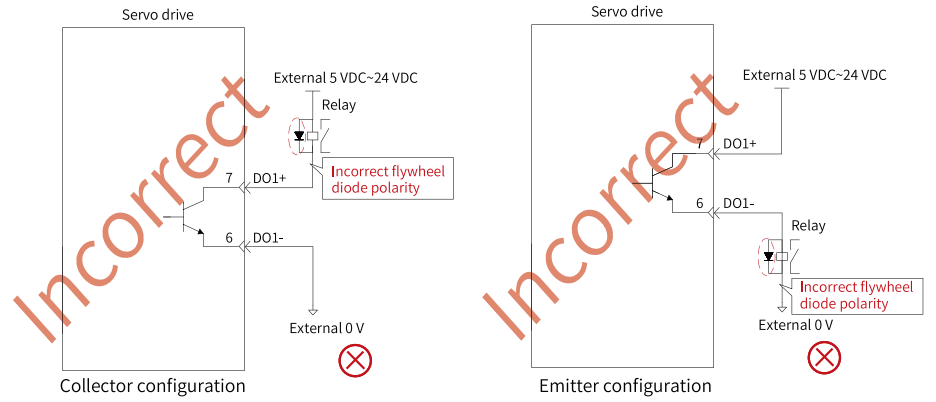
- When the host controller provides relay input:



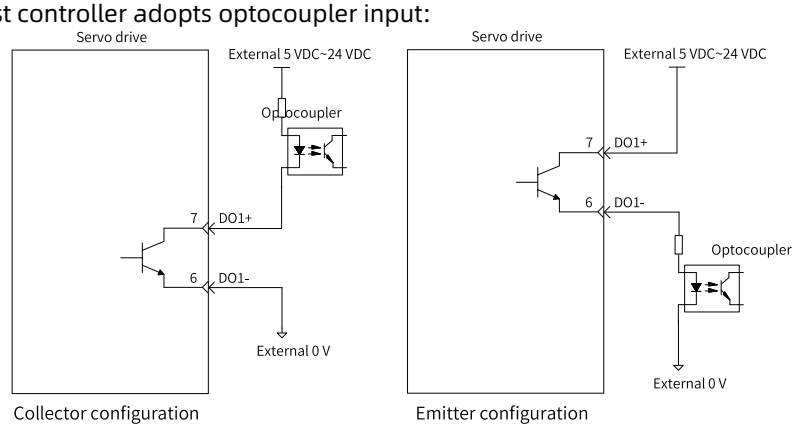
Note

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





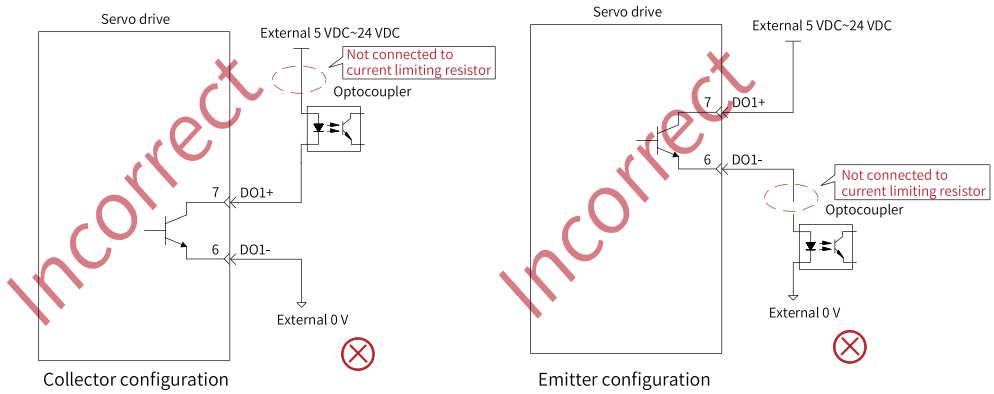
- When the host controller adopts optocoupler input:



Note

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

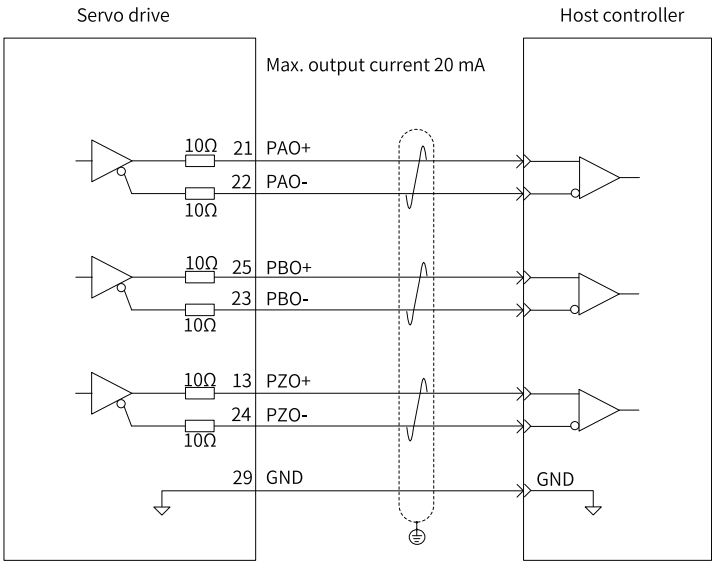
- Max. voltage: 30 VDC
- Max. current: DC 50 mA

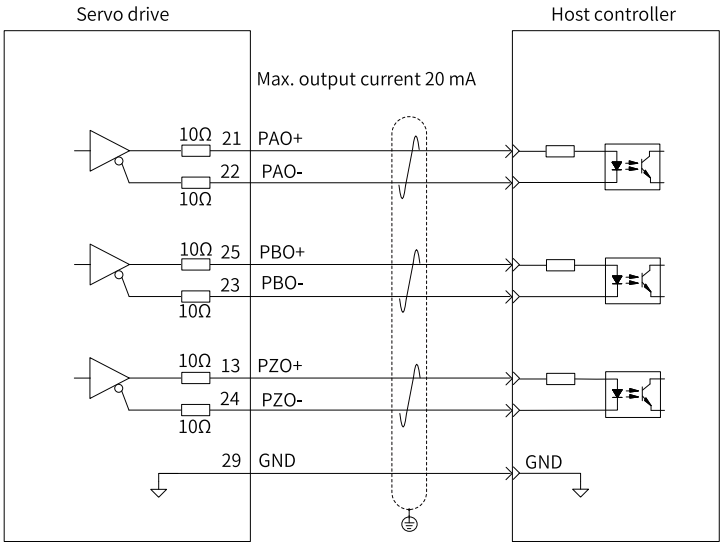


6.4.4.2 Encoder Frequency-Division Output Signals

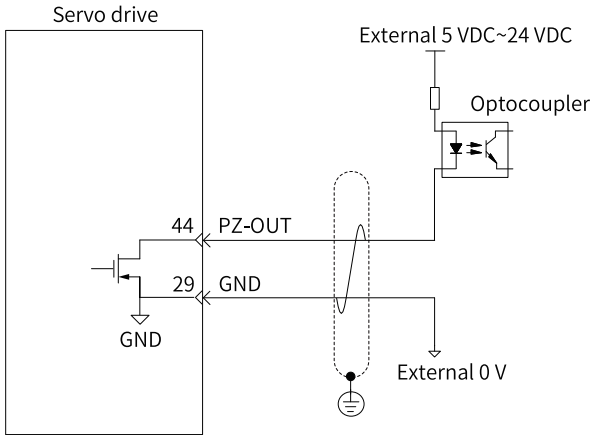
Encoder frequency dividing output circuit outputs differential signals via differential drive. Typically, this circuit provides feedback signals to the host controller in a position control system. Use a differential or an optocoupler receiving circuit on the host controller side to receive feedback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

For details about terminal layout, see *"Table 6-16 Specifications of encoder frequency-division output signals" on page 107*.





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



Caution

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

6.4.4.3 AI/AO Signals

For details about terminal layout, see *"Table 6-17 Specifications of AI/AO signals" on page 108*.

Analog input signal

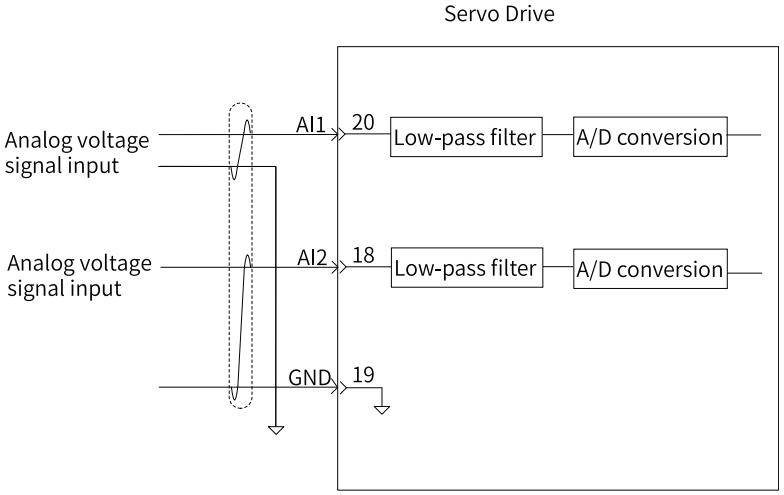
The input terminals for analog speed and signals are AI1 and AI2.

AI1 is a voltage-type analog input terminal with a resolution of 16 bits. The voltage value is set in group H03.

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

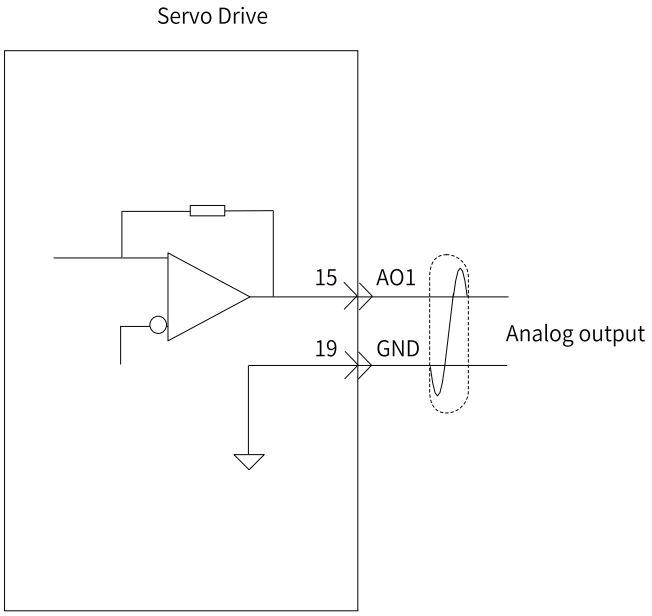
- Voltage-type input specification: -10 V to +10 V; maximum allowable voltage: ±12 V

- Input impedance: about 74 kΩ



Analog output signal

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



6.4.4.4 Position Reference Input Signals

An output circuit for the reference pulse or symbol signal at the host controller can either be differential drive output or OC output. The following table lists the maximum input frequency and minimum pulse width of these output modes.

Table 6–19 Correspondence between pulse input frequency and pulse width

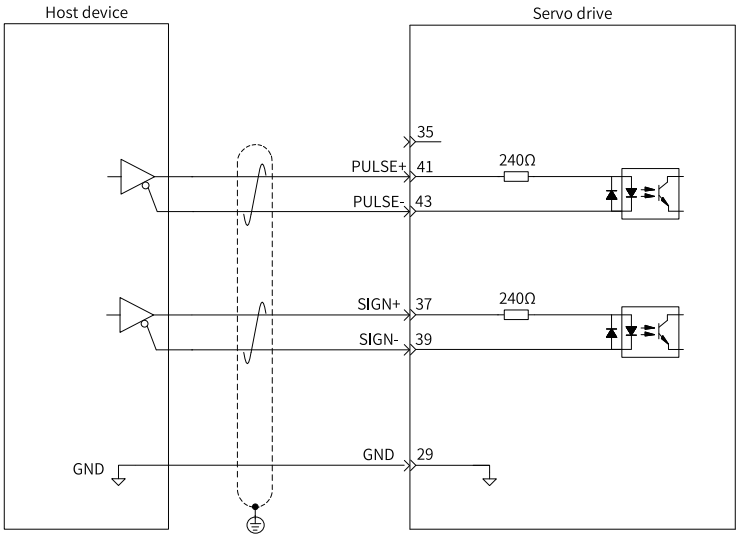
Pulse form		Single-channel max. pulse frequency (pps)	Min. pulse width (μs)	Voltage (V)
Low speed	Differential	200 kpps	1	> 3.0
	OC	200 kpps	2.5	24
High-speed differential		4 Mpps	0.125	> 3.0

Note

- You can either use high-speed pulses or low-speed pulses, but not both of them together.
- If the output pulse width of the host controller is smaller than the minimum pulse width, a pulse receiving error will occur on the drive.
- The symbol  represents shielded twisted pairs.

Low-speed pulse reference input

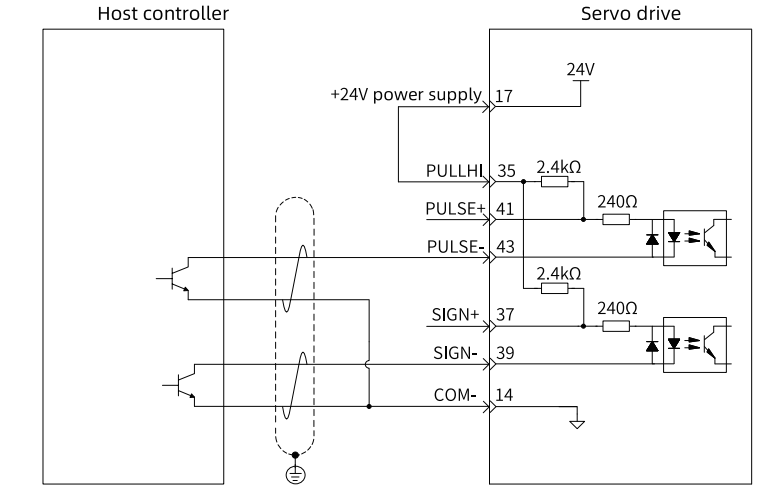
- Differential mode



- Open-collector mode

  When the internal 24 V power supply of the servo drive is used:

NPN



PNP

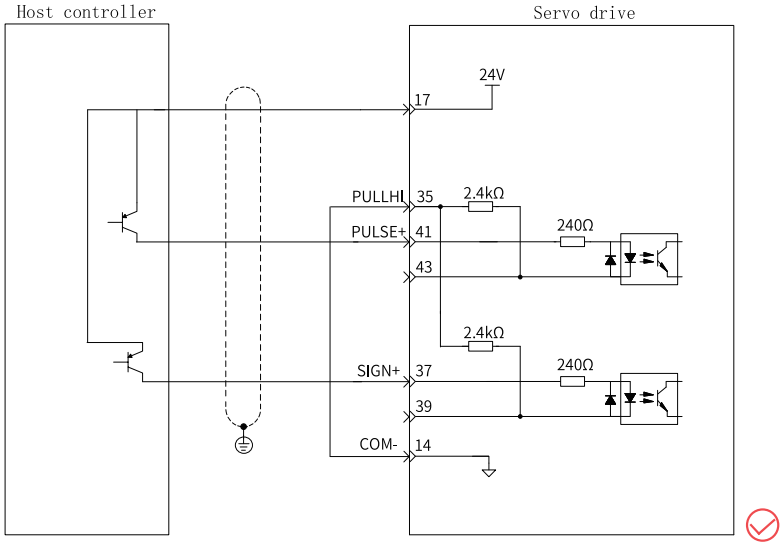


Figure 6-12 Correct: The internal 24 V power supply of the servo drive is used.

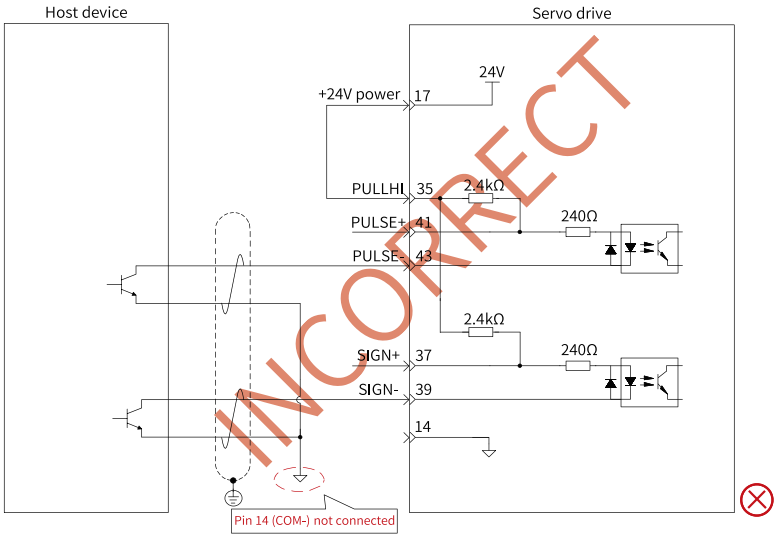
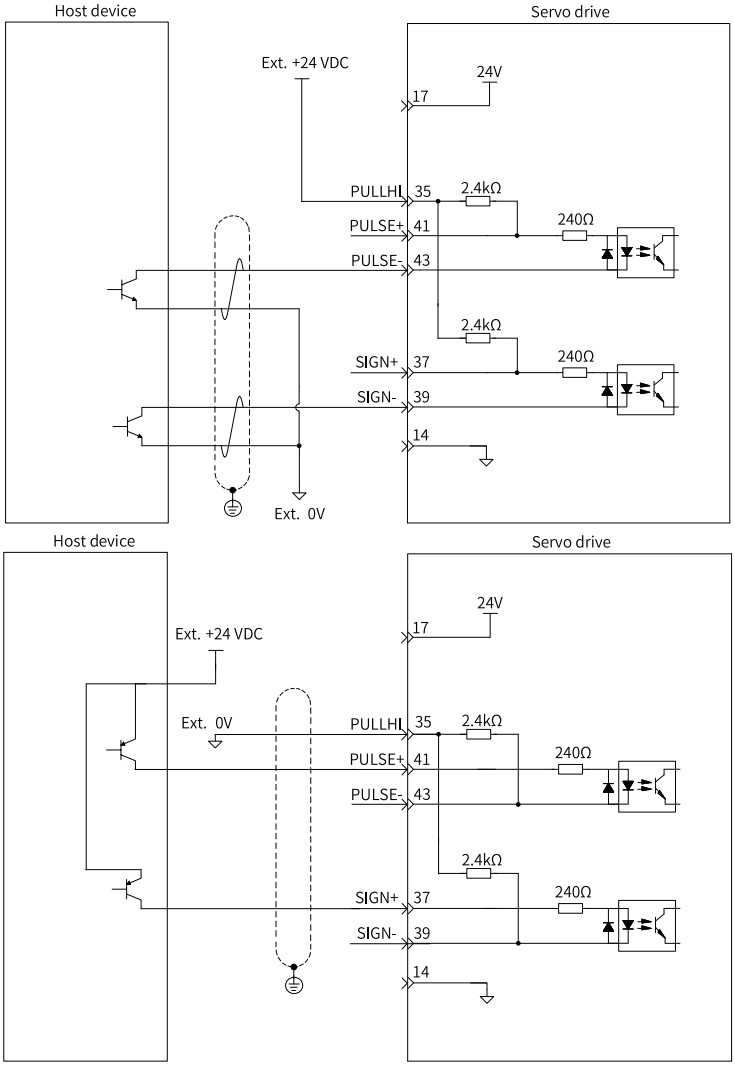


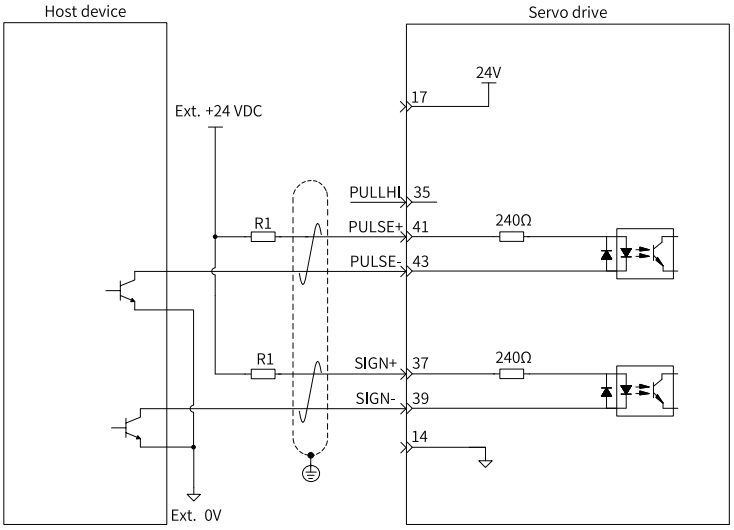
Figure 6-13 Wrong: Pin 14 (COM-) is not connected, which cannot form a closed-loop circuit.

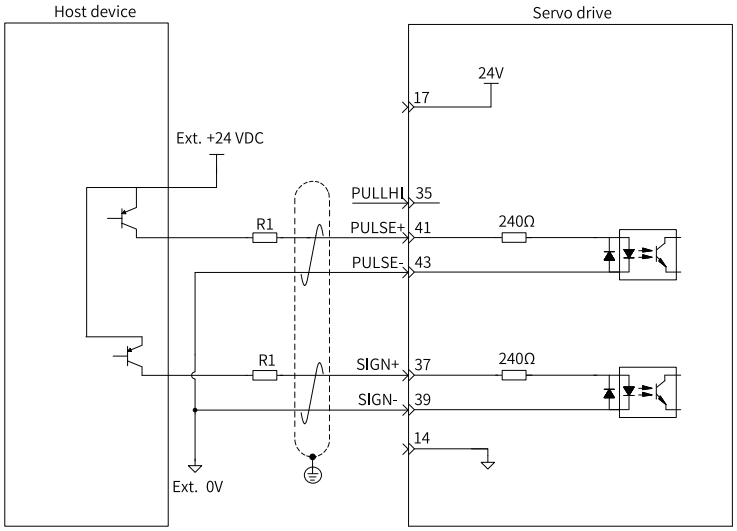
When the external power supply is used:

- Scheme 1: Using the internal resistor of the servo drive (recommended)



- Scheme 2: Using the external regenerative resistor





Value of resistor R1 shall satisfy the following formula:

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

Table 6–20 Recommended resistance of R1

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

- The following figures show examples of incorrect wiring.
- Incorrect wiring 1: The current limiting resistor is not connected, resulting in terminal burnout.

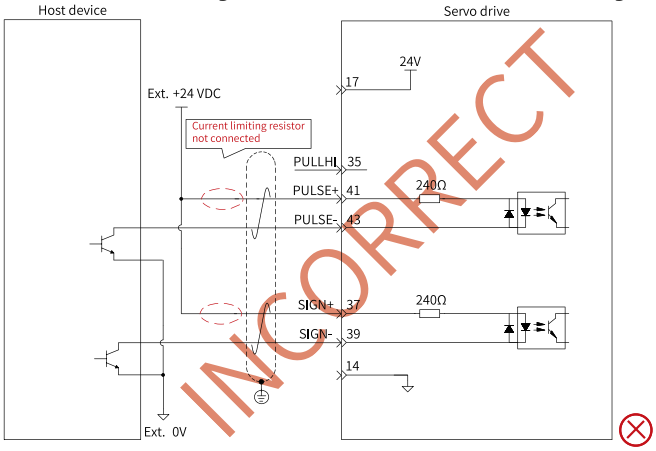


Figure 6-14 Incorrect wiring example 1: The current limiting resistor is not connected, resulting in terminal burnout.

Note

- A detection feature is added on SIGN+ and SIGN- to detect if SIGN+ is connected to 24 V, SIGN- is connected to external 0 V, but no current limit resistor is connected. When this case is detected, the drive issues an E991.1 warning.
- In this case, check the wiring and then test the drive. Otherwise, the port may be damaged.
- This feature cannot detect polarity reversal.

- Incorrect wiring 2: Multiple terminals share the same current-limit resistor, resulting in pulse receiving error.

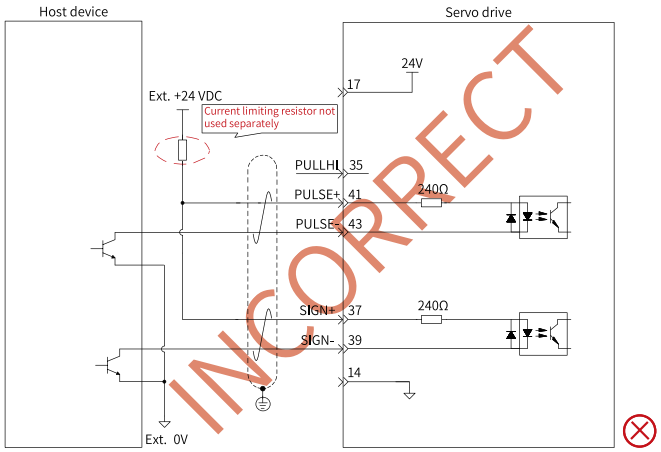


Figure 6-15 Incorrect wiring example 2: Multiple terminals share the same current limiting resistor, resulting in pulse receiving errors.

- Incorrect connection 3: SIGN terminals are not connected, resulting in pulse receiving failure on the two terminals.

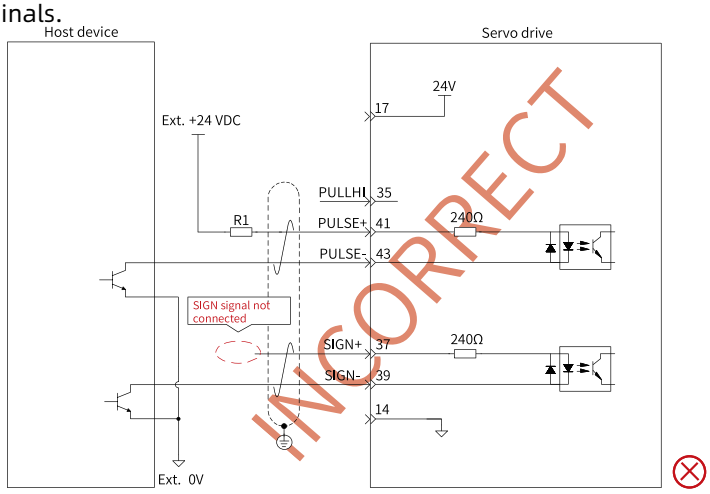


Figure 6-16 Incorrect wiring example 3: SIGN terminals are not connected, resulting in pulse receiving failure on the two terminals.

- Incorrect connection 4: Terminals are not correctly connected, resulting in burnout of terminals.

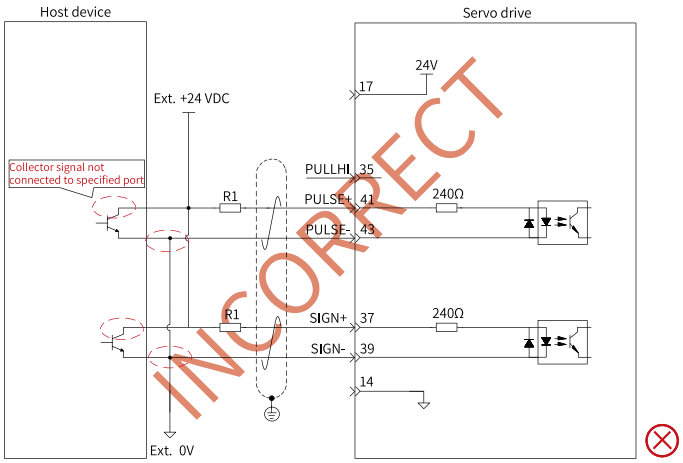


Figure 6-17 Incorrect wiring example 4: Terminals are connected incorrectly, resulting in terminal burnout.

- Multiple terminals share the same current-limiting resistor, resulting in pulse receiving errors.

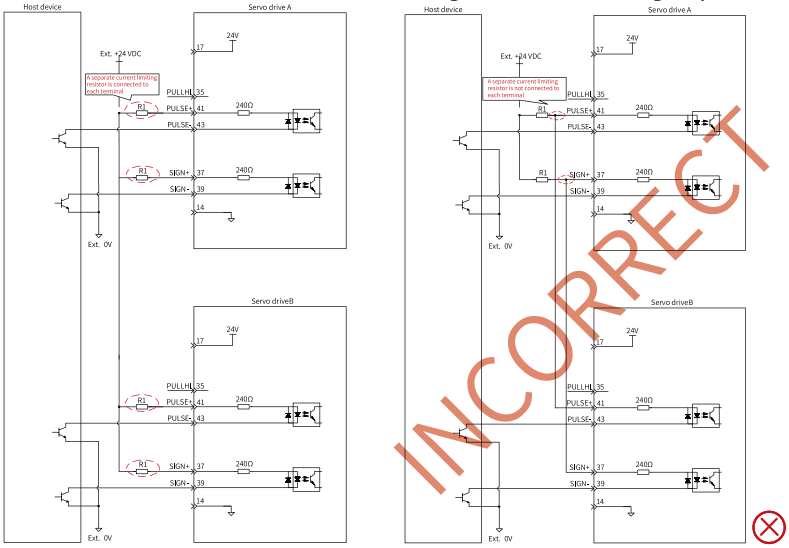
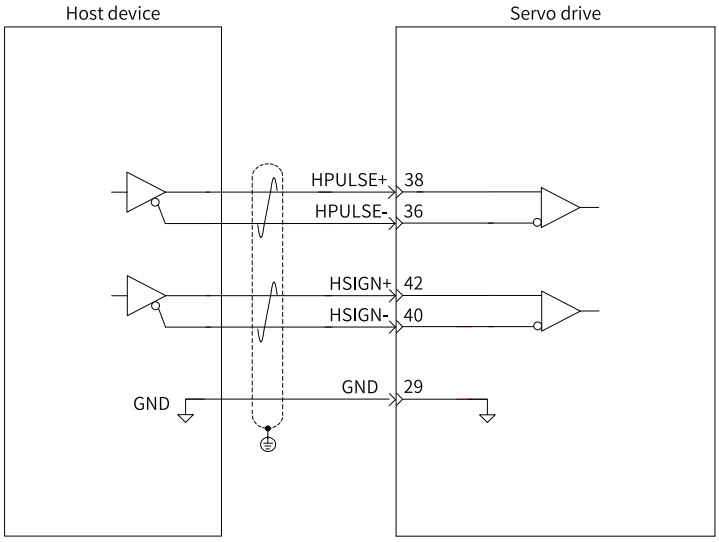


Figure 6-18 Incorrect wiring example 5: Multiple terminals share the same current limiting resistor, resulting in pulse receiving errors.

High-speed pulse reference input

High-speed reference pulse and symbol signals at the host controller can only be output to the servo drive via differential drive output.



Note

- This is a 5 V system. Do not input 24 V power.
- A detection feature is added on HSIGN+ and HSIGN- to detect if HSIGN+ is connected to 24 V, HSIGN- is connected to external 0 V, but no current limit resistor is connected. When this case is detected, the drive issues an E991.1 warning.
- In this case, check the wiring and then test the drive. Otherwise, the port may be damaged.
- This feature cannot detect polarity reversal.

Caution

The differential input must be 5 V. Otherwise, unstable pulse input will occur on the servo drive, resulting in the following situations:

- Pulse loss during pulse input
- When inputting reference direction, the direction will reverse.
- Connect 5V GND of the host controller to the GND of the servo drive to reduce noise interference.

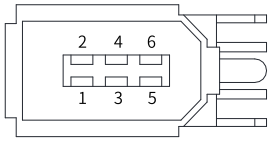
6.5 CN2 Encoder Terminal

6.5.1 Terminal Arrangement

Note

- Primary encoder: The main encoder.
- Secondary encoder: The slave encoder when the fully closed loop feature is used.

Terminal Arrangement



Encoder signal terminal CN2 (drive side)

Figure 6-19 Terminal pin arrangement

Table 6–21 Pin assignment

Pin No.	Name	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 second encoder; 2. CLK± signal of the communication-type encoder
4	PS4-/CLK-	
5	PS3+/DATA+	1. PS± signal of the first encoder; 2. DATA± signal of the communication-type encoder; 3. Gantry synchronization signal
6	PS3-/DATA-	
Enclosure	PE	Shield

Note

It is recommended to use shielded twisted pair cables. Connect the shield layer to the CN2 terminal housing to reduce noise interference.

6.5.2 Wiring Precautions and Requirements

- Ground the shielded layers on both the servo drive side and the motor side. Otherwise, the servo drive will report a false alarm.
- Given the voltage drop caused by cable resistance and signal attenuation caused by distributed capacitance, it is recommended to use twisted-pair cables of 26AWG or above (as per UL20276 standard) with length no longer than 10 m as the encoder cable.

Note

It is recommended to use 22AWG to 26AWG cables and a matching terminal AMP170359-1 for 10B, 20B, 40B, and 75B series motors. If a longer cable is required, increase the cable diameter properly. See *"Table 6-22 Recommended cables" on page 123* for details.

6.5.3 Cable Requirements

Note

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

Table 6–22 Recommended cables

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

Note

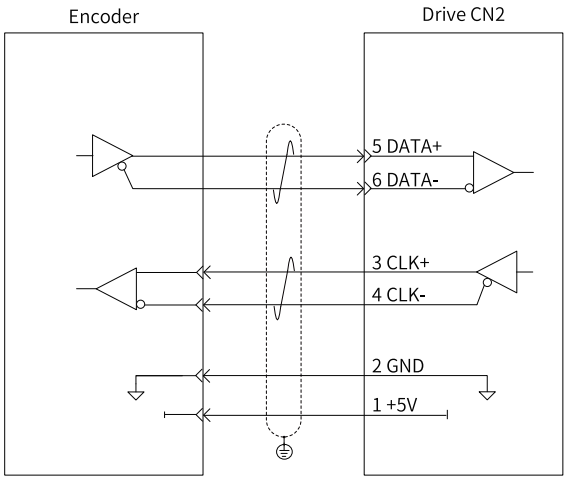
- The preceding length can be increased by 2 m to 3 m.
- For cables higher than 16AWG, contact the sales personnel.
- The letter P in the preceding table indicates twisted pairs, in which 1P represents +5V/0V twisted pair, 2P represents DC+/- twisted pair and PS+/- twisted pair, and 3P represents +5V/0V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

6.5.4 Wiring Examples

6.5.4.1 Communication with the Master Encoder

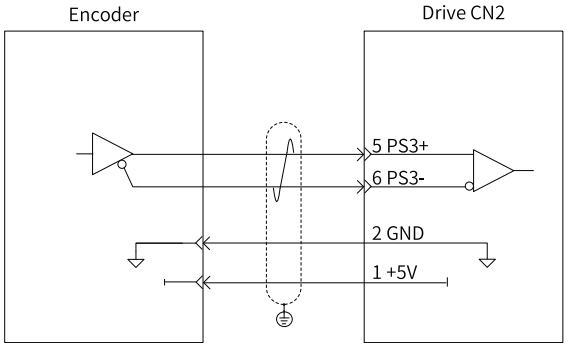
Wiring of Endat2.2/SSI/BiSS-C master encoder

The drive sends a clock signal to the master encoder, which exchanges data with the servo drive through DATA signals.



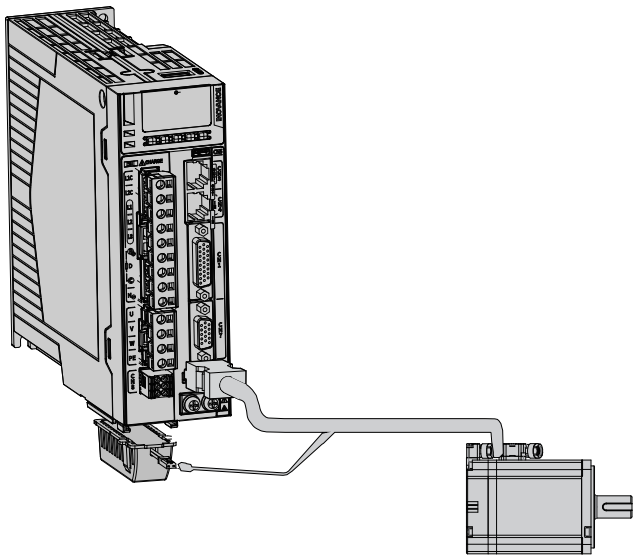
Wiring of Inovance/TAMAGAWA/Nikon master encoder

The master encoder interacts with the servo drive through PS3+ and PS3-.



For cable specifications and model requirements, see *"6.5.3 Cable Requirements" on page 123*.

Wiring of Inovance rotary motor



6.5.4.2 Communication with the Second Encoder

Set H0F.06 to 0 and change the 2nd encoder interface to CN2. CN7 is connected by default (H0F.06 = 1).

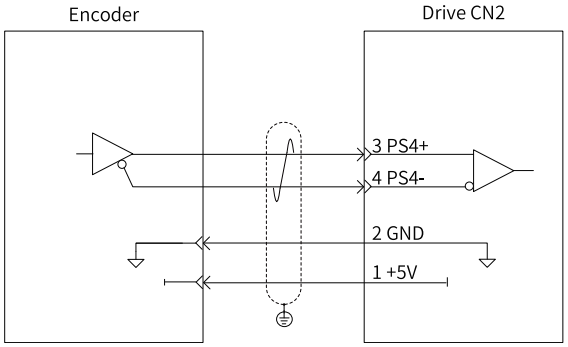
Wiring of Endat2.2/SSI/BiSS-C second encoder

When the drive communicates with the primary encoder properly, it indicates the 1st encoder is present. With the Endat2.2/SSI/BiSS-C 2nd encoder, the drive sends the clock signal to the 2nd encoder, while the 2nd encoder transmits data to the drive through DATA signals.

For details, see "Wiring of Endat2.2/SSI/BiSS-C master encoder".

Wiring of Inovance/TAMAGAWA/Nikon second encoder

When the drive communicates with the primary encoder properly, it indicates the 1st encoder is present. With the Inovance/TAMAGAWA/Nikon 2nd encoder, the drive interacts with the 2nd encoder through PS4+ and PS4- signals.



For cable specifications and model requirements, see *"6.5.3 Cable Requirements" on page 123*.

6.5.5 Adapters of Power Cables and Encoder Cables

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

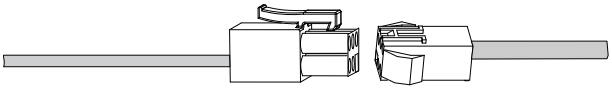


Figure 6-20 Power cable adapter

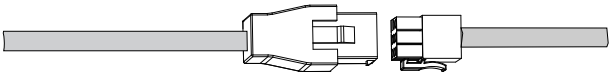


Figure 6-21 Encoder cable adapter

6.6 Communication Terminals CN3 and CN4

6.6.1 Terminal Layout

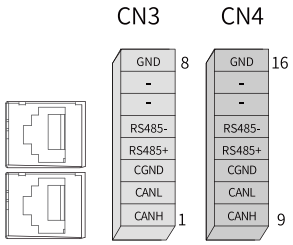


Figure 6-22 Communication terminal pin layout of the servo drive

Table 6–23 Description of communication terminal pins

Pin No.	Assignment	Description
1 and 9	CANH	CAN communication port
2 and 10	CANL	
3 and 11	CGND	CAN communication ground
4 and 12	RS485+	Modbus RTU communication port
5 and 13	RS485–	
6 and 14	-	-
7 and 15	-	-

Pin No.	Assignment	Description
8 and 16	GND	Signal reference ground
Enclosure	PE	Shield

6.6.2 Wiring Precautions and Requirements

Rules

When using CAN communication, connect the CGND terminal of the host controller device to the CGND terminal of the servo driver, as shown in the following figure.

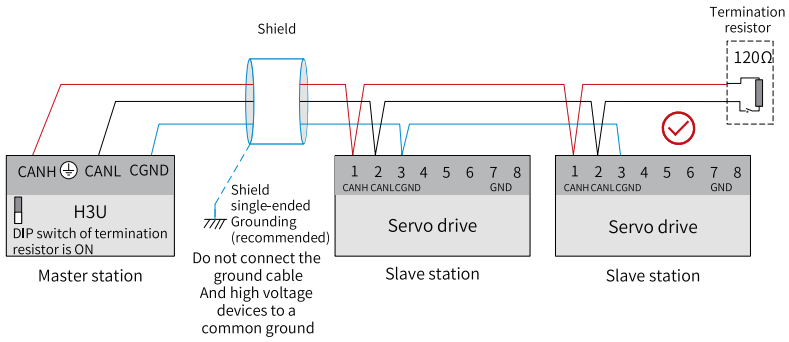


Figure 6-23 Correct CAN connection way

Caution

- The PLC carries built-in communication termination resistor and the corresponding DIP switch must be set to "ON".
- It is recommended to ground the shield at single end.
- Do not connect the CGND terminal of the host controller to the GND terminal of the servo drive. Otherwise, the servo drive may be damaged.

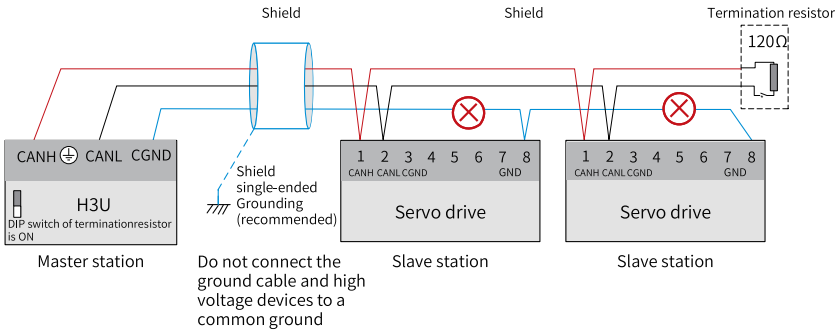


Figure 6-24 Incorrect CAN connection way

CAN communication bus and multi-node connection

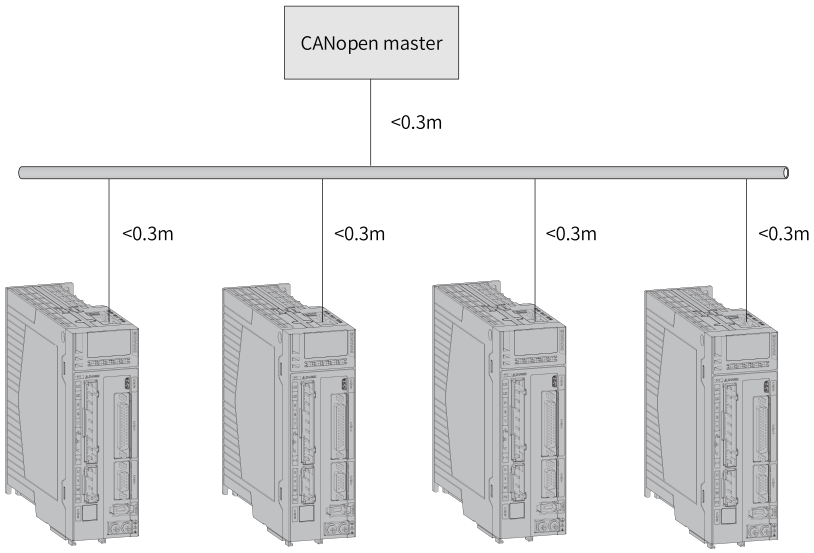


Figure 6-25 CAN communication network topology

Connect the CAN communication network in the bus topology, as shown in *"Figure 6-25" on page 127*.

Connect each CAN transceiving device to the bus by using a branch cable shorter than 0.3 m. Otherwise, reflection may occur and cause communication problems.

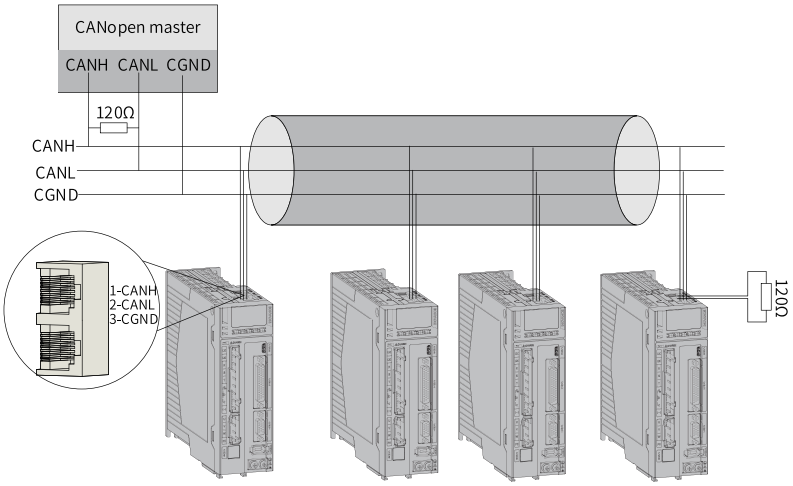


Figure 6-26 CANopen wiring diagram

It is recommended to use shielded twisted pairs. Connect two 120 Ω termination resistors at each end of the bus to prevent signal reflection. Typically, ground the shield in the single-point grounding mode. Using a multimeter to measure the resistance between CANH and CANL helps to confirm whether the junction resistance on the field is correct. The normal resistance value is about 60 Ω (with two resistors in parallel connection). Up to 64 devices can be connected.

When CAN devices communicate over a long distance, CGND of different CAN circuits must be mutually connected to ensure the reference potential of different communication devices is the same.

Recommended Connection Modes of Different Cables

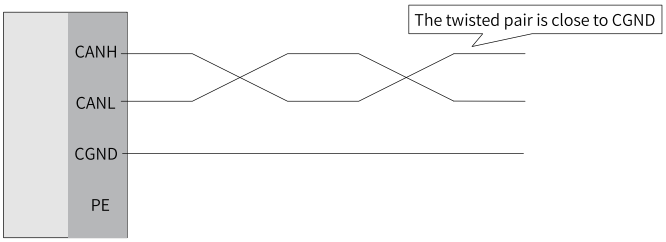


Figure 6-27 Recommended connection mode 1

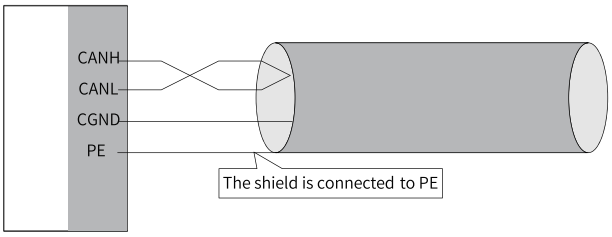


Figure 6-28 Recommended connection mode 2

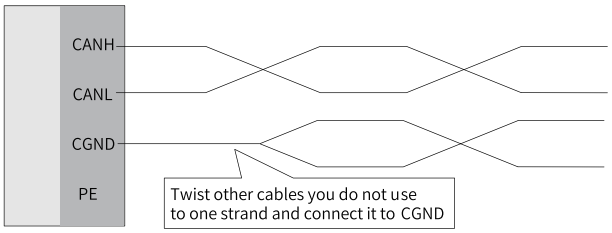


Figure 6-29 Recommended connection mode 3

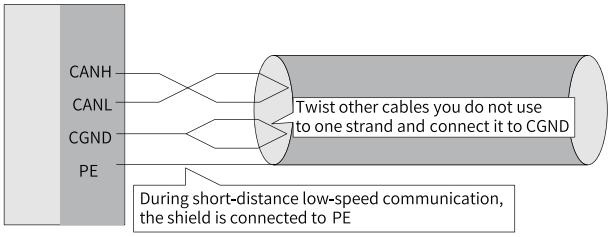


Figure 6-30 Recommended connection mode 4

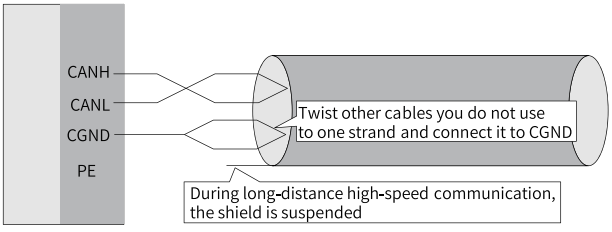


Figure 6-31 Recommended connection mode 5

Wiring for other devices without external CGND ports

- **The device is a non-isolated CAN device and shares the GND or COM port with other signals.** Connect the GND or COM port of the device with the CGND port of the drive, as shown in the following figure.

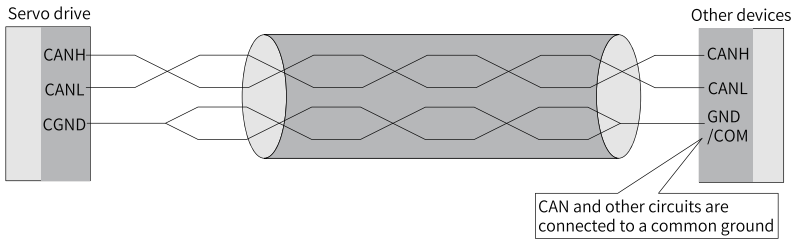


Figure 6-32 Connection mode for sharing the ground with other circuits

- **The CAN terminal of the device has no common ground with other ports.**
  Do not connect the CGND port to any cable. Use a cable of at least 12AWG to connect the PE of each device. Separate the cable from the CAN communication cable by a distance greater than 5 cm, as shown in the following figure.

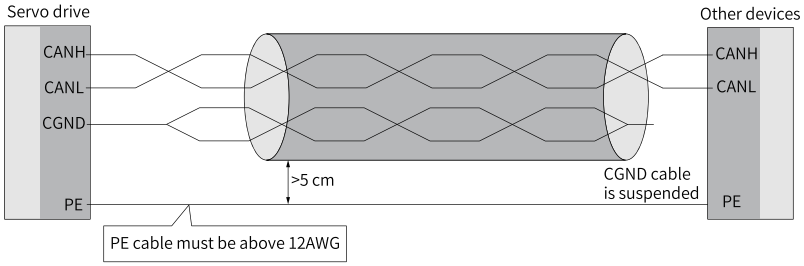


Figure 6-33 The CAN terminals of other devices have no external ground ports.

Recommended CAN communication cable layout

CAN communication is susceptible to interference. Route the CAN communication cables away from interference sources to prevent interference.

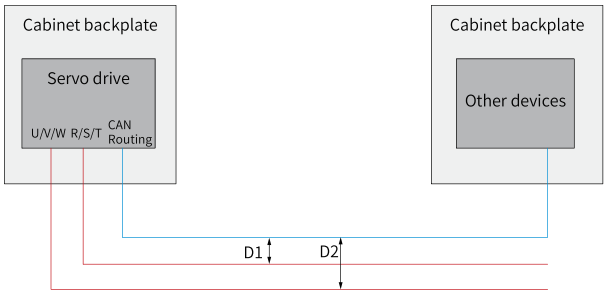


Figure 6-34 Recommended routing modes

Route the CAN cable and any interfering cable perpendicularly to each other. For parallel routing, keep a distance D1 greater than 20 cm between the CAN cable and an R/S/T cable, or keep a distance D2 greater than 50 cm between the CAN cable and a U/V/W cable. If interference cables are routed closely along the backplate of the cabinet, the distance between the CAN communication cable and the cabinet backplate must be longer than 1 cm.

The R/S/T power cable, U/V/W power cable, and CAN communication cables, after passing through the cabinet, are routed in three cable troughs respectively. The distance L3 among the cable troughs must be longer than 20 cm. The preceding principle also applies when interference cables and CAN communication cables are routed in the same cable trough.

6.6.3 Wiring Examples

6.6.3.1 CAN Communication Connection Examples

CAN communication with PLC

The following figure shows the cable used for the communication between the servo drive and PLC in CAN communication networking.

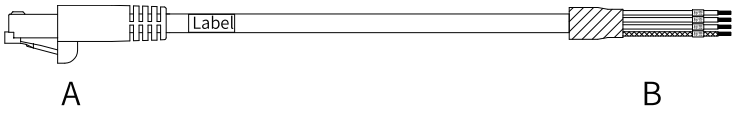


Figure 6-35 Diagram of the drive-to-PLC communication cable

Use a three-conductor shielded cable to connect the CAN bus, with the three conductors connected to CANH, CANL, and CGND (CGND represents isolated RS485 circuit signal reference ground) respectively. Connect the twisted pairs to the CANH and CANL terminals. Connect the CGND terminal to the CAN reference ground. Connect the shield to the device ground. Connect 120 Ω termination resistors only at the head and tail ends of the bus to prevent CAN signal reflection.

Table 6–24 Pin connections of the cable used for CAN communication between the servo drive and PLC

RJ45 on the drive (A)			PLC side (B)		
Communication type	Pin No.	Definition	Communication type	Pin No.	Definition
CAN	1	CANH	CAN	1	CANH
	2	CANL		2	CANL
	3	CGND		3	CGND
-	Housing	PE (shield)	-	Housing	PE (shield)

CAN communication for multiple drives installed in parallel

The following figure shows the cable used for multi-drive CAN communication.

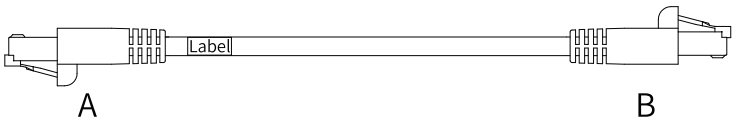


Figure 6-36 Diagram of the multi-drive communication cable

Table 6–25 Connection of pins of the multi-drive communication cable (only CAN pins used)

RJ45 on the drive (A)			RJ45 on drive side (B)		
Communication type	Pin No.	Definition	Communication type	Pin No.	Definition
CAN	1	CANH	CAN	1	CANH
	2	CANL		2	CANL
	3	CGND		3	CGND
-	Housing	PE (shield)	-	Housing	PE (shield)

Use the daisy chain mode for CAN bus, as shown in the following figure.

- Shielded twisted pair cables are recommended for connecting the CAN bus. Twisted pairs are recommended for connecting CANH and CANL.
- Connect 120 Ω termination resistors only at both ends of the bus to prevent signal reflection.
- Connect the CAN signal reference grounds of all the nodes together.
- Up to 127 nodes can be connected.

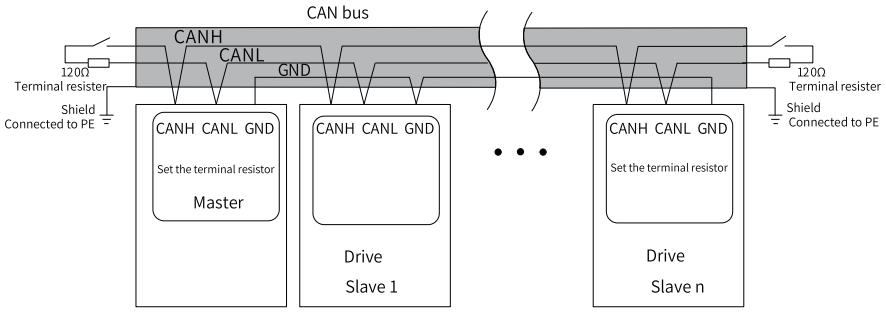


Figure 6-37 CAN bus topology

Caution

Do not connect the CGND terminal of the host controller to the GND terminal of the servo drive. Otherwise, the servo drive may be damaged.

6.6.3.2 Wiring example of RS485 communication

RS485 communication connection with PLC

The following figure shows the cable connection between the servo drive and the PLC during RS485 communication networking.

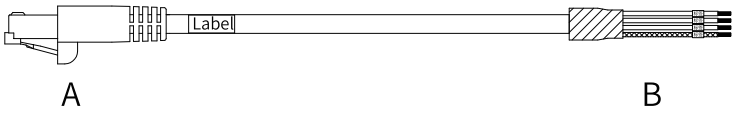


Figure 6-38 Diagram of the drive-to-PLC communication cable

Use a three-conductor shielded cable to connect the RS485 bus, with three conductors connected to 485+, 485-, and GND, respectively. GND represents non-isolated RS485 signal reference ground. Connect the twisted pairs to the RS485+ and RS485– terminals. Connect the third cable to the RS485 reference ground (GND). Connect the shield to the device ground (PE). Connect 120 Ω termination resistors only at the head and tail ends of the bus to prevent RS485 signal reflection.

Table 6–26 Pin connections of the cable used for CAN communication between the servo drive and PLC

RJ45 on the drive (A)			PLC side (B)		
Communication type	Pin No.	Definition	Communication type	Pin No.	Definition
RS485	4	485+	RS485	4	485+
	5	485-		5	485-
	8	GND		8	GND
-	Housing	PE (shield)	-	Housing	PE (shield)

RS485 communication for multiple drives installed in parallel

The following figure shows the cable connection between multiple servo drives during RS485 communication networking.

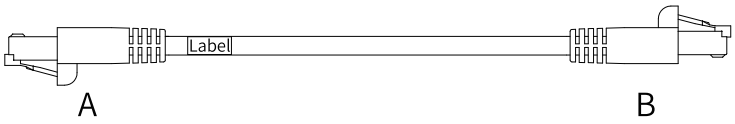


Figure 6-39 Diagram of the multi-drive communication cable

Table 6–27 Pin connections of the cable used for multi-drive RS485 communication (pins in 485 group used only)

RJ45 on the drive (A)			RJ45 on drive side (B)		
Communication type	Pin No.	Definition	Communication type	Pin No.	Definition
RS485	4	485+	RS485	4	485+
	5	485-		5	485-
	8	GND		8	GND
-	Housing	PE (shield)	-	Housing	PE (shield)

In case of a large number of nodes, connect the RS485 communication using the daisy chain mode. Connect the RS485 signal reference grounds of all the nodes (up to 128 nodes) together.

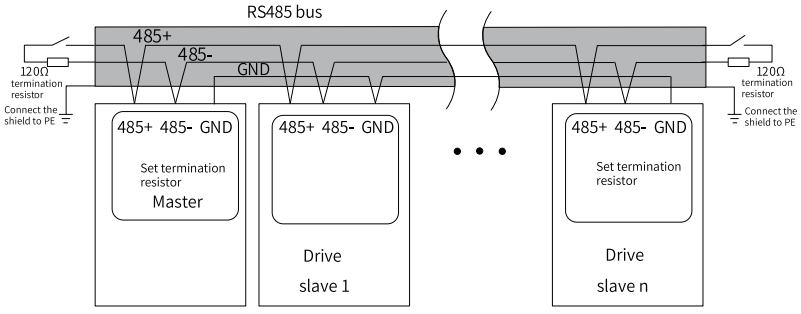


Figure 6-40 RS485 bus topology

Caution

- Set the termination resistor: Insert S6-L-T03-0.0 into the RJ45 connector.
- Do not connect the CGND terminal of the host controller to the GND terminal of the servo drive. Failure to comply will damage the machine.

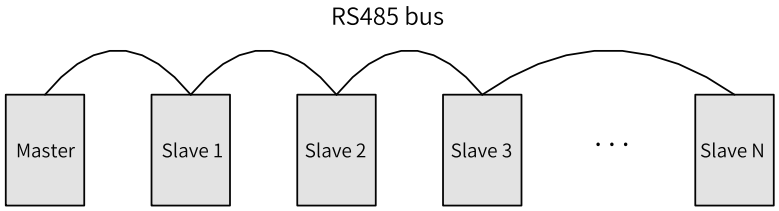


Figure 6-41 Daisy chain mode

The following table lists the maximum number of nodes and transmission distance supported by the Inovance standard RS485 circuit at different transmission rates.

Table 6–28 Transmission distance and number of nodes

No.	Transmission rate (kbps)	Transmission distance (m)	Number of nodes	Cable size (AWG)
1	115.2	100	128	26
2	19.2	1000	128	26

6.7 Communication Terminal CN5

Terminal layout

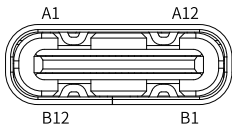


Table 6–29 Pin assignment of communication terminal CN5

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

Terminal description

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

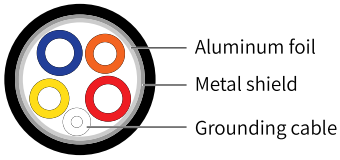


Figure 6-42 Recommended cables

Note

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

6.8 STO Safety Terminal (CN6)

6.8.1 Terminal layout

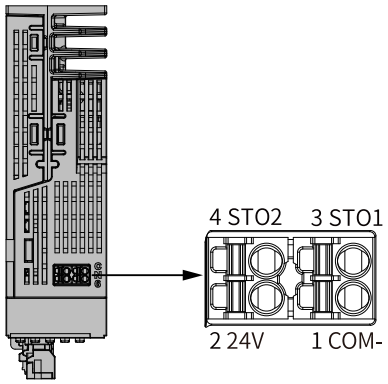
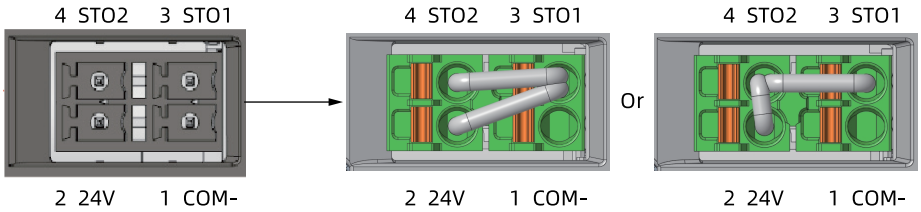


Table 6–30 STO safety terminal pins of servo drives

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

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

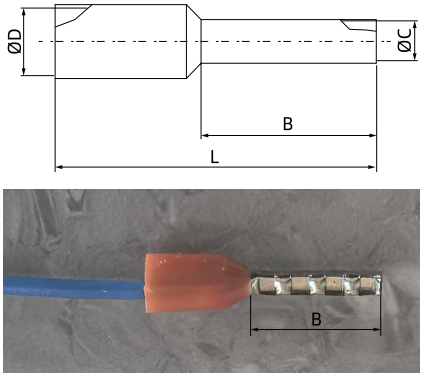
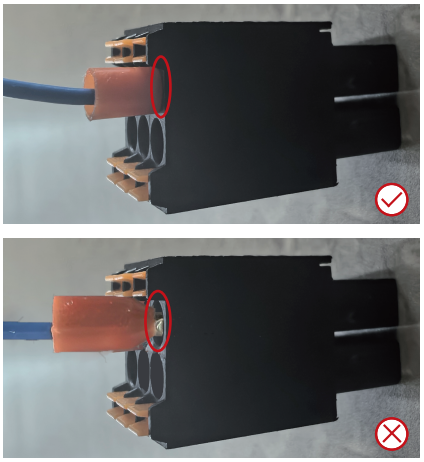
To facilitate commissioning, additional pin with supply voltage (+24 V) is integrated. STO1 and STO2 need to be short-circuited to the 24 V pin if a safety circuit is installed but the STO function of CN6 is not used. This can disable the STO function of CN6.



STO applies to the following servo drives:

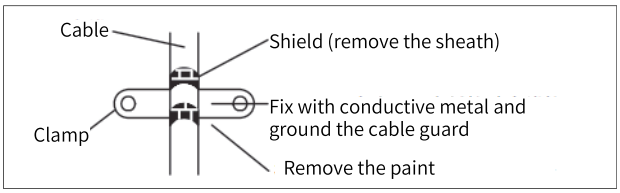
Size	Power range (kW)	Structure	W × H × D (mm^3)
A	0.2 to 0.4	Split-type structure	45.5 × 170 × 150
B	0.4 to 0.75	Split-type structure	45.5 × 170 × 180
C	0.75 to 1.5	Split-type structure	55 × 170 × 173
D	1.5 to 3	Split-type structure	80 × 170 × 183
E	2 to 7.5	Split-type structure	90 × 250 × 230

6.8.2 Wiring Precautions and Requirements

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

EMC requirements

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



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

Additional requirements

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

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

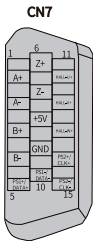
6.9 CN2 Encoder Terminal

6.9.1 Terminal layout

Note

- Primary encoder: The master encoder.
- Secondary encoder: The slave encoder when the fully closed-loop function is used.

Terminal layout



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-	• PS- signal of first encoder • DATA- signal of communication encoder • 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+	• PS+ signal of first encoder • DATA+ signal of communication encoder • Gantry synchronization signal	13	HALL_W+	Hall signal W
6	Z+	Encoder pulse phase Z+/-	14	PS2+/CLK+	• PS± signal of second encoder • CLK± signal of 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

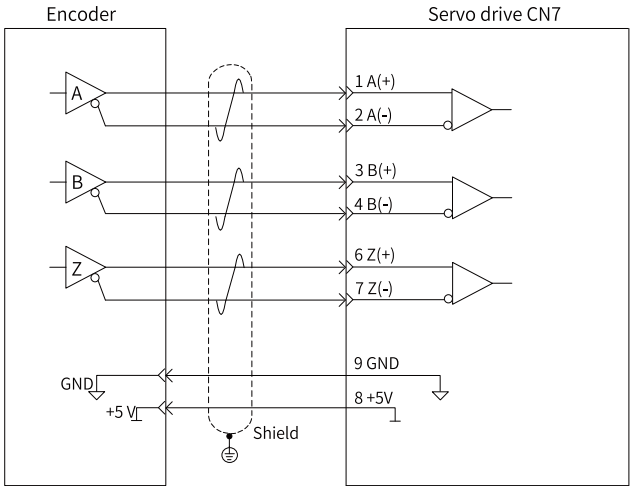
Hall signals support only 3.3 V voltage input.

6.9.2 Wiring Examples

6.9.2.1 Communication with the First Encoder

Wiring of ABZ incremental encoder (TTL signal)

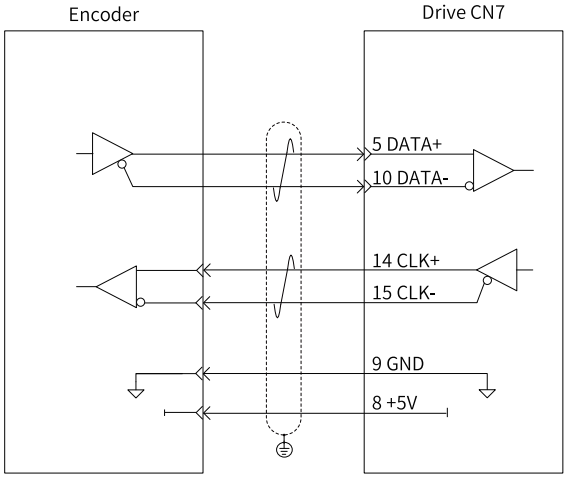
Use shielded twisted pairs to match the high input frequency.



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

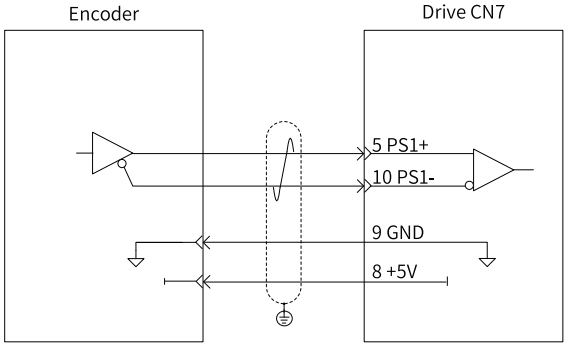
Wiring of Endat2.2/SSI/BiSS-C master encoder

The drive sends a clock signal to the master encoder, which exchanges data with the servo drive through a DATA signal.



Wiring of Inovance/TAMAGAWA/Nikon master encoder

The master encoder interacts with the servo drive through PS1+ and PS1-.



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

Table 6–31 Recommended cable between the servo drive and linear motor encoder

Cable Size	Line Resistance	Allowable Length
26AWG (0.13 mm^2)	143 Ω/km	8.0 m
25AWG (0.15 mm^2)	89.4 Ω/km	14.0 m
24AWG (0.21 mm^2)	79.6 Ω/km	15.0 m
23AWG (0.26 mm^2)	68.5 Ω/km	18.0 m
22AWG (0.32 mm^2)	54.3 Ω/km	23.0 m
21AWG (0.41 mm^2)	42.7 Ω/km	29.0 m

If the consumption current of the motor encoder is higher than 200 mA, you can calculate the allowable cable length according to the following formula.

$$L2=\frac{\triangle U_{max2}}{I_{Encoder}x2R_{Unit}}$$

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

6.9.2.2 Communication with the Second Encoder

The second encoder is connected to the CN7 port (H0F.06 = 1) by default.

Wiring of ABZ incremental encoder (TTL signal)

For details, see *" Wiring of ABZ incremental encoder (TTL signal)" on page 137*.

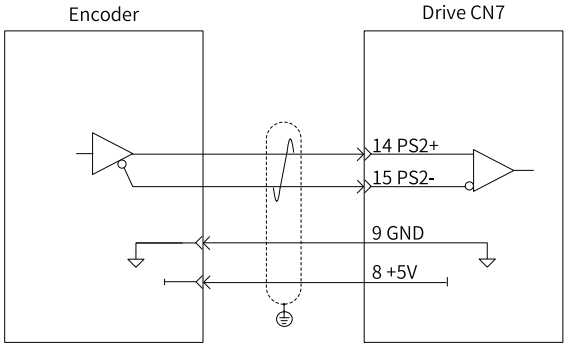
Wiring of Endat2.2/SSI/BiSS-C second encoder

The drive communicates with the first encoder normally, that is, the first encoder exists all the time. In the case of the Endat2.2/SSI/BiSS-C second encoder, the drive sends clock signals to the encoder and the encoder exchanges data with the drive through DATA signals.

For details, see *" Wiring of Endat2.2/SSI/BiSS-C master encoder" on page 138*.

Wiring of Inovance/TAMAGAWA/Nikon second encoder

The drive communicates with the first encoder normally, that is, the first encoder exists all the time. In the case of the Inovance/TAMAGAWA/Nikon second encoder, the encoder exchanges data with the drive through PS2+ and PS2- signals.



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

Table 6–32 Recommended cable between the servo drive and linear motor encoder

Cable Size	Line Resistance	Allowable Length
26AWG (0.13 mm^2)	143 Ω/km	8.0 m
25AWG (0.15 mm^2)	89.4 Ω/km	14.0 m
24AWG (0.21 mm^2)	79.6 Ω/km	15.0 m

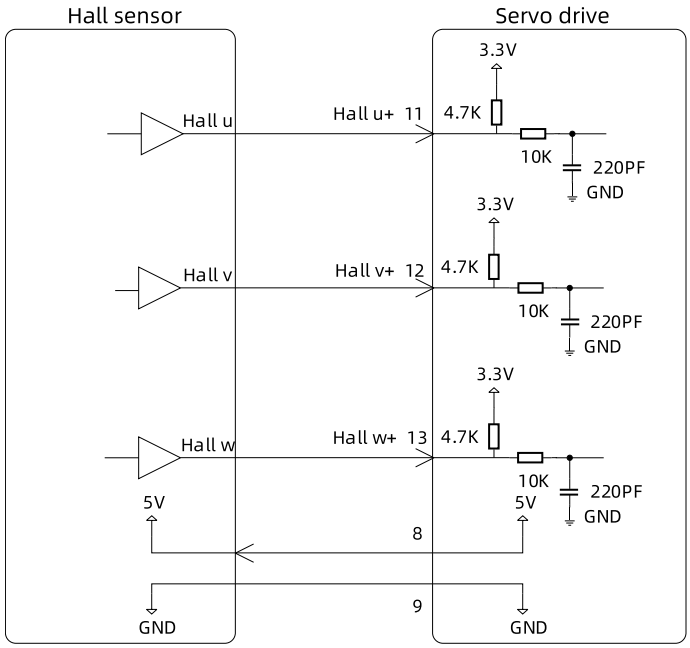
Cable Size	Line Resistance	Allowable Length
23AWG (0.26 mm^2)	68.5 Ω/km	18.0 m
22AWG (0.32 mm^2)	54.3 Ω/km	23.0 m
21AWG (0.41 mm^2)	42.7 Ω/km	29.0 m

If the consumption current of the motor encoder is higher than 200 mA, you can calculate the allowable cable length according to the following formula.

$$L2=\frac{\triangle U_{max2}}{I_{Encoder} x 2R_{Unit}}$$

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

6.9.2.3 Connecting with the Hall Sensor

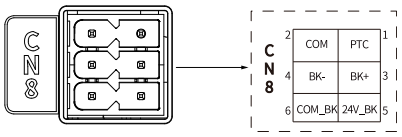


Note

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

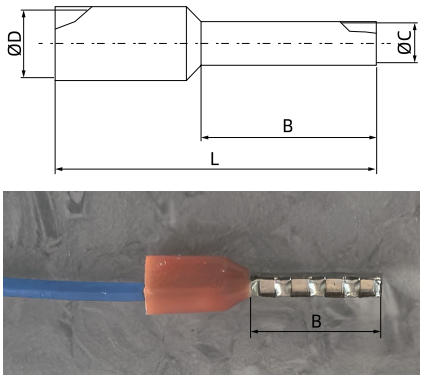
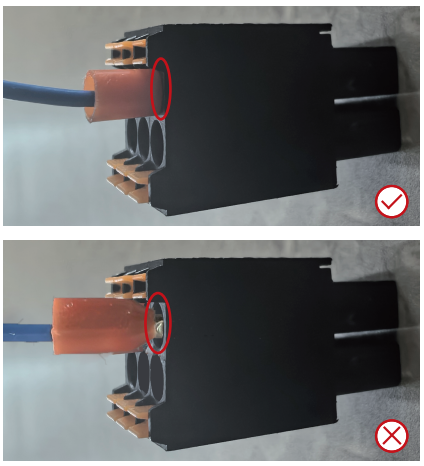
6.10 Description of Brake and PTC Input Terminal (CN8)

6.10.1 Terminal Arrangement



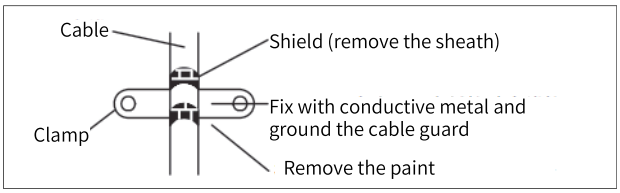
Pin No.	Description	Description	Pin No.	Description	Description
1	PTC	Motor temperature feedback input	2	COM-	Onboard 24V, COM
3	BK+	Brake+	4	BK-	Brake-
5	24V_BK	External power supply for the brake	6	COM_BK	Brake 24V, COM

6.10.2 Wiring Precautions and Requirements

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

EMC requirements

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



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

Additional requirements

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

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

6.10.3 Wiring Examples

6.10.3.1 PTC Wiring Example

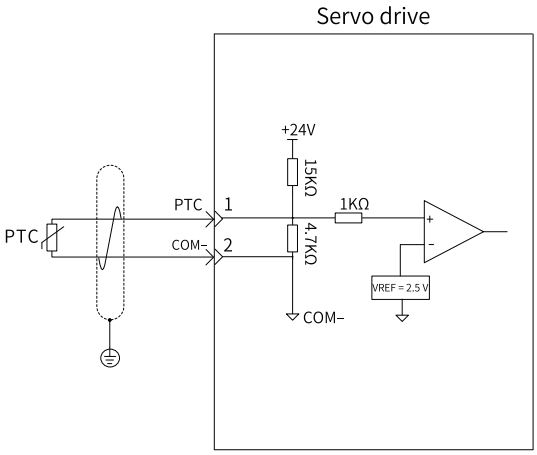


Figure 6-43 PTC wiring diagram

Note

- The resistance range triggering PTC circuit overtemperature operation is 1.8 kΩ to 3.85 kΩ. When selecting PTC, note that the PTC resistance value must be less than 1.8 kΩ when the PTC does not operate, and larger than 3.85 kΩ when the PTC operates for overtemperature.
- Only switching thermistors are supported. Connect the shielded cable between the servo drive and the motor properly during wiring.

6.10.3.2 Brake Wiring Examples

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

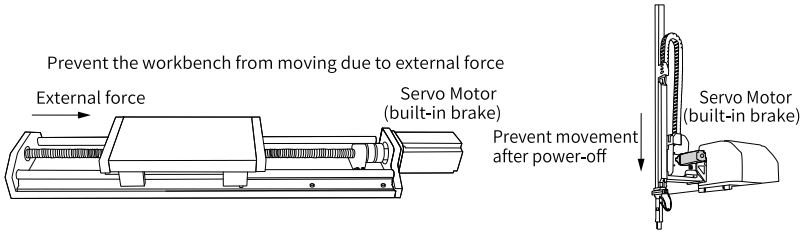
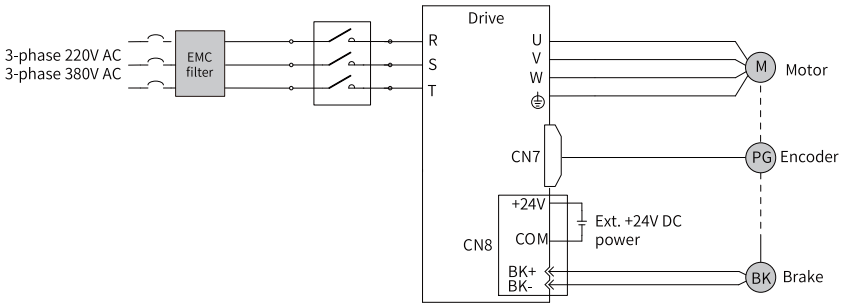


Figure 6-44 Application of the brake

Caution

- Use the built-in brake for position-lock purpose only. Do not use this brake for any other purposes (such as braking) other than position-lock in the stop state.
- The motor with brake should be controlled by the servo drive itself. It is not recommended to use a PLC to control the brake.
- The brake coil has no polarity.
- After the motor stops, switch off the servo-ON (S-ON) signal.
- When a motor with brake runs, the brake may generate a clicking sound, which does not affect its function.
- When brake coils are energized (the brake is released), magnetic flux leakage may occur at the shaft end.
- Do not use instruments such as magnetic sensors near the motor.

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



Pay attention to the following precautions during wiring:

When determining the length of the motor brake cable, take full account the voltage drop caused by cable resistance. The input voltage must be 24 V±10% to enable the brake to work properly.

Note

- In the standard environment, the number of brake outputs at the drive side can reach at least 5 million. For details on the standard environment, see *"5.2.2 Installation Environment" on page 68*.
- The brake must not share the power supply with other electrical devices. This is to prevent a malfunction of the brake due to a drop in the voltage or current when other electrical devices work in tandem.
- Use cables with a cross-sectional area above 0.5 mm^2.

6.11 Expansion Safety Function Terminals CN9 and CN10

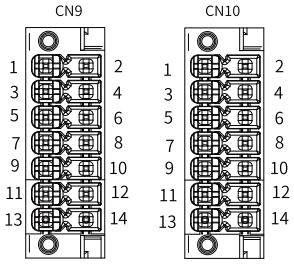


Figure 6-45 Description of CN9 and CN10 pins

Table 6–33 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 6–34 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

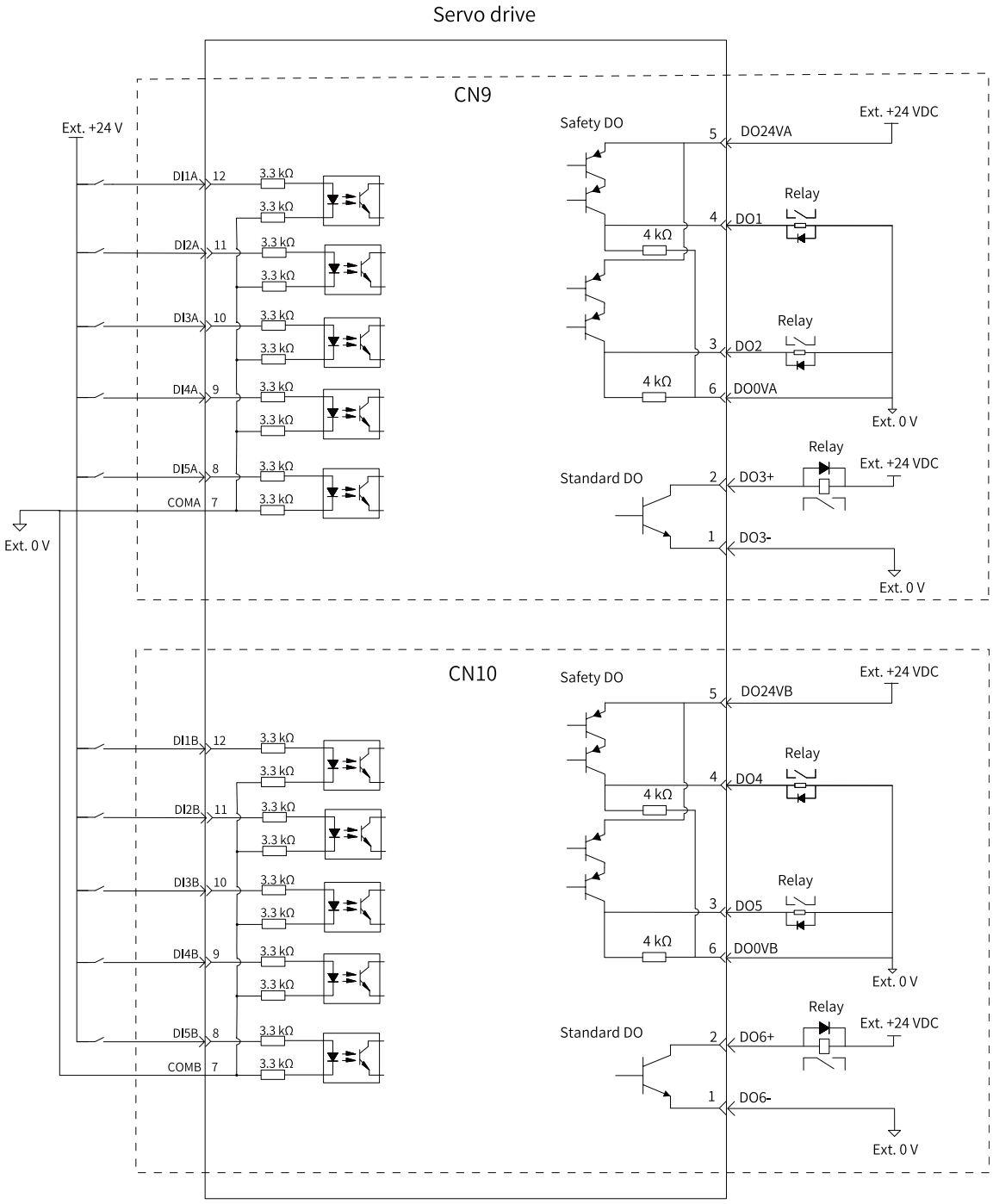
DI Wiring Requirements
Care must be taken in wiring to avoid introducing 24 V and DI short circuit failures. The following recommended method or method with equivalent effect may be used. Do as follows: • Insert 0 V between 24 V and DI signal line using a flat cable. • Use shielded wires for 24 V and 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

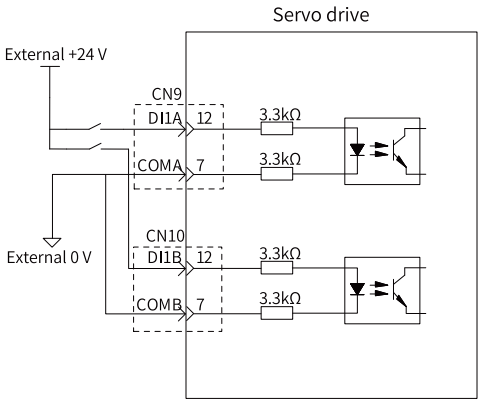
For basic information about DI/DO, see *" Basic DI information" on page 144* and *" Basic DO information" on page 145*.

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.

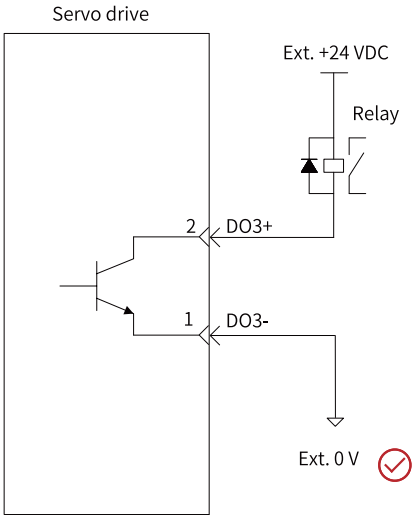


The safety DI is a source-type input. Perform wiring according to the characteristics of the load circuit.

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:**

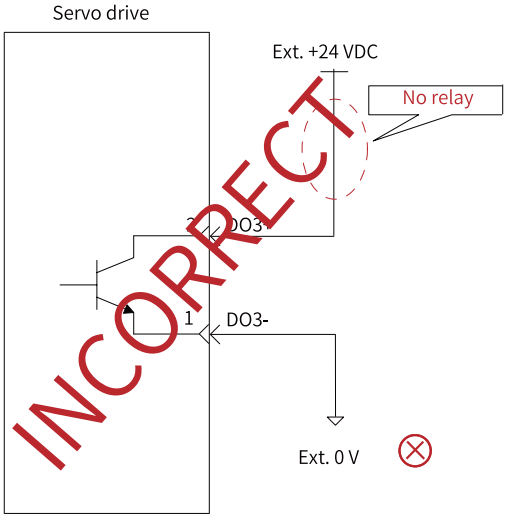


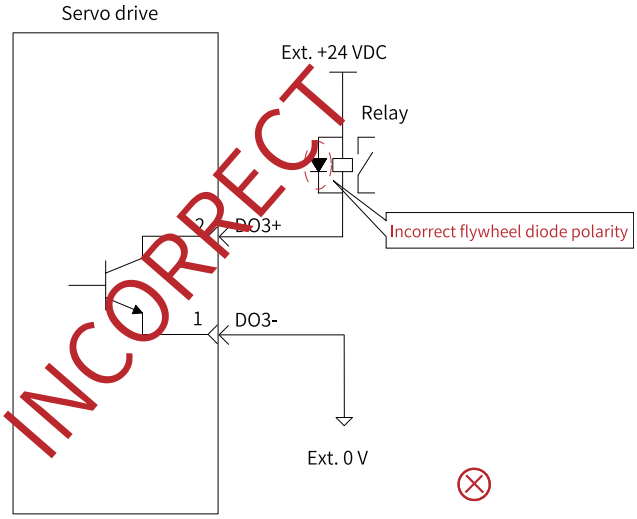
Note

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

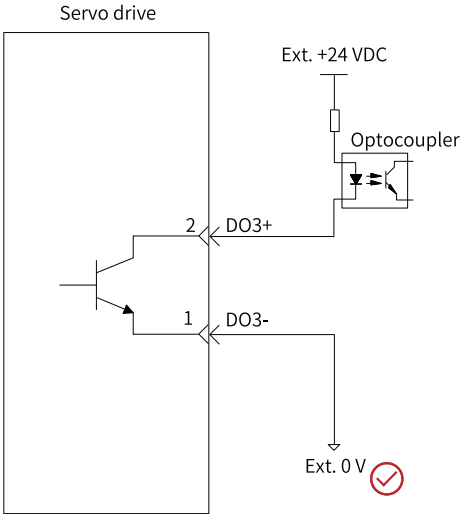
For the external voltage and current range of the DO, see *" Basic DO information" on page 145*.

  - **Incorrect wiring:**

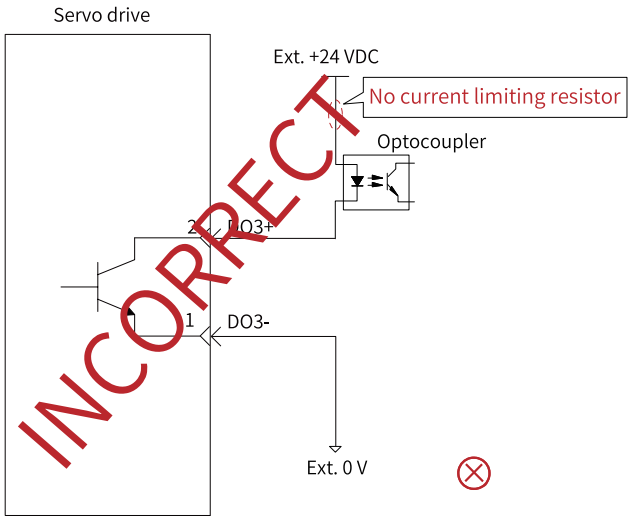




- **When the host controller adopts optocoupler input:**
  - **Correct wiring:**



  - **Incorrect wiring:**

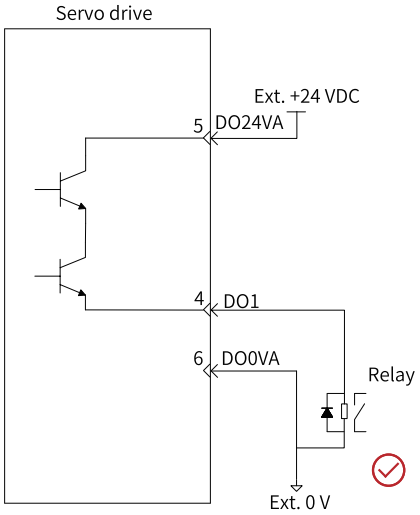


Safety digital output

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:**

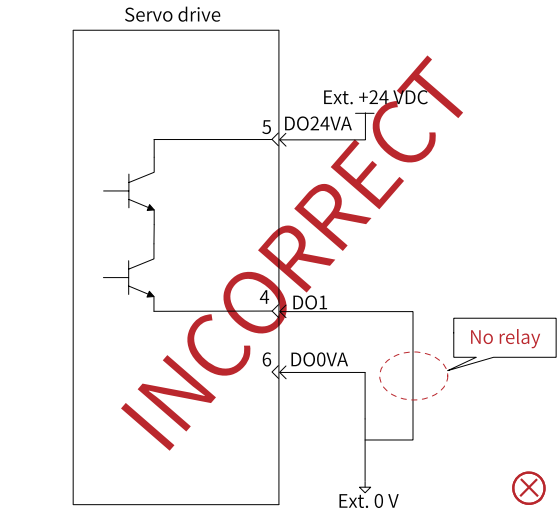


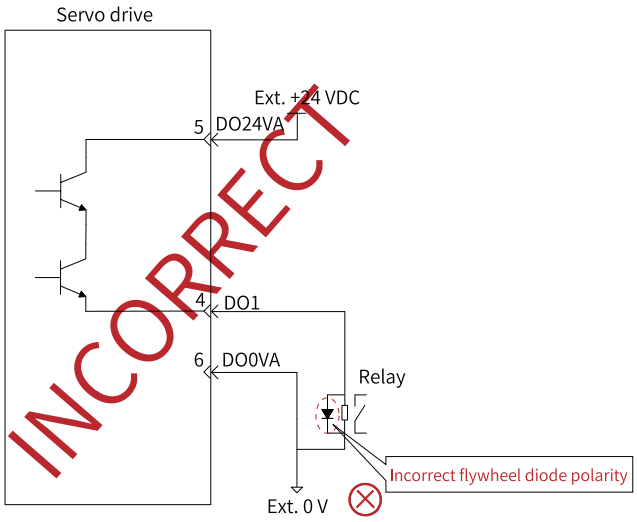
Note

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

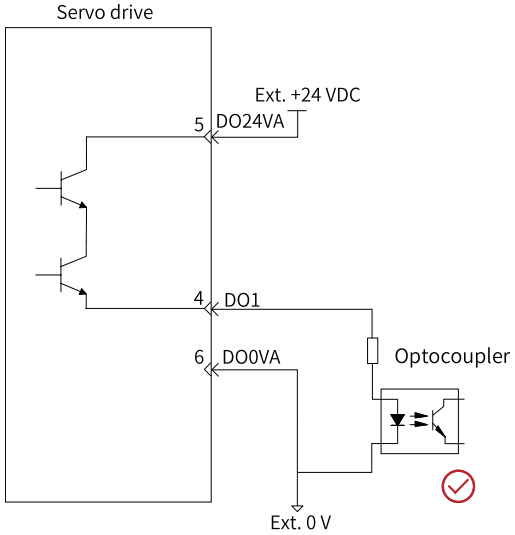
For the external voltage and current range of the DO, see *" Basic DO information" on page 145*.

  - **Incorrect wiring:**



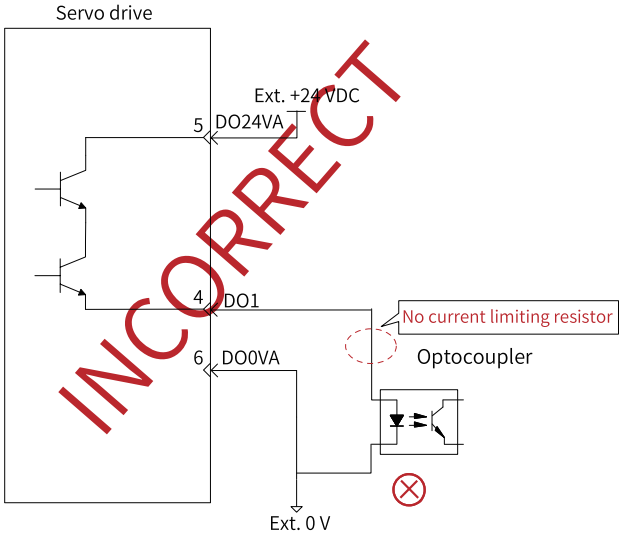


- **When the host controller adopts optocoupler input:**
  - **Correct wiring:**



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:**

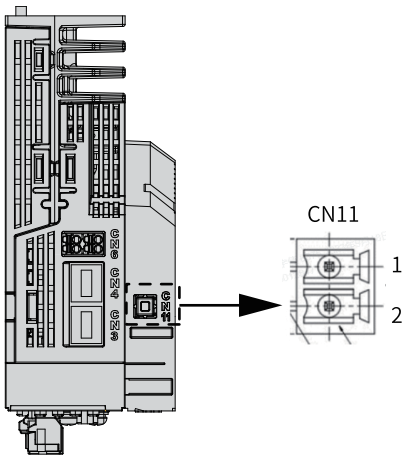


6.12 CN11 24V Terminal

Note

The CN11 24 V standby power input terminal is only available in functional safety and standby power-enabled products.

Terminal Arrangement



Pin No.	Description	Description	Pin No.	Description	Description
1	GND_BP	0 V input of the backup power supply	2	24V_BP	24 V input of the backup power supply

Description

Models with backup power can have separate power supply to the control circuit. When the main circuit is not energized, 24V BP supplies power to the control circuit to maintain functions like

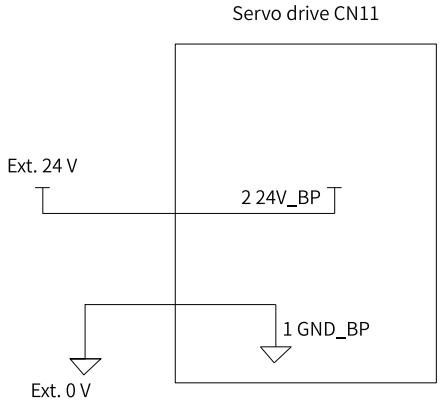
programming, parameter configuration in the software tool, and communication. The operating panel of the drive shows "nrd.1" under this circumstance.

Table 6–35 Power input specifications

Item	Specification
Power input range	Voltage: 24 V DC±15% (must be SELV/PELV power supply)
Power of the external power supply	≥ 50 W

Wiring

As shown in the following figure.



6.13 Grounding

6.13.1 Grounding Requirement (CE)

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

Danger

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

Caution

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

6.13.2 Grounding Requirements (UL)

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

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

6.13.3 Wiring Precautions

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

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

6.13.4 Wiring Examples

6.13.4.1 Single-Drive Grounding

For grounding of a single drive, see *" System connection diagram" on page 64*.

6.13.4.2 Multi-Drive Grounding

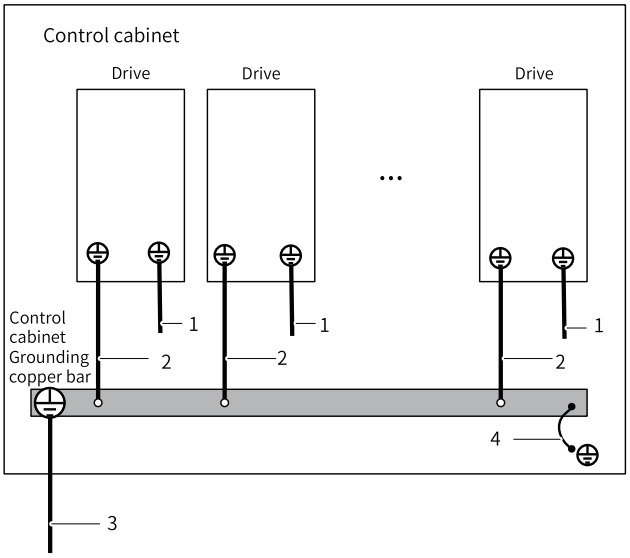


Figure 6-46 Multi-drive grounding

Table 6–36 Description of parallel grounding of multiple drives

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

6.13.4.3 Grounding of the Control Cabinet System

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

Table 6–37 Wiring requirements

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

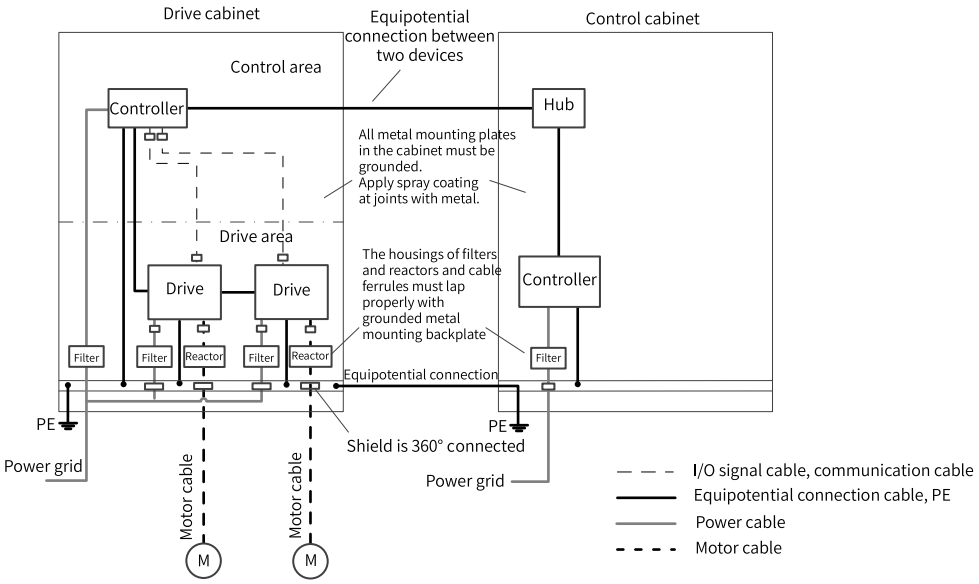


Figure 6-47 Recommended wiring for the control cabinet system

6.14 Wiring of Options

6.14.1 Wiring of the Braking Resistor

When the capacitance of the bus is insufficient, the extra energy can be consumed by connecting an external braking resistor to the P⊕ and C terminals.

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

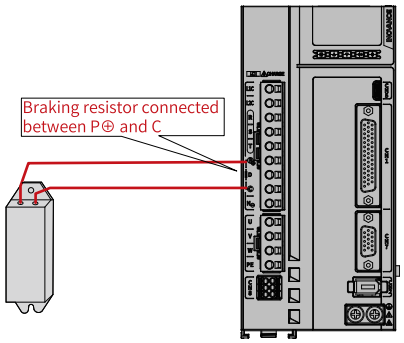


Figure 6-48 Wiring of external braking resistor

For cables (CE) used for terminals P⊕ and C, see *"6.3.4.1 Cable Specifications (CE)" on page 95*. For recommended cable specifications (UL), see *"6.3.4.2 Cable Specifications (UL)" on page 98*.

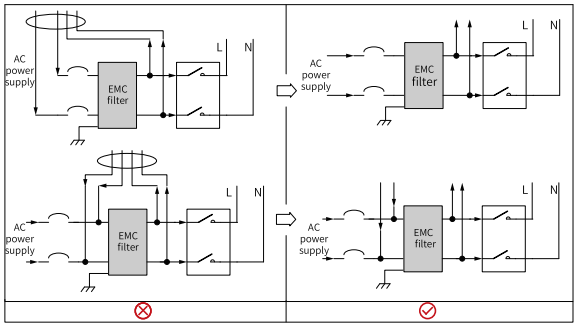
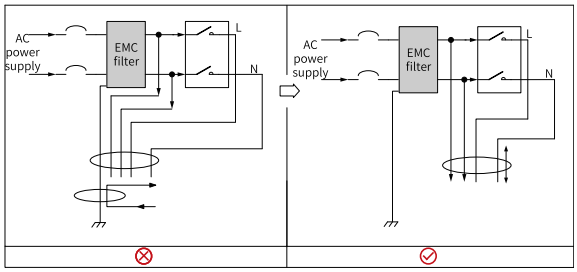
Caution

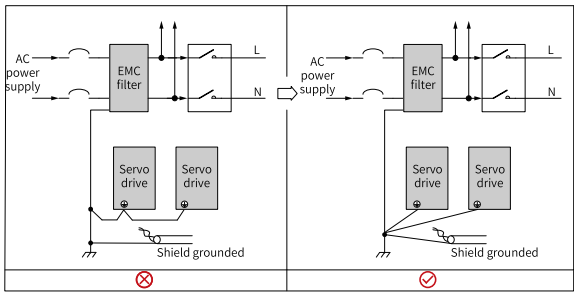
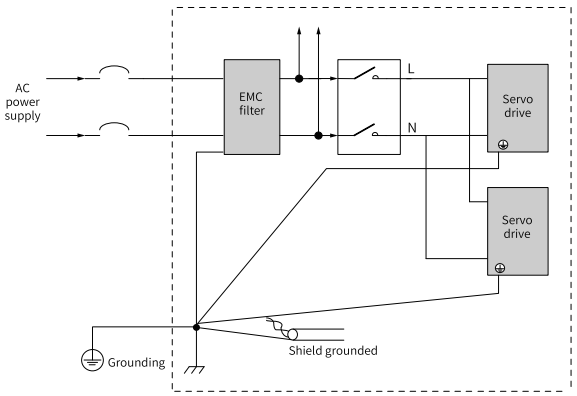
Observe the following precautions when connecting the braking resistor:

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

6.14.2 Wiring of the Power Supply Filter

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

No.	Precautions	Wiring example
1	Do not place the input and output cables of the EMC filer in the same duct or bundle them together.	 Figure 6-49 Separate routing of EMC filter input and output cables
2	Route the grounding cable and the output power cable of the EMC filter through different routes.	 Figure 6-50 Separate routing of the grounding cable and output power cable

No.	Precautions	Wiring example
3	Use a separate grounding cable as short and thick as possible for the EMC filter. Do not share the grounding cable with other grounding devices.	 Figure 6-51 Single-point grounding
4	Ground the EMC filter inside the cabinet. If the EMC filter and the servo drive are installed in the same control cabinet, fix the EMC filter and the servo drive on the same metal plate. Make sure the contact part is in good conductive condition, and ground the metal plate properly.	 Figure 6-52 Grounding of the EMC filter

6.14.3 Wiring of Surge Protection Device

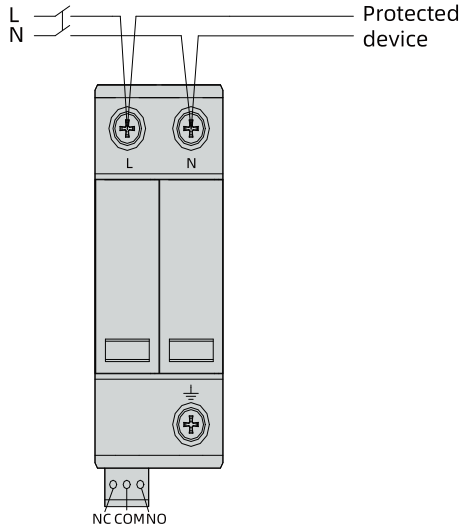
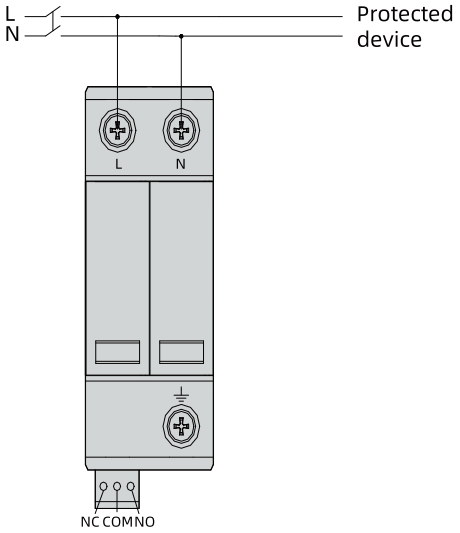
6.14.3.1 Wiring Precautions and Requirements

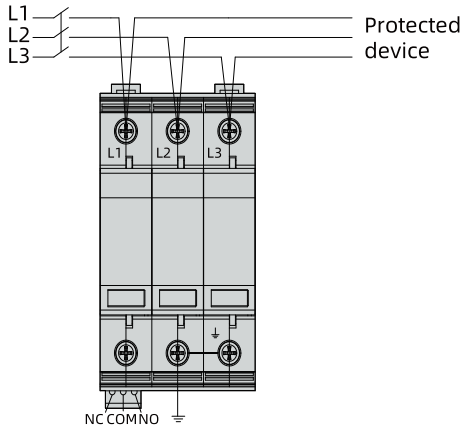
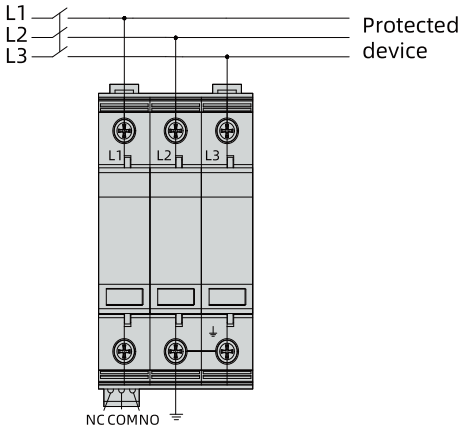
- A proper fuse or circuit breaker must be connected in series in the upstream of the power supply surge protection device.
- The power supply must be disconnected during wiring. Never operate with power on. When connecting to the power supply, strictly follow the wiring labels and PE on the product.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

6.14.3.2 Wiring Example

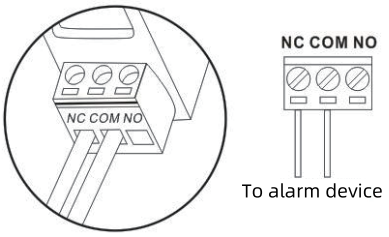
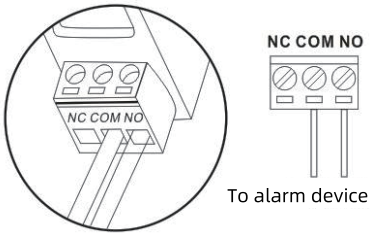
Wiring method

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

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

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

Alarm wiring

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

Installation and inspection

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

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

6.15 Post-wiring Inspection

After wiring is done, check the following items.

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

6.16 Solutions to Common EMC Problems

6.16.1 Residual Current Device Malfunction

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

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

When malfunction occurs on the RCD, take the following measures.

Table 6–38 Measures against leakage current

Symptom	Possible Cause	Solution
The RCD trips at the moment of power-on.	The anti-interference performance of the RCD is weak.	• It is recommended to use Siemens or Schneider RCDs. • Use a RCD with a higher tripping current. • Move the unbalanced load to the front end of the RCD.
	The tripping current of the RCD is too low.	
	An unbalanced load is connected to the rear end of the RCD.	
	The capacitance of the front end of the servo drive is too high.	
The RCD trips during operation.	The anti-interference performance of the RCD is weak.	• It is recommended to use Siemens or Schneider RCDs. • Use a RCD with a higher tripping current. • Install a simple filter on the input side of the drive and wind the magnetic ring on the LN and RST cables near the RCD, as shown in *"Figure 6-53 Magnetic ring on the input side" on page 161*. • Reduce the carrier frequency without compromising the performance. • Reduce the length of motor cables.
	The tripping current of the RCD is too low.	
	An unbalanced load is connected to the rear end of the RCD.	
	For motor cables and the motor, the distributed capacitance to ground is too high.	

Figure 6-53 Magnetic ring on the input side

6.16.2 Harmonic Suppression

To suppress harmonics and improve the power factor to allow the drive to fulfill the standards, install an AC input reactor on the input side of the drive. For details about the reactor models, see "Options" > "Peripheral Electrical Components" > "AC Input Reactor" in the User Guide. For installation methods, see *"5.2.7.2 Instructions for Installing the AC Input Reactor" on page 77*.

6.16.3 Control Circuit Interference

6.16.3.1 High-speed Pulse Interference

Take corrective measures as described in the following table.

No.	Procedure
1	Use shielded twisted pair cables with both ends of the cable grounded. For details, see *"I/O signal cable selection" on page 108*.
2	Connect the motor enclosure to the PE terminal of the drive.
3	Connect the PE terminal of the drive to the PE terminal of the mains power supply.
4	Add an equipotential bonding grounding cable between the host controller and drive. For details, see *"Grounding the control cabinet system" on page 105*.
5	Separate signal cables from power cables with a distance of at least 30 cm.
6	Wind the signal cable around the ferrite clamp or magnetic ring by one or two turns. For details, see *"5.2.7.4 Instructions for Installing Magnetic Ring and Ferrite Clamp" on page 78*.
7	Wind the drive output (U/V/W) cables around the magnetic ring by two to four turns. For details, see *"5.2.7.4 Instructions for Installing Magnetic Ring and Ferrite Clamp" on page 78*.
8	Use a shielded power cable and properly ground its shield.

6.16.3.2 Control Circuit Wiring Interference

For analog/frequency-division input/fully closed-loop wiring, see *"6.16.3.1 High-speed Pulse Interference" on page 162* for details.

6.16.3.3 Common I/O Signal Interference

The drive generates very strong interference during operation. The drive may interfere with or be interfered with by other devices due to improper routing or grounding. In such cases, take the following measures.

No.	Procedure
1	Use shielded cables as the I/O signal cables and connect the shield to the PE terminal. For details, see *"6.4.3 Cable Specifications and Model Requirements" on page 108*.
2	Reliably connect the PE terminal of the motor to the PE terminal of the servo drive, and connect the PE terminal of the servo drive to the PE terminal of the grid.
3	Add an equipotential bonding grounding wire between the host controller and the servo drive.
4	Wind the drive output (U/V/W) cables around the magnetic ring by two to four turns. For details, see *"5.2.7.4 Instructions for Installing Magnetic Ring and Ferrite Clamp" on page 78*.
5	Increase the filter capacitance for low-speed DIs. A capacitance up to 0.1 μF is recommended, as shown in *"Figure 6-54 Increasing filtering on I/O signal cables" on page 163*.
6	Increase the filter capacitance between AI and GND. A capacitance up to 0.22 μF is recommended.
7	Wind the signal cable around the magnetic ring or ferrite clamp by one or two turns. For details, see *"5.2.7.4 Instructions for Installing Magnetic Ring and Ferrite Clamp" on page 78*.
8	Use a shielded power cable and properly ground its shield.

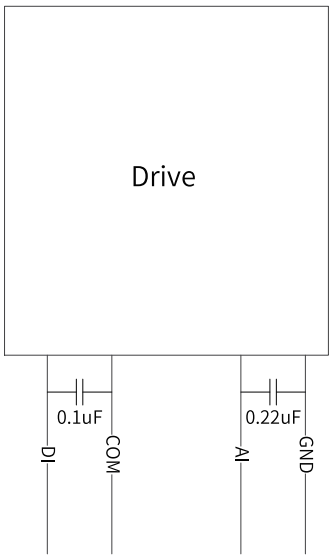


Figure 6-54 Increasing filtering on I/O signal cables

6.16.4 Communication Interference

Take corrective measures as described in the following table.

Step	Solution
1	Install a 120 Ω termination resistor on each end of the bus.
2	Replace with multi-conductor shielded twisted pair cables and ground both ends of the shield.
3	Separate communication cables from power cables with a distance of at least 30 cm.
4	Adopt daisy chain mode for multi-node communication layout.
5	Add an equipotential bonding grounding cable between nodes during multi-node communication. For details, see *" Grounding the control cabinet system" on page 105*.
6	Install ferrite clamps on both sides of the communication cable or wind the magnetic ring by one or two turns. For details, see *"5.2.7.4 Instructions for Installing Magnetic Ring and Ferrite Clamp" on page 78*.
7	Wind the drive output (U/V/W) cables around the magnetic ring by two to four turns. For details, see *"5.2.7.4 Instructions for Installing Magnetic Ring and Ferrite Clamp" on page 78*.
8	Use a shielded power cable and properly ground its shield.

7 Commissioning Tools

7.1 Keypad

7.1.1 Keypad Display

Table 7–1 LED display and actual data

Display	Actual data	Display	Actual data	Display	Actual data	Display	Actual data
0	0	9	9	h	h	r	r
1	1	A	A	c	c	t	t
2	2	b	B	J	J	U	U
3	3	C	C	L	L	y	y
4	4	d	D	n	n	T	T
5	5	E	E	N	N	u	u
6	6	F	F	o	o	-	-
7	7	H	H	P	P	-	-
8	8	G	G	q	q	-	-

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

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

Display mode switchover

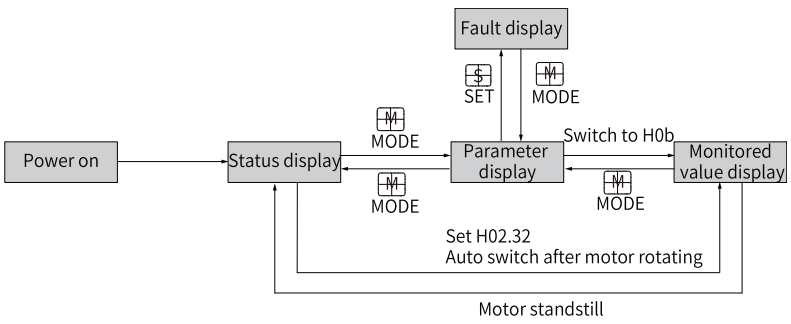


Figure 7-1 Switchover among different display modes

- The keypad enters status display immediately upon power-on.

- Press MODE to switch among different display modes based on the conditions shown in *"Figure 7-1" on page 164* .
- In status display mode, set H02.32 to select the monitored parameter. When the motor rotates, the operation panel automatically switches to the monitoring display mode. After the motor stops, the panel automatically restores to the status display mode.
- In parameter display mode, after you select the parameter to be monitored in group H0b, the keypad switches to monitored information display.
- When a fault occurs, the operation panel immediately enters the fault display mode, and all 5-digit LEDs blink. Press SET to stop the LEDs from blinking, and then press MODE to switch to parameter display.

Status display

Display	Name	Scenario	Description
	reset Servo drive initializing	Upon power-on.	The servo drive is in the initialization or reset status. After initialization or reset is completed, the servo drive automatically switches to other status.
	nrd.x Servo not ready	The servo drive is initialized, but is not ready.	Definition of "nrd.x": For specific causes and troubleshooting methods, see *"Table 7-2 Cause and solution for display of "nrd.x"" on page 166*
	RDY Servo ready	The servo drive is ready to run.	The servo drive is ready to run and waits for the enabling signal from the host controller.
	Run Servo running	Setting the S-ON signal to ON.	The servo drive is running.
	JOG Jog	The servo drive is in jog running state.	See *"8.7 Jog" on page 224* for details.
	STO STO function display selection	If there is no fault or alarm, the servo drive is in the ready state and STO is activated	Check whether the 24 V input of the STO terminal is disconnected.

STO function display selection:

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

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

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

Table 7–2 Cause and solution for display of "nrd.x"

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

Parameter display

Parameters of the SV680P-INT series servo are divided into groups H00 to H34 based on their functions. A parameter can be located quickly based on the parameter group it belongs to. For details, see section "Parameter Description".

- Display of parameter groups

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

For example, H02.00 is displayed as follows:

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

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

    Such numbers are displayed on one interface (five digits). For signed numbers, the highest bit "-" represents the negative symbol.

    For example, -9999 is displayed as follows:



For example, 65535 is displayed as follows:



- Signed number with more than 4 digits and unsigned number with more than 5 digits

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

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

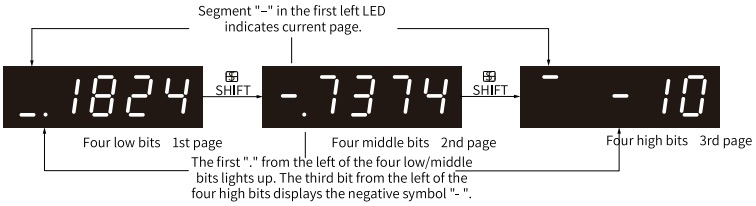


Figure 7-2 Display of "-1073741824"

For example, 1073741824 is displayed as follows:

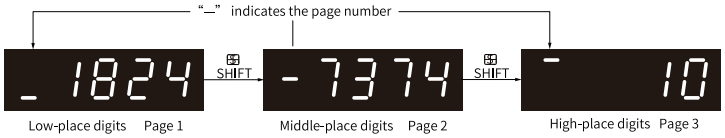


Figure 7-3 Display of "1073741824"

- Display of the decimal point

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

Display	Name	Description
	Decimal point	100.0

- Display of parameter setting status

Display	Name	Scenario	Description
	Done Parameter setting completed	The parameter has been set.	The parameter has been set and saved to the servo (Done). The servo drive can execute other operations.
	F.InIt Restore to default settings	Parameter initialization is in progress (H02.31 = 1).	The servo drive is restoring parameters to default values (Function Code Initialize). After parameter initialization is done, switch on the control power supply again.
	Error Incorrect password	The user password (H02.30) is activated, but the password entered is incorrect.	An incorrect password is entered. You need to enter the password again.

Display	Name	Scenario	Description
	TunE	The one-key auto-tuning function is enabled.	The function of auto-tuning with one-key is in progress.
	FAIL	The one-key auto-tuning function is enabled.	The function of auto-tuning with one key fails.
	AdJ_ (auto-tuning)	Enable tuning: phase sequence tuning and resistance and inductance tuning.	The drive is in the auto-tuning process.

Fault display

- The operating panel can display present or previous faults and errors. For details about troubleshooting, see *" Troubleshooting Faults and Alarms" on page 1169*.
- When a fault or an alarm occurs, the operation panel immediately displays the corresponding fault or alarm code. When multiple faults or alarms occur, the operation panel displays the fault or alarm code of the highest fault level.
- Set in H0b.33 the number of history faults that can be viewed. View H0b.34 to check the selected fault or alarm codes.
- You can clear the latest 20 faults or alarms saved in the servo drive by setting H02.31 to 2.

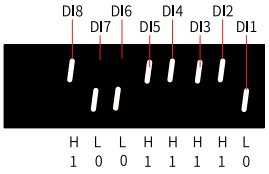
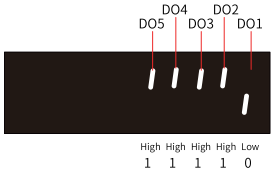
For example, "E941.0" is displayed as following:

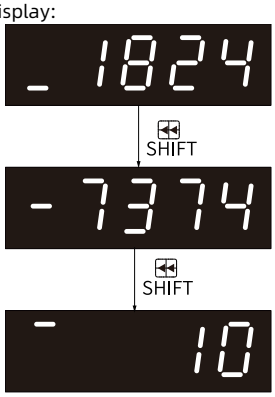
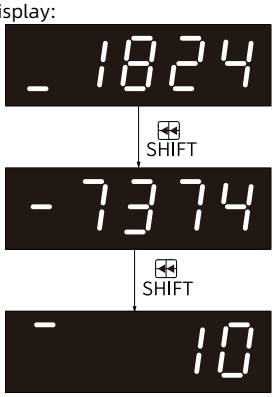
Display	Name	Description
	E941.0 Alarm code	E: A fault or alarm occurs on the servo drive. 941.0: the alarm code

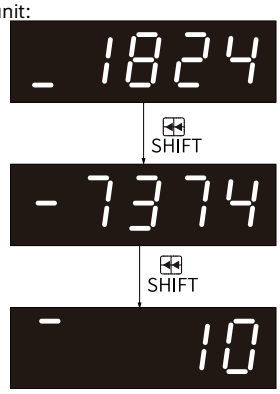
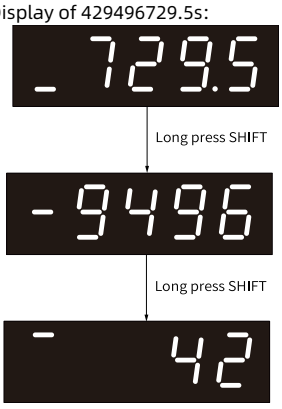
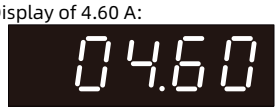
Monitoring information display

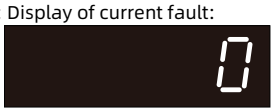
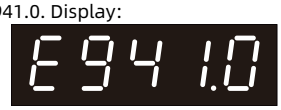
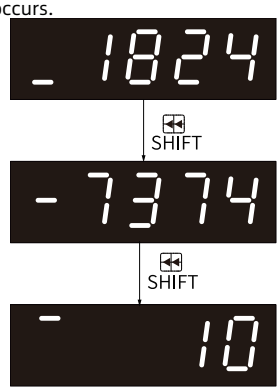
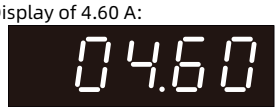
- Group H0b: The parameters in this group are used to monitor the running status of the servo drive. You can enable panel monitoring display by setting H02.32. The parameter group number displayed is H0b and the group offset is the value set by H02.32.
- When H02.32 is set to a valid group offset, the motor enters the state display mode when it is at a standstill and enters the parameter display mode when the motor is in the rotating state. The mode switchover is irrelevant to the S-ON signal of the servo.
- For example, when H02.32 is set to 00, when the motor changes from the standstill state to rotation state, the display switches from "Status display mode" to "Parameter display mode", and the display displays the parameter value corresponding to H0b.00.

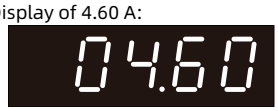
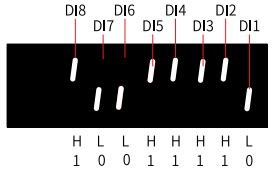
The following table describes the monitoring parameters in group H0b.

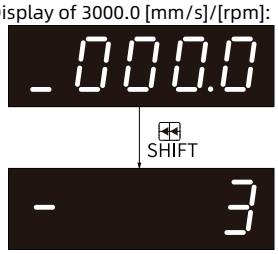
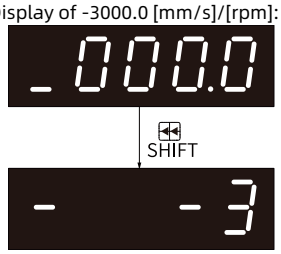
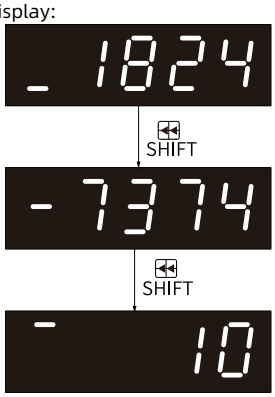
Parameter	Name	Accuracy	Unit	Description	Example
H0b.00	Actual motor speed	1	[mm/s]/[rpm]	Displays the actual motor speed.	Display of 3000 (mm/s)/rpm:  Display of -3000 [mm/s]/[rpm]: 
H0b.01	Speed reference	1	[mm/s]/[rpm]	Displays the present speed reference of the drive in the position and speed control modes.	Display of 3000 (mm/s)/rpm:  Display of -3000 [mm/s]/[rpm]: 
H0b.02	Internal torque reference	0.1	%	Displays the current torque reference value. The value 100.0% corresponds to the rated motor torque.	Display of 100.0%:  Display of -100.0%: 
H0b.03	Monitored DI state	1	-	Displays the optocoupler status of DI1 to DI8: Upper LED segments turned on: The optocoupler is switched off (indicated by "1"). Lower LED segments turned on: The optocoupler is switched on (indicated by "0"). The H0b.03 value read by the software tool is a decimal.	For example, if DI1 is low level and DI2 to DI8 are high level, The corresponding binary value is "10011110", and the value of H0b.03 read in the software tool is 158. The keypad display is as follows: 
H0b.05	Monitored DO state	1	-	Displays the optocoupler status of DO1 to DO5: Upper LED segments turned on: The optocoupler is switched off (indicated by "1"). Lower LED segments turned on: The optocoupler is switched on (indicated by "0"). The value of H0b.05 read in the software tool is a decimal.	For example, if DO1 is low level and DO2 to DO5 are high level: The binary value is "11110". The value of H0b.05 read by the background software is 30. The keypad display is as follows: 

Parameter	Name	Accuracy	Unit	Description	Example
H0b.07	Absolute position counter	1	Reference unit	Indicates the current absolute position of the motor (in reference unit).	1073741824 referent units display: 
H0b.09	Mechanical angle	0.1	°	Indicates the current mechanical angle (p) of the motor. The value 0 indicates that the mechanical angle is 0°. Maximum value of H0b.09 for an incremental encoder: Number of encoder pulses per revolution × 4 – 1. (For example, the maximum value of H0b.09 for a 2500-PPR incremental encoder is 9999.) Maximum value of H0b.09 for an absolute encoder is 65535. Actual mechanical angle: $\text{Actual mechanical angle} = \frac{\text{H0b.09}}{\text{H0b.09 max. value}+1} \times 360.0\text{deg}$	Display of 10000 p: 
H0b.10	Electrical angle	0.1	°	Displays current electrical angle of the motor.	Display of 360.0°: 
H0b.12	Average load ratio	0.1	%	Indicates the percentage of the average load torque to the rated torque of the motor.	Display of 100.0%: 
H0b.13	Input position reference counter (displayed in 32-bit decimal)	1	Reference unit	Counts and displays the number of input position references.	1073741824 referent units display: 

Parameter	Name	Accuracy	Unit	Description	Example
H0b.15	Encoder position deviation counter (32-bit decimal display)	1	Encoder unit	Encoder position deviation = Sum of input position references (encoder unit) – Sum of pulses fed back by the encoder (encoder unit)	Display of 10000 in encoder unit: 
H0b.17	Feedback pulse counter (32-bit decimal display)	1	Encoder unit	Counts and displays the number of pulses fed back by the encoder (encoder unit).	Display of 1073741824 in encoder unit: 
H0b.19	Total power-on time (32-bit decimal)	0.1	s	Counts and displays the total power-on time of the servo drive.	Display of 429496729.5s: 
H0b.24	Effective value of phase current	0.1	A	Displays the effective value of the phase current of the motor.	Display of 4.60 A: 
H0b.26	Bus voltage	0.1	V	Displays the DC bus voltage of the main circuit input voltage after rectification.	After 200 V AC rectification, 311.0 V is displayed as follows:  After 400 VAC rectification, 537.0 V is displayed as follows: 
H0b.27	Module temperature	1	℃	Displays the temperature of the power module inside the servo drive.	Display of 27℃: 

Parameter	Name	Accuracy	Unit	Description	Example
H0b.33	Fault record	1	-	Set the number of historical faults to be viewed. 0: Present fault 1: Last fault 2: 2nd to last fault ... 19: 19th last fault	0: Display of current fault: 
H0b.34	Fault code of the selected fault	1	-	H0b.33 is used to set the number of historical faults to be viewed, and H0b.34 is used to display the faults. When no fault occurs, the displayed value of H0b.34 is E000.0.	If H0b.33 is 0, and H0b.34 is E941.0, the current fault code is 941.0. Display: 
H0b.35	Timestamp of the selected fault	0.1	s	Indicates the total servo operation time when the selected fault occurred. When no fault occurs, the value of H0b.35 is displayed as "0.0".	If H0b.34 = E941.0 and H0b.35 = 1073741824, the present fault code is 941 and the total operating time of the drive is 1073741824s when the fault occurs. 
H0b.37	Motor speed upon the selected fault	1	[mm/s]/[rpm]	Indicates the motor speed upon occurrence of the selected fault. When no fault occurs, the value of H0b.37 is 0.	Display of 3000 (mm/s)/rpm:  Display of -3000 [mm/s]/[rpm]: 
H0b.38	Motor phase U current upon selected fault	0.1	A	Indicates the effective value of motor phase U winding current upon occurrence of the selected fault. When no fault occurs, the value of H0b.38 is displayed as "0.0".	Display of 4.60 A: 

Parameter	Name	Accuracy	Unit	Description	Example
H0b.39	Motor phase V current upon displayed fault	0.1	A	Indicates the effective value of motor phase V winding current upon occurrence of the selected fault. When no fault occurs, the value of H0b.39 is displayed as "0.0".	Display of 4.60 A: 
H0b.40	Bus voltage upon occurrence of the selected fault	0.1	V	Indicates the DC bus voltage of the main circuit when the selected fault occurred. When no fault occurs, the value of H0b.40 is displayed as "0.0".	After 200 V AC rectification, 311.0 V is displayed as follows:  After 400 VAC rectification, 537.0 V is displayed as follows: 
H0b.41	Input terminal state upon selected fault	1	-	Indicates the high/low level state of the eight DI terminals upon occurrence of the selected fault. The method for determining the DI level status is the same as that of H0b.03. When no fault occurs, all DIs are displayed as low level in H0b.41 (indicated by the decimal value 0).	Display of "H0b.41 = 158": 
H0b.53	Position deviation counter (displayed in 32-bit decimal)	1	Reference unit	Position deviation = Sum of input position references (reference unit) - Sum of pulses fed back by the encoder (reference unit)	Display of 10000 in reference unit: 

Parameter	Name	Accuracy	Unit	Description	Example
H0b.55	Actual motor speed	0.1	[mm/s]/[rpm]	Displays the actual motor speed.	Display of 3000.0 [mm/s]/[rpm]:  Display of -3000.0 [mm/s]/[rpm]: 
H0b.64	Real-time input position reference counter	1	Reference unit	It displays the position reference counter before being divided or multiplied by the electronic gear ratio. It is irrelative to the current servo state and control mode.	1073741824 referent units display: 

7.1.2 Description

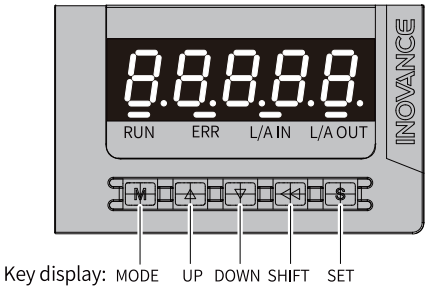


Figure 7-4 Appearance of the operation panel

The operation panel of the drive consists of a 5-digit, 8-segment LED screen, 5 keys and 4 status indicators. The keypad is used for display, parameter setting, user password setting and general functions operations.

Keys

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

Table 7-3 Functions of keys

Name	Illustration	Description
MODE		Switch between modes. Return to the upper-level menu.
UP		Increase the number indicated by the blinking digit of the LED.
DOWN		Decrease the number indicated by the blinking digit of the LED.
SHIFT		Shift the blinking digit of the LED. View the high digits of the number consisting of more than 5 digits.
SET button		Switch to the next-level menu. Execute commands such as storing parameter setpoints.

7.1.3 Parameter Setting

Example of parameter settings

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

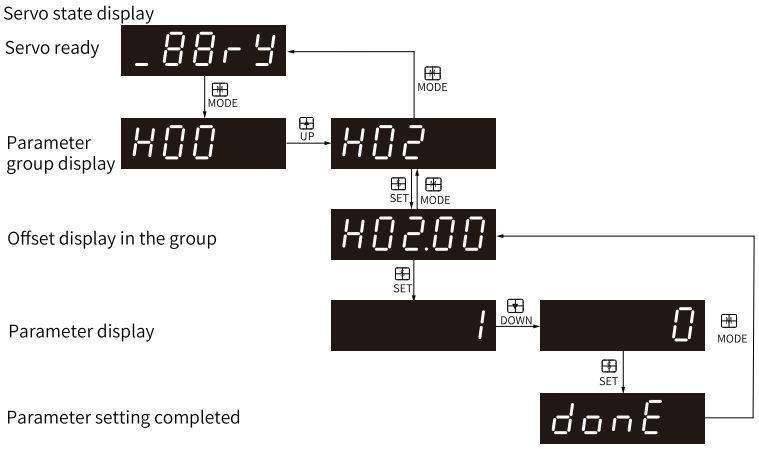


Figure 7-5 Example of parameter settings

For details about the keys, see table "Descriptions of keys". *"Table 7-3 Functions of keys" on page 175*

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

Forced DI/DO Signals

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

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

Forced DI signal input

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

- Procedure:

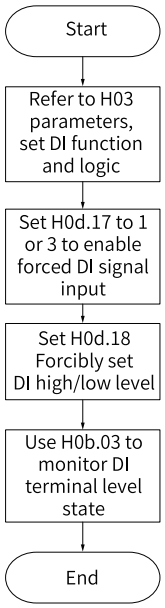


Figure 7-6 Forced DI signal setting procedure

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

Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0d.17	200d-12h	Forced DI/DO switch	bit0: Forced DI enable switch 0: Disable 1: Enable bit1: Forced DO enable switch 0: Disable 1: Enable	0	-	Real time	"H0d_en.17" on page 893

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

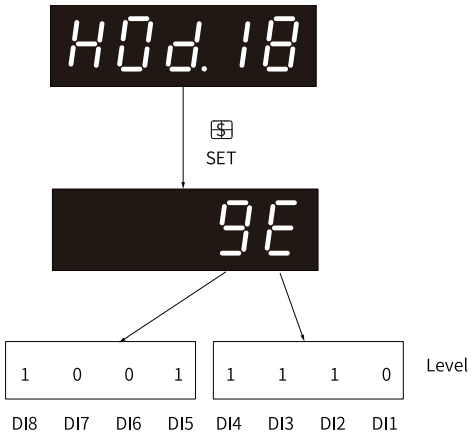


Figure 7-7 Meaning of the H0d.18 setpoint

You can monitor the DI level state through H0b.03, as shown below. The keypad display is as follows:

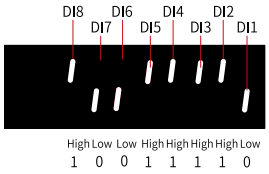


Figure 7-8 DI level states corresponding to H0b.03

Note

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

- Exit
  The forced DI function is not retentive upon power-off. After power-on again or setting H0d.17 to 0, normal DI functions apply.

Forced DO signal

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

- Operation Method

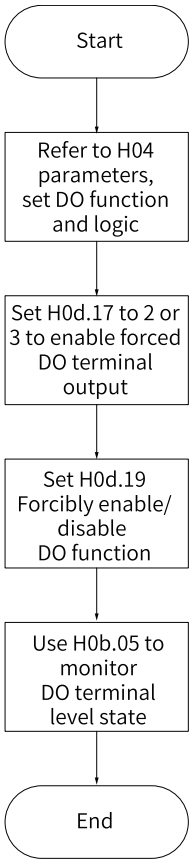


Figure 7-9 Procedure for setting forced DO signal output

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

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

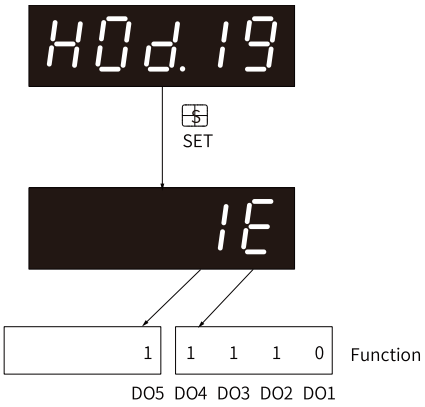


Figure 7-10 Meaning of the H0d.19 setpoint

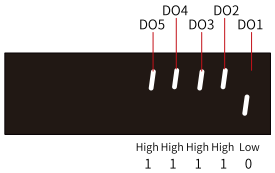


Figure 7-11 Display of H0b.05 when all DO are "active high"

- Exit

  The forced DO function is not retentive upon power-off. Normal DOs apply after restart, or you can set H0d.17 to 0 to return to the normal DO mode.

User password

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

- Setting the user password

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

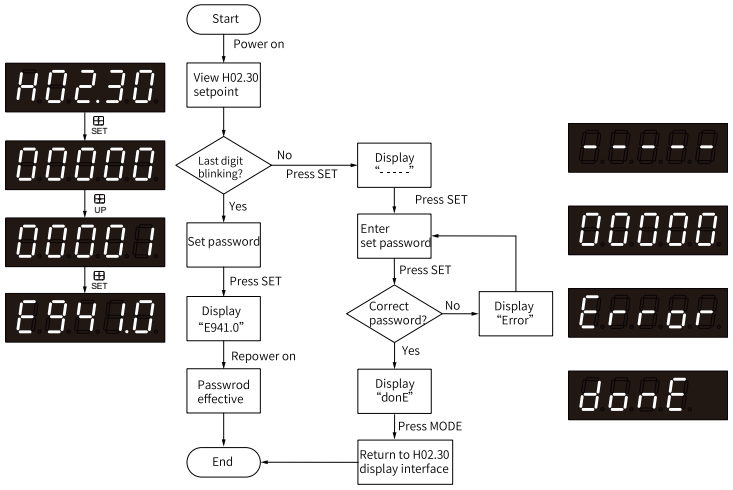


Figure 7-12 Procedure for setting the user password

- Changing the user password

To change the user password, input the current password first to grant permissions on parameter setting. Enter H02.30 again, and then set a new password according to the method described in the preceding figure.

Note

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

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

7.2 Commissioning Software

7.2.1 Install

1. Access to the software

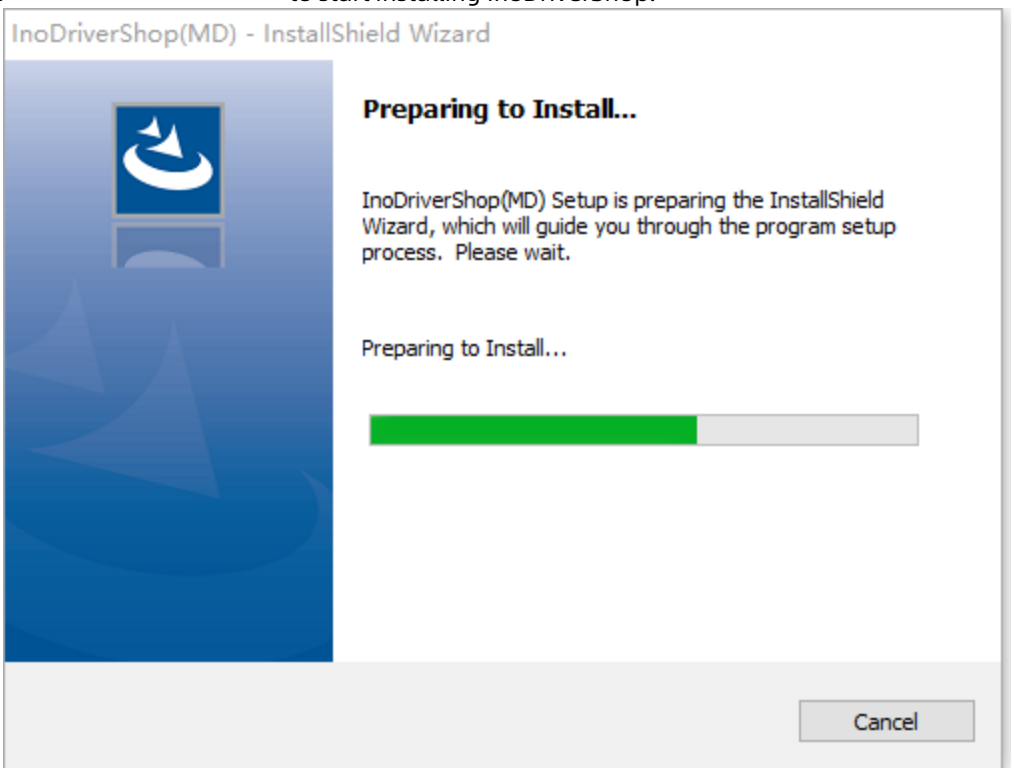
   a. Visit the official website of Inovance as shown below.
   https://www.inovance.com/global

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

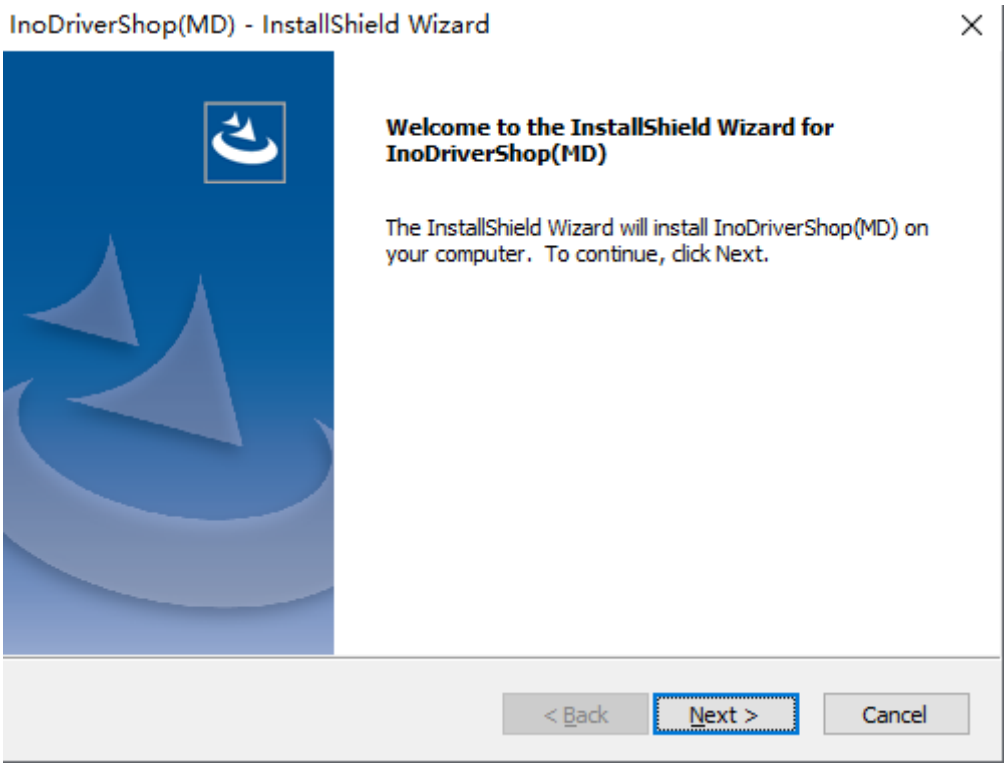
   c. Click "Download".

2. Decompress the downloaded package.

3. Click InoDriverShop.exe to start installing InoDriverShop.

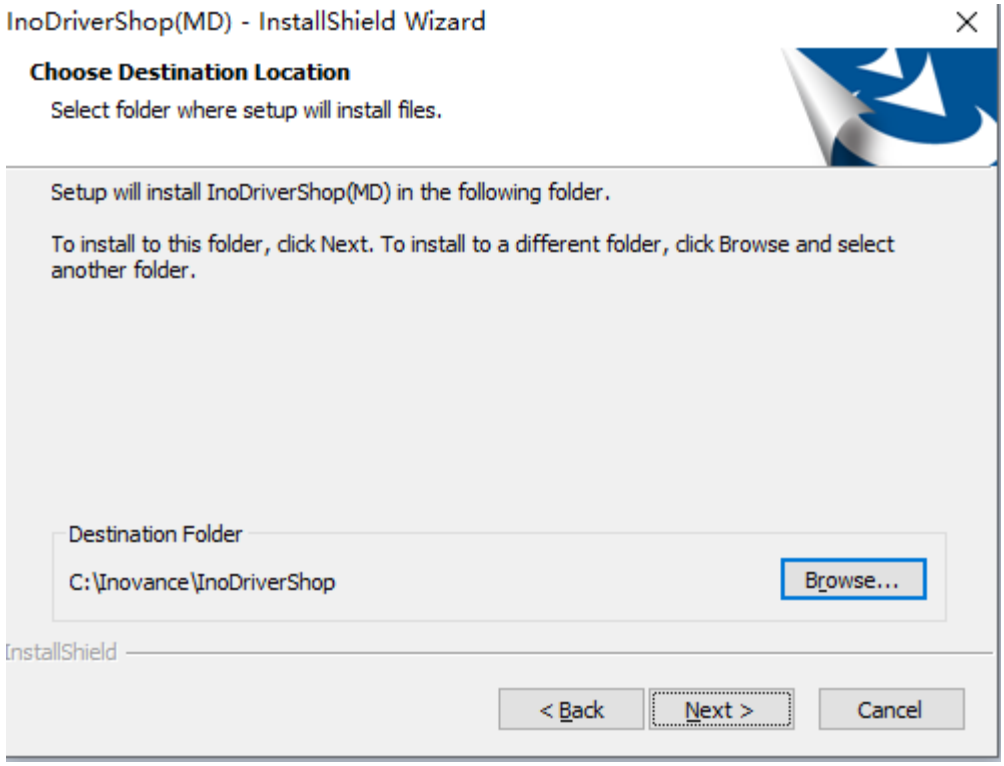


4. Click "Next".

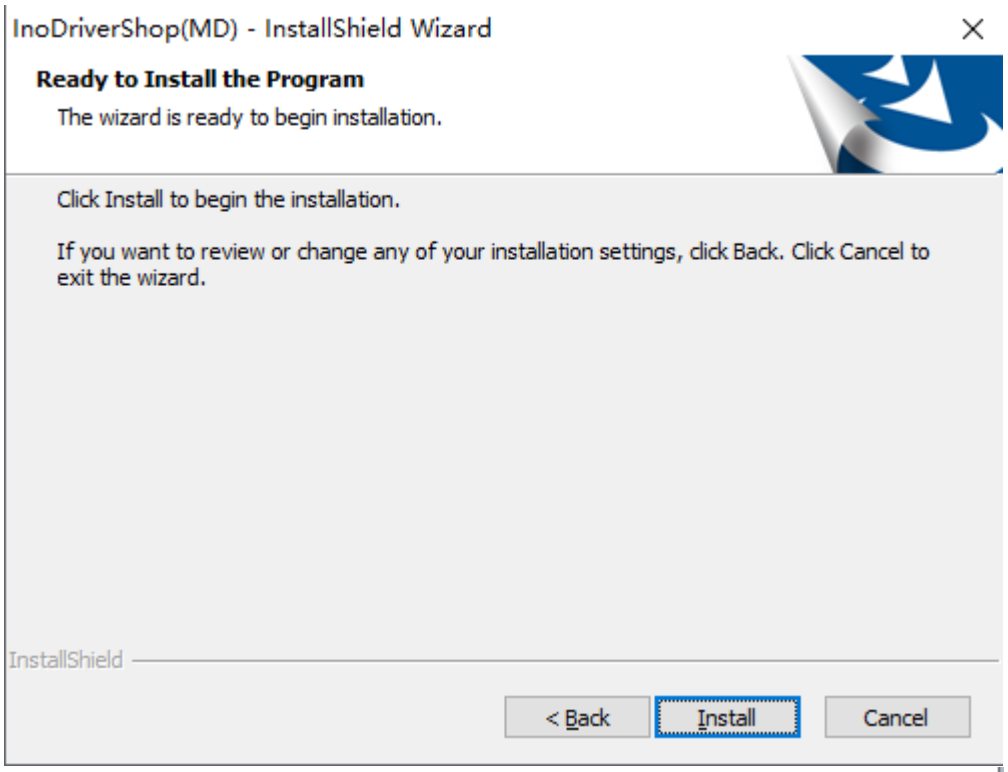


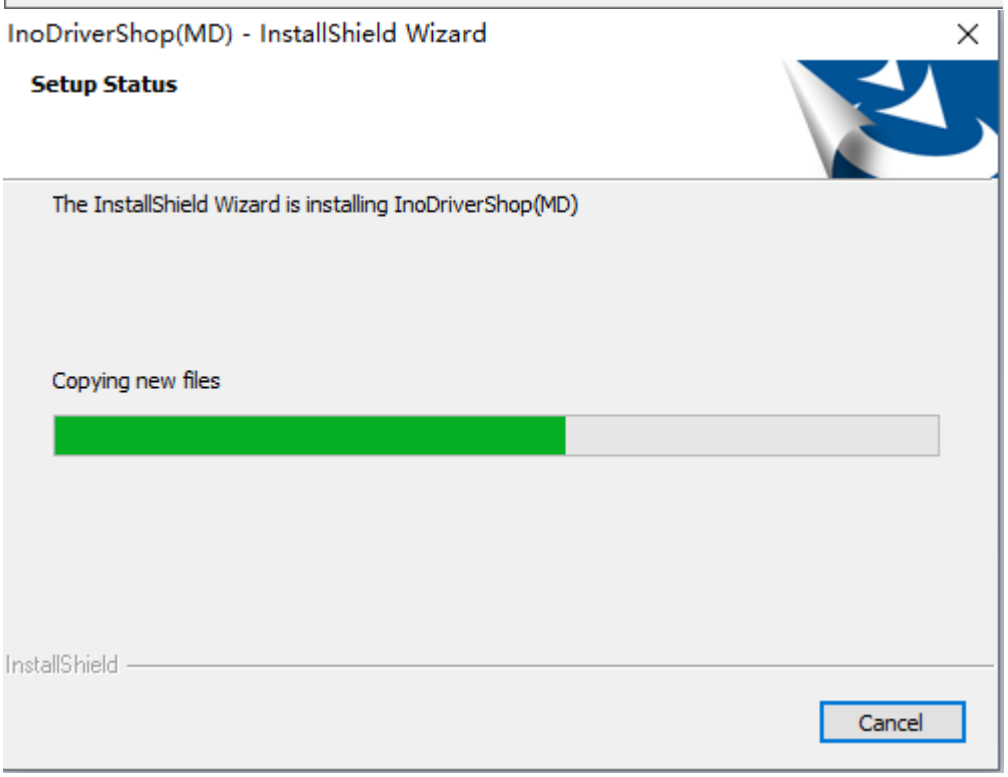
5. You can select the directory for installation as needed through the "Browse" button. The default installation directory is C:\Program Files\Inovance\InoDriverShop.
   If you upgrade InoDriverShop online, InoDriverShop will be upgraded directly in the original directory.

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

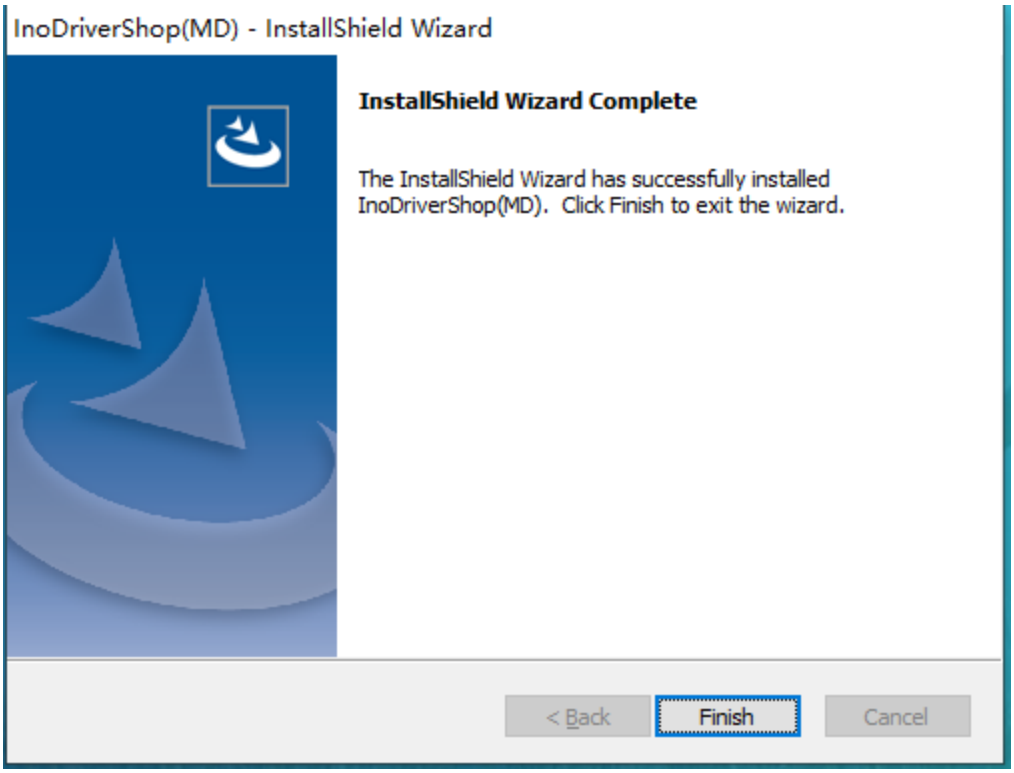


6. Click "Install" to start installation.





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



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



7.2.2 Connection

1. Start InoDriverShop.

- Double-click  to start InoDriverShop.

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

2. Create a project.

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

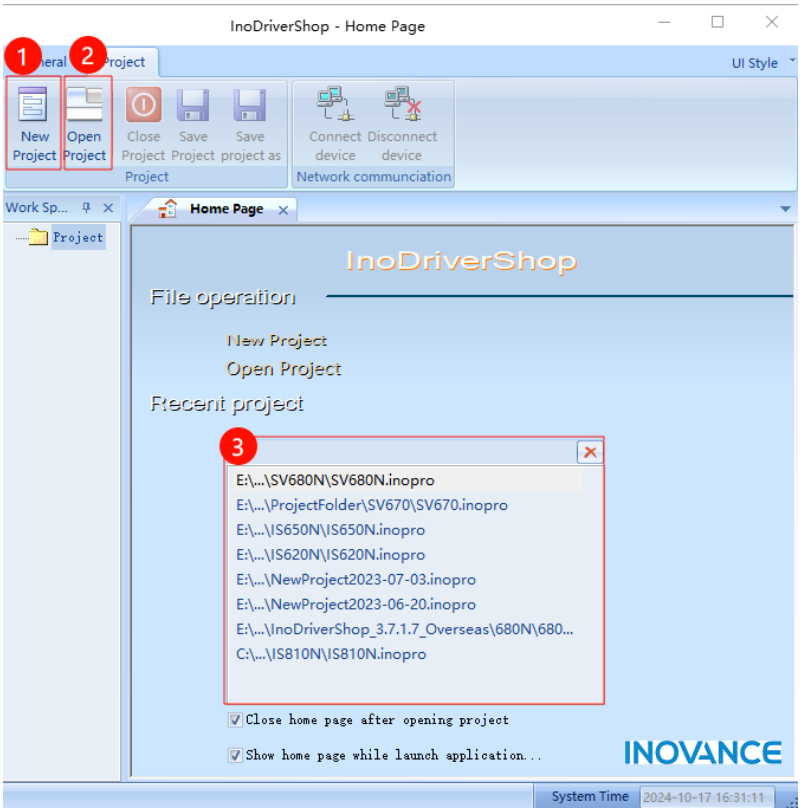


Figure 7-13 InoDriverShop startup dialog box

Note

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

b. Open the Project Guide wizard.

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

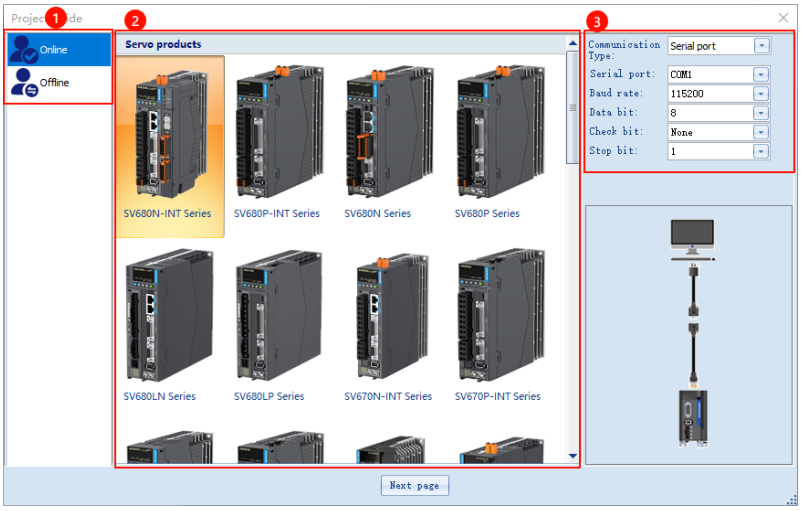


Figure 7-14 Project creation wizard

c. Click "Next" to create a project.

- Create an online device, as shown below. The device is automatically scanned. Select the device to be commissioned and click "Finish".

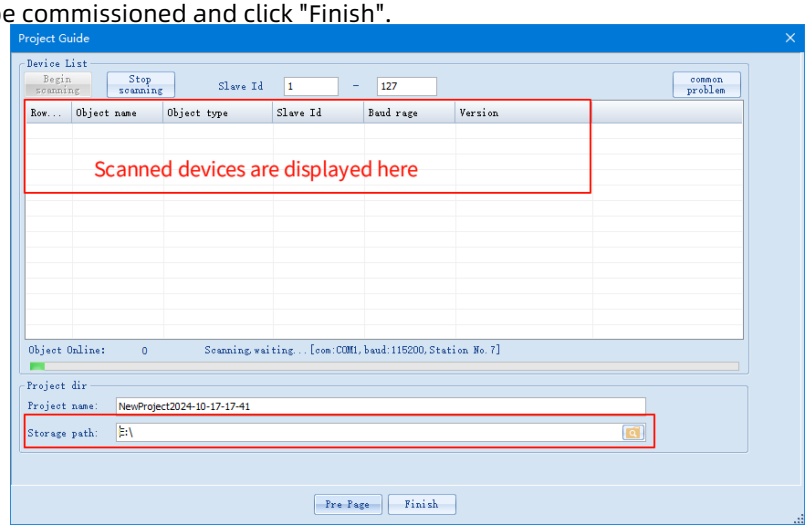


Figure 7-15 Scan page

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

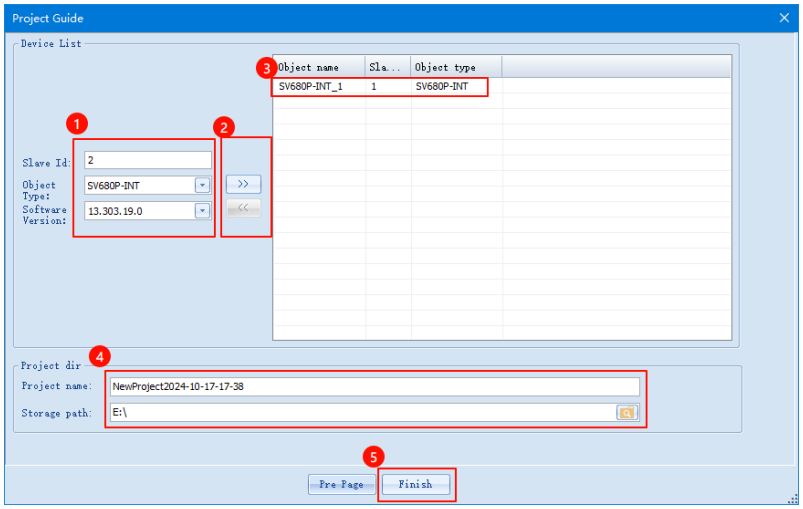


Figure 7-16 Project creation wizard for offline device

Note

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

d. The project has been created.

3. The wizard is shown as follows.

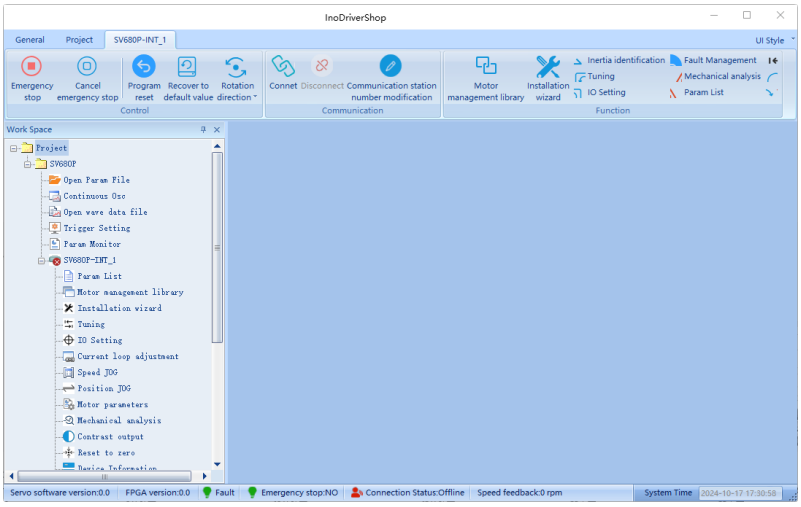


Figure 7-17 Wizard

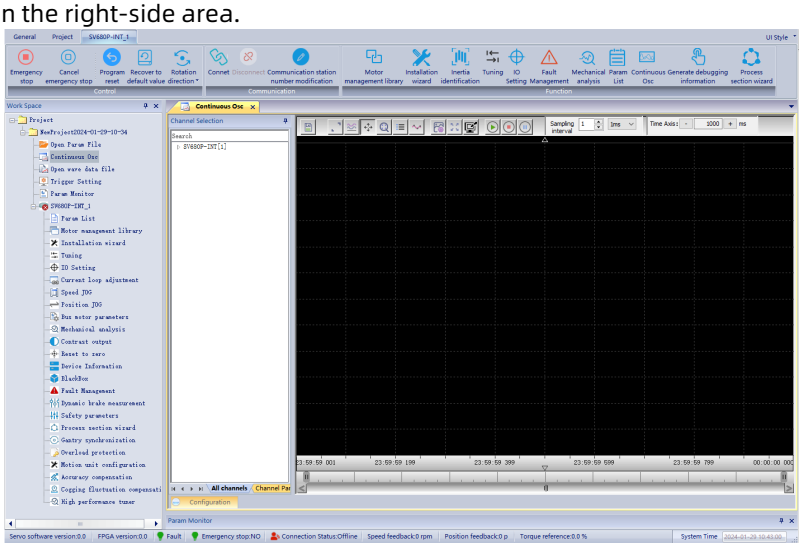
Note

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

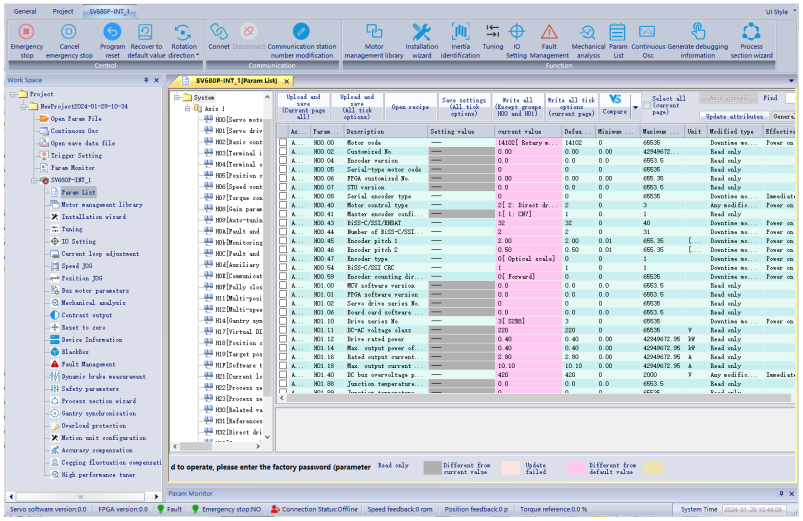
7.2.3 Common Software Functions

InoDriverShop provides the following functions:

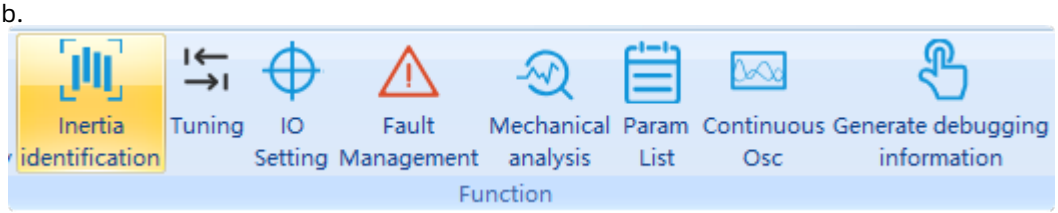
- Oscilloscope: Detects and saves the instantaneous data during operation. In the work area, double-click "Continuous OSC" in the navigation pane to open the view of the continuous oscilloscope in the right-side area.

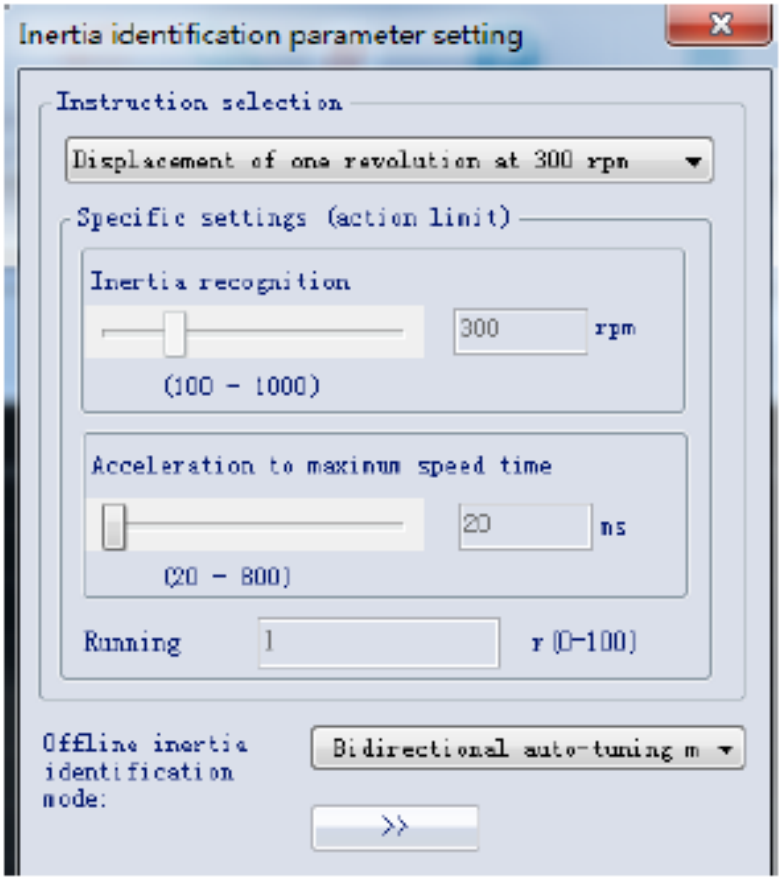


- Parameter management: Reads and downloads parameters in batches. In the work area, double-click "Parameter list" in the navigation pane to open the view of the parameter list in the right-side area. The values of the drive parameters are displayed in the parameter list. You can modify the parameter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

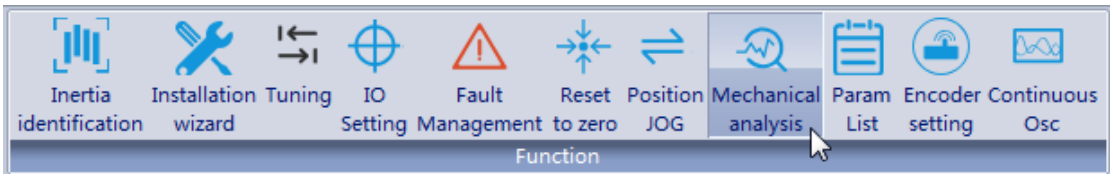


- Inertia auto-tuning: Performs auto-tuning on the load inertia ratio. Select the drive axis that you want to operate from the drop-down list and set the inertia auto-tuning parameters. After setting the inertia auto-tuning parameters, click the button at the bottom to go to the inertia auto-tuning tab.

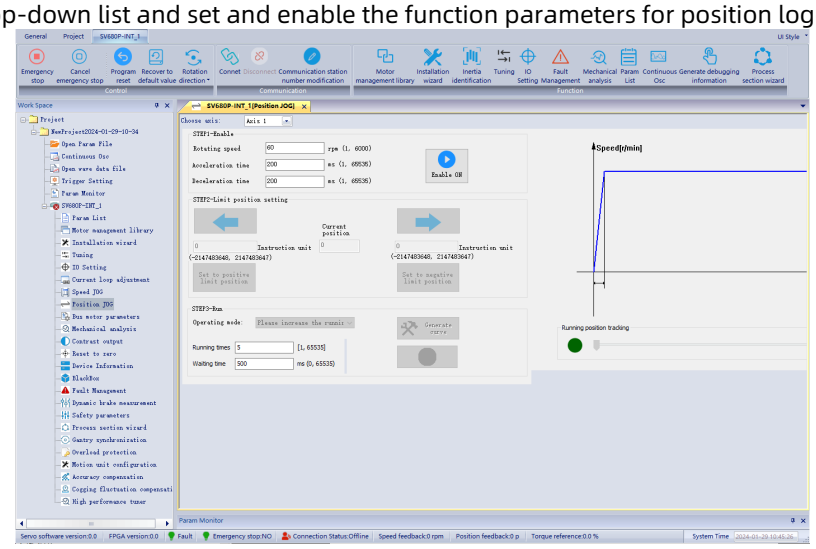




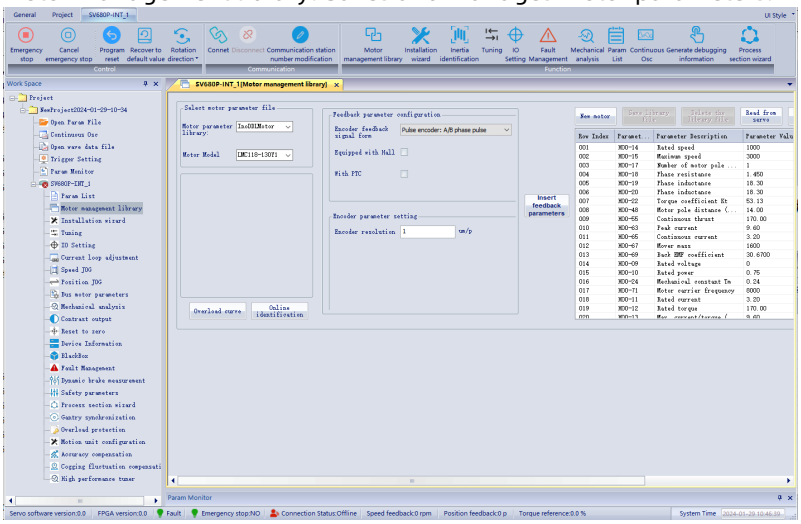
- Mechanical analysis: Analyzes the resonance frequency of the mechanical system.



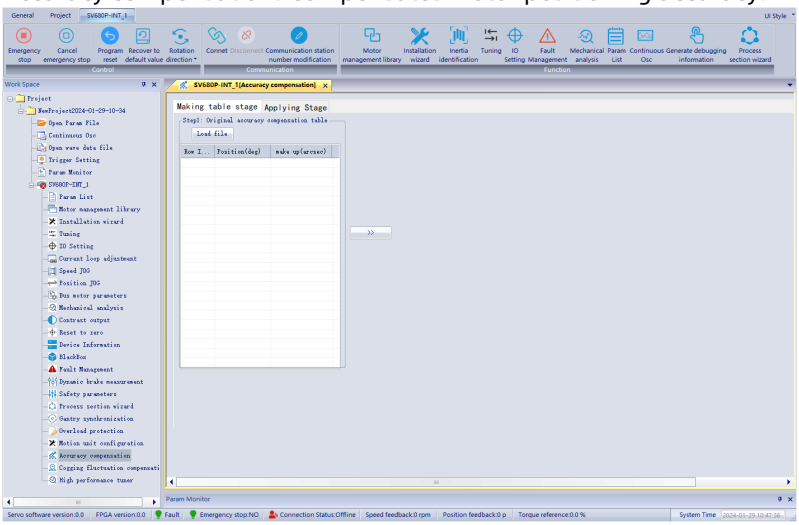
- Motion JOG: Generates position references to make the motor run. Select the target drive axis from the drop-down list and set and enable the function parameters for position logging.



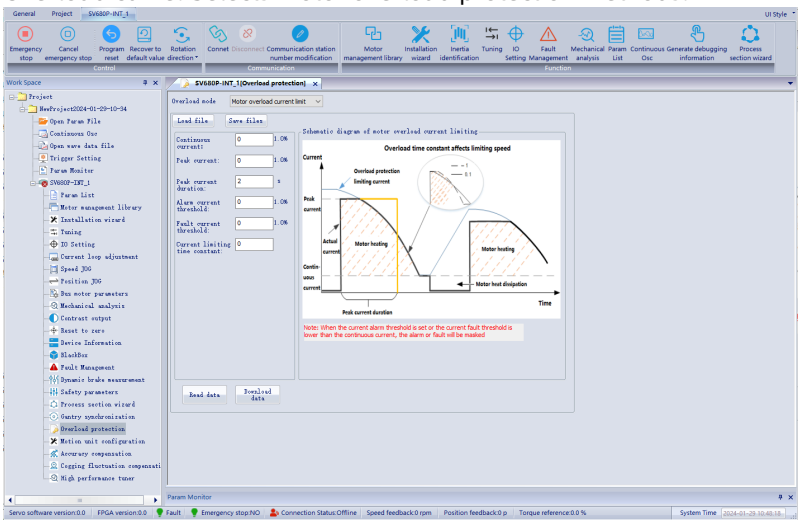
- Gain tuning: Adjusts the rigidity level and monitors the motion data.
- Motor management library: Saves and manages motor parameters.



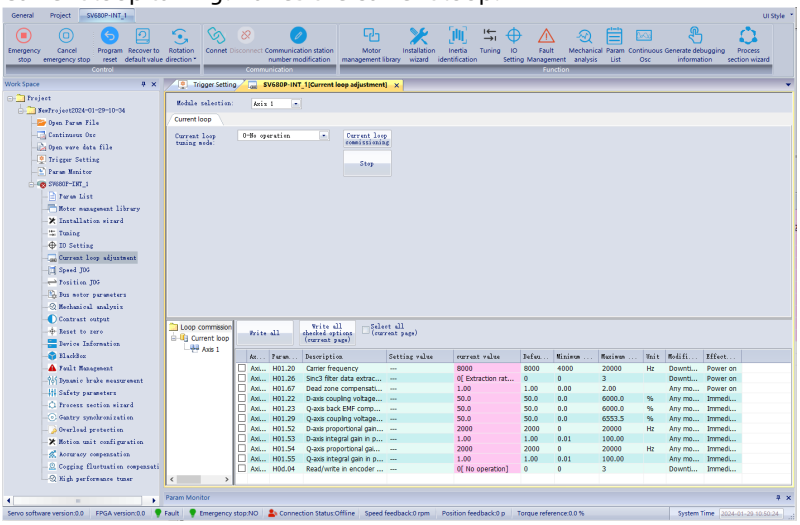
- Accuracy compensation: Compensates motor positioning accuracy.



- Overload curve: Selects motor overload protection methods.



- Current loop tuning: Tunes the current loop.



- Host computer homing: For the homing method, see *"11.8.6 Homing Operation" on page 365*.

8 Commissioning and Operation

8.1 Commissioned Objects

Types of motors supported by the drive:

Motor type	Component type	Compatibility	Remarks
DDL motor	Temperature detection	Switching PTC	-
	Position feedback	Inovance communication encoder	-
		Sine-cosine analog encoder	It must be used together with an Inovance T5 interpolator.
		ABZ incremental encoder (with TTL signal)	The maximum frequency supported by AB quadrature signals is 4 MHz.
		BiSS-C encoder	The maximum data length is 32-bit.
		SSI encoder	The maximum data length is 32-bit.
		EnDat 2.2 encoder	-
		Switching UVW Hall sensor	-
	Limit signal device	Switch	For DI input specifications, see *"6.4.1 Terminal Layout" on page 106*
DDR motor	Temperature detection	Switching PTC	-
	Position feedback	Inovance communication encoder	23-bit, 26-bit
		Sine-cosine analog encoder	It must be used together with an Inovance T5 interpolator.
		ABZ incremental encoder (with TTL signal)	The maximum frequency supported by AB quadrature signals is 4 MHz.
		BiSS-C encoder	The maximum data length is 32-bit.
		SSI encoder	The maximum data length is 32-bit.
		EnDat 2.2 encoder	-
		Switching UVW Hall sensor	-
	Limit signal device	Switch	For DI input specifications, see *"6.4.1 Terminal Layout" on page 106*
Servo motor	Temperature detection	Switching PTC	-
	Position feedback	Inovance communication encoder	23-bit, 26-bit
		Sine-cosine analog encoder	It must be used together with an Inovance T5 interpolator.
		ABZ incremental encoder (with TTL signal)	The maximum frequency supported by AB quadrature signals is 4 MHz.
		BiSS-C encoder	The maximum data length is 32-bit.
		EnDat 2.2 encoder	-
		SSI encoder	The maximum data length is 32-bit.
		Nikon encoder	17-bit, 20-bit
		TAMAGAWA encoder	17-bit, 23-bit
		Switching UVW Hall sensor	-
	Limit signal device	Switch	For DI input specifications, see *"6.4.1 Terminal Layout" on page 106*

8.2 Commissioning Process

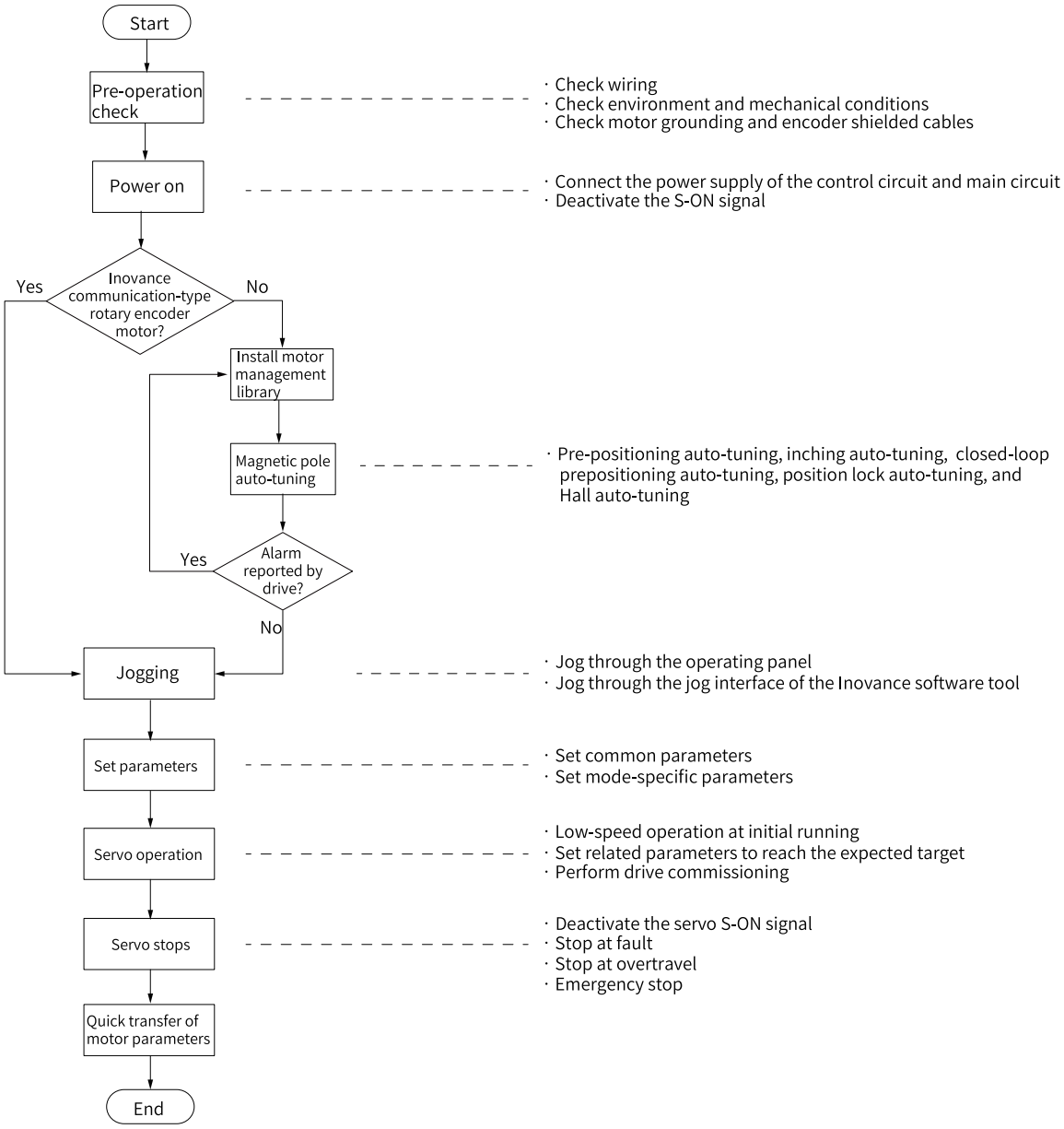


Figure 8-1 Commissioning flowchart of the drive

8.3 Pre-operation Inspection

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

Table 8–1 Pre-operation checklist

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

No.	Item	Tick
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 properly connected.	☐
5	The servo drive and servo motor are grounded properly.	☐
6	The tension applied on the cable is within the specified range.	☐
7	All the wiring terminals are properly insulated.	☐
8	The encoder shield is reliably connected to the PE interface of the encoder.	☐
Environment and mechanical conditions		
1	No unwanted objects (such as cable terminals and metal chippings) that may cause short circuit of the signal cable and power cable exist inside or outside the servo drive.	☐
2	The drive and the external braking resistor are placed on incombustible objects.	☐
3	Motor installation and shaft and mechanical connection are reliable.	☐
4	The motor and connected machine are in good condition and ready to run.	☐

8.4 Power-on

Connect the input power

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

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

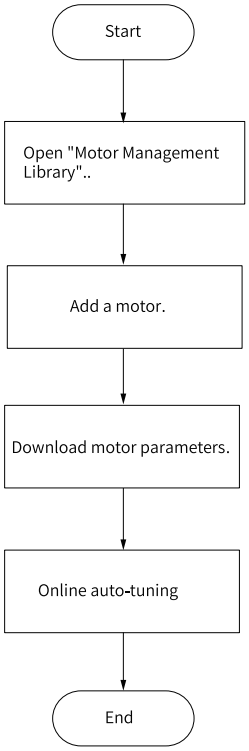
Note

- To connect the main circuit to a single-phase power supply (200 VAC to 240 VAC), use any two of terminals L1, L2, L3.
- If the keypad keeps displaying "nrd.x" or a fault code, see *"7.1.1 Keypad Display" on page 164* for troubleshooting.

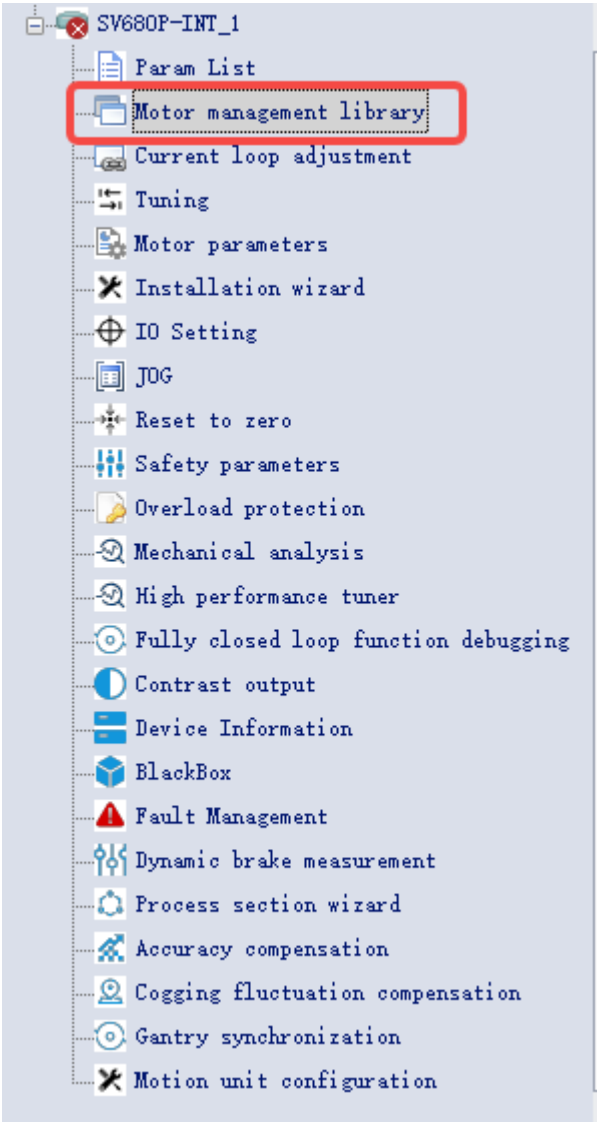
8.5 Installing the Motor Management Library

8.5.1 Installation Procedure

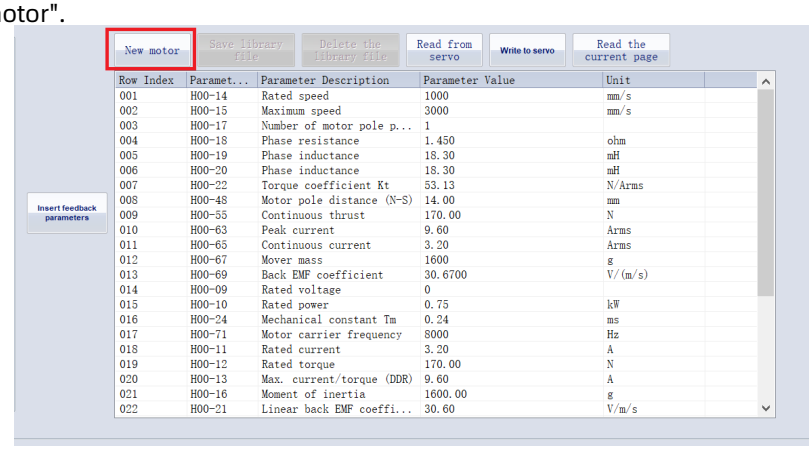
New motor matching



1. Open "InoDriverShop.exe", create a SV680-INT project, and click "Motor management library" in the left pane. The motor management library allows you to create and manage your own motor libraries.



2. Click "New motor".



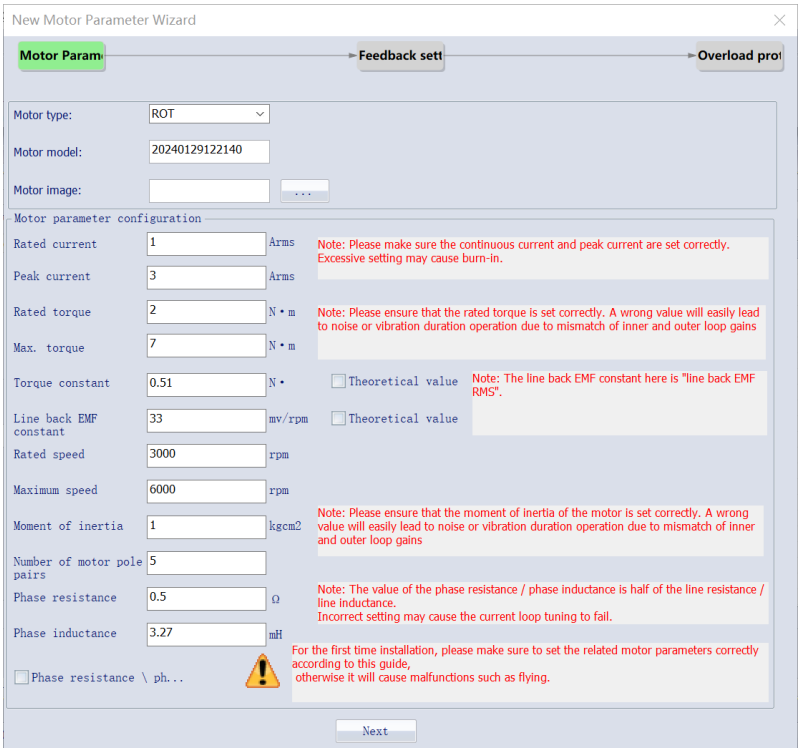
3. Set motor parameters.

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

Note

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

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

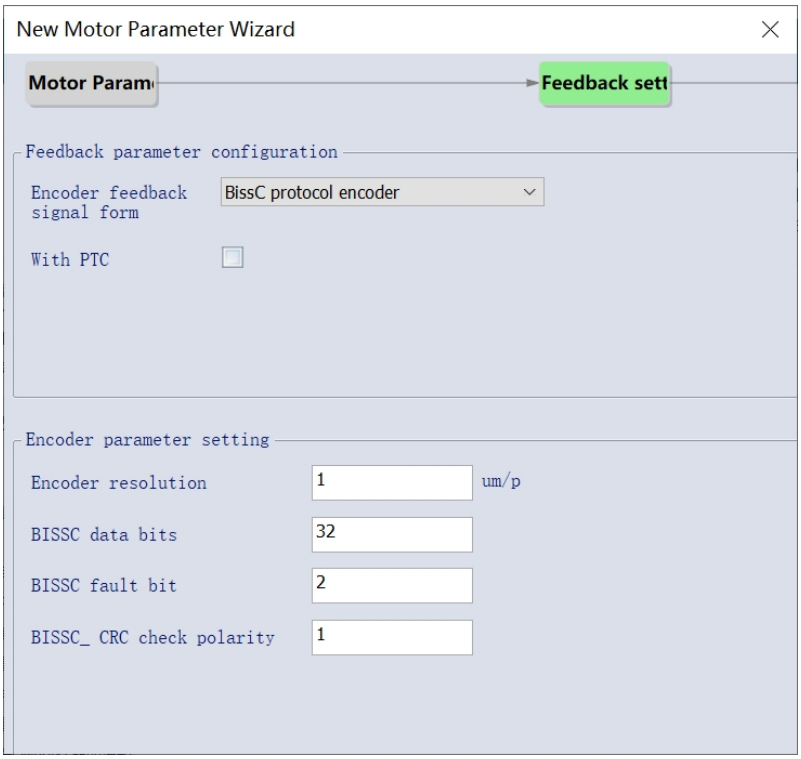


b. Select the correct encoder and configure the encode parameters correctly according to the corresponding encoder manual.

Note

Select the correct encoder type and ensure that the encoder parameters are set correctly. Failure to comply may result in the following consequences:

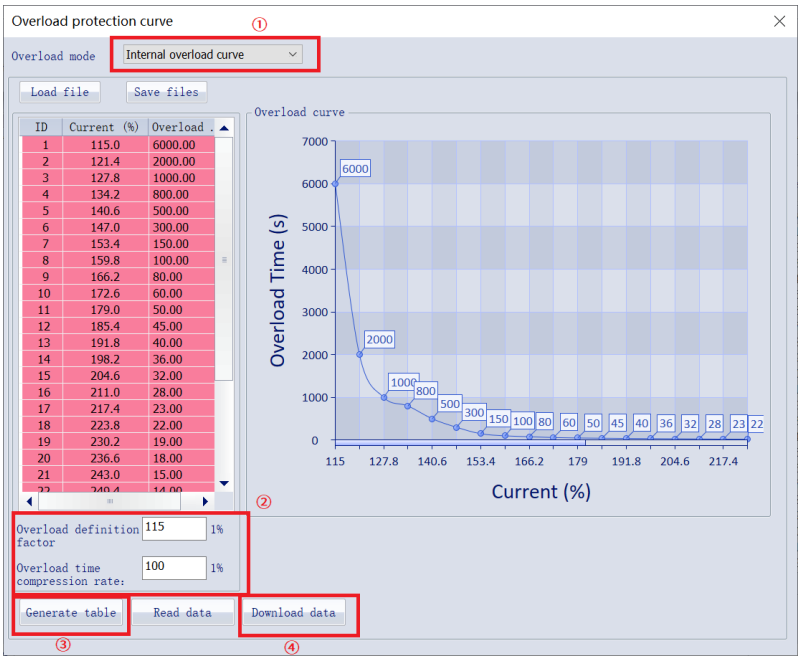
- The servo position information is incorrect, resulting in mal-function of the motor.
- Motor runaway: Such as motor runaway, stall, and overspeed
- The motor does not show the above symptoms, but the servo reports motor overtemperature protection (E630.0), motor runaway (E234.0), and motor overspeed (E500.x) faults.



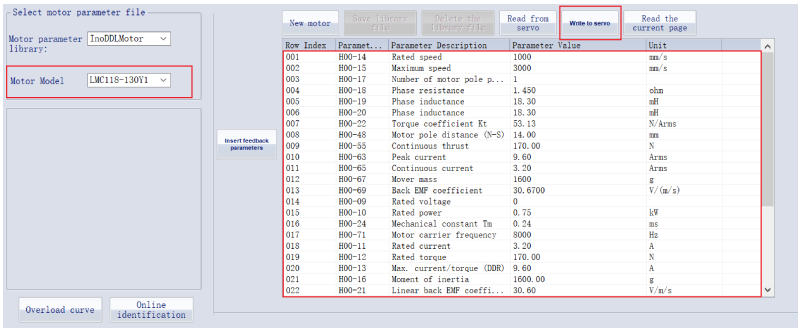
Note

- ABZ incremental encoder with TTL signals are classified into encoders with Z signals and those without Z signals. Incorrect configurations may cause errors.
- Inovance T5 interpolator: The T5 interpolator converts analog signals or pulse signals into communication signals. The number of communication signal lines converted is fixed to 8388608. You need to configure the parameters of the input interpolator.
- BiSS-C encoders:
  - BiSS-C encoders generally have data bits and fault bits, whose length can be found in the corresponding encoder manual. For linear motors, the total length of the data bit is required. For rotary motors, the total length of the data bit and the length of single-turn data are required. Generally, the length of the fault bit is 2-bit.
  - Check the communication frequency and recovery time according to the encoder manual.
  - The CRC mode is used.
- SSI encoders:
  - SSI encoders generally have data bits and fault bits, whose length can be found in the corresponding encoder manual. For linear motors, the total length of the data bit is required. For rotating motors, the total length of the data bit and the length of single-turn data are required.
  - The SSI encoder uses the parity check method.
  - You need to configure the communication frequency (baud rate) and recovery time (from the time of the first falling edge of the clock signal to the time of the first rising edge).
- EnDat 2.2 encoders:
  - The data length needs to be set for EnDat 2.2 encoders. For linear motors, only the total length of the data bit is required. For rotary motors, the total length of the data bit and the length of single-turn data are required.
  - You need to configure the communication frequency (baud rate) and recovery time (from the time of the first falling edge of the clock signal to the time of the first rising edge).
- For details about how to configure encoders, see *"8.5.2.1 Encoder Parameter Configuration Process" on page 200*.

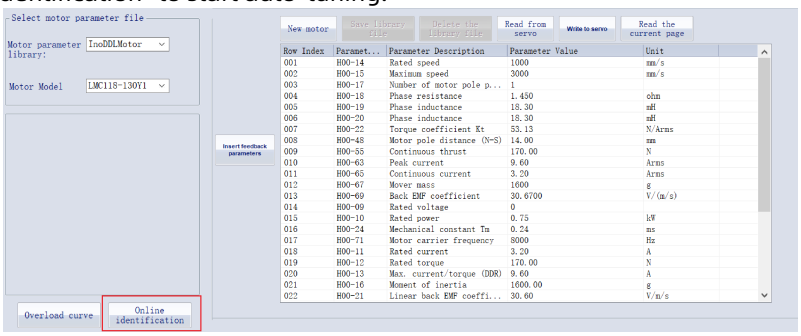
c. Select the overload protection mode, and click "Finish". For details about overload protection settings, see *" Motor overload protection" on page 197*.



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



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



Motor overload protection

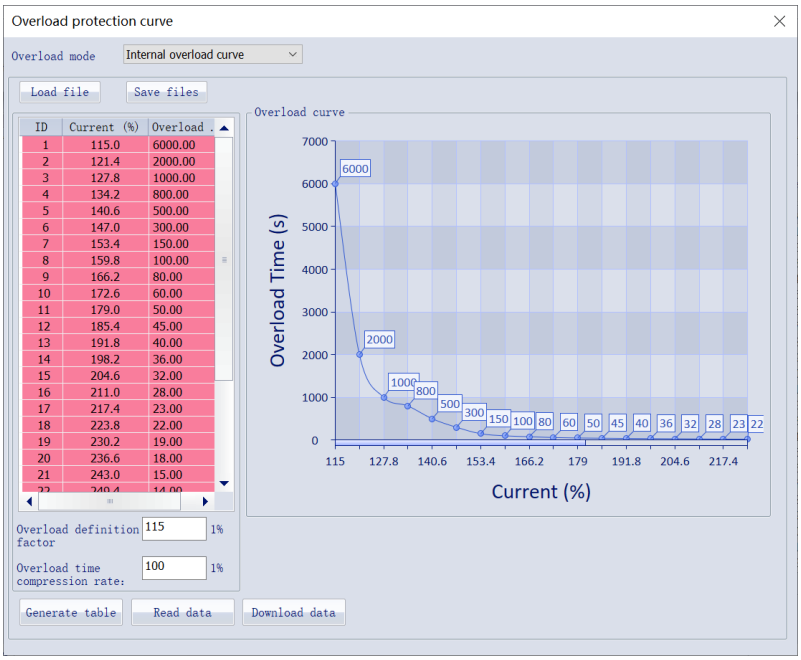
The SV680-INT series servo drive provides three motor overload protection methods, including internal overload curve download, overload curve download, and motor overload current limit.

Method 1: Internal overload curve download

This mode provides two parameter tuning overload curves, namely overload thermal threshold coefficient and overload time compression ratio.

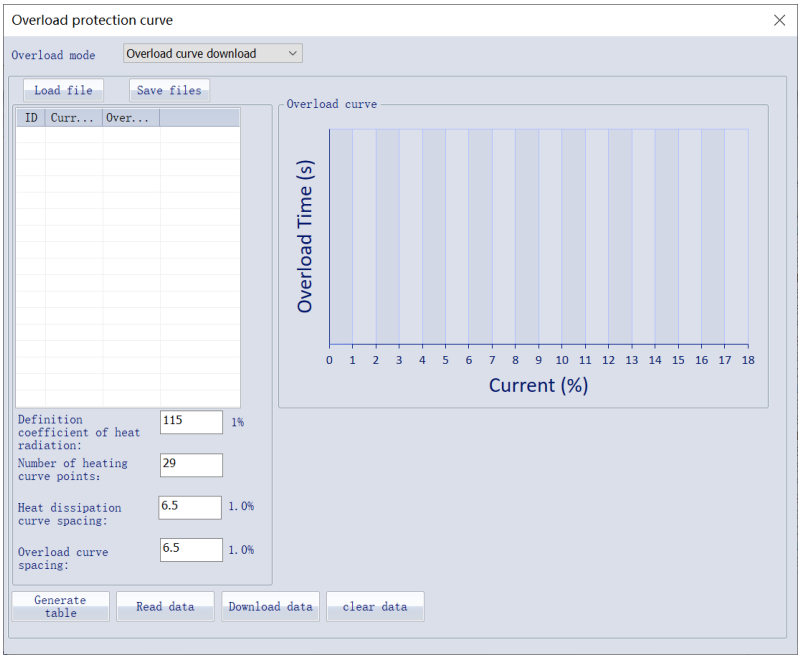
The overload thermal threshold coefficient is a current value (empirical value: about 115%) at which the motor keeps running continuously. The motor can finally stay at a constant temperature due to balance between heating and heat dissipation. To be specific, if the motor current is higher than this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

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



Method 2: Overload curve download

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



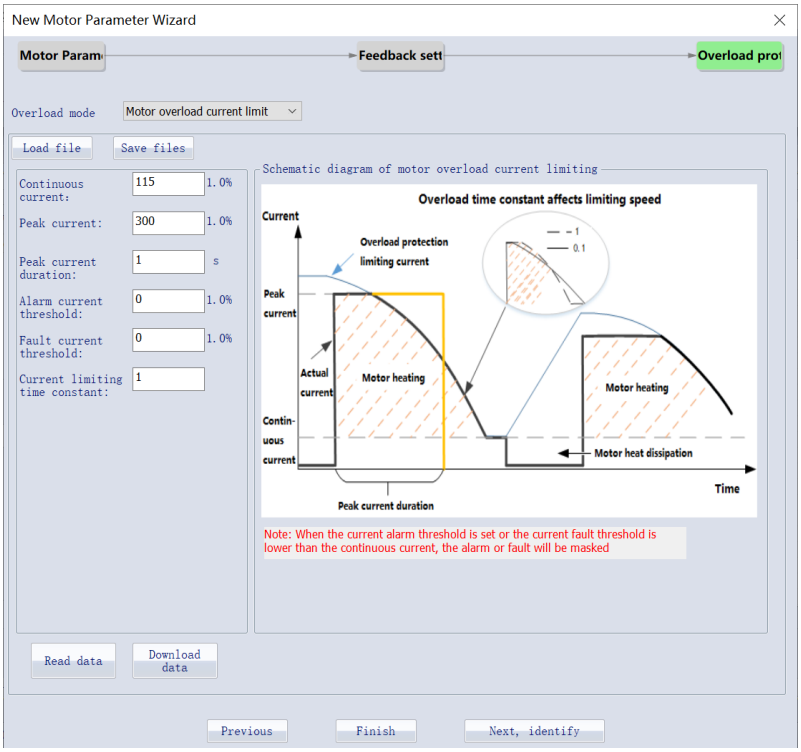
Method 3: Motor overload current limit

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

- Thermal threshold current: This parameter takes effect when the motor overload current limit is enabled. It is the rated motor current percentage. When this value is exceeded, the motor keeps heating up. The default value 115% applies to Inovance motors. It is recommended to set this parameter to 100% for third-party motors. If the overload characteristics of the motor is of poor performance, it is recommended to reduce the values of H32.73, H32.74, H32.75, and H32.76 when motor current limit protection is enabled.
- Peak current: It defines the ratio of the peak current that can be reached by the motor to the rated current of the motor.
- Peak current duration: The maximum heat that can be reached by the motor is calculated based on the maximum peak current duration. Then the maximum heat is used as the motor overload alarm threshold.
- Current threshold for alarm: An alarm will be reported when the limited current for protection falls below this threshold.
- Current threshold for fault: A fault will be reported when the limited current for protection falls below this threshold.

Note

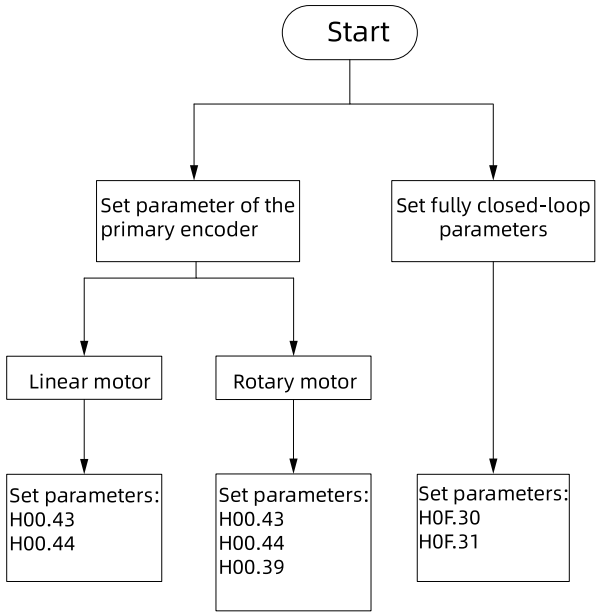
As the minimum value of the current limit protection is the thermal threshold current, when the current threshold for alarms and faults is lower than the thermal threshold current, the fault and alarm cannot be reported.



8.5.2 Encoder Configuration

8.5.2.1 Encoder Parameter Configuration Process

The encoder parameters that need to be set manually for different scenarios are shown in the flowchart. In most cases, other parameters can use the default value.



The following table describes **parameter configuration examples** for various scenarios based on the encoder protocol.

Encoder protocol type	Primary encoder parameter configuration
BiSS-C	*"Master encoder parameter configuration example" on page 201*
SSI	*"Primary encoder parameter configuration example" on page 203*
EnDat	*"Master encoder parameter configuration example" on page 206*

8.5.2.2 BiSS-C Encoder

Frame structure

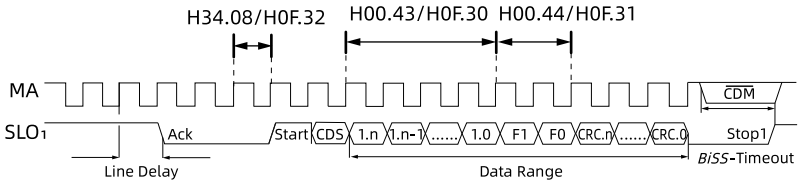


Figure 8-2 BiSS-C frame structure diagram

Note:

- MA: The clock signal.
- SLO $_1$: The data signal.
- Line Delay: The line transmission delay.
- Ack: The acknowledgment time.

- Start: The start bit.
- CDS: The signal sent by the encoder during register communication with subsequent electronic devices (Register information).
- Data Range: 1.n to 1.0 indicate position data information, F1 and F0 are alarm index bits indicating abnormal conditions in the encoder, and CRC.n to CRC.0 indicate CRC data, which supports 6-bit CRC codes in the 0x43 format.
- CDM: The signal received by the encoder during register communication with subsequent electronic devices.

Master encoder parameter configuration example

Pre-configuration inspection

1. Prepare the hardware:

- Servo drive: SV680P-INT
- Motor: Rotary motor + BiSS-C single-turn 24-bit encoder

2. Wiring inspection: Confirm that the encoder is connected to the drive CN7 terminal.

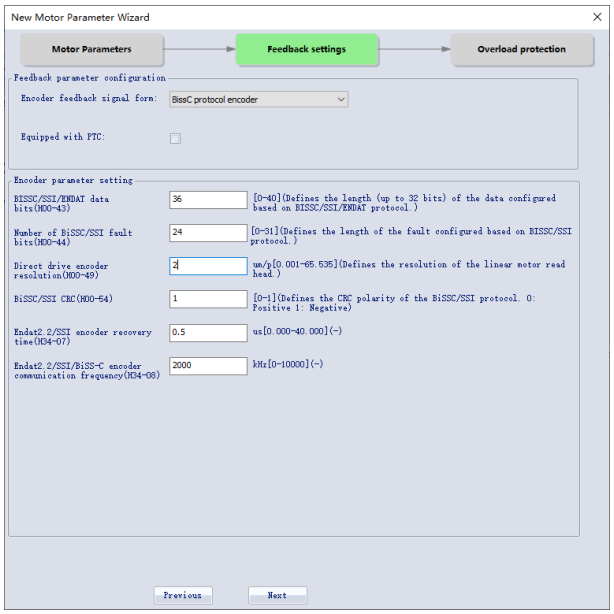
Procedure

1. Obtain encoder parameters from the encoder guide, for example:

Data length (H00.43)	Single-turn data length (H00.39)	Error + Alarm bit length (H00.44)	Whether CRC check is bit-inverted (H00.54)	Frequency set through communication (H34.08)
36-bit	24-bit	2-bit	Bit-inverted	120 kHz to 2500 kHz

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

2. Configure the function parameters based on the encoder parameters.



3. After writing the function parameters to the servo, perform a reset operation in the software tool to read data from the BiSS-C encoder.

4. Manually push or jog the rotary motor for one revolution.
5. Because the encoder resolution (single-turn data length) is 24-bit, the theoretical position change is 2^{24}= 16777216. Read the actual position from parameter H0b.07 in the software tool. If the position is close to the theoretical value, the configuration is valid.

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".

Troubleshooting

If a communication error (740 fault) occurs, you can identify the cause of error by checking H0b.28.

Table 8–2 Bits of H0b.28

Bit	Definition	Value range	Bit description
0	Communication timeout error	0 to 1	0: Normal 1: Fault
1	Reserved	-	-
2	CRC check error	0 to 1	0: Normal 1: Fault
3	Register access error	0 to 1	
4 to 6	Reserved	-	-
7	Single-turn calculation error	0 to 1	0: Normal 1: Fault
8 to 12	Reserved	-	-
13	Counting increment error	0 to 1	0: Normal 1: Fault
14	Reserved	-	-
15	Reserved	-	-

For details about troubleshooting, see chapter "Troubleshooting Common Encoder Configuration Errors".

8.5.2.3 SSI Encoder

Protocol frame structure

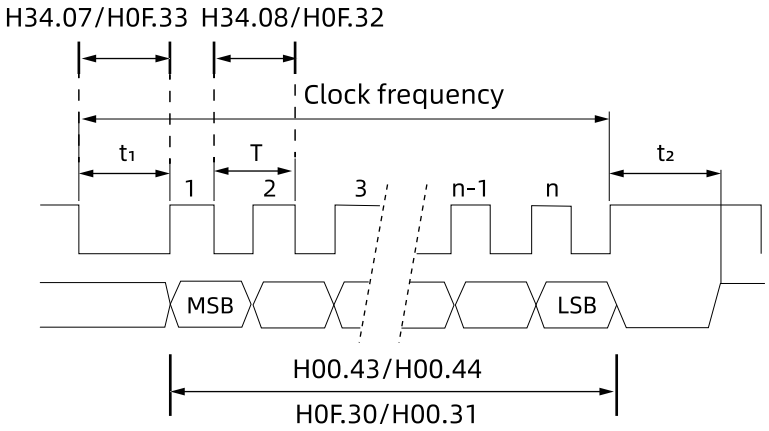


Figure 8-3 SSI frame structure

Note:

- t1: the encoder recovery time. This is the time from the first falling edge to the first rising edge of the clock.
- T: the transmission time of one bit.
- t2: the timeout period. It indicates the low-level signal after the data frame is sent.
- MSB: the first data bit.
- LSB: the last data bit.

Primary encoder parameter configuration example

Pre-configuration check

1. Prepare hardware:

- Servo drive: SV680P-INT
- Motor: Linear motor + SSI encoder

2. Wiring check: Connect the SSI encoder to the CN7 terminal of the drive.

Configuration procedure

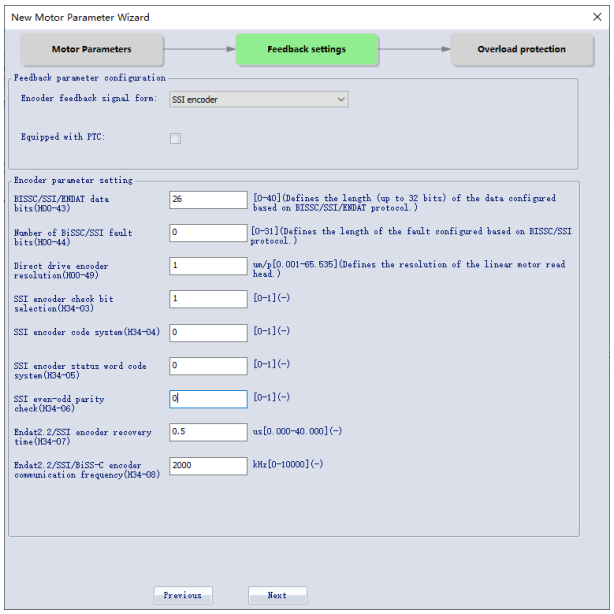
1. Obtain the encoder parameters from the encoder guide, for example:

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).

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



3. After writing the parameters to the servo, reset the drive through the software. Then, the drive can read data from the encoder.
4. Run the linear motor through manual pushing or jogging. The total travel of this linear motor model is about 520 mm.
5. 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 H0b.07 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

Other parameters in the SSI encoder configuration can retain their default values. However, if position feedback data becomes garbled, the following parameters need to be configured according to the encoder guide:

Param.	Description
H34.03	SSI encoder parity bit check
H34.04	SSI encoder code system selection
H34.05	SSI encoder status word code system selection
H34.06	SSI encoder parity check enable

Troubleshooting

If a communication error (740 fault) occurs, you can identify the cause of error by checking H0b.28.

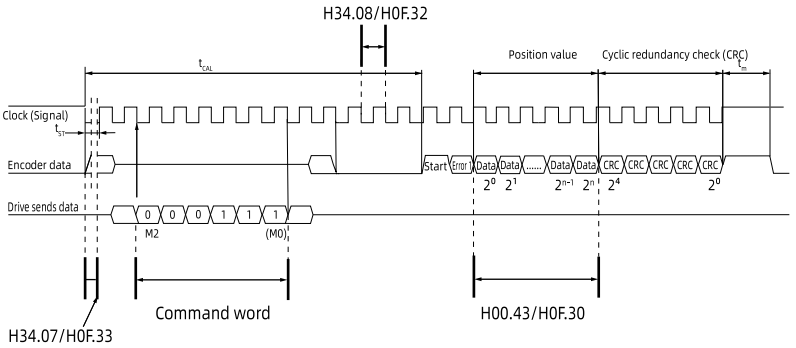
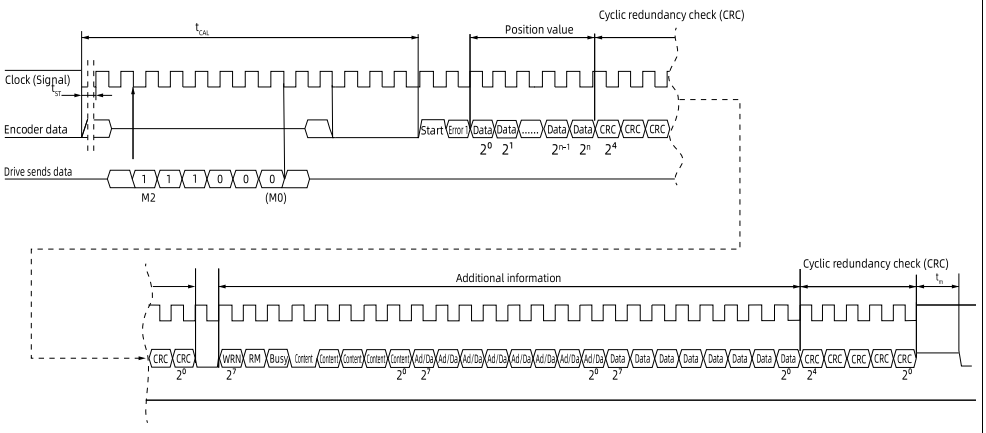
Table 8–3 Bits of H0b.28

Bit	Definition	Value range	Bit description
0	Communication timeout error	0 to 1	0: Normal 1: Fault
1	Reserved	-	-
2	CRC check error	0 to 1	0: Normal 1: Fault
3	Register access error	0 to 1	
4 to 6	Reserved	-	-
7	Single-turn calculation error	0 to 1	0: Normal 1: Fault
8 to 12	Reserved	-	-
13	Counting increment error	0 to 1	0: Normal 1: Fault
14	Reserved	-	-
15	Reserved	-	-

For details about troubleshooting, see chapter "Troubleshooting Common Encoder Configuration Errors".

8.5.2.4 EnDat 2.2 Encoder

Protocol frame structure

Additional data	Structure diagram
No additional data	 Figure 8-4 EnDat frame structure (without additional data)
One additional data	 Figure 8-5 EnDat frame structure (one additional data)

Note:

- t_{ST} : the encoder recovery time. This is the time from the first falling edge to the first rising edge of the clock.
- M2 to (M0): the command words.
- t_{CAL} : the encoder calculation time.
- Start to CRC: the position data. Start indicates the start bit, Error indicates the error bit, Data indicates the data bit, and CRC indicates the CRC bit.
- t_m : the timeout period. It indicates the low-level signal after the data frame is sent.

When additional data is used, the system can transmit additional data based on the function of the additional data.

Master encoder parameter configuration example

Pre-configuration inspection

1. Prepare the hardware:

- Servo drive: SV680P-INT

- Motor: Linear motor + EnDat 2.2 encoder

2. Wiring inspection: Connect the EnDat 2.2 encoder to the drive CN7 terminal

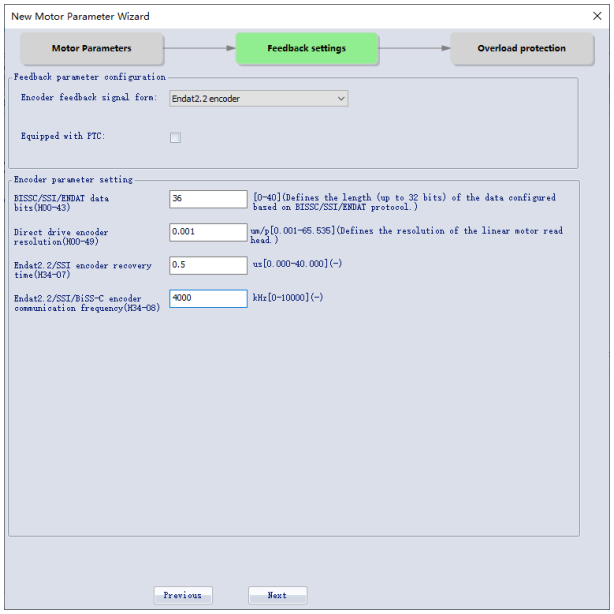
Procedure

1. 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).

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



3. After writing the parameter numbers to the servo, perform a reset operation in the software tool to read parameters from the EnDat 2.2 encoder.
4. Manually push or jog the linear motor for a distance of approximately 100 mm. According to the encoder guide, if the encoder resolution is 0.001 μm/p, the theoretical position change is 100 × 1000/0.001 = 100000000. Read the actual position through parameter H0b.07 in the software tool. If the position is close to the theoretical value, the configuration is valid.
5. You can also set H0d.04 to 2 to read data from the encoder ROM. If H34.14 and H34.15 are both 0, no communication errors exist.

Other parameters

You can set H0D.04 to 1 to allow the Heidenhain encoder to read the following alarm parameters from the encoder ROM:

Param.	Description
H34.12	Error types supported by Endat2.2 encoders 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 Endat2.2 encoders 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
H34.15	Alarm values outputted by EnDat 2.2 encoders

Method to check specific error messages:

Taking alarms as an example:

1. Check supported types: View the alarm types defined in H34.13 (bit assignment).
2. Verify output values: If a bit in the value outputted by H34.15 is 1 and H34.13 supports the alarm types defined in this bit, the corresponding bit alarm is present.

Troubleshooting

If a communication error (740 fault) occurs, you can identify the cause of error by checking H0b.28.

Table 8–4 Bits of H0b.28

Bit	Definition	Value range	Bit description
0	Communication timeout error	0 to 1	0: Normal 1: Fault
1	EnDat level 1 fault	-	-
2	CRC check error	0 to 1	0: Normal 1: Fault
3	EnDat level 2 fault	0 to 1	0: Normal 1: Fault
4	EnDat error message 1	0 to 1	0: Normal 1: Fault
5	EnDat error message 2	0 to 1	0: Normal 1: Fault
6 to 8	Reserved	-	-
9	EnDat additional data 1 CRC error	0 to 1	0: Normal 1: Fault
10	EnDat additional data 2 CRC error	0 to 1	0: Normal 1: Fault
11 to 12	-	-	-
13	Counting increment error	0 to 1	0: Normal 1: Fault

Bit	Definition	Value range	Bit description
14	EnDat level 3 fault 1	0 to 1	0: Normal 1: Fault
15	EnDat level 3 fault 2	0 to 1	0: Normal 1: Fault

For details about troubleshooting, see chapter "Troubleshooting Common Encoder Configuration Errors".

8.5.2.5 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).

Possible cause	Troubleshooting method	Solution
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 202*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.

8.6 Magnetic Pole Auto-tuning

Overview

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

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

Method	Motion range	Applicable motor	Applicable encoder	Load capacity
Pre-positioning	High	Barrel/U-shaped	All	Weak
Inching	Small	All	Optical scale	Medium
Hall auto-tuning	None	High power	All	Strong
Position lock	Tiny	All	All	Strong
Closed-loop pre-positioning	High	All	All	Strong
Voltage injection auto-tuning	Tiny	Iron-core motors	All	Weak

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

Method	Property	Applicable scenario	Advantage and disadvantage
Hall auto-tuning	Static auto-tuning	Scenarios where the rotor is not allowed to move when the motor is powered on.	Advantages: Initial angle auto-tuning is not required after power-on.
			Disadvantages: Increased cost since an additional Hall device is required. (If static auto-tuning is selected, it is recommended to use this method first.)
Voltage injection auto-tuning	Static auto-tuning	Motors with brake or lock shaft	Advantages: Auto-tuning can be performed in the shaft-locked or brake state. No action is taken during auto-tuning.
			Disadvantages: Noise during auto-tuning. Actions during auto-tuning even when the motor is not in the shaft-locked state.

Note

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

Auto-tuning state

The states are different when you match different encoders.

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

Auto-tuning states are as follows.

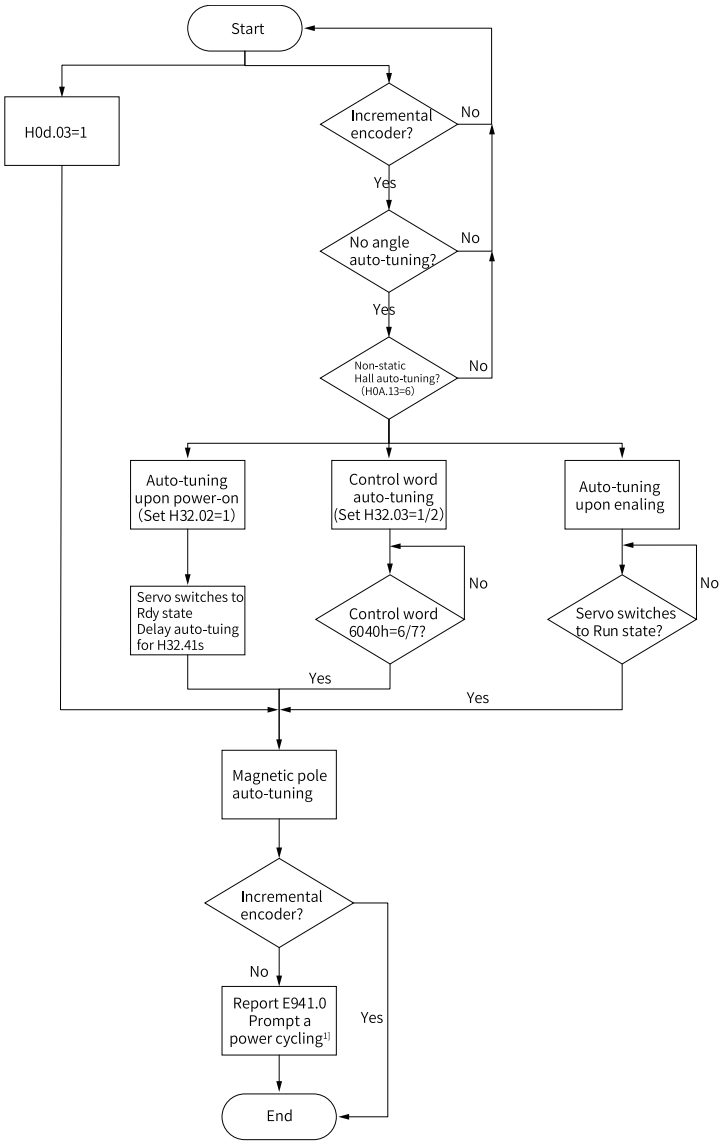


Figure 8-6 Flow chart of magnetic pole auto-tuning state

Note

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

8.6.1 Auto-tuning Process

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

Process without a Hall device

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

The flowchart is as follows.

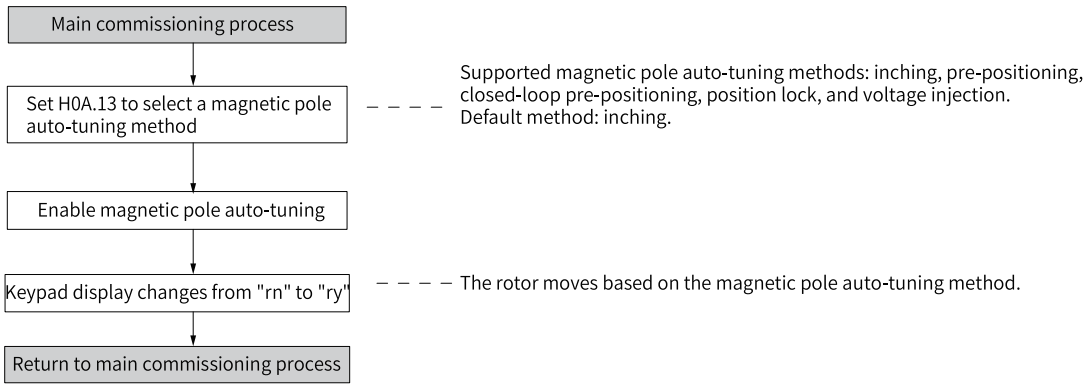


Figure 8-7 Flowchart for magnetic pole auto-tuning without a Hall device

Process with a Hall device

Applicable method: Hall device auto-tuning

The flowchart is as follows.

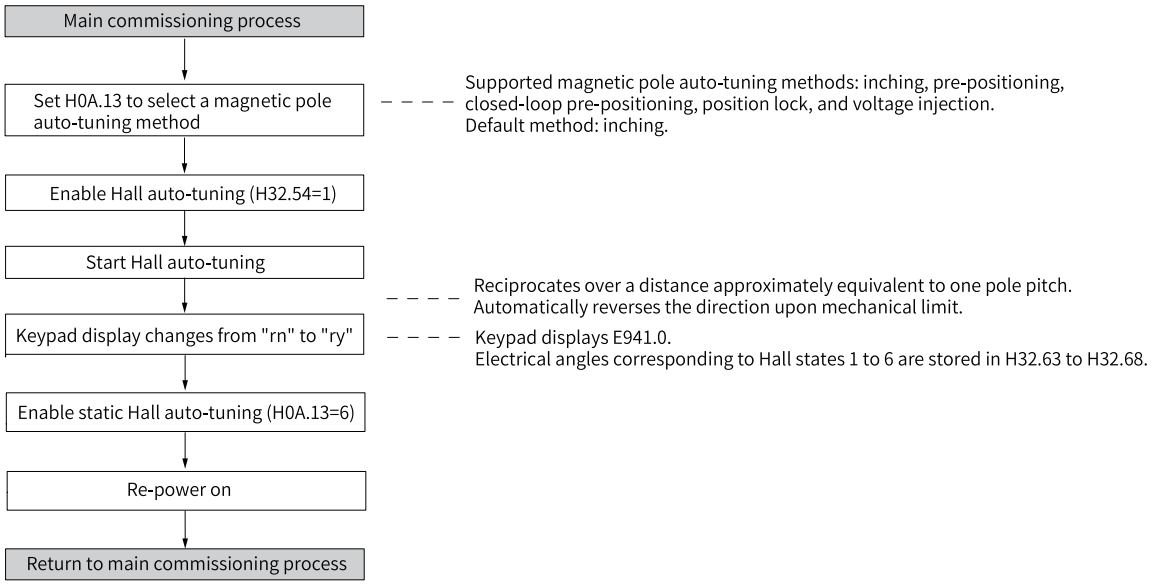


Figure 8-8 Flowchart for magnetic pole auto-tuning with a Hall device

8.6.2 Pre-positioning Auto-tuning

For details about how to perform pre-positioning auto-tuning, see *" Process without a Hall device" on page 215*.

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

Table 8–5 Pre-positioning Auto-tuning

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0A.13	200A-0Eh	Angle auto-tuning mode	0: Angle auto-tuning through pre-positioning 1: Angle auto-tuning through inching 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	0	-	At stop	*" H0A_en.13" on page 854*

8.6.3 Inching Auto-tuning

For details about how to perform inching auto-tuning, see *" Process without a Hall device" on page 215*.

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0A.13	200A-0Eh	Angle auto-tuning mode	0: Angle auto-tuning through pre-positioning 1: Angle auto-tuning through inching 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	0	-	At stop	"H0A_en.13" on page 854
H32.10	2032-0Bh	Max. reference current in angle auto-tuning through inching	10.0 to 300.0	100.0	%	At stop	"H32_en.10" on page 1070
H32.13	2032-0Eh	Threshold for motor rotation in angle auto-tuning through inching (ROT/DDR)	0.001 to 20.000	0.200	deg	At stop	"H32_en.13" on page 1070
H32.14	2032-0Fh	Motor standstill threshold (ROT/DDR) in angle auto-tuning through inching	0.1 to 100.0	1.0	[mm/s]/[rpm]	At stop	"H32_en.14" on page 1071
H32.15	2032-10h	Motor action threshold (DDL) in angle auto-tuning through inching	0.001 to 20.000	0.200	mm	At stop	"H32_en.15" on page 1071
H32.16	2032-11h	Motor standstill threshold (DDL) in angle auto-tuning through inching	0.1 to 100.0	1.0	mm/s	At stop	"H32_en.16" on page 1071

Note

- Make sure that the motor phase sequence is correct during angle auto-tuning through inching. Otherwise, auto-tuning may fail.
- If auto-tuning fails, troubleshoot the fault according to the fault subcode "Table 8-6" on page 218 .

Table 8–6 Related faults

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

8.6.4 Closed-Loop Pre-positioning Auto-tuning

For details about how to perform close-loop pre-positioning auto-tuning, see *" Process without a Hall device" on page 215*.

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

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0A.13	200A-0Eh	Angle auto-tuning mode	0: Angle auto-tuning through pre-positioning 1: Angle auto-tuning through inching 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	0	-	At stop	*" H0A_en.13" on page 854*
H32.20	2032-15h	Max. reference current in angle auto-tuning through pre-positioning (closed-loop)	10.0 to 300.0	100.0	%	At stop	*" H32_en.20" on page 1072*

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H32.22	2032-17h	Electrical angle reference in angle auto-tuning through pre-positioning (closed-loop)	0.0 to 360.0	0.0	deg	At stop	"H32_en.22" on page 1072
H32.23	2032-18h	Electrical angle reference change range in angle auto-tuning through pre-positioning (closed-loop)	10.0 to 170.0	90.0	deg	At stop	"H32_en.23" on page 1072
H32.24	2032-19h	Motor stop threshold (ROT/DDR) in angle auto-tuning through pre-positioning (closed-loop)	0.1 to 100.0	1.0	[mm/s]/[rpm]	At stop	"H32_en.24" on page 1072
H32.26	2032-1Bh	Damping in angle auto-tuning through pre-positioning (closed-loop)	0.00 to 655.35	0.00	[N/(m/s)]/[N·m/rpm]	At stop	"H32_en.26" on page 1073

Note

If the auto-tuning fails, see the specific fault subcode "Table 8-7" on page 219 to rectify the fault.

Table 8–7 Related faults

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

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

8.6.5 Position Lock Auto-tuning

For the use of position lock auto-tuning, see *" Process without a Hall device" on page 215*.

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0A.13	200A-0Eh	Angle auto-tuning mode	0: Angle auto-tuning through pre-positioning 1: Angle auto-tuning through inching 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	0	-	At stop	*" H0A_en.13" on page 854*
H32.30	2032-1Fh	Max. reference current in angle auto-tuning through position lock	10.0 to 300.0	100.0	%	At stop	*" H32_en.30" on page 1074*
H32.33	2032-22h	Motor action threshold (ROT/DDR) in angle auto-tuning through position lock	0.001 to 20.000	0.200	deg	At stop	*" H32_en.33" on page 1074*

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H32.34	2032-23h	Motor standstill threshold (ROT/DDR) in angle auto-tuning through position lock	0.1 to 100.0	1.0	[mm/s]/[rpm]	At stop	"H32_en.34" on page 1074
H32.35	2032-24h	Motor action threshold (DDL) in angle auto-tuning through position lock	0.001 to 20.000	0.200	mm	At stop	"H32_en.35" on page 1074
H32.36	2032-25h	Motor standstill threshold (DDL) in angle auto-tuning through position lock	0.1 to 100.0	1.0	mm/s	At stop	"H32_en.36" on page 1075
H32.38	2032-27h	Inertia ratio in angle auto-tuning through position lock	0.00 to 120.00	0.00	-	At stop	"H32_en.38" on page 1075
H32.39	2032-28h	Gain class in angle auto-tuning through position lock	4 to 31	12	level	At stop	"H32_en.39" on page 1075

Note

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

Table 8–8 Related faults

Fault code	Name	Description
E602.0	Angle auto-tuning locked-rotor	• Check for motor stall. • Check whether power cables are correctly connected. • If a locked-rotor fault is reported when the motor moves, check the motor movement threshold and reduce it accordingly.
E602.1	Angle auto-tuning overtravel	Large movement is detected during auto-tuning. • Set a proper auto-tuning inertia ratio and appropriately increase the auto-tuning gain level. • Contact the manufacturer technical support engineers.

Fault code	Name	Description
E602.3	Excessive encoder feedback fluctuation during angle auto-tuning	When the encoder resolution is low and there is fluctuation, the motor standstill conditions are not met. Check the static speed feedback fluctuation of the encoder, and increase the value of motor standstill threshold in angle auto-tuning through inching appropriately.
E602.6	Angle auto-tuning not convergent	• Check whether the machine is affected by other vibration sources. Check whether external electromagnetic interference exists. If yes, install a magnetic ring and connect a shielded cable. • Check whether the angle gain is so high that the angle auto-tuning is not convergent.

8.6.6 Hall auto-tuning

For details about how to perform Hall magnetic pole auto-tuning, see *" Process with a Hall device" on page 215*.

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0A.13	200A-0Eh	Angle auto-tuning mode	0: Angle auto-tuning through pre-positioning 1: Angle auto-tuning through inching 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	0	-	At stop	*" H0A_en.13" on page 854*
H32.54	2032-37h	Hall auto-tuning selection	0 to 65535	0	-	At stop	*" H32_en.54" on page 1078*
H32.55	2032-38h	Manual tuning of Hall signal U/V/W	0 to 7	0	-	At stop	*" H32_en.55" on page 1078*
H32.56	2032-39h	U/V/W filter time of Hall signal	0 to 10	5	ms	Real time	*" H32_en.56" on page 1078*
H32.57	2032-3Ah	Hall closed-loop stall speed	0 to 65535	2	[mm/s]/[rpm]	At stop	*" H32_en.57" on page 1078*

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H32.58	2032-3Bh	Hall closed-loop stall current	0.0 to 300.0	120.0	%	At stop	"H32_en.58" on page 1079
H32.59	2032-3Ch	Hall closed-loop stall window time	0 to 2000	10	ms	At stop	"H32_en.59" on page 1079
H32.60	2032-3Dh	Hall closed loop inertia ratio	0.00 to 120.00	0.00	-	At stop	"H32_en.60" on page 1079
H32.61	2032-3Eh	Hall closed loop stiffness	4 to 31	12	-	At stop	"H32_en.61" on page 1079
H32.62	2032-3Fh	Electrical angle save flag	0 to 65535	0	-	Real time	"H32_en.62" on page 1080
H32.63	2032-40h	Electrical angle of Hall 1	0 to 65535	0	-	At stop	"H32_en.63" on page 1080
H32.64	2032-41h	Electrical angle of Hall 2	0 to 65535	0	-	At stop	"H32_en.64" on page 1080
H32.65	2032-42h	Electric angle of Hall 3	0 to 65535	0	-	At stop	"H32_en.65" on page 1080
H32.66	2032-43h	Electrical angle of Hall 4	0 to 65535	0	-	At stop	"H32_en.66" on page 1081
H32.67	2032-44h	Electrical angle of Hall 5	0 to 65535	0	-	At stop	"H32_en.67" on page 1081
H32.68	2032-45h	Electric angle of Hall 6	0 to 65535	0	-	At stop	"H32_en.68" on page 1081

8.6.7 Voltage Injection Auto-tuning

For details about how to perform voltage injection auto-tuning without a Hall device, see "Process without a Hall device" on page 215.

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

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

- If this auto-tuning method is used in the non-shaft-locked state. The motor performs minor actions during auto-tuning.

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0A.13	200A-0Eh	Angle auto-tuning mode	0: Angle auto-tuning through pre-positioning 1: Angle auto-tuning through inching 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	0	-	At stop	"H0A_en.13" on page 854

Note

- Ensure that the motor phase sequence is correct during angle auto-tuning through voltage injection. Otherwise, auto-tuning can fail.
- Auto-tuning through voltage injection is applicable only to iron-core motors, ROT motors, and DDR motors, but not DDL motors.
- For DDL motors, if other auto-tuning methods fail, perform the following tests before performing angle auto-tuning through voltage injection:Perform angle auto-tuning through voltage injection on five different positions with power on when the software is not reset and record the five auto-tuned values (H00.28). You can perform angle auto-tuning through voltage injection on this DDL only if the maximum deviation among the five auto-tuned values is within 5400.
- If auto-tuning fails, see "Table 8-9 Related faults" on page 224.

Table 8–9 Related faults

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

8.7 Jog

Caution

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

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

The jog operation can be triggered through **the keypad speed mode, software tool speed mode, DI, and keypad position mode**.

Note

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

Jogging through the keypad in speed control mode

- Commissioning procedure

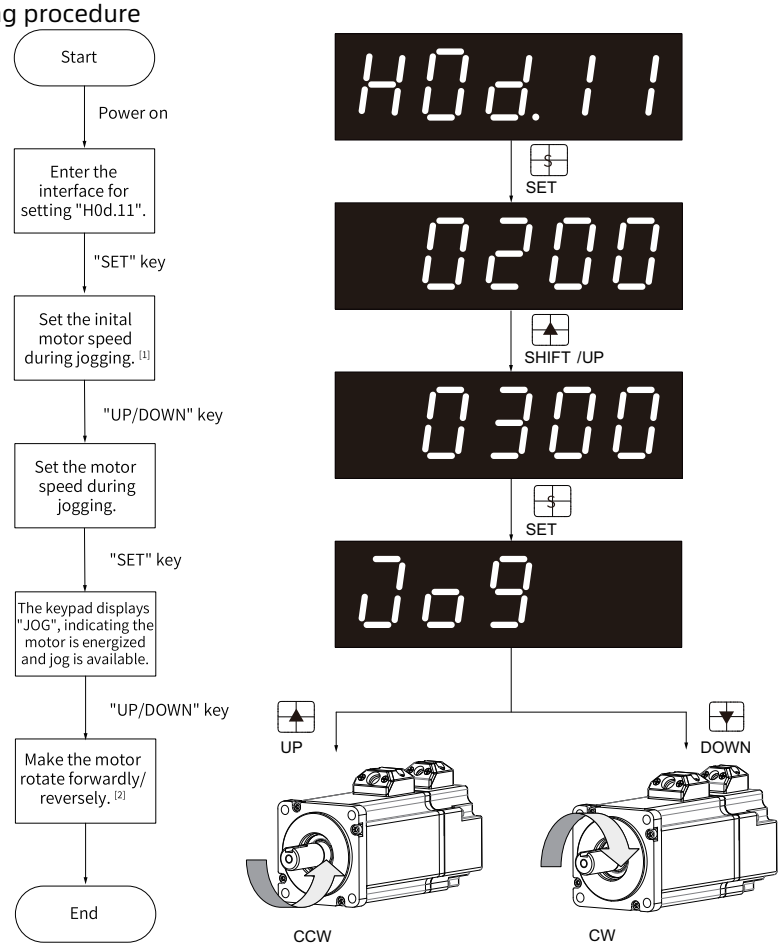


Figure 8-9 Jog setting procedure

Note

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

- Procedure:

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

   The operating panel displays the default jog speed defined by H06.04 at this moment.
2. After pressing the SET key, adjust the jog speed through the UP/DOWN key and press the SET key to enter the jog state.

   The keypad displays "JOG", and the motor is energized.
3. Press and hold the UP/DOWN key to make the motor jog forwardly or reversely.
4. Press the "MODE" key to exit from jog and return to the upper-level menu.

   The setpoint of H06.04 is not saved, which is restored to the default value again.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H06.04	2006-05h	DI jog speed reference	0 to 10000	150	[mm/s]/[rpm]	Real time	"H06_en.04" on page 796

Jogging through the software tool

Procedure:

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

Jog through DI

Note

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

Procedure:

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

☆ Related parameters:

No.	Name	Function name	Description
FunIN.18	JOGCMD+	Forward jog	Active: Input based on the reference Inactive: Operation reference input stopped
FunIN.19	JOGCMD-	Reverse jog	Active: Input based on the inverted reference Inactive: Operation reference input stopped

Jogging through keypad in position control mode

Procedure:

1. Enter the jog mode by setting H0d.08 on the keypad.
   The keypad displays the default jog speed.
2. After pressing the SET key, adjust the jog speed through the UP/DOWN key and press the SET key to enter the jog state.
3. The keypad displays "JOG-P", and the motor is energized.
4. Press and hold the UP/DOWN key to make the motor jog forwardly or reversely.
   Press the MODE key to exit the jog mode and return to the previous menu.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H06.12	2006-0Dh	Ramp-up/down time of jog speed	0 to 65535	10	ms	Real time	"H06_en.12" on page 798

8.8 Commissioning

To set the general parameters of the servo drive, see "Installation wizard" in InoDriverShop.

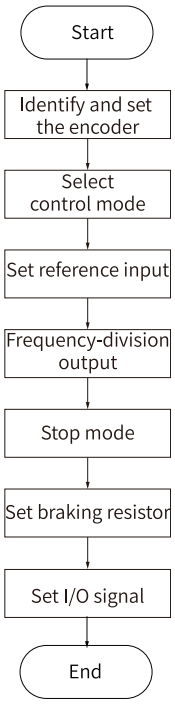


Figure 8-10 Installation wizard flowchart

Note

Parameters set in the setup wizard process will not be written to the drive. After all settings in setup installation wizard are done, you can check the configured parameters in Parameter List and click Write to write parameters to the drive in batches.

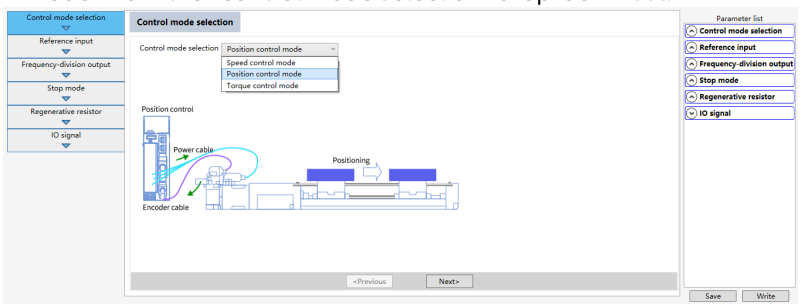
Encoder tuning and configuration

For details about how to configure Inovance or third-party motors and encoders, see chapter "Installing the Motor Management Library".

Control mode selection

Only three modes are supported: speed, position, and torque. After selecting a control mode, click "Next" to set corresponding parameters. The sub-process that needs to be set vary with the control mode. The following takes position control as an example.

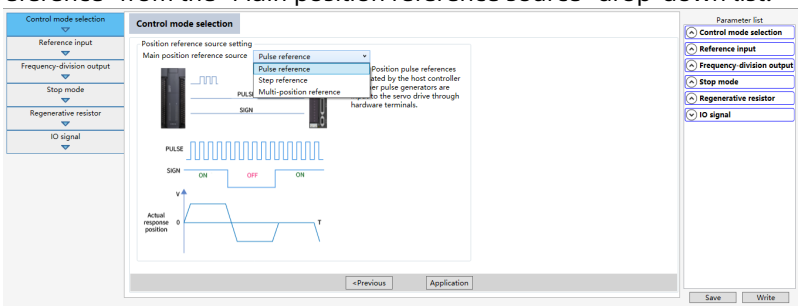
1. Select "Position mode" from the "Control mode selection" drop-down list.



☆ Related parameters:

Parameter	Comm. address	Parameter name	Range	Default Value	Unit	Change mode
H02.00	2002-01h	Control mode selection	0: Speed control mode 1: Position control mode 2: Torque control mode 3: Torque/Speed control mode 4: Speed/Position control mode 5: Torque/Position control mode 6: Torque/Speed/Position compound mode 7: Process segment 8: CANopen mode	1	-	At stop

2. Select "Pulse reference" from the "Main position reference source" drop-down list.



☆ Related parameters:

Parameter	Comm. address	Parameter name	Range	Default Value	Unit	Change mode
H05.00	2005-01h	Main position reference source	0: Pulse reference 1: Step amount 2: Multi-position reference	0	-	Real time

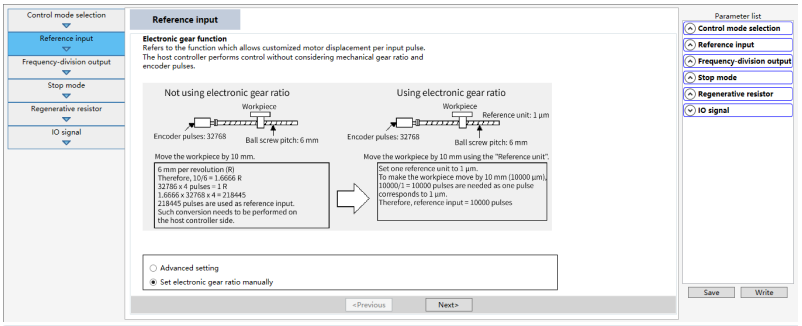
3. After setting the sub-process of the control mode, click "Application" to enter the sub-process of "Reference input".

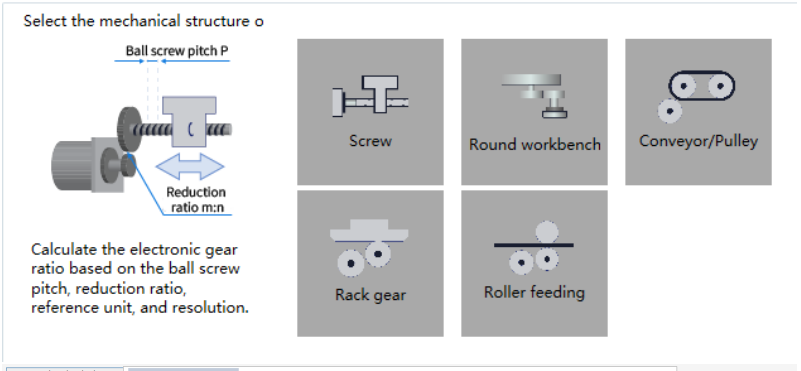
Reference input setting

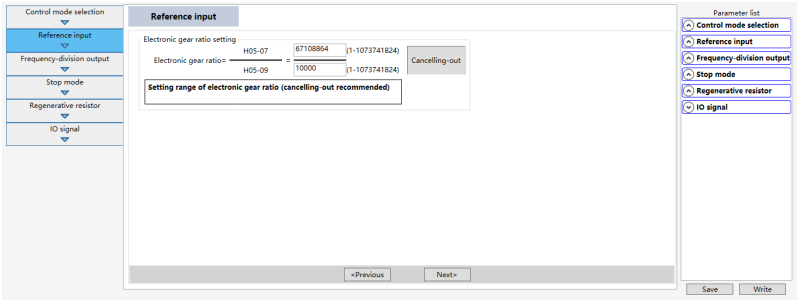
This process is used to set the gear ratio, high/low speed pulse access selection, reference form, and positioning completed threshold.

- The gear ratio can be set in two ways: "Advanced setting" and "Set electronic gear ratio manually".
  Set electronic gear ratio manually: You can input the electronic gear ratio manually.

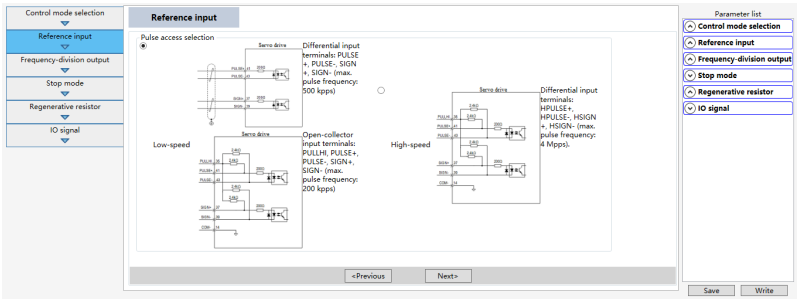
  Advanced setting: You can estimate the electronic gear ratio based on different mechanical transmission modes. The mechanical transmission models shown in the following figures are supported.



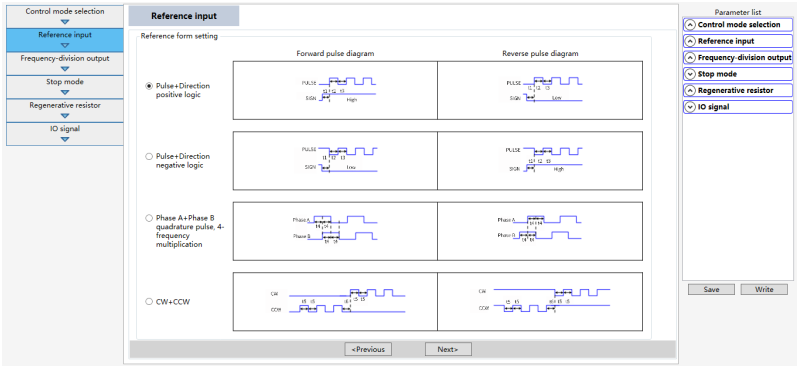




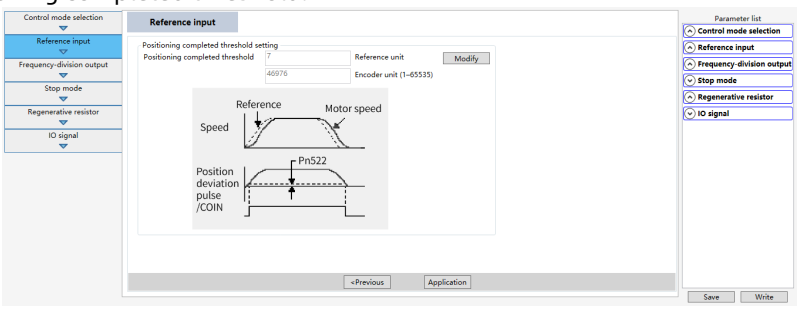
- Select the high/low speed pulse access mode.



- Set the reference form.



- Set the positioning completed threshold.



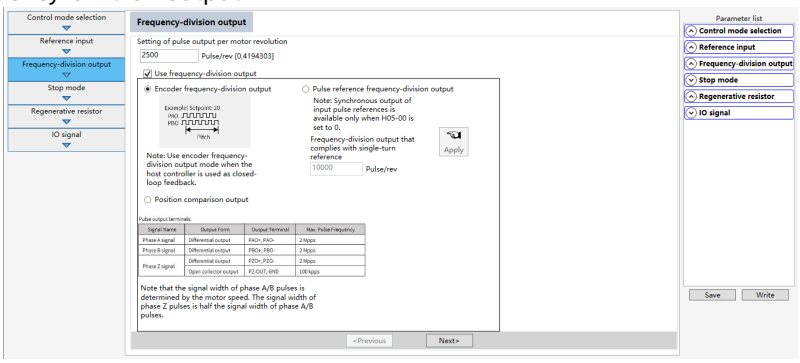
☆ Related parameters:

Parameter	Comm. address	Parameter name	Range	Default Value	Unit	Change mode
H05.02	2005-03h	Number of position references per motor revolution	0 to 4294967295	0	[P/N-N]/ [P/Rev]	At stop
H05.07	2005-08h	Electronic gear ratio 1 (numerator)	1 to 1073741824	67108864	-	Real time
H05.09	2005-0Ah	Electronic gear ratio 1 (denominator)	1 to 1073741824	10000	-	Real time
H05.11	2005-0Ch	Electronic gear ratio 2 (numerator)	1 to 1073741824	67108864	-	Real time
H05.13	2005-0Eh	Electronic gear ratio 2 (denominator)	1 to 1073741824	10000	-	Real time

Frequency-division output setting

This process is used to set the encoder frequency-division output, pulse output source, and pulse output feedback direction.

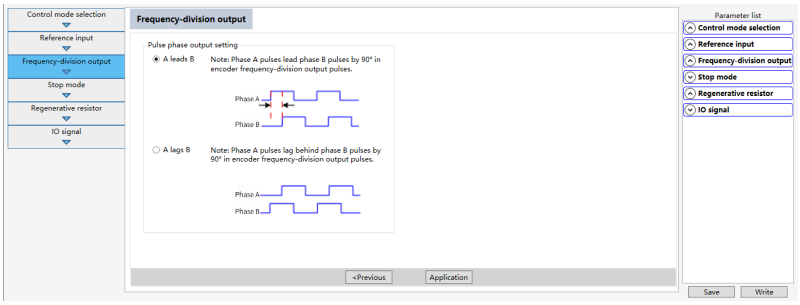
- Encoder frequency-division output



☆ Related parameters:

Parameter	Comm. address	Parameter name	Range	Default Value	Unit	Change mode
H05.17	2005-12h	Number of encoder frequency-division pulses	0 to 4194303	2500	[P/N-N]/ [P/Rev]	At stop

- Pulse output source



☆ Related parameters:

Parameter	Comm. address	Parameter name	Range	Default Value	Unit	Change mode
H02.03	2002-04h	Output pulse phase	0: Phase A leads phase B 1: Phase A lags behind phase B	0	-	At stop

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

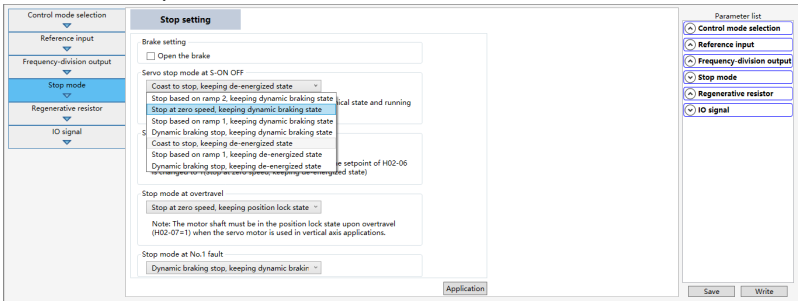
The direction of "forward drive" in overtravel prevention is the same as that defined by H02.02.

The output of the servo drive is phase A + phase B quadrature pulse. The relationship between phase A and phase B pulses can be changed directly through H02.03 (Output pulse phase).

Stop mode settings

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

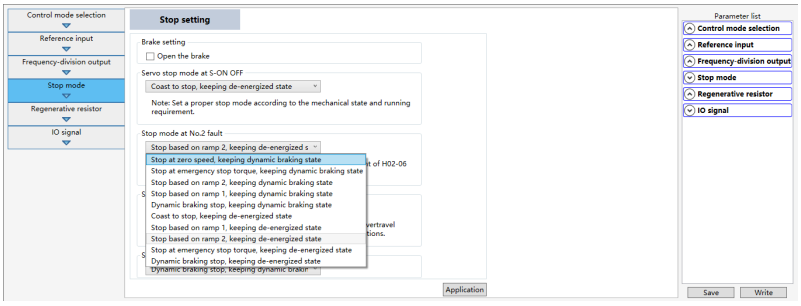
1. Select whether to use the brake in "Brake setting".
2. Select the stop mode for stop at S-ON OFF.



☆ Related parameters:

Parameter	Comm. address	Parameter name	Range	Default Value	Unit	Change mode
H02.05	2002-06h	Stop mode at S-OFF	-4: Stop based on ramp 2, keeping dynamic braking state -3: Stop at zero speed, keeping dynamic braking state -2: Stop based on ramp 1, keeping dynamic braking state -1: Dynamic braking stop, keeping dynamic braking state 0: Coast to stop, keeping de-energized state 1: Stop based on ramp 1, keeping de-energized state 2: Dynamic braking stop, keeping de-energized state	0	-	Real time

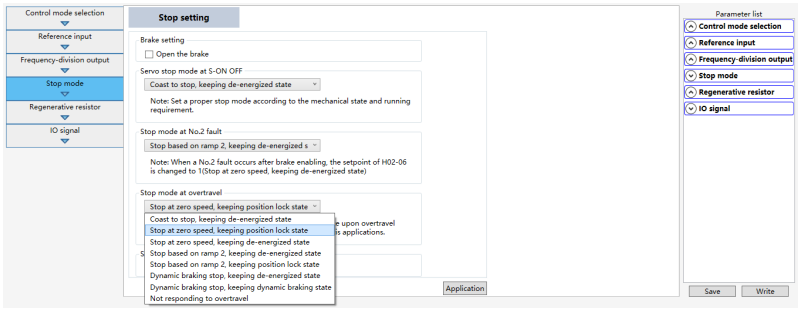
3. Select the stop mode at No.2 fault.



☆ Related parameters:

Parameter	Comm. address	Parameter name	Range	Default Value	Unit	Change mode
H02.06	2002-07h	Stop mode at No.2 fault	-5: Stop at zero speed, keeping dynamic braking state -4: Stop at emergency stop torque, keeping dynamic braking state -3: Stop based on ramp 2, keeping dynamic braking state -2: Stop based on ramp 1, keeping dynamic braking state -1: Dynamic braking stop, keeping dynamic braking state 0: Coast to stop, keeping de-energized state 1: Stop based on ramp 1, keeping de-energized state 2: Stop based on ramp 2, keeping de-energized state 3: Stop at emergency stop torque, keeping de-energized state 4: Dynamic braking stop, keeping de-energized state	2	-	Real time

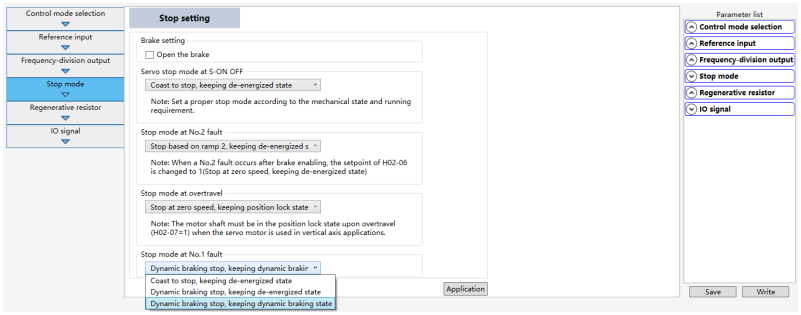
4. Select the stop mode at overtravel.



☆ Related parameters:

Parameter	Comm. address	Parameter name	Range	Default Value	Unit	Change mode
H02.07	2002-08h	Stop mode at overtravel	0: Coast to stop, keeping de-energized state 1: Stop at zero speed, keeping position lock state 2: Stop at zero speed, keeping de-energized state 3: Stop based on ramp 2, keeping de-energized state 4: Stop based on ramp 2, keeping position lock state 5: Dynamic braking stop, keeping de-energized state 6: Dynamic braking stop, keeping dynamic braking state 7: Not responding to overtravel	1	-	At stop

5. Select the stop mode at No.1 fault.



☆ Related parameters:

Parameter	Comm. address	Parameter name	Range	Default Value	Unit	Change mode
H02.08	2002-09h	Stop mode at No. 1 fault	0: Coast to stop, keeping de-energized state 1: Dynamic braking stop, keeping de-energized state 2: Dynamic braking stop, keeping dynamic braking state	2	-	At stop

Brake settings

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

Caution

- Use the built-in brake for position-lock purpose only. Do not use this brake for any other purposes (such as braking) other than position-lock in the stop state.
- The motor with brake should be controlled by the servo drive itself. It is not recommended to use a PLC to control the brake.
- The brake coil has no polarity.
- After the motor stops, switch off the servo-ON (S-ON) signal.
- When a motor with brake runs, the brake may generate a clicking sound, which does not affect its function.
- When brake coils are energized (the brake is released), magnetic flux leakage may occur at the shaft end.
- Do not use instruments such as magnetic sensors near the motor.

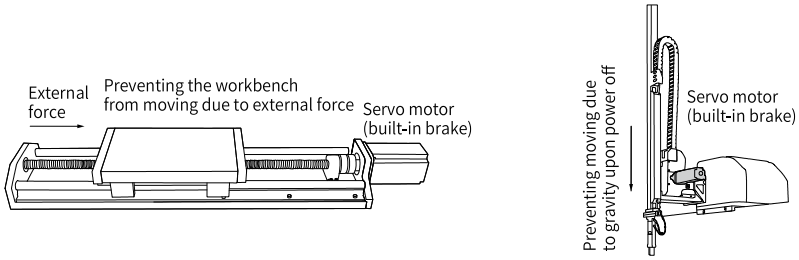


Figure 8-11 How the brake works

Table 8–10 Brake specifications

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

Note

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

- Brake software settings

  For motors with a brake, use BK+/BK- of CN8 on the servo drive and set H02.16 to 1.

  The brake sequences are different in the normal state and fault state.

  ☆ Related parameters:

Parameter	Comm. address	Parameter name	Range	Default Value	Unit	Change mode
H02.16	2002-11h	Brake switch	0: OFF 1: ON	0	-	Real time

- Brake sequence in normal state

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

  - Standstill: The motor speed is lower than 20 rpm.
  - Rotation: The motor speed is equal to or larger than 20 rpm.

- Brake sequence for motor at standstill

  If the servo ON signal becomes OFF, and the current motor speed is smaller than 20 RPM, the servo drive acts according to the brake time sequence for motor static state.

Caution

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

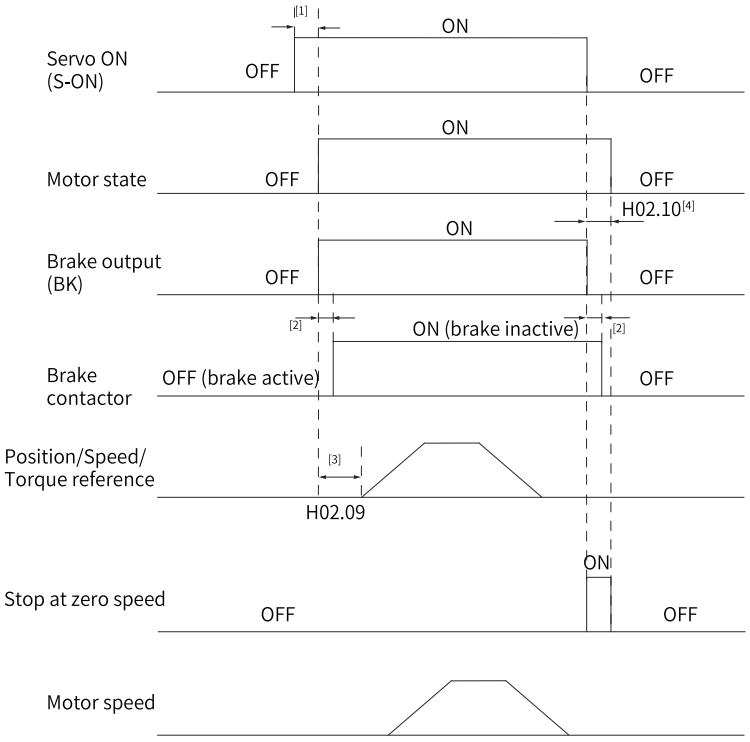


Figure 8-12 Brake sequence for motor at standstill

Note

- [1]: When the S-ON signal is switched on, the brake output is set to "ON" at a delay of about 80 ms, with motor being energized at the same time.
- [2]: For delay of brake contactor actions, see *"Table 8-10" on page 235*.
- [3]: The interval time, starting from the moment when brake output is set to "ON" to the moment when a command is input, must be higher than the setpoint of H02.09.
- [4]: When the S-ON signal is switched off with motor at standstill (motor speed lower than 20 rpm), the brake output is set to "OFF". You can set in H02.10 the delay of the motor in entering the de-energized state after the brake output is set to "OFF".

☆ Related parameters:

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

- Brake time sequence in motor rotating status

  If the S-ON signal is off, and the current motor speed is equal to or higher than 20 rpm, the drive acts according to the brake sequence in motor rotating state.

Caution

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

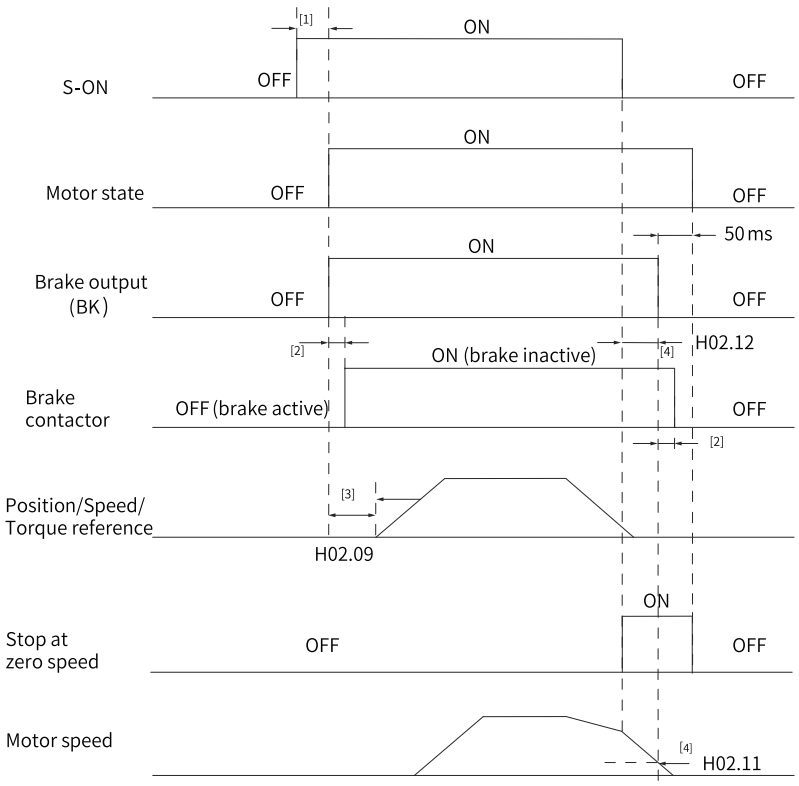


Figure 8-13 Brake sequence for a rotating motor

Note

- [1]: When the S-ON signal is switched on, the brake output is set to "ON" at a delay of about 80 ms, with motor being energized at the same time.
- [2]: For delay of brake contactor actions, see *"Table 8-10" on page 235*.
- [3]: The interval time, starting from the moment when brake output is set to "ON" to the moment when a command is input, must be higher than the setpoint of H02.09.
- [4]: When the motor is rotating and S-ON is OFF, the motor enters a non-energized state when the brake outputs OFF after the delay set in H02.12 or the speed feedback is less than H02.11.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Range	Default Value	Unit	Change mode
H02.11	2002-0Ch	Motor speed threshold at brake output OFF in rotation state	20 to 3000	30	[mm/s]/ [rpm]	Real time
H02.12	2002-0Dh	Delay from S-ON off to brake output off in the rotary state	1 to 65535	500	ms	Real time

- Brake sequence in fault state

  Servo drive faults can be classified into No.1 faults and No.2 faults based on the stop mode. The brake time sequence for the servo drive in the fault state changes with the fault class.

  - In cases of No.1 faults:

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

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

  - In case of No.2 faults:

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

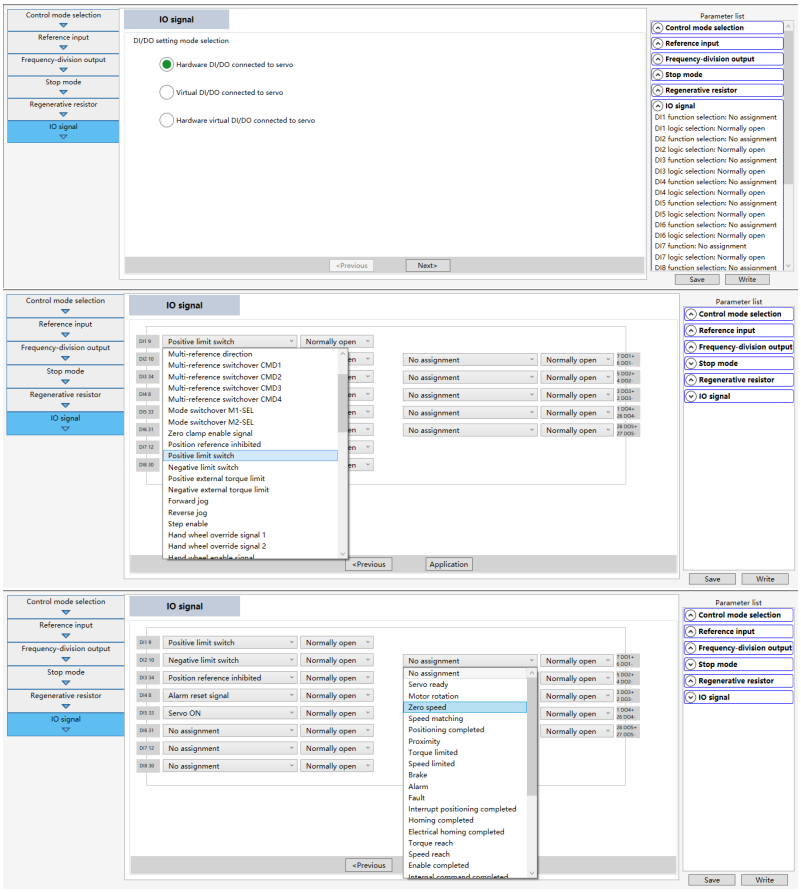
    In this case, the servo motor stops at zero speed first. When the actual motor speed is lower than 20 RPM, the brake output signal immediately becomes OFF, but the motor is still in the energized state within the time defined by H02.10.

Input/Output signal settings

The I/O signal setting is the same as "DI/DO setting mode selection".

The DI/DO setting modes include "Hardware DI/DO connected to servo", "Virtual DI/DO connected to servo", and "Hardware virtual DI/DO connected to servo".

The corresponding default function will be generated based on different control modes selected in "Control mode selection", or you can define the function as needed.



General parameters of the servo drive are set.

After preceding steps are done, you can view all the configured parameters in "Parameter list". If parameters in the sub-process need to be adjusted, click the corresponding tab to enter the sub-process directly and reset parameters.

After confirming parameters are set correctly, click "Write" to write parameters to the drive or click "Save" to save the parameters.

8.9 Enable operation

Switch on the S-ON signal.

When the drive of P model or N model is ready to run, the keypad displays "run" or "88rn" respectively.

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

Table 8–11 Operation of the drive

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

Power-on sequence diagram

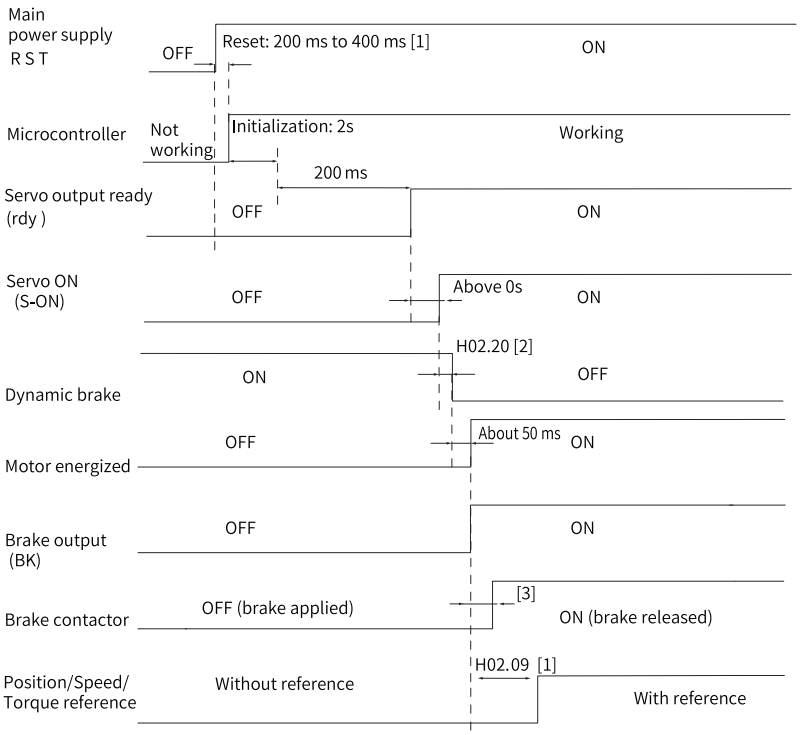


Figure 8-14 Power-on sequence diagram

Note

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

Sequence diagram for stop at alarm or fault

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

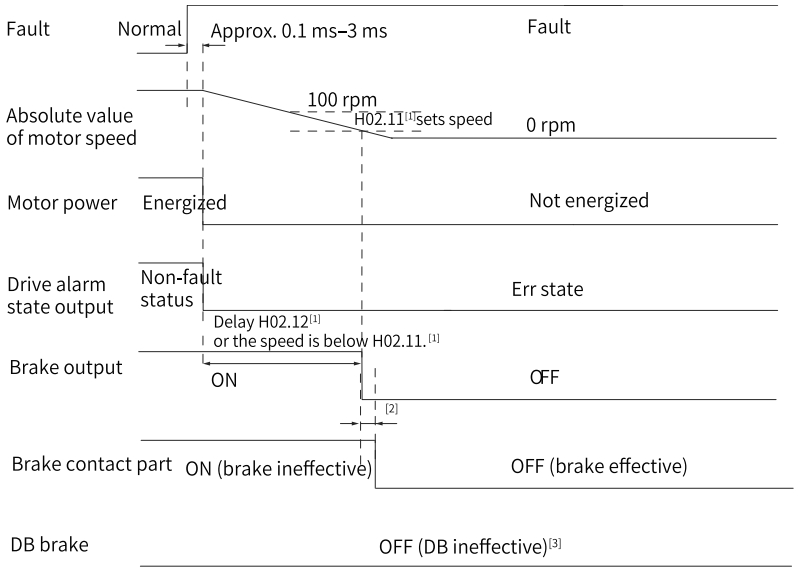


Figure 8-15 Sequence of "Coast to stop, keeping de-energized state" at No. 1 fault

Note

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

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

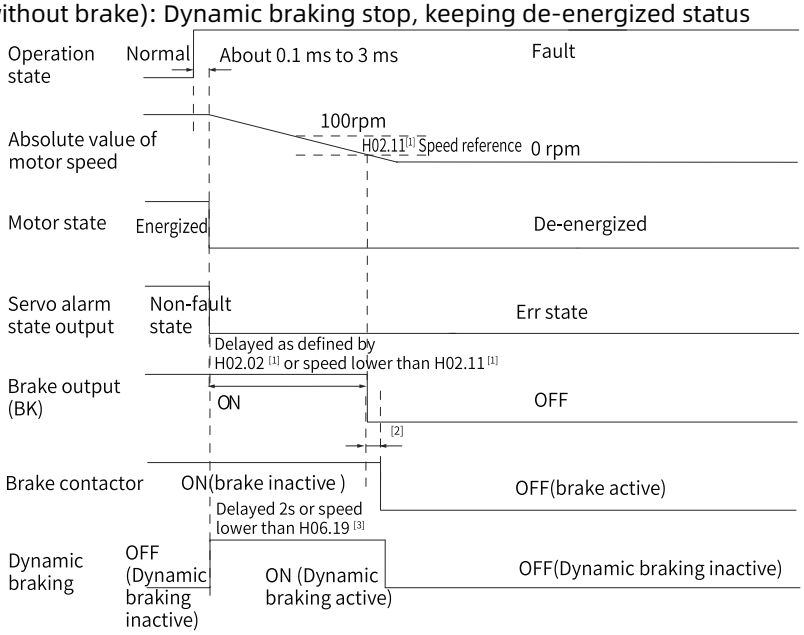


Figure 8-16 Sequence of "Dynamic braking stop, keeping de-energized state" at No. 1 fault

Note

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

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

Figure 8-17 Sequence of "Dynamic braking stop, keeping dynamic braking state" at No. 1 fault

Note

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

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

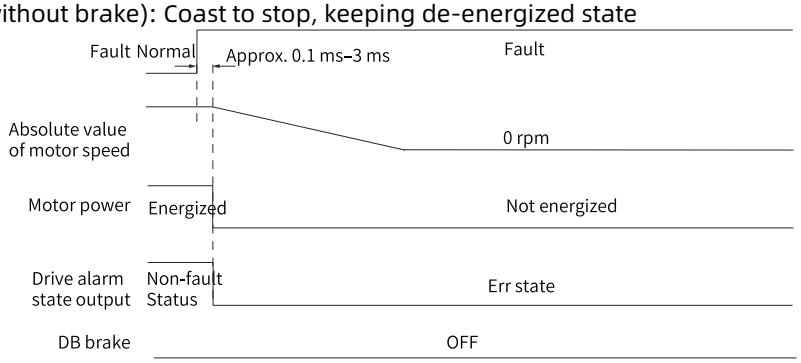


Figure 8-18 Sequence of "Coast to stop, keeping de-energized state" at No.2 fault

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

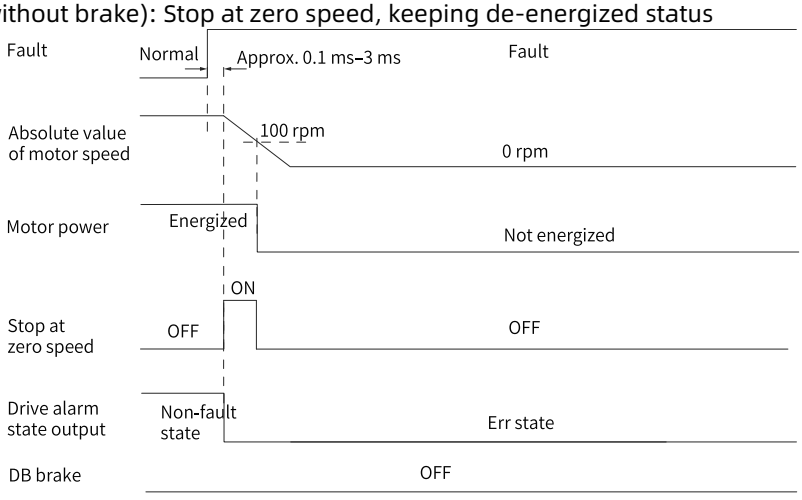


Figure 8-19 Sequence of "Stop at zero speed, keeping de-energized state" at No. 2 fault (without brake)

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

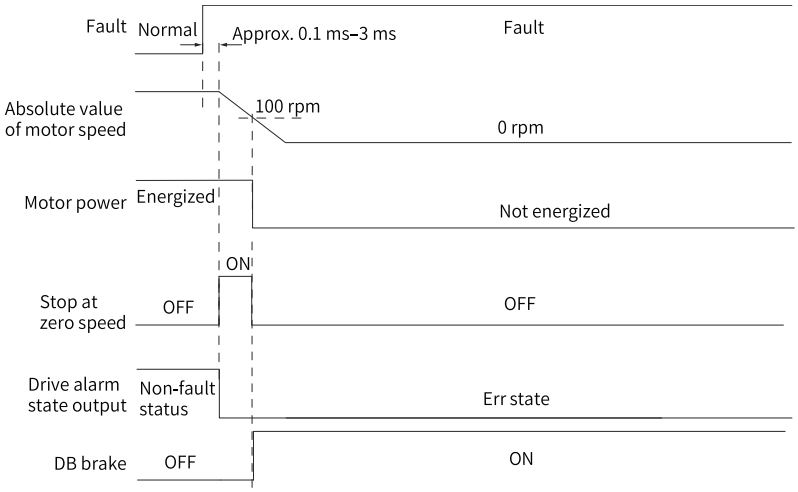


Figure 8-20 Sequence of "Stop at zero speed, keeping dynamic braking state" at No. 2 fault (without brake)

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

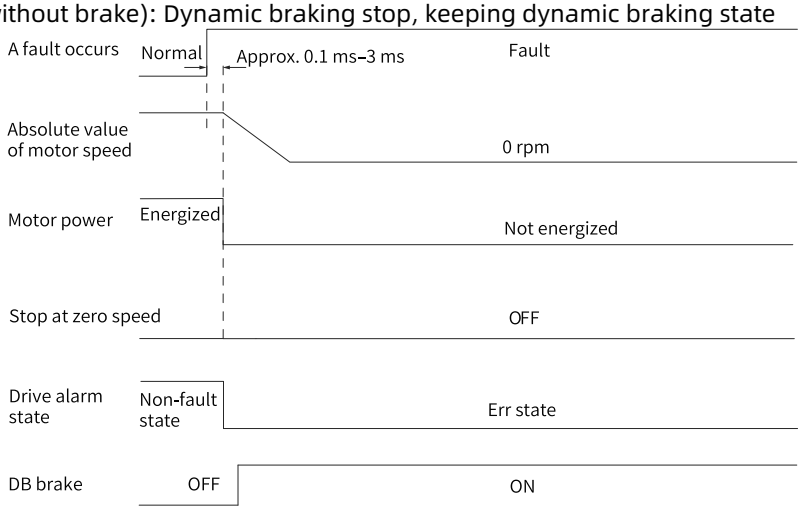


Figure 8-21 Sequence of "Dynamic braking stop, keeping dynamic braking state" at No. 2 fault (without brake)

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

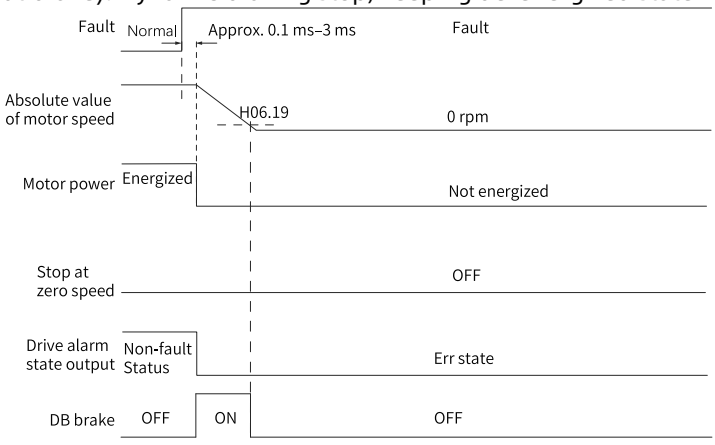


Figure 8-22 Sequence of "Dynamic braking stop, keeping de-energized state" at No. 2 fault (without brake)

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

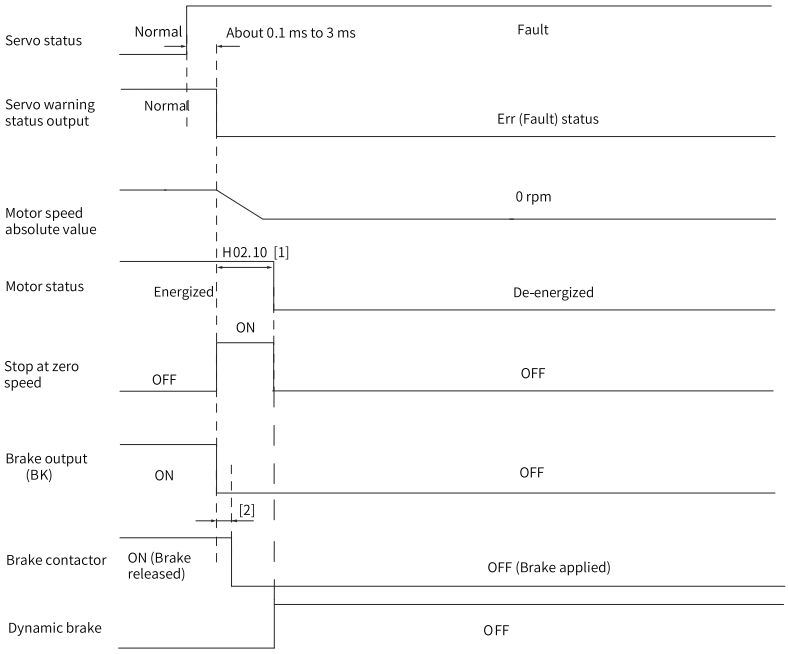


Figure 8-23 Sequence of "Stop at zero speed, keeping dynamic braking state" at No. 2 fault (with brake)

Note

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

- When a No. 3 alarm occurs on the servo drive, such as E900.0 (DI emergency braking), E950.0 (Positive limit switch alarm), and E952.0 (Negative limit switch alarm), the servo drive stops according to *"Figure 8-24 Sequence for alarms that cause stop" on page 245*.
- Alarms that cause stop: Stop at zero speed, keeping position lock status

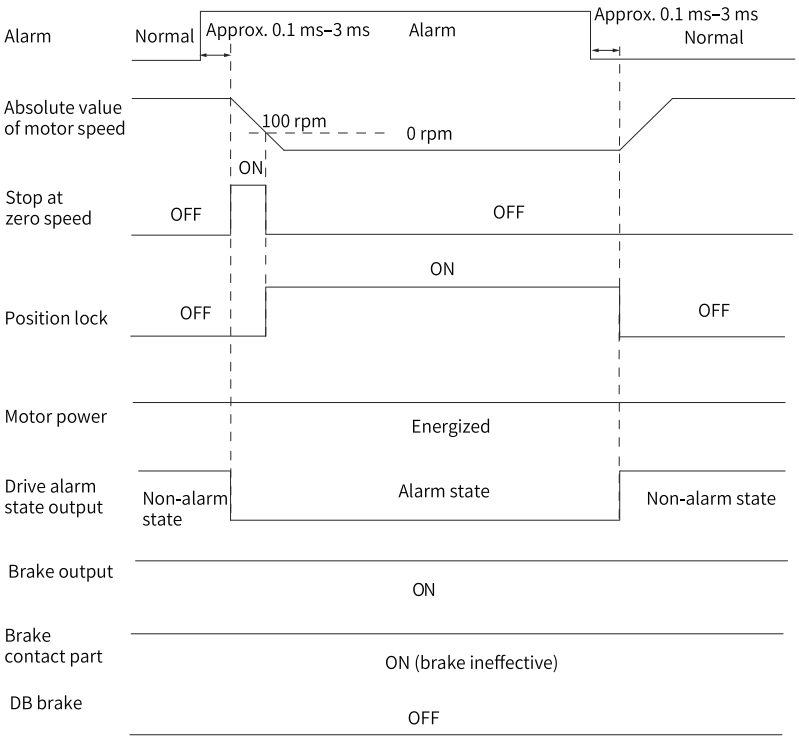


Figure 8-24 Sequence for alarms that cause stop

The other alarms do not affect the operation state of the drive. The sequence diagram for these alarms is shown in *"Figure 8-25 Sequence for alarms that do not cause stop" on page 245*.

- Alarms that do not cause stop

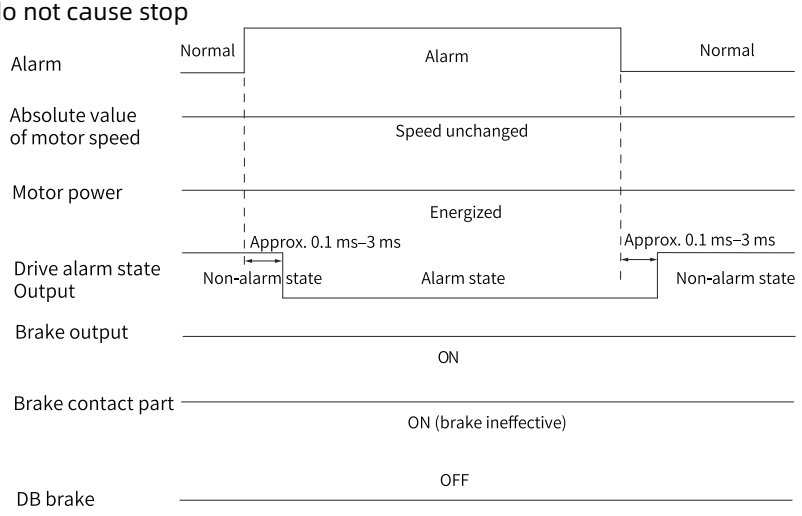


Figure 8-25 Sequence for alarms that do not cause stop

- Fault reset

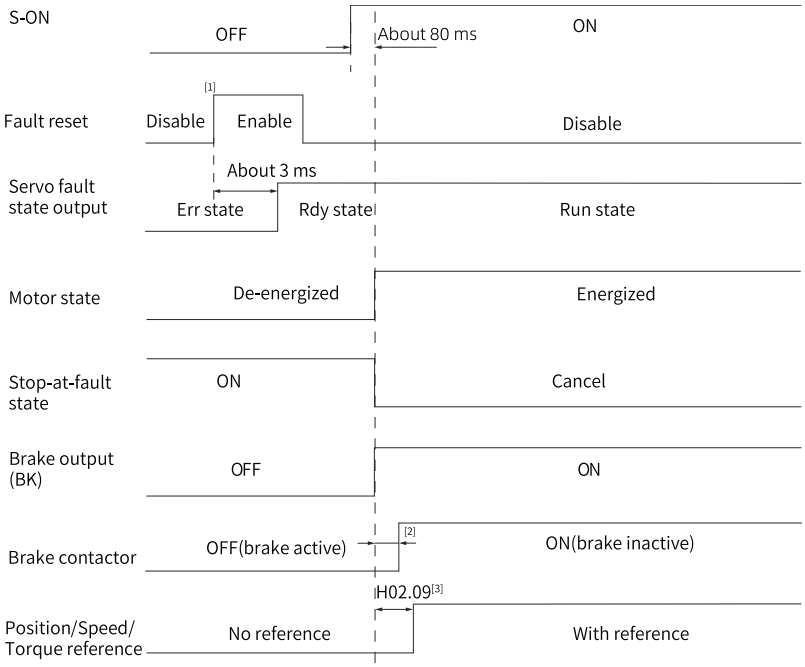


Figure 8-26 Sequence for fault reset

Note

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

8.10 Servo Drive Stop

Five type of stop modes are available for the servo drive: coast to stop, stop at zero speed, ramp to stop, stop at emergency-stop torque, and dynamic braking stop, along with three kinds of stop status: de-energized, position lock, and dynamic braking. See the following table for details.

Table 8–12 Comparison among different stop modes

Stop mode	Description	Feature
Coast to stop	The motor is de-energized and coasts to 0 RPM. The deceleration time is affected by the mechanical inertia and mechanical friction.	This mode features smooth and slow deceleration with small mechanical shocks.
Stop at zero speed	The motor decelerates to 0 rpm immediately and stops.	Features quick deceleration with obvious mechanical shock.
Ramp to stop	The motor decelerates to 0 RPM smoothly upon position/speed/ torque reference input.	Features smooth and controllable deceleration with small mechanical shock.
Stop at emergency-stop torque	The drive outputs reverse braking torque to stop the motor.	Features quick deceleration with obvious mechanical shock.
Dynamic braking	The motor is in the dynamic braking status.	Features quick deceleration with obvious mechanical shock.

Table 8–13 Comparison among different stop states

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

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

Stop at S-ON OFF

Deactivate the S-ON signal through communication. The servo drive stops accordingly.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H02.05	2002-06h	Stop mode at S-OFF	-4: Stop based on ramp 2, keeping dynamic braking state -3: Stop at zero speed, keeping dynamic braking state -2: Stop based on ramp 1, keeping dynamic braking state -1: Dynamic braking stop, keeping dynamic braking state 0: Coast to stop, keeping de-energized state 1: Stop based on ramp 1, keeping de-energized state 2: Dynamic braking stop, keeping de-energized state	0	-	Real time	"H02_en.05" on page 741

Stop upon fault

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H02.06	2002-07h	Stop mode at No.2 fault	-5: Stop at zero speed, keeping dynamic braking state -4: Stop at emergency stop torque, keeping dynamic braking state -3: Stop based on ramp 2, keeping dynamic braking state -2: Stop based on ramp 1, keeping dynamic braking state -1: Dynamic braking stop, keeping dynamic braking state 0: Coast to stop, keeping de-energized state 1: Stop based on ramp 1, keeping de-energized state 2: Stop based on ramp 2, keeping de-energized state 3: Stop at emergency stop torque, keeping de-energized state 4: Dynamic braking stop, keeping de-energized state	2	-	Real time	"H02_en.06" on page 741

Stop at overtravel

★Terms:

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H02.07	2002-08h	Stop mode at overtravel	0: Coast to stop, keeping de-energized state 1: Stop at zero speed, keeping position lock state 2: Stop at zero speed, keeping de-energized state 3: Stop based on ramp 2, keeping de-energized state 4: Stop based on ramp 2, keeping position lock state 5: Dynamic braking stop, keeping de-energized state 6: Dynamic braking stop, keeping dynamic braking state 7: Not responding to overtravel	1	-	At stop	"H02_en.07" on page 742

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

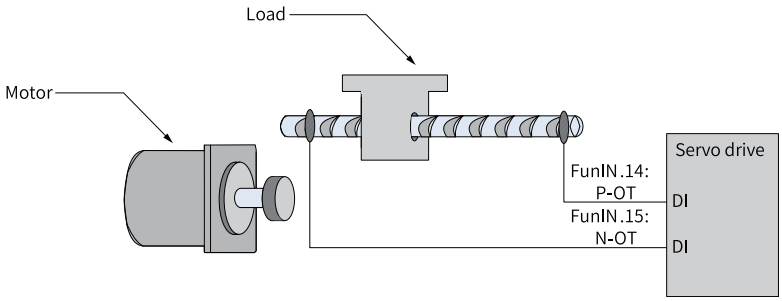


Figure 8-27 Installation of limit switches

To use the limit switch function, assign two DI terminals of the drive respectively with function 14 (FunIN.14: P-OT, positive limit switch) and function 15 (FunIN.15: N-OT, negative limit switch) to receive the limit switch input level signals, and set the active logics of DI terminals. The servo derive determines whether to enable or disable the limit switch function based on the DI terminal level.

☆ Related parameters:

No.	Name	Function name	Function
FunIN.14	P-OT	Positive limit switch	When the machine moves beyond the specified range, overtravel prevention applies. Inactive: Forward drive permitted Active: Forward drive inhibited
FunIN.15	N-OT	Negative limit switch	When the machine moves beyond the specified range, overtravel prevention applies. Inactive: Reverse drive permitted Active: Reverse drive inhibited

Emergency stop

Two emergency stop modes are supported:

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

  ☆ Related parameters:

No.	Name	Function name	Function
FunIN.34	Emergency-Stop	Braking	Invalid: Current running state unaffected Active: The drive stops according to the stop mode defined by H02.18 or 605Ah.

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

  When this function is enabled, the drive will stop in the stop mode defined by H02.05 or 605Ch regardless of the operating status.

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0d.05	200d-06h	Emergency stop	0: No operation 1: Emergency stop	0	-	Real time	"H0d_en.05" on page 892
H02.05	2002-06h	Stop mode at S-OFF	-4: Stop based on ramp 2, keeping dynamic braking state -3: Stop at zero speed, keeping dynamic braking state -2: Stop based on ramp 1, keeping dynamic braking state -1: Dynamic braking stop, keeping dynamic braking state 0: Coast to stop, keeping de-energized state 1: Stop based on ramp 1, keeping de-energized state 2: Dynamic braking stop, keeping de-energized state	0	-	Real time	"H02_en.05" on page 741
H02.15	2002-10h	Alarm display on the LED	0: Immediately output alarm message 1: Do not output alarm message	0	-	Real time	"H02_en.15" on page 744
H02.18	2002-13h	Quick stop mode	0: Coast to stop, keeping de-energized state 1: Stop by ramp 1, keeping de-energized state 2: Stop by ramp 2, keeping de-energized state 3: Stop at emergency stop torque, keeping de-energized state 5: Stop by ramp 1, keeping position lock state 6: Stop by ramp 2, keeping position lock state 7: Stop at emergency stop torque, keeping position lock state	2	-	Real time	"H02_en.18" on page 745

Quick stop

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
605Ah	605Ah	Quick stop mode	0: Coast to stop, keeping de-energized state 1: Ramp to stop as defined by 6084h/ 609Ah (HM), keeping de-energized state 2: Ramp to stop as defined by 6085h, keeping de-energized state 3: Stop at emergency stop torque, keeping de-energized state 5: Ramp to stop as defined by 6084h/ 609Ah (HM), keeping position lock state 6: Ramp to stop as defined by 6085h, keeping position lock state 7: Stop at emergency stop torque, keeping position lock state	2	-	Real time	"605Ah" on page 1124

Halt

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
605Dh	605Dh	Halt mode	1: Ramp to stop as defined by 6084h/ 609Ah (HM), keeping position lock state 2: Ramp to stop as defined by 6085h, keeping position lock state 3: Stop at emergency stop torque, keeping position lock state	1	-	Real time	"605Dh" on page 1125

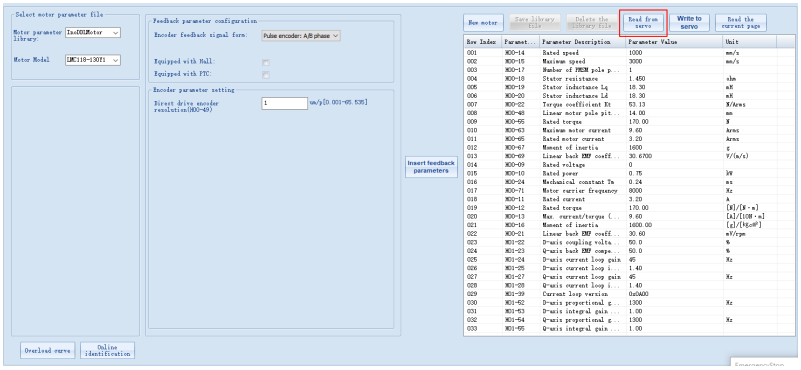


Do not set the deceleration time to an excessively low value. An excessively low value will lead to a long stop distance, incurring the risk of collision.

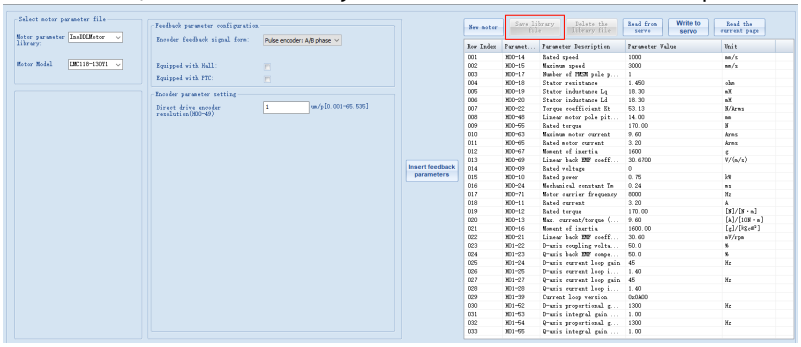
8.11 Quick Transfer of Motor Parameters

To import parameters of a running motor from a drive to another one which is connected to a motor of the same type, do as follows:

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



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



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

9 Tuning

9.1 Overview

The servo drive must drive the motor as quick and accurate as possible to follow the commands from the host controller or internal setting. To meet such requirements, gain tuning is required.

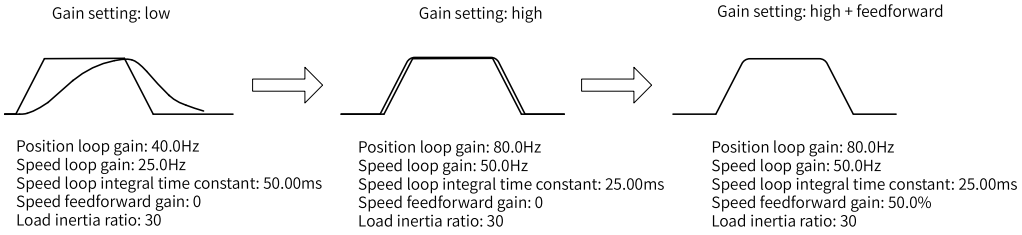


Figure 9-1 Examples of gain tuning

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.

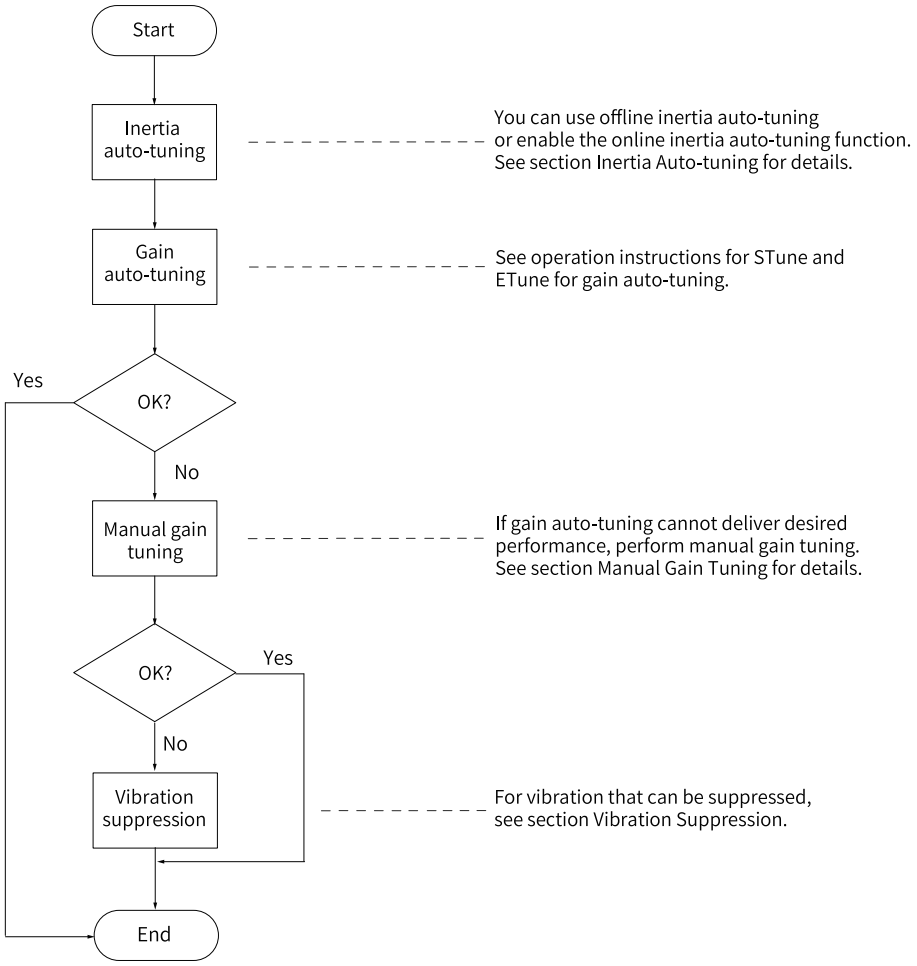


Figure 9-2 Gain tuning process

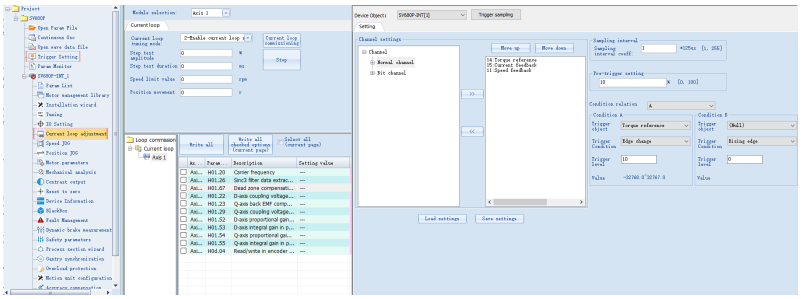
9.2 Current Loop Tuning

Current loop parameter tuning

As the innermost loop of a servo control system, the response and stability of the current loop play a vital role in the 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.

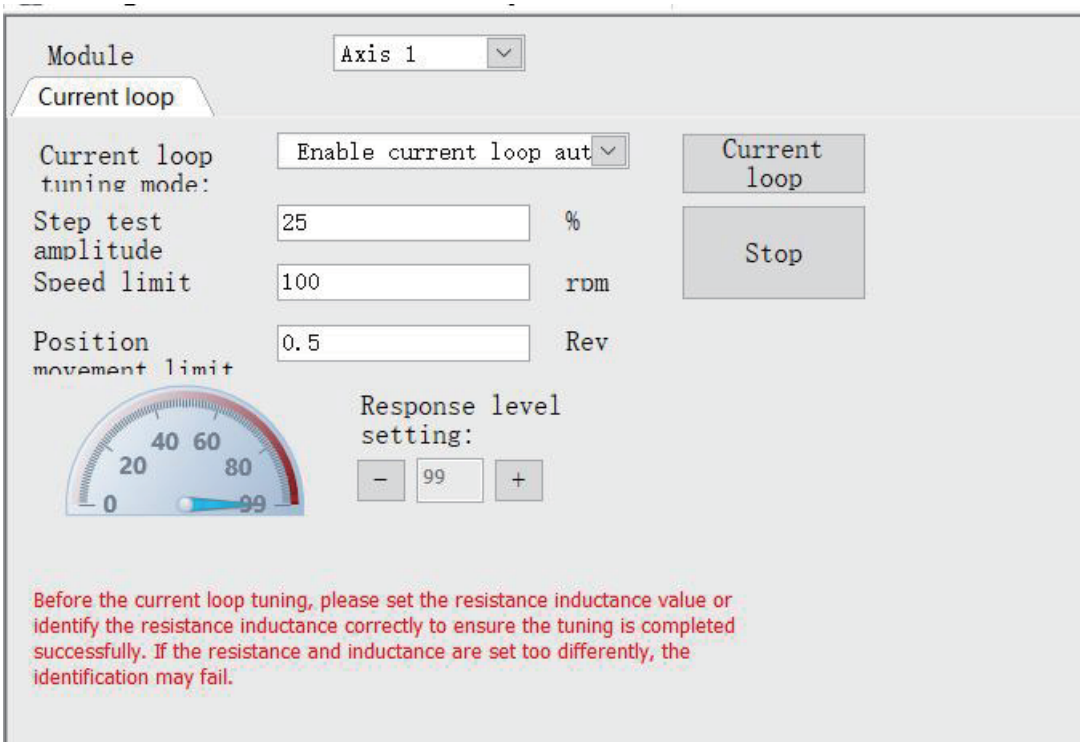


Three current loop tuning modes are available, as described below.

1. **Current loop auto-tuning**

   This mode provides a static auto-tuning method for the current loop. After this mode is enabled, 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 responsiveness and bandwidth of the current loop.



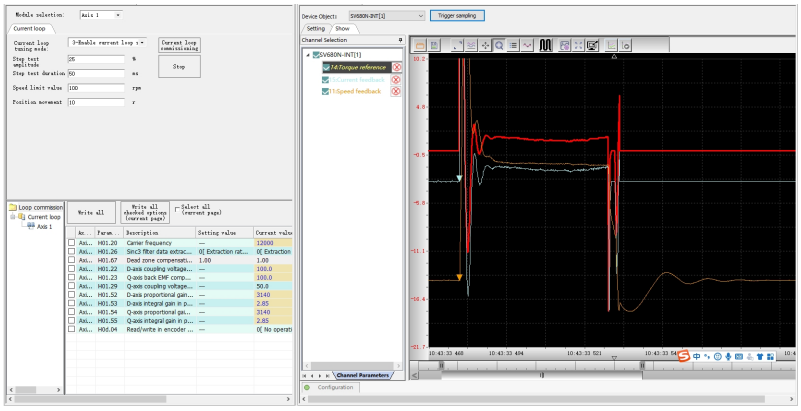
Note

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

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. **Step Test Mode**

   This mode provides a dynamic method for observing the current loop step response. Its parameter settings are the same as static step test. Users can manually adjust the current loop gain parameters to observe 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.

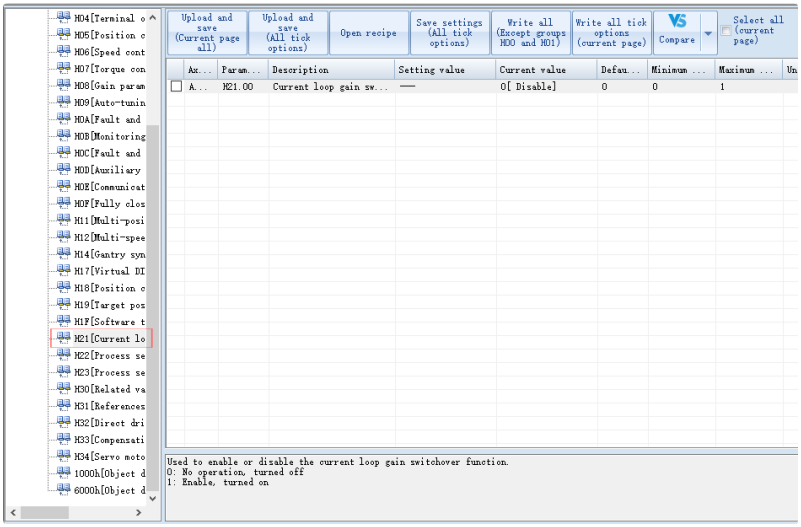
Current loop gain switchover

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 SV680-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 based on 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 obtain the inertia ratio through inertia auto-tuning.

The following two inertia auto-tuning modes are available:

- Offline inertia auto-tuning
  To enable offline inertia auto-tuning, use H0d.02 (Offline inertia auto-tuning) and make the motor rotate and execute inertia auto-tuning through the keypad. Offline inertia auto-tuning does not involve the host controller.
- Online inertia auto-tuning
  Send a command from the host controller to the servo drive to make the motor act accordingly to finish inertia auto-tuning. Online inertia auto-tuning involves the host controller.

Note

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

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

9.3.1 Offline inertia auto-tuning

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

The motor must meet the following requirements:

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

Danger

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

- The required number of revolutions (H09.09) is fulfilled.
  View the values of H09.06 (Maximum speed of inertia auto-tuning), H09.07 (Time constant for accelerating to the maximum speed during inertia auto-tuning), and H09.09 (Number of revolutions per inertia auto-tuning) to ensure the travel distance that starts from the stop position is larger than the value of H09.09. Otherwise, decrease the value of H09.06 or H09.07 until this requirement is met.

Offline inertia auto-tuning procedure:

1. Switch off the S-ON signal.
2. In parameter display mode, switch to H0d.02 and press SET to enable offline inertia auto-tuning.
3. Press the UP/DOWN key to perform offline inertia auto-tuning.
4. To make the motor stop at zero speed, release the UP/DOWN key. Pressing the UP/DOWN key again starts a new inertia auto-tuning. The initial direction of operation is determined by the UP/DOWN key. For applications allowing unidirectional operations only, set H09.05 to 1.
5. Wait until the value displayed on the keypad is stabilized.
6. Hold the SET key down until the operating panel displays "SAVE".
7. Press the MODE key to exit.

For 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.

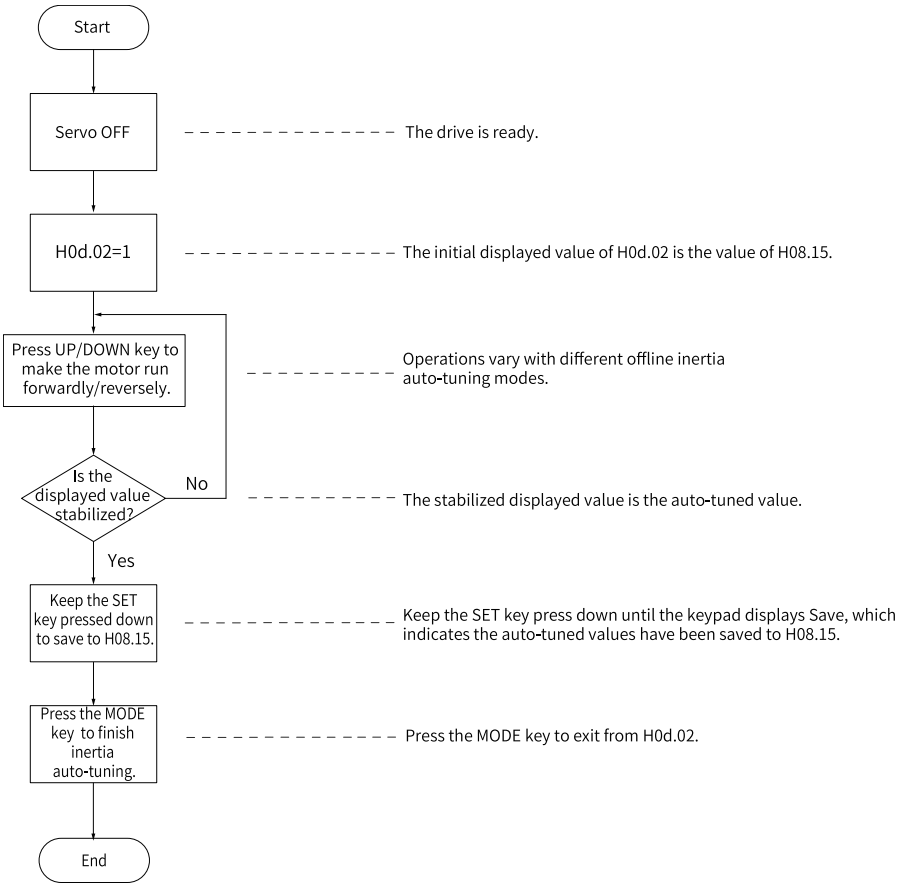


Figure 9-3 Offline inertia auto-tuning flowchart

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H09.05	2009-06h	Offline inertia auto-tuning mode	0: Bidirectional 1: Unidirectional	0	-	At stop	"H09_en.05" on page 835
H09.06	2009-07h	Maximum speed of inertia auto-tuning	100 to 1000	500	[mm/s]/[rpm]	At stop	"H09_en.06" on page 836
H09.07	2009-08h	Time constant for accelerating to maximum speed during inertia auto-tuning	10 to 5000	125	ms	At stop	"H09_en.07" on page 836
H09.08	2009-09h	Interval time upon completion of inertia auto-tuning	50 to 10000	800	ms	At stop	"H09_en.08" on page 836

Parameter	Comm. address	Parameter name	Value range	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 836
H0d.02	200d-03h	Inertia auto-tuning	0 to 65	0	-	Real time	"H0d_en.02" on page 891

9.3.2 Online inertia auto-tuning

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

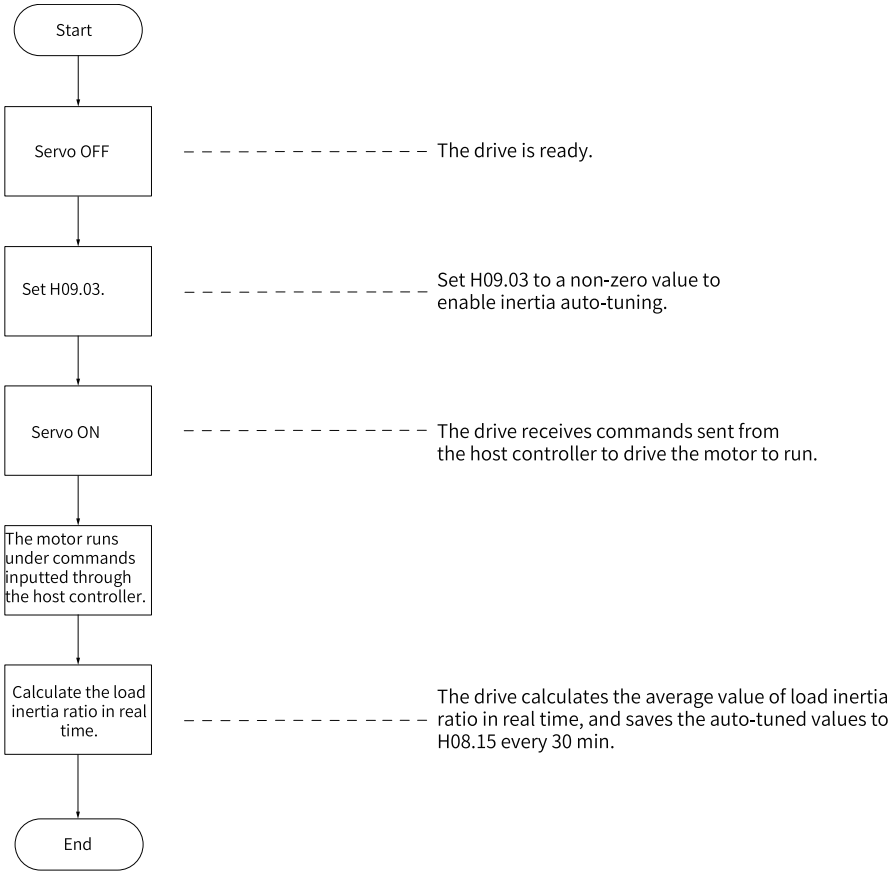


Figure 9-4 Online inertia auto-tuning flowchart

Note

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

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H09.03	2009-04h	Online inertia auto-tuning mode	0: Disabled 1: Enabled, changing slowly 2: Enabled, changing normally 3: Enabled, changing quickly	0	-	Real time	"H09_en.03" on page 835

9.4 Automatic Gain Tuning

9.4.1 STune

Overview

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

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

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

Note

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

- The load inertia changes quickly.
- The load torque changes quickly.
- Low-speed operation (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, manually set the correct inertia ratio.

Procedure

- **Procedure flowchart**

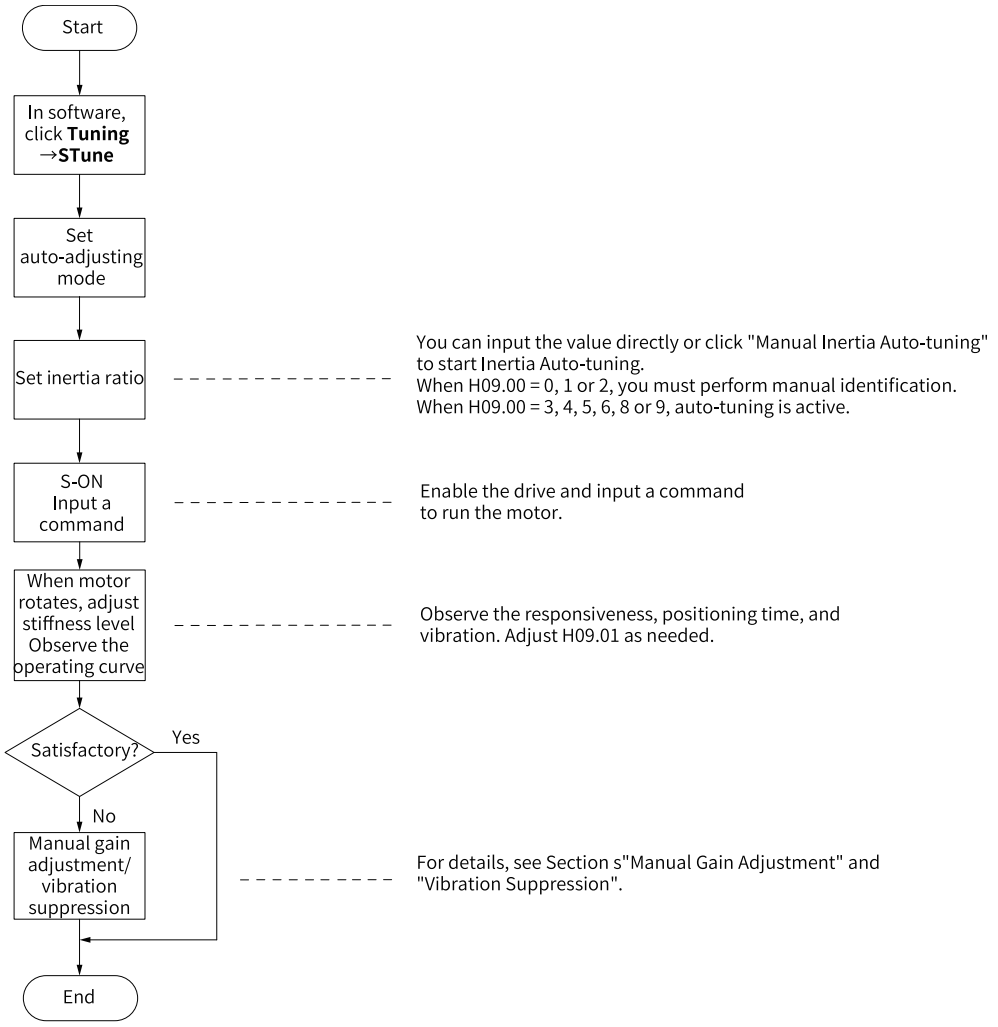


Figure 9-5 Procedure flowchart

- **Description**

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

  1. Select the automatic gain tuning mode.

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

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

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

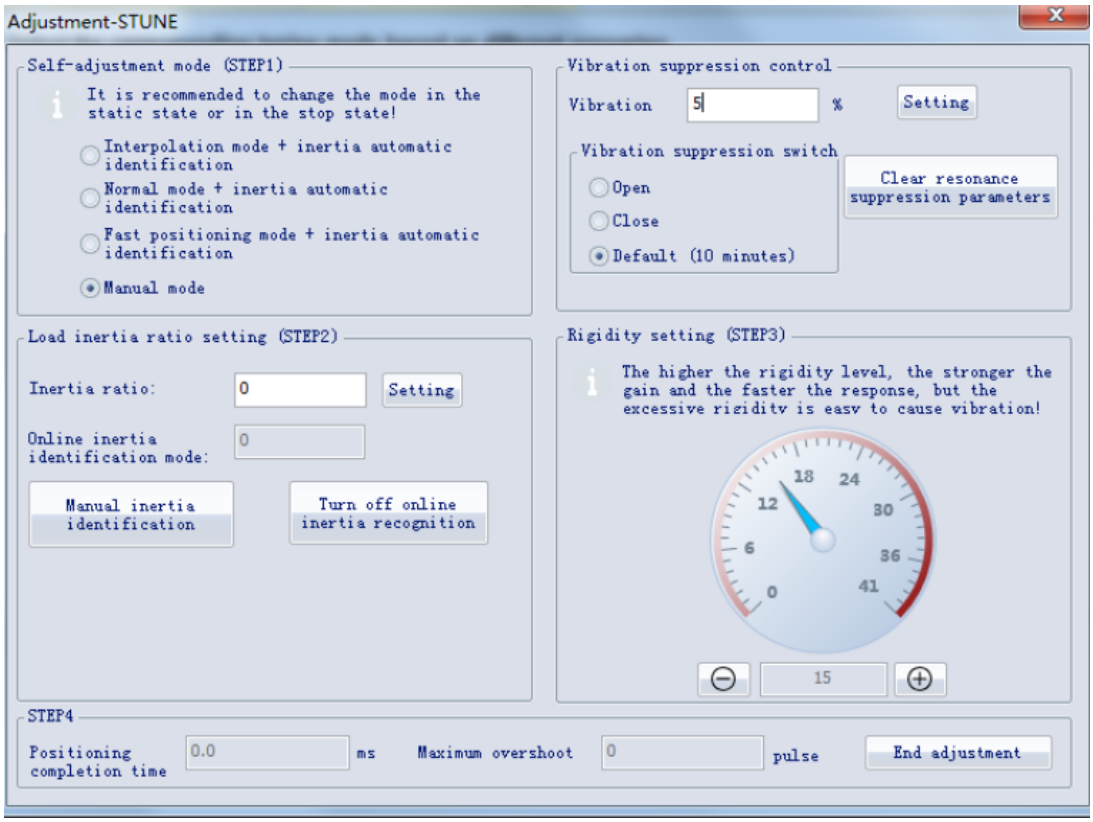
2. Gradually adjust the stiffness level during operation of the load. The present stiffness level value will be automatically written to the drive. Keep monitoring the operating waveform after increasing the stiffness level (increase by one level at a time) until desired performance is achieved.
3. In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

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

   To modify the STune time, set H09.37.
4. In STune modes 3, 4, 5, 6, 8, and 9, resonance will be suppressed automatically. If the resonance is not well suppressed, set H09.58 to 1 to clear the resonance suppression parameter settings, decrease the rigidity level, and perform STune again.
5. In multi-axis trajectories, perform single-axis commissioning first to determine the highest response of each axis and modify the response of each axis manually to ensure position responses of different axes are consistent.

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

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



Note

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

Additional information

Load inertia ratio range

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

Stiffness meter setting

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

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

Table 9–1 Stiffness levels

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

The following seven gain auto-tuning modes are available.

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

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

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

- Positioning mode (H09.00 is set to 2)
  Based on *"Table 9-2" on page 265*, the 2nd gain parameters (H08.03 to H08.05 and H07.06) are also automatically updated and saved based on the rigidity level set in H09.01. In addition, the position loop gain in the 2nd gain parameters has a higher rigidity level than that in the 1st gain parameters.

  Table 9–3 Parameters updated automatically in positioning mode

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

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

  Table 9–4 Parameters with fixed values in positioning mode

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

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

  Gain switchover is automatically activated in positioning mode.

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

Note

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

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

  ☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	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 838
H09.19	2009-14h	Bandwidth level of the 3rd notch	0 to 20	2	-	Real time	"H09_en.19" on page 839
H09.20	2009-15h	Depth level of the 3rd notch	0 to 99	0	-	Real time	"H09_en.20" on page 839
H09.21	2009-16h	Frequency of the 4th notch	50 to 8000	8000	Hz	Real time	"H09_en.21" on page 839
H09.22	2009-17h	Bandwidth level of the 4th notch	0 to 20	2	-	Real time	"H09_en.22" on page 839

Parameter	Comm. address	Parameter name	Value range	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 840
H09.58	2009-3Bh	STune resonance suppression reset selection	0: Disable 1: Enable	0	-	Real time	"H09_en.58" on page 845

Note

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

Solutions to common faults

E661.0: STune failure.

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

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	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 845

9.4.2 ETune

Overview

ETune is a wizard-type auto-tuning 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 STune function is intended to be used in applications featuring slight load inertia change.

Procedure

- **Procedure flowchart**

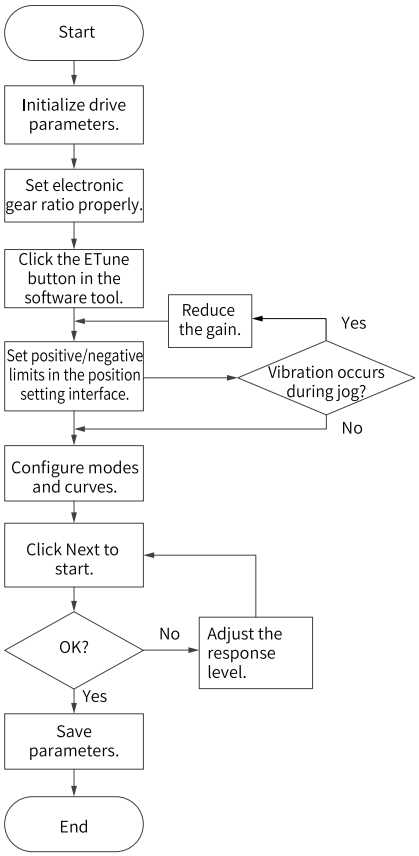
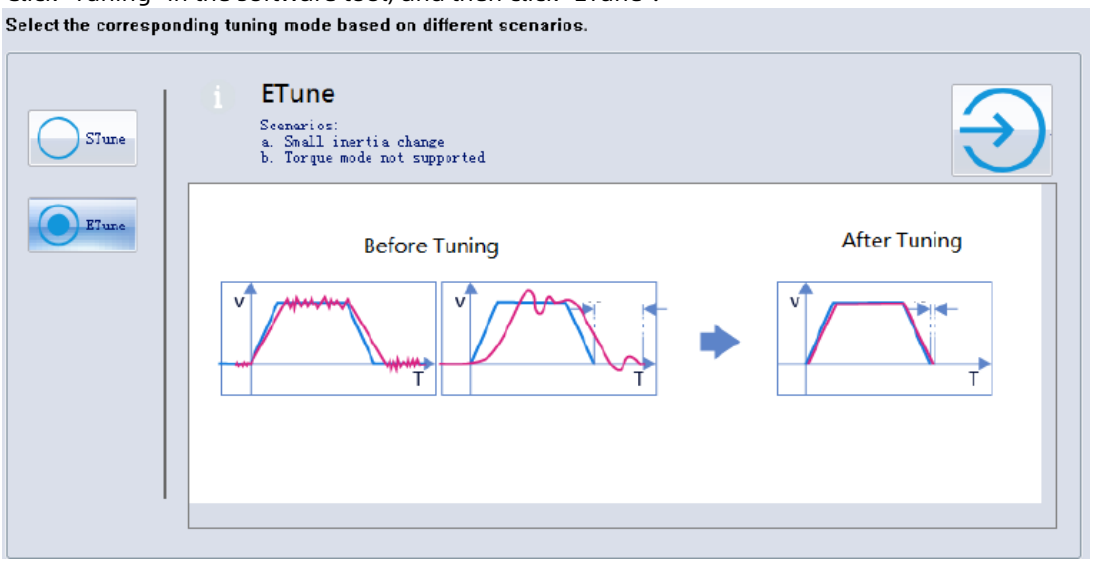


Figure 9-6 Procedure flowchart

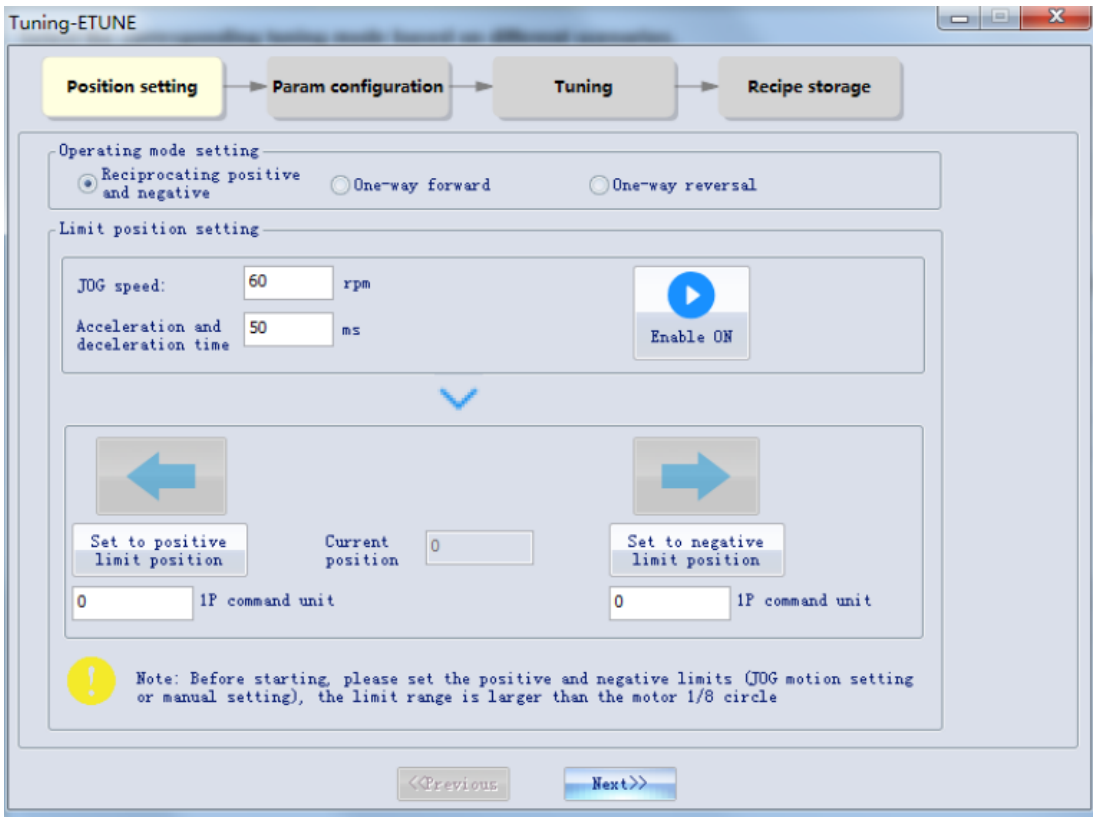
- **Description**

1. Click "Tuning" 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 positive and negative" 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.



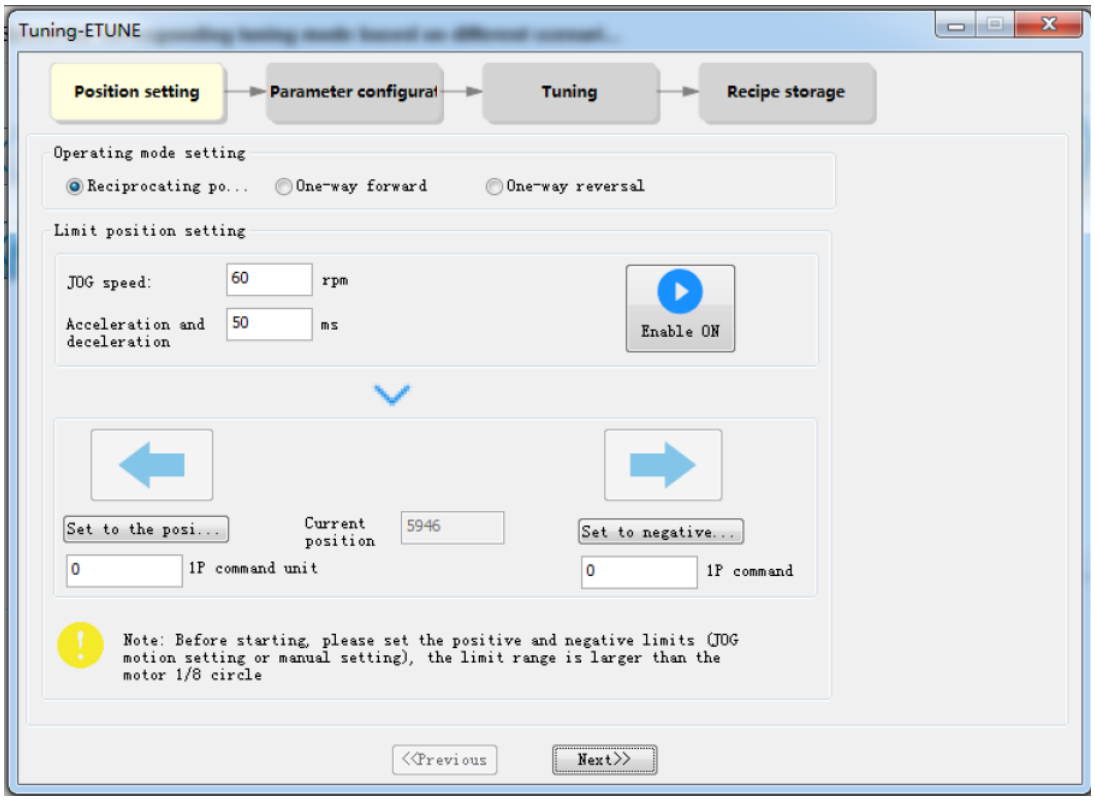
3. Specify the positive and negative limit positions allowed by the motor. The difference between the positive and negative limits defines the position reference pulses for the motor, which is also the value before multiplication/division by the electronic gear ratio.

   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

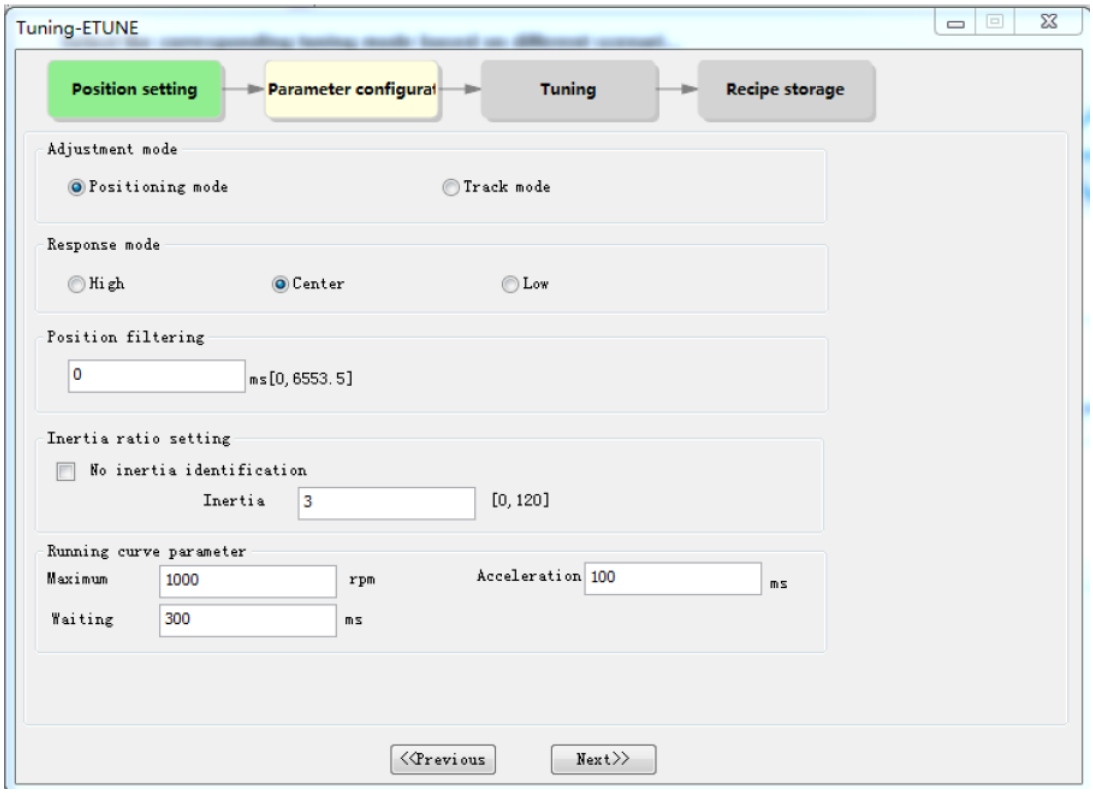
The difference between the positive and negative position limits must be larger than 1/8 of one revolution. The larger the value of the limit position, the better the adaptability of the auto-tuned parameters, but the longer will ETune adjustment take.



4. Click "Next to switch" to go to the mode parameter setting step.

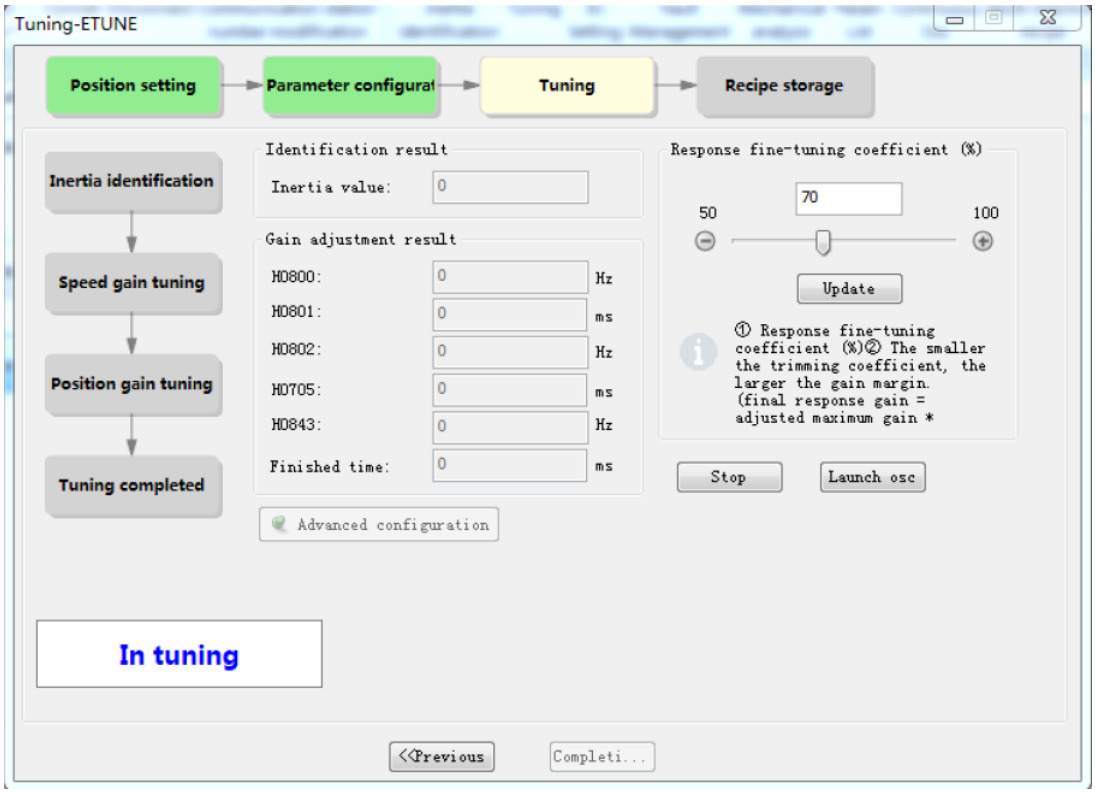
   The tuning mode is divided into Positioning mode and Track mode.

   Inertia auto-tuning is optional. If you choose not to perform inertia auto-tuning, set a correct inertia ratio (the value of 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.

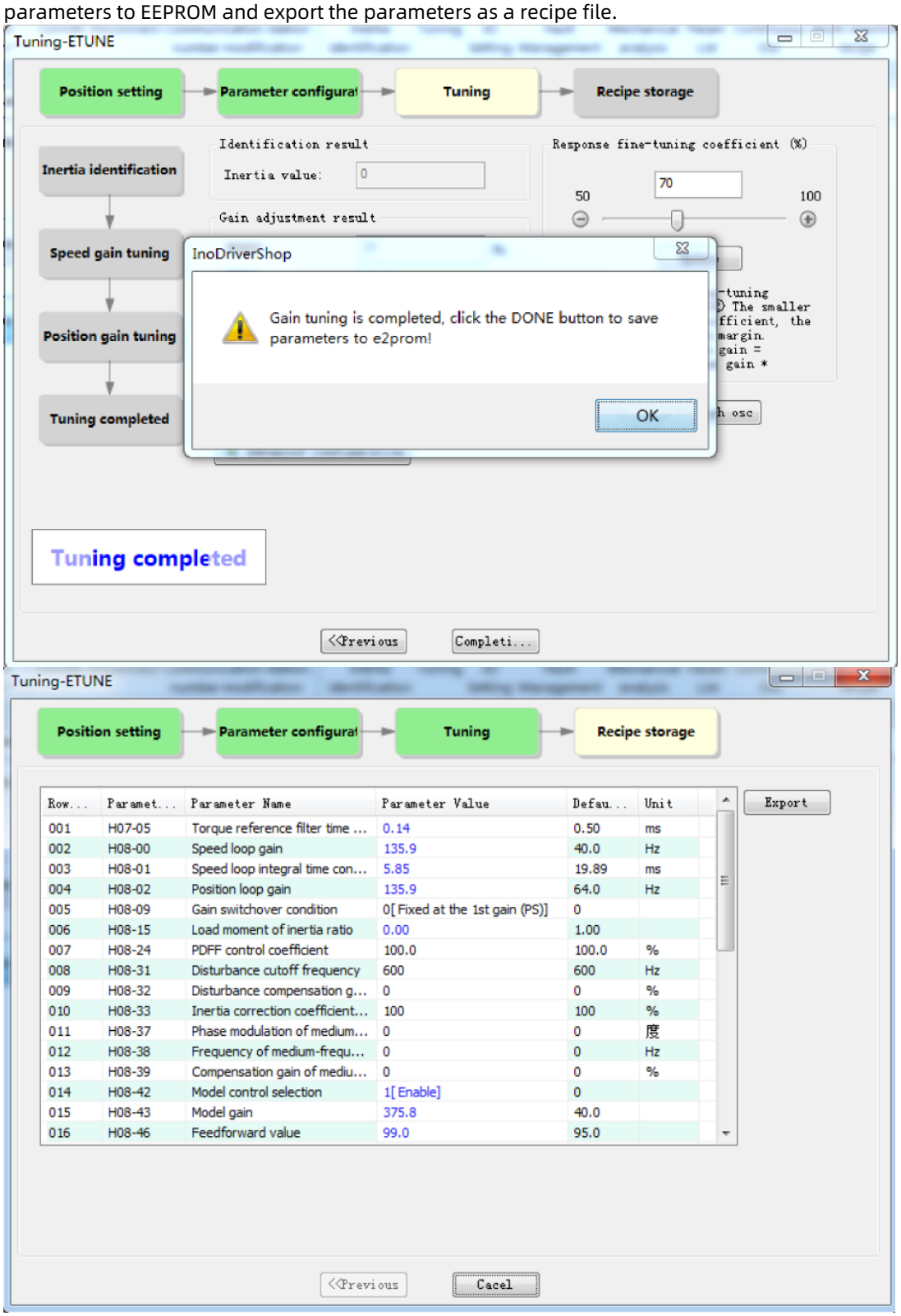


5. Click **" Next "** to start auto-tuning.

- 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 done, the drive starts gain auto-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.



Precaution

- 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 excessively 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 symptom	Cause	Solution
E662.0: ETune failure	Check whether resonance during ETune operation can be suppressed.	• Set the notch manually when vibration cannot be suppressed automatically. • Modify the electronic gear ratio to improve the command resolution, or increase the command filter time constant in the parameter configuration interface. • 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 the mechanism is eccentric. • An alarm occurs during auto-tuning and causes interruption. • 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 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 Basic Parameters

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

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

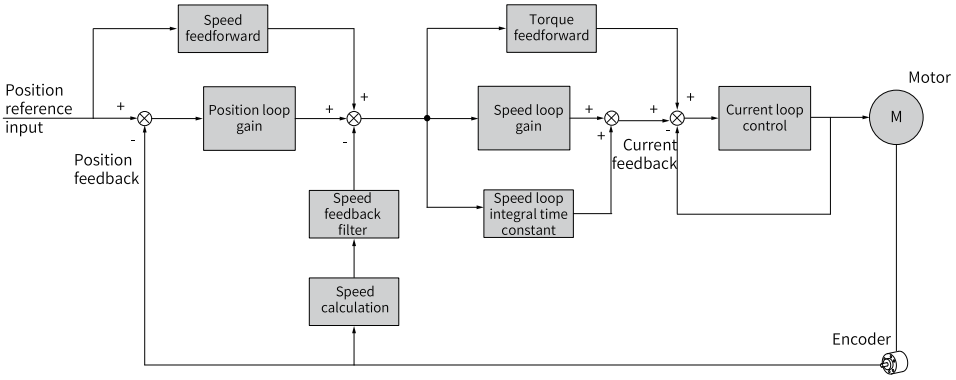


Figure 9-7 Basic control for manual gain tuning

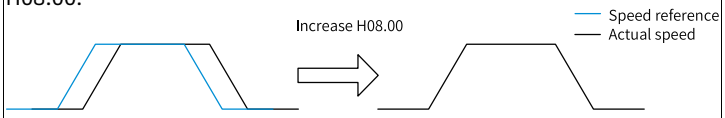
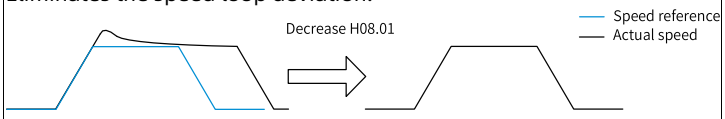
Caution

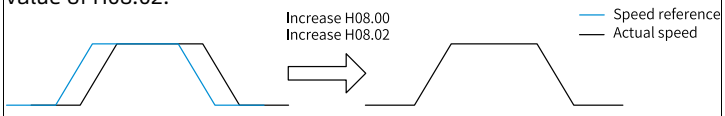
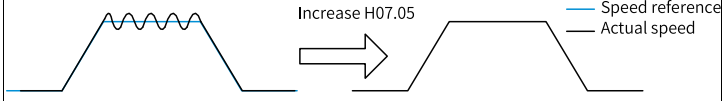
The response level of the inner loop must be higher than that of the outer loop. If it is not observed, the system may be unstable.

The current loop gain has been set with the highest level of responsiveness by default, avoiding the need for tuning. You only need to tune the position loop gain, speed loop gain, and other auxiliary gains. The default current loop gain may not be appropriate when you match it against a third-party motor. Therefore, automatic gain tuning of the current loop is required. For gain tuning in position control mode, the position loop gain must be increased together with the speed loop gain, and the responsiveness of the former must be lower than the latter.

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

Table 9–5 Gain tuning parameters

Procedure	Parameter	Name	Description
1	H08.00	Speed loop gain	Parameter function: Determines the maximum frequency of a variable speed reference that can be followed by the speed loop. When H08.15 (Load inertia ratio) is correctly set, the maximum frequency that can be followed by the speed loop is the setpoint of H08.00.  Tuning method: • Increasing the setpoint without incurring extra noise or vibration shortens the positioning time, stabilizes the speed, and improves the follow-up behavior. • If noise occurs, decrease the setpoint. • If mechanical vibration occurs, enable the resonance suppression function by referring to *"Vibration suppression" on page 298*.
2	H08.01	Speed loop integral time constant	Parameter function: Eliminates the speed loop deviation.  Tuning method: Set H08.01 according to the following formula: 500 ≤ H08.00 × 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.

Procedure	Parameter	Name	Description
3	H08.02	Position loop gain	Parameter function: Defines the maximum frequency of position references that can be followed by the position loop. The maximum following frequency of the position loop equals the value of H08.02.  Tuning method: To ensure system stability, the maximum following frequency of the speed loop is 3 to 5 times of the maximum following frequency of the position loop. $3 \leqslant \frac{2 \times \pi \times H08.00}{H08.02} \leqslant 5$ For example, when H08.00 is set to 40.0 Hz, H08.02 must meet the following requirement: 50.2 Hz ≤ H08.02 ≤ 83.7 Hz. Adjust the setting based on the positioning time. Increasing the setpoint shortens the positioning time and improves the anti-interference capacity of a motor at standstill. An excessively high setpoint may easily lead to system instability and oscillation.
4	H07.05	Torque reference filter time constant	Parameter function: Eliminates the high-frequency noise and suppresses mechanical resonance.  Tuning method: Ensure that the cutoff frequency of the torque reference low-pass filter is higher than 4 times of the maximum follow frequency of the speed loop. $\frac{1000}{2 \times \pi \times H07.05} \geqslant (H08.00) \times 4$ 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 298*. An excessively high setpoint weakens the responsiveness of the current loop. To suppress vibration at stop, increase H08.00 and decrease H07.05. If strong vibration occurs upon stop, decrease the setpoint of H07.05.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H07.05	2007-06h	Torque reference filter time constant 1	0.00 to 30.00	0.50	ms	Real time	"H07_en.05" on page 811
H08.00	2008-01h	Speed loop gain	0.0 to 2000.0	40.0	Hz	Real time	"H08_en.00" on page 818
H08.01	2008-02h	Speed loop integral time constant	0.15 to 512.00	19.89	ms	Real time	"H08_en.01" on page 818
H08.02	2008-03h	Position loop gain	0.0 to 2000.0	64.0	Hz	Real time	"H08_en.02" on page 818

9.5.2 Gain Switchover

Gain switchover can be triggered by the internal state of the drive or an external DI. It is only effective in position and speed control modes. Gain switchover achieves the following purposes:

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

H08.08 = 0

When H08.08 is set to 0, the 1st gain 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.

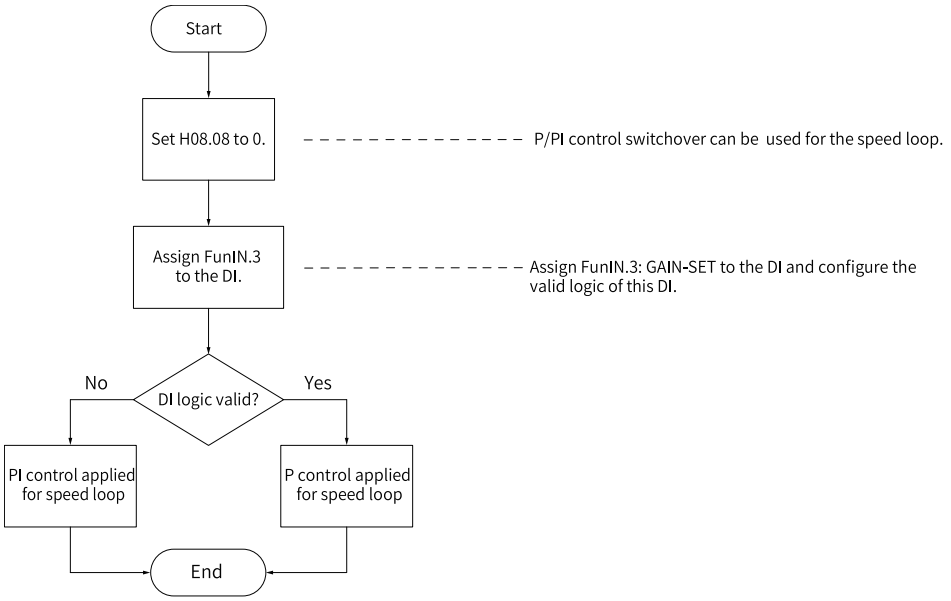


Figure 9-8 Gain switchover flowchart (H08.08 set to 0)

H08.08 = 1

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

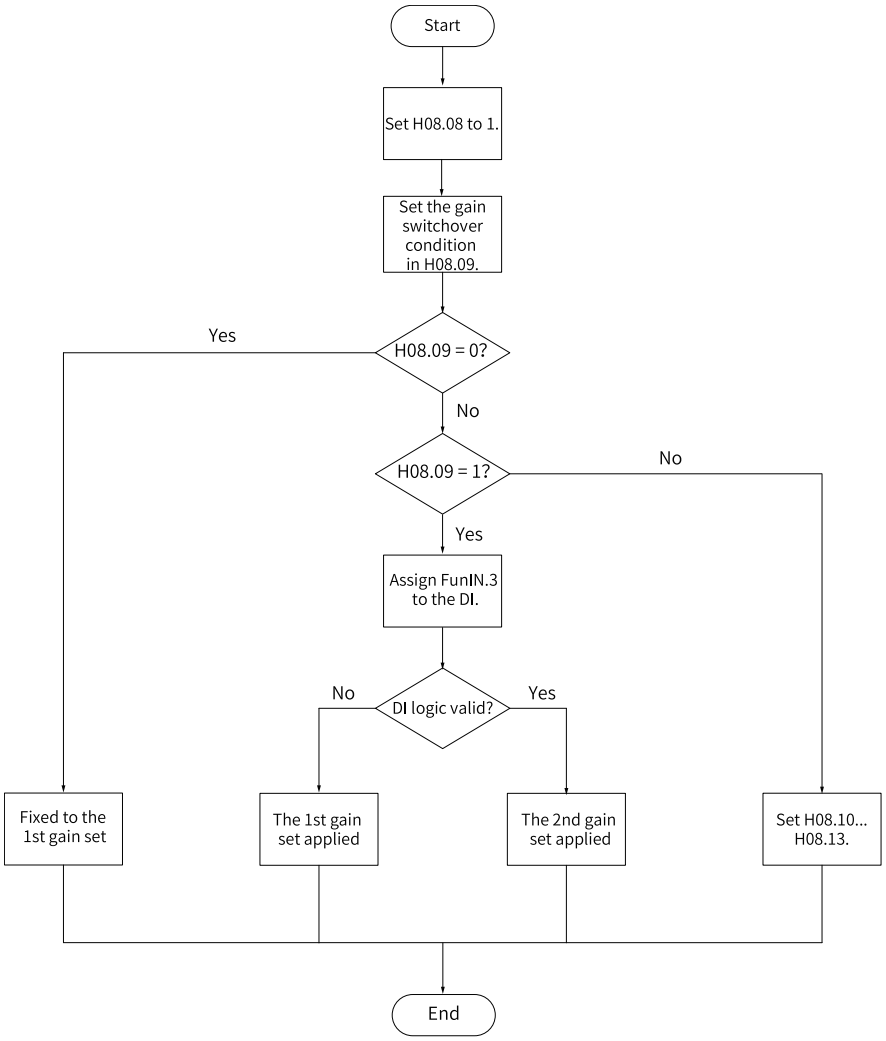
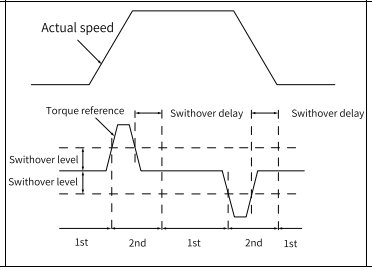
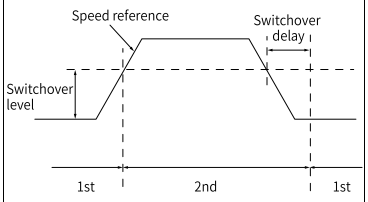
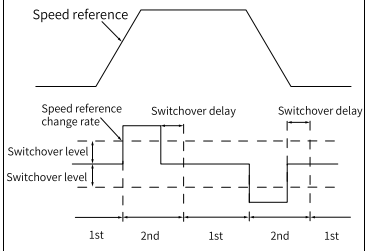
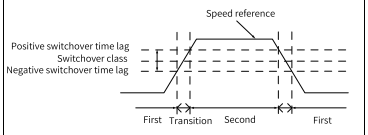
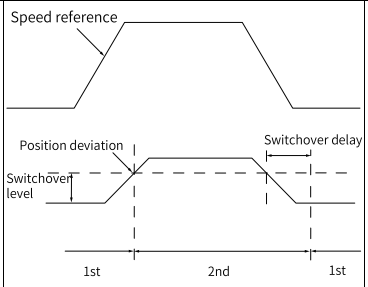
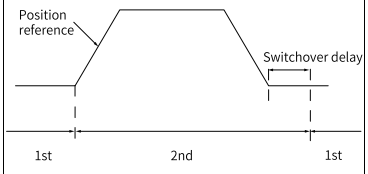
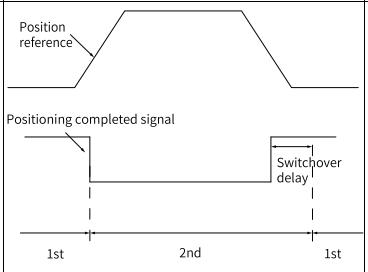
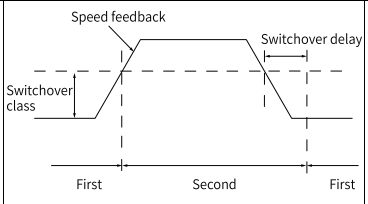


Figure 9-9 Gain switchover flowchart when H08.08 is set to 1

10 types of gain switchover conditions are available. The following table describes the diagrams and parameters of different modes.

Table 9–6 Gain switchover conditions

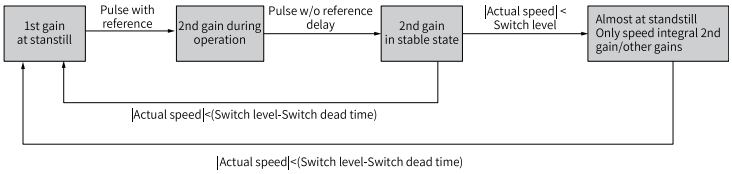
Gain switchover condition			Related parameters		
H08.09 Setpoint	Condition	Diagram	Delay time (H08.10)	Switchover level (H08.11)	Switchover hysteresis (H08.12)
0	Fixed at 1st gain	-	Inactive	Inactive	Inactive
2	Torque reference		Active	Active (%)	Active (%)

Gain switchover condition			Related parameters		
H08.09 Setpoint	Condition	Diagram	Delay time (H08.10)	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	Speed reference high/low-speed threshold		Inactive	Active (RPM)	Active (RPM)
6	Following error actual value		Active	Active (encoder unit)	Active (encoder unit)
7	Position reference		Active	Inactive	Inactive
8	Positioning not completed		Active	Inactive	Inactive
9	Actual speed		Active	Active (RPM)	Active (RPM)
10	Position reference available + Actual speed	See the following note for details.	Active	Active (RPM)	Active (RPM)

Caution

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

Note



☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H08.08	2008-09h	2nd gain mode setting	0: Fixed to the 1st gain set, P and PI switched as defined by bit26 of external 60FEh 1: Switched between the 1st and 2nd gain set as defined by H08.09	1	-	Real time	"H08_en.08" on page 819
H08.09	2008-0Ah	Gain switchover condition selection	0: Fixed to the 1st gain set (PS) 1: Switched as defined by bit26 of 60FEh or DI-based switchover 2: Torque reference excessively high (PS) 3: Speed reference excessively high (PS) 4: Speed reference change rate excessively high (PS) 5: Speed reference low/high speed threshold (PS) 6: Position deviation excessively high (P) 7: Position reference available (P) 8: Positioning unfinished (P) 9: Actual speed (P) 10: Position reference available + Actual speed (P)	0	-	Real time	"H08_en.09" on page 820
H08.10	2008-0Bh	Gain switchover delay	0.0 to 1000.0	5.0	ms	Real time	"H08_en.10" on page 821
H08.11	2008-0Ch	Gain switchover level	0 to 20000	50	-	Real time	"H08_en.11" on page 822

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H08.12	2008-0Dh	Gain switchover time lag	0 to 20000	30	-	Real time	"H08_en.12" on page 822
H08.13	2008-0Eh	Position gain switchover time	0.0 to 1000.0	3.0	ms	Real time	"H08_en.13" on page 822

9.5.3 Position reference filter

Name	Function	Applicable scenario	Impact of excessive filtering
Position reference filter	The position reference filter is used to filter the position references (in encoder unit) divided or multiplied by the electronic gear ratio, smoothening motor operation and reducing impact to the machine.	• The acceleration/deceleration process is not performed on the position references sent from the host controller. • The pulse reference frequency is low. • The electronic gear ratio is larger than 10.	The response delay is prolonged.

9.5.4 Feedforward gain

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

Speed feedforward

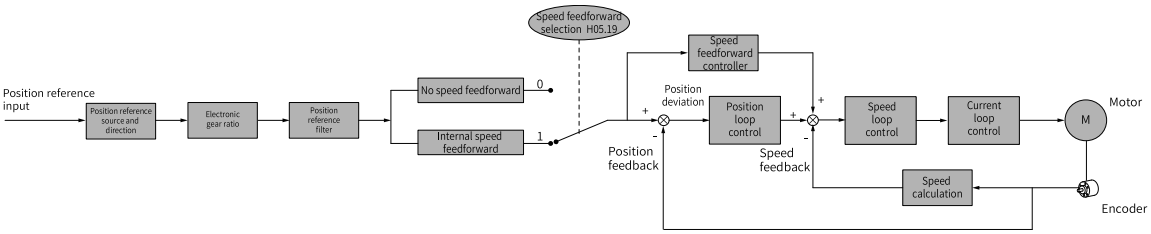


Figure 9-10 Procedure for speed feedforward control

Procedure for setting speed feedforward:

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

Parameter	Name	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) the speed feedforward signal source.
		2: 60B1h used as speed offset	-
		3: Zero phase control	-

2. Set speed feedforward parameters.

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

   ☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H08.18	2008-13h	Speed feedforward filter time constant	0.00 to 64.00	0.50	ms	Real time	"H08_en.18" on page 823
H08.19	2008-14h	Speed feedforward gain	0.0 to 100.0	0.0	%	Real time	"H08_en.19" on page 823

Zero phase control

Zero phase control is used to compensate for the position deviation caused by start delay of the position reference, reducing the position deviation upon start/stop in the position control mode.

The loop calculation model is shown in the following figure.

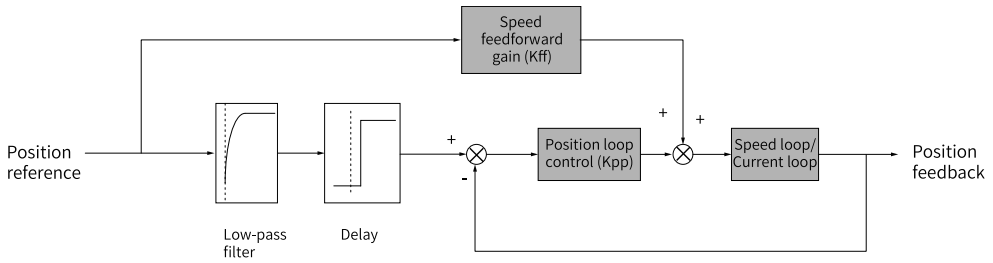


Figure 9-11 Zero phase control

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.04	2005-05h	First-order low-pass filter time constant	0.0 to 6553.5	0.0	ms	At stop	"H05_en.04" on page 773
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 778
H08.17	2008-12h	Zero phase delay	0.0 to 4.0	0.0	ms	Real time	"H08_en.17" on page 823

Torque feedforward

In position control mode, torque feedforward can be used to improve torque reference responsiveness and reduce the position deviation during operation at constant acceleration/deceleration rate.

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

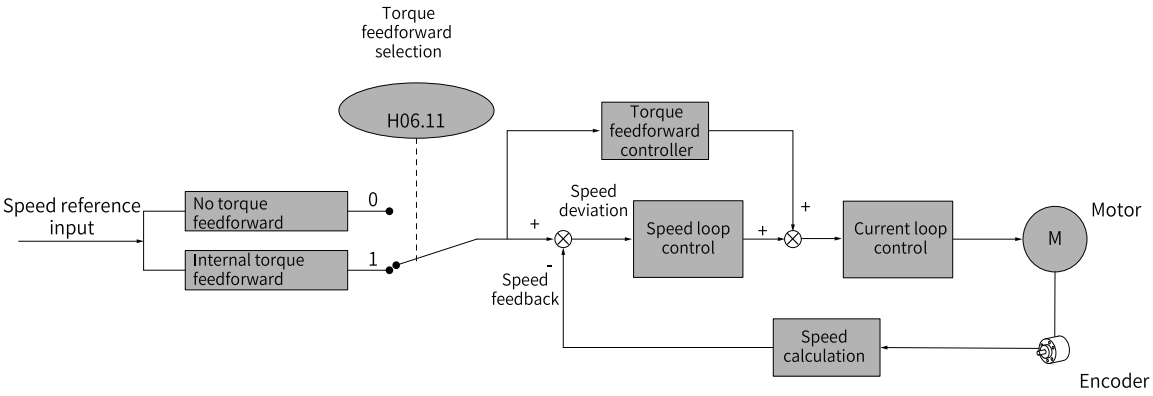


Figure 9-12 Torque feedforward function

Procedure for setting torque feedforward:

1. Set the torque feedforward signal source.

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

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

2. Set torque feedforward parameters.

Parameter	Name	Description
H08.20	Torque feedforward filter time constant	Parameter function: • Increasing the value of H08.21 improves the response but may cause overshoot during acceleration/deceleration. • Decreasing the value of H08.20 suppresses overshoot during acceleration/deceleration. Increasing the value of H08.20 suppresses the noise. Tuning method: • Keep H08.20 to the default value, and then gradually increase the value of H08.21 from 0 to a certain value at which torque feedforward achieves the desired effect. • Tune 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 Pseudo Differential Feedforward Control

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

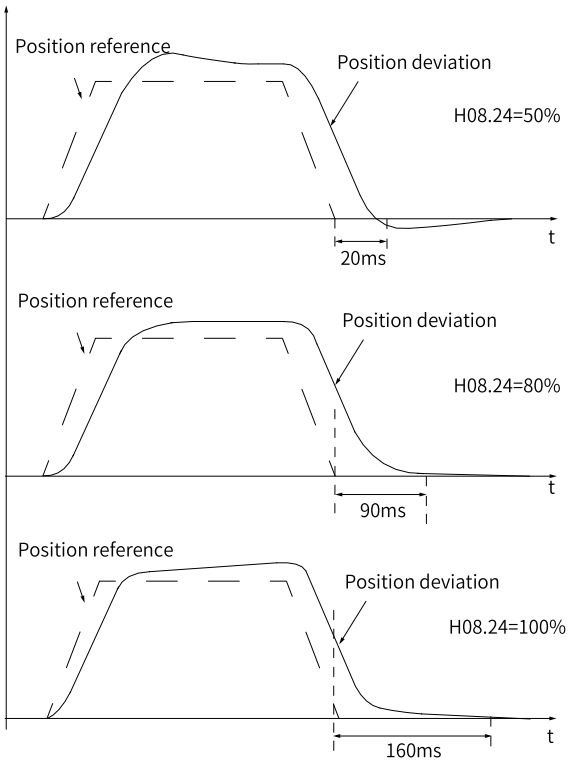


Figure 9-13 Example of PDFF control

By 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	Pseudo differential feedforward control coefficient	Parameter function: • Defines the control method of the speed loop in non-torque control modes. Tuning method: • 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 pseudo differential feedforward control achieves the desired effect. • When H08.24 is set to 100.0, the speed loop control method does not change and the default proportional integral control is used.

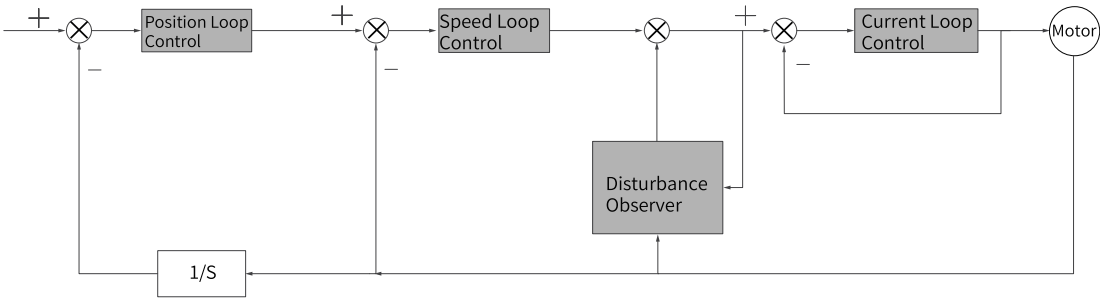
9.5.6 Torque Disturbance Observer

This function is intended to be used in non-torque control modes.

Disturbance observer

The disturbance observer is used to observe external disturbance. You can set different cutoff frequencies and compensation values to observe and suppress the disturbance within the frequency range.

The following figure shows the control block diagram of the disturbance observer.



Note

1/S: Integral term

Parameter	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 calibration coefficient	H08.33 needs to be changed only when the inertia ratio does not reflect the actual condition. The acting inertia is the product of the set inertia and H08.33. It is recommended to use the default value of H08.33.

☆ Related parameters:

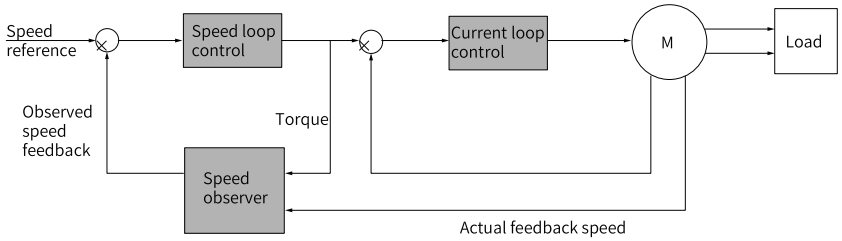
Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H08.31	2008-20h	Disturbance cutoff frequency	1 to 4000	600	Hz	Real time	"H08_en.31" on page 827
H08.32	2008-21h	Disturbance compensation gain	0 to 100	0	%	Real time	"H08_en.32" on page 827
H08.33	2008-22h	Disturbance observer inertia calibration coefficient	1 to 1600	100	%	Real time	"H08_en.33" on page 827

9.5.7 Speed Observer

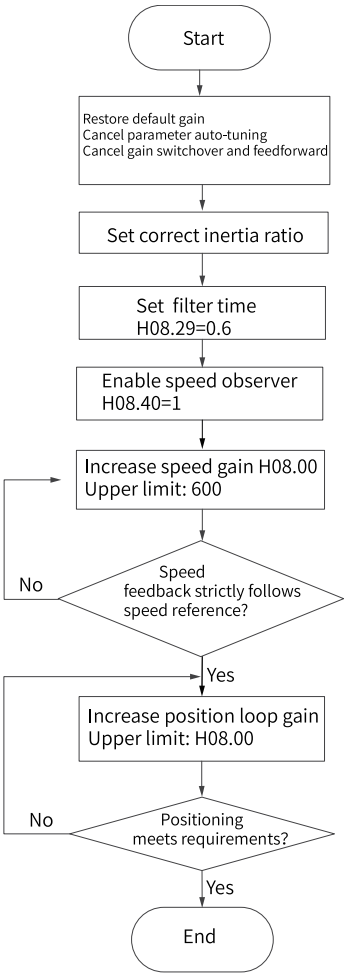
The speed observer, which facilitates quick positioning, applies in applications with slight load characteristic change and constant inertia.

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

The block diagram for the speed observer is as follows.



Commissioning procedure



Note

- Before using the speed observer, set H08.15 (Load inertia ratio) to a proper value or perform inertia auto-tuning. A wrong inertia ratio can cause vibration.
- Setting H08.27, H08.28, or H08.29 to excessively low or high values can result in motor vibration.

Related parameters

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H08.00	2008-01h	Speed loop gain	0.0 to 2000.0	40.0	Hz	Real time	"H08_en.00" on page 818
H08.27	2008-1Ch	Cutoff frequency of speed observer	50 to 600	170	Hz	Real time	"H08_en.27" on page 826
H08.28	2008-1Dh	Speed observer inertia calibration coefficient	1 to 1600	100	%	Real time	"H08_en.28" on page 826

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H08.29	2008-1Eh	Speed observer filter time	0.00 to 10.00	0.80	ms	Real time	"H08_en.29" on page 826
H08.40	2008-29h	Speed observer enable	0: Disable 1: Enable	0	-	Real time	"H08_en.40" on page 828

9.5.8 Model Tracking

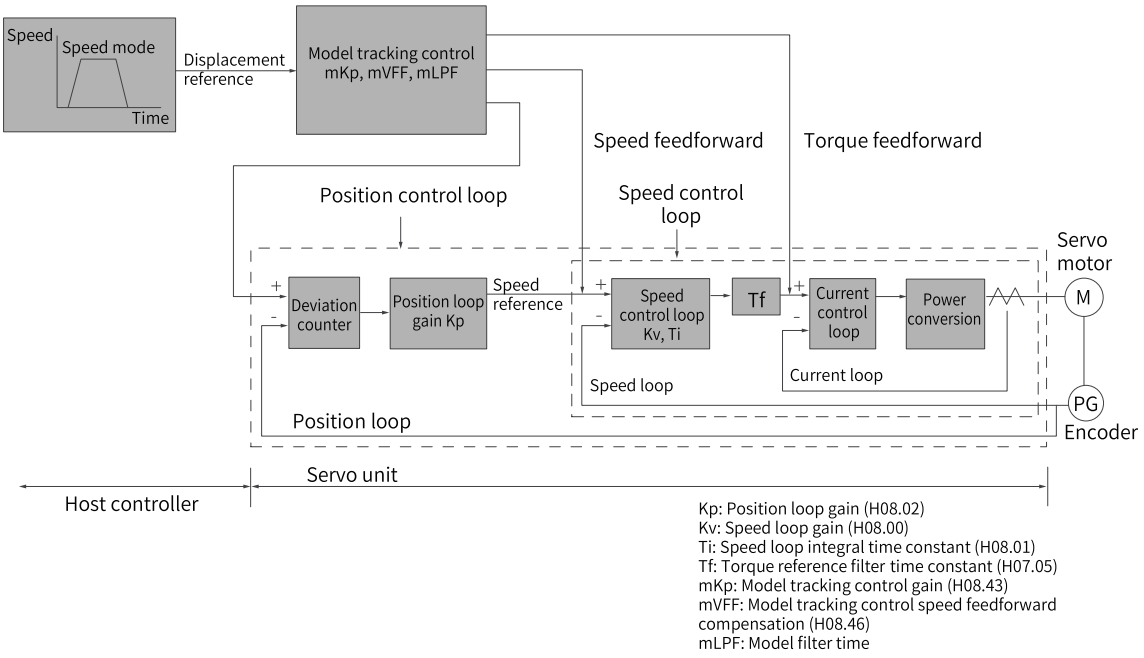
Model tracking control can be used to improve responsivity and shorten the positioning time. It is available only in position control mode.

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

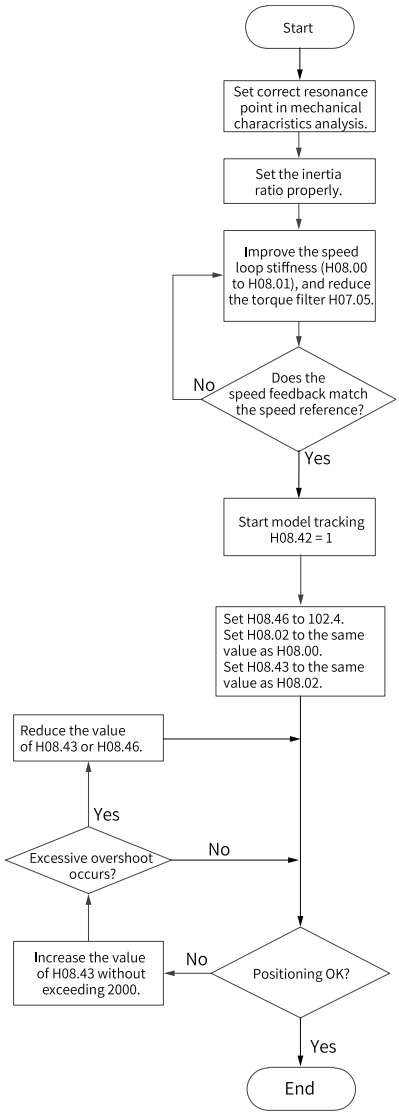
However, manual tuning is needed in the following situations:

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

The block diagram for model tracking control is as follows.



Commissioning procedure



Note

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

Related parameters

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H07.05	2007-06h	Torque reference filter time constant 1	0.00 to 30.00	0.50	ms	Real time	"*H07_en.05*" *on page 811*
H08.00	2008-01h	Speed loop gain	0.0 to 2000.0	40.0	Hz	Real time	"*H08_en.00*" *on page 818*
H08.01	2008-02h	Speed loop integral time constant	0.15 to 512.00	19.89	ms	Real time	"*H08_en.01*" *on page 818*

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H08.02	2008-03h	Position loop gain	0.0 to 2000.0	64.0	Hz	Real time	"H08_en.02" on page 818
H08.42	2008-2Bh	Model control enable	0: Disable 1: Enable 2: Reserved 3: New model tracking 4: Model tracking B	0	-	Real time	"H08_en.42" on page 828
H08.43	2008-2Ch	Model gain	0.1 to 2000.0	40.0	-	Real time	"H08_en.43" on page 829
H08.46	2008-2Fh	Feedforward value	0.0 to 102.4	95.0	-	Real time	"H08_en.46" on page 829

9.5.9 Friction Compensation

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

Note

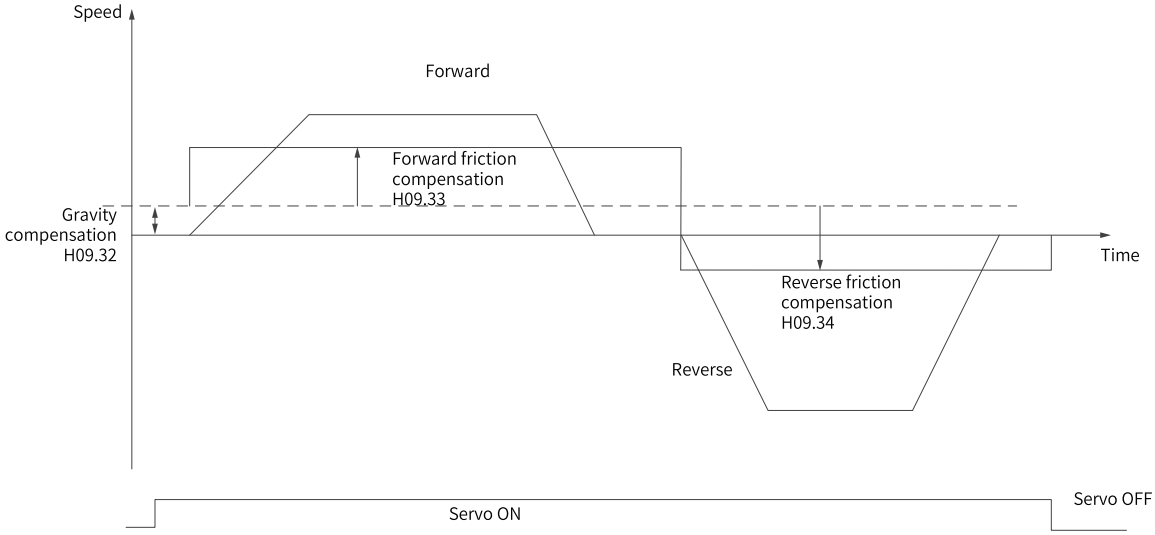
Friction compensation is effective only in the position mode.

☆Related parameters

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H09.32	2009-21h	Gravity compensation value	-100.0 to +100.0	0.0	%	Real time	"H09_en.32" on page 840
H09.33	2009-22h	Forward friction compensation value	0.0 to 100.0	0.0	%	Real time	"H09_en.33" on page 840
H09.34	2009-23h	Negative friction compensation value	-100.0 to 0.0	0.0	%	Real time	"H09_en.34" on page 841

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H09.35	2009-24h	Friction compensation speed	0.0 to 20.0	2.0	-	Real time	"H09_en.35" on page 841
H09.36	2009-25h	Friction compensation speed selection	0: Slow mode+Speed reference 1: Slow mode+Model speed 2: Slow mode+Speed feedback 3: Slow mode+Observed speed 16: Quick mode +Speed reference 17: Quick mode +Model speed 18: Quick mode +Speed feedback 19: Quick mode+Observed speed	0x0	-	Real time	"H09_en.36" on page 841

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 introduced due to physical characteristics of the encoder scale, as shown below.

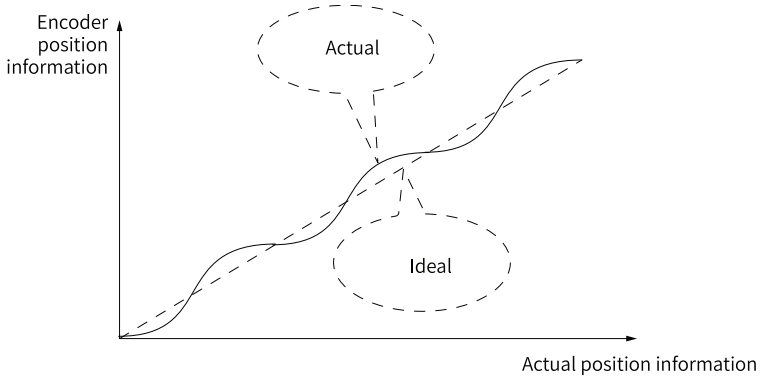


Figure 9-14 Encoder feedback

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 fluctuations in the output of the entire control system. When the control loop gain is high, the fluctuations can be amplified, which may incur additional vibration noise.

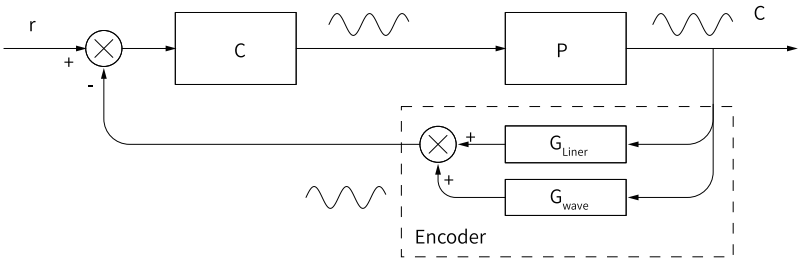


Figure 9-15 Control system loop with fluctuation

Given the preceding conditions, the SV680-INT series drive is designed with a scale fluctuation suppressor to "isolate" the fluctuations incurred by the encoder feedback. It suppresses fluctuations in the output caused by speed fluctuation and prevents 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.

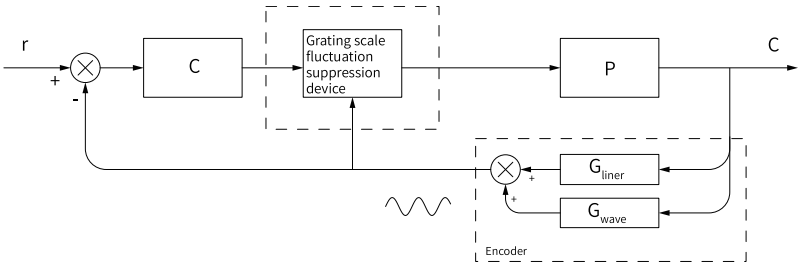


Figure 9-16 Schematics of the scale fluctuation suppressor

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.

Parameter	Name	Default value	Value range	Description
H00.45	Encoder pitch 1	2 mm	0.00 to 655.35	Unit: [mm]/[deg]
H00.46	Encoder pitch 2	0.5 mm	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: Inactive 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 Ripple Compensation

The motor cogging torque ripple compensation function is used to compensate for the torque ripple caused by the motor cog, suppressing the speed fluctuation caused by the cogging torque ripple under low control loop gain, ensuring system stability, and reducing the speed fluctuation.

The SV680-INT series drive supports two applicable scenarios for general-purpose rotary (ROT) motors and direct-drive rotary (DDR) motors[1]:

Note

[1]: DDR refers to a direct drive torque motor.

- **ROT/DDR motors with Inovance absolute encoders**
  In this scenario, compensation data is obtained before the motor is delivered. You do not need to manually obtain the compensation data. You only need to set H06.28 to enable or disable this function.

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H06.28	2006-1Dh	Cogging torque ripple compensation	0 to 1	1	-	At stop	"H06_en.28" on page 799

- **ROT/DDR motors with incremental encoders (Incremental communication encoder with Inovance T5 interpolator and ABZ incremental encoder with TTL signals)**
  In this scenario, you need to perform auto-tuning on motor cogging torque ripples and obtain the compensation table before you can enable the cogging torque ripple compensation function. Angle auto-tuning and homing must be completed before auto-tuning and compensation can take effect. The flowchart is as follows:

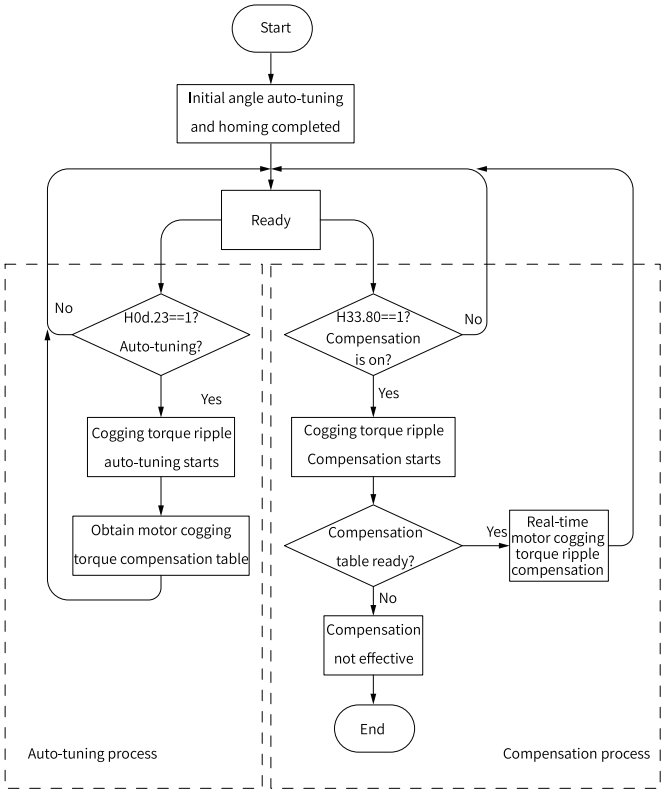


Figure 9-17 Flowchart of ROT/DDR motors with incremental encoder

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H33.80	2033-51h	Motor cogging torque ripple compensation data storage position	0: Stored in the encoder 1: Stored in the Flash	0	-	At stop	"H33_en.80" on page 1100
H0d.23	200d-18h	Motor cogging torque fluctuation auto-tuning enable	0: Disable 1: Enable	0	-	At stop	"H0d_en.23" on page 895

When auto-tuning of motor torque ripple is enabled (H0d.23 = 1), the SV680-INT drive moves the motor for several revolutions to obtain a torque ripple compensation table.

Note

During this process, you need to ensure that the motor has enough operating range to avoid collision. To avoid external disturbance, it is recommended to perform auto-tuning with the motor disconnected from the load.

After auto-tuning is completed, motor torque ripple compensation is automatically enabled (H06.28 = 1). This function takes effect after the drive is powered off and powered on again and angle auto-tuning and homing are completed. You can manually disable this function (H06.28 = 0) when compensation is not required.

9.6 Parameter Tuning in Different Control Modes

Perform parameter tuning in the sequence of inertia auto-tuning > gain auto-tuning > manual gain tuning in all control modes.

9.6.1 Parameter Tuning in Speed Control Mode

Parameter tuning in speed control mode is the same as that in position control mode, except for the position loop gain (H08.02 and H08.05) *"9.6.2 Parameter Tuning in Position Control Mode" on page 296*. For details, see .

9.6.2 Parameter Tuning in Position Control Mode

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

Gain parameters in position control mode:

- 1st gain:

Parameter	Name	Function	Default value
H07.05	Torque reference filter time constant 1	These parameters set the time constant of the torque reference filter.	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:

Parameter	Name	Function	Default value
H07.06	Torque reference filter time constant 2	These parameters set the time constant of the torque reference filter.	0.27 ms
H08.03	2nd speed loop gain	Defines the speed loop proportional gain.	75.0 Hz

Parameter	Name	Function	Default value
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 selection	Defines the gain switchover condition.	0
H08.10	Gain switchover delay	Defines the gain switchover delay.	5.0 ms
H08.11	Gain switchover level	Defines the gain switchover level.	50
H08.12	Gain switchover time lag	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

Parameter	Name	Function	Default value
H08.18	Speed feedforward filter time constant	Defines the speed feedforward filter time constant.	0.50 ms
H08.19	Speed feedforward gain	Defines the speed feedforward gain.	0.0%
H08.20	Torque feedforward filter time constant	Defines the torque feedforward filter time constant.	0.50 ms
H08.21	Torque feedforward gain	Defines the torque feedforward gain.	0.0%
H08.22	Speed feedback filter option	Defines the speed feedback filter 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	Pseudo differential feedforward 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	Time constant of torque disturbance observer filter	Defines the filter time constant of the disturbance observer.	0.5 ms
H09.04	Suppression mode of low-frequency resonance	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 suppression 1 at the mechanical end	Defines the setting of low-frequency resonance suppression filter.	2

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

Manually fine tune the following gain parameters.

Parameter	Name	Function	Default value
H07.05	Torque reference filter time constant 1	These parameters set the time constant of the torque reference filter.	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%

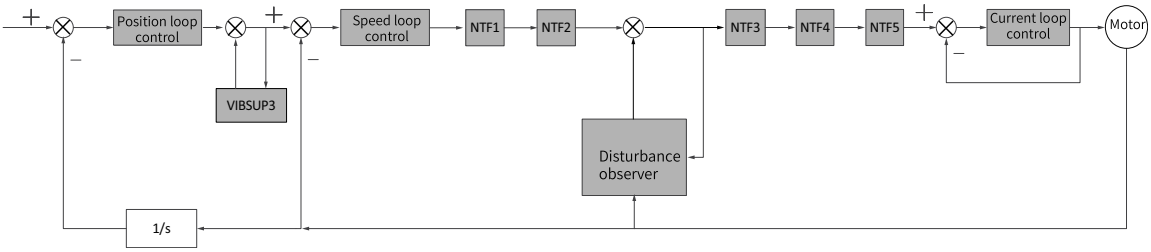
9.6.3 Parameter Tuning in Torque Control Mode

Parameter tuning in torque control mode are classified into two types based on the condition:

- If the actual speed reaches the speed limit, the adjustment method is the same as that described in *"9.6.1 Parameter Tuning in Speed Control Mode" on page 296*.
- If the actual speed does not reach the speed limit, the adjustment method is the same as that described in *"9.6.1 Parameter Tuning in Speed Control Mode" on page 296*, except the position/speed loop gain and speed loop integral time constant.

9.7 Vibration Suppression

The block diagram of vibration suppression is as follows:



Where:

- NTF1–5: 1st notch to 5th notch
- VIBSUP3: Suppression of medium- and low-frequency vibration
- 1/s: Integral element

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H08.53	2008-36h	Medium- and low-frequency jitter suppression frequency 3	0.0 to 300.0	0.0	Hz	Real time	"H08_en.53" on page 830
H08.54	2008-37h	Medium- and low-frequency jitter suppression compensation 3	0 to 200	0	%	Real time	"H08_en.54" on page 830
H08.56	2008-39h	Medium- and low-frequency jitter suppression phase modulation 3	0 to 600	100	%	Real time	"H08_en.56" on page 830

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 × H07.059 (ms) × 0.001]

Notch

The notch reduces the gain at certain frequencies to suppress mechanical resonance. After the vibration is suppressed by the notch, you can continue to increase the gain. The following figure shows how the notch works.

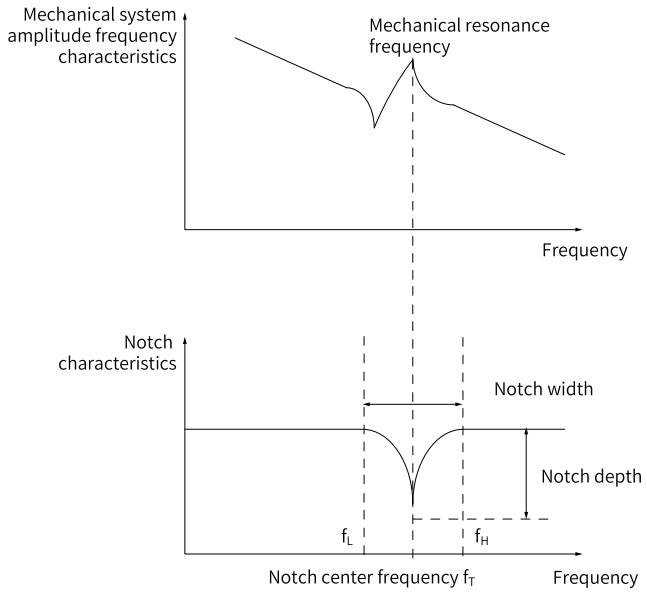


Figure 9-18 How the notch works

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
Bandwidth 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.

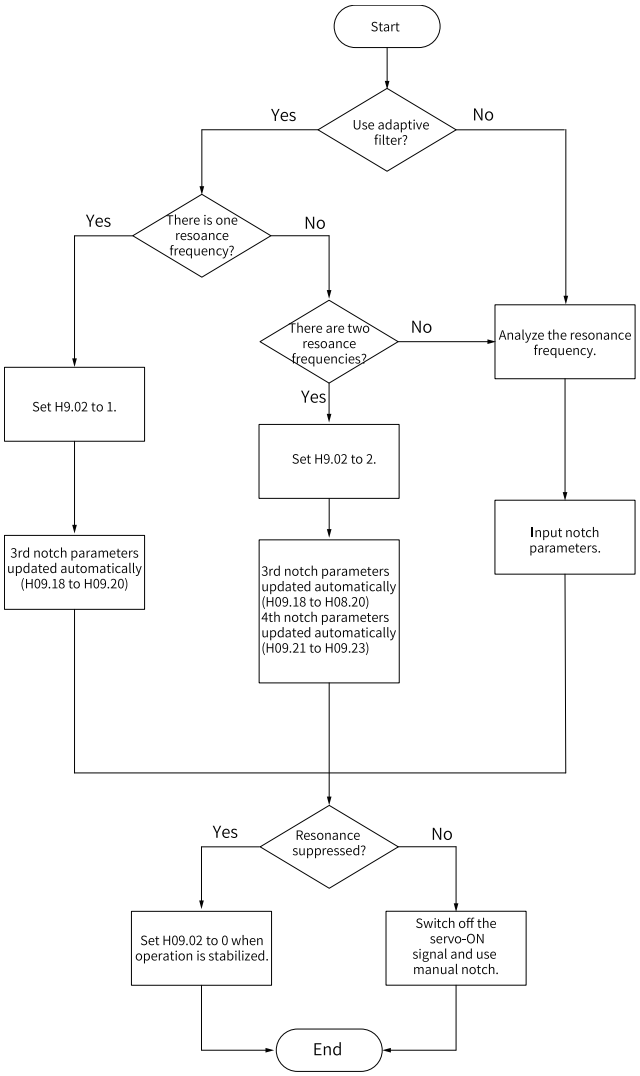


Figure 9-19 Procedure for setting a notch

- 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 intensify resonance.
  5. If resonance persists after the notch is working for a period of time, switch off the S-ON signal.

6. If more than two resonance frequencies exist, the problem cannot be solved only by using the adaptive notches. In this case, add a manual notch. Use the manual notch, or use all the four notches as manual ones (H09.02 = 0).

Note

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

- Procedure for setting the manual notch:

  1. Analyze the resonance frequency.
  2. When using the manual notch, set the notch frequency to same value as the actual resonance frequency obtained in the following ways: The resonance frequency can be obtained by using the following methods:
     - Use the "Mechanical characteristic analysis" function in the Inovance software tool.
     - Calculate the resonance frequency based on the motor phase current displayed on the oscilloscope interface of the software tool.
     - Set H09.02 (Adaptive notch mode) to 3. The drive detects the resonance frequency and saves the detected value to H09.24 automatically during operation.
  3. Input the resonance frequency obtained in step 1 to the parameter of the selected notch, and input the width level and depth level of this notch.
  4. If resonance has been suppressed, it indicates the notch functions well and you can continue tuning 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

  $f_H - f_L$: Notch filter bandwidth, indicating the frequency bandwidth where the amplitude attenuation reaches -3dB relative to the notch center frequency.

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

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

  When the depth level is 0, the input is completely suppressed at the center frequency. When the depth level is 99, the input can be fully passed at the center frequency. Therefore, a lower depth level indicates a higher notch depth and a stronger suppression effect. Note that an excessively low depth level may lead to system oscillation.

Note

If the amplitude frequency characteristic curve obtained through the mechanical analysis function does not have obvious peak, it indicates that vibration occurs actually. Such vibration may not be mechanical resonance, and cannot be suppressed by the notch. It occurs because the gain reaches the limit, and can be suppressed only by reducing the gain or the filter time of torque reference.

The following figure shows the frequency characteristics of the notch.

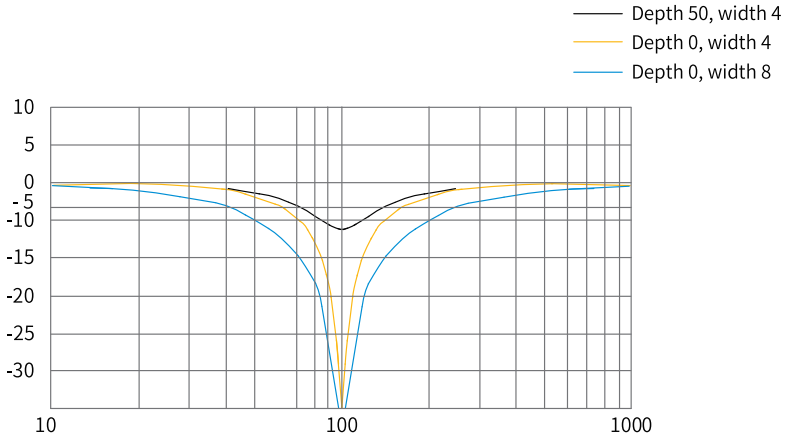


Figure 9-20 Notch frequency characteristics

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H09.02	2009-03h	Adaptive notch mode selection	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 834
H09.12	2009-0Dh	Frequency of the 1st notch	50 to 8000	8000	Hz	Real time	"H09_en.12" on page 837
H09.13	2009-0Eh	Bandwidth level of the 1st notch	0 to 20	2	-	Real time	"H09_en.13" on page 837
H09.14	2009-0Fh	Depth level of the 1st notch	0 to 99	0	-	Real time	"H09_en.14" on page 837
H09.15	2009-10h	Frequency of the 2nd notch	50 to 8000	8000	Hz	Real time	"H09_en.15" on page 838

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H09.16	2009-11h	Bandwidth level of the 2nd notch	0 to 20	2	-	Real time	"H09_en.16" on page 838
H09.17	2009-12h	Depth level of the 2nd notch	0 to 99	0	-	Real time	"H09_en.17" on page 838
H09.18	2009-13h	Frequency of the 3rd notch	50 to 8000	8000	Hz	Real time	"H09_en.18" on page 838
H09.19	2009-14h	Bandwidth level of the 3rd notch	0 to 20	2	-	Real time	"H09_en.19" on page 839
H09.20	2009-15h	Depth level of the 3rd notch	0 to 99	0	-	Real time	"H09_en.20" on page 839
H09.21	2009-16h	Frequency of the 4th notch	50 to 8000	8000	Hz	Real time	"H09_en.21" on page 839
H09.22	2009-17h	Bandwidth level of the 4th notch	0 to 20	2	-	Real time	"H09_en.22" on page 839
H09.23	2009-18h	Depth level of the 4th notch	0 to 99	0	-	Real time	"H09_en.23" on page 840
H09.24	2009-19h	Auto-tuned resonance frequency	0 to 5000	0	Hz	Read-only	"H09_en.24" on page 840
H09.41	2009-2Ah	Frequency of the 5th notch	50 to 8000	8000	Hz	Real time	"H09_en.41" on page 842
H09.42	2009-2Bh	Bandwidth level of the 5th notch	0 to 20	2	-	Real time	"H09_en.42" on page 843
H09.43	2009-2Ch	Depth level of the 5th notch	0 to 99	0	-	Real time	"H09_en.43" on page 843

9.7.2 Low-frequency resonance suppression at the mechanical end

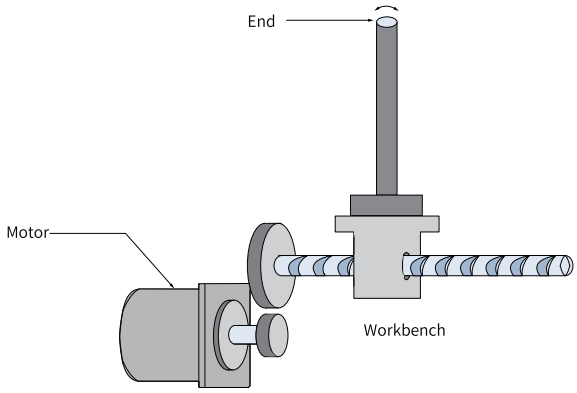


Figure 9-21 Low-frequency vibration at the mechanical end

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 299*. Use the low-frequency resonance suppression function to reduce such vibration.

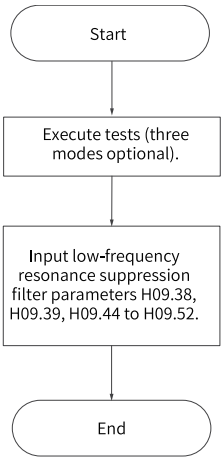


Figure 9-22 Procedure for setting low-frequency resonance suppression filter

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.

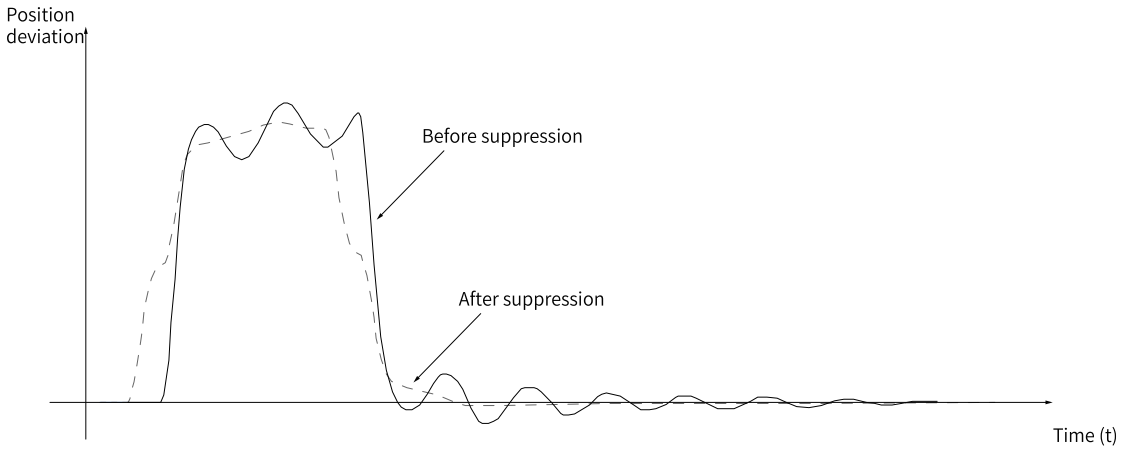


Figure 9-23 Low-frequency resonance suppression effect

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H09.38	2009-27h	Frequency of low-frequency resonance suppression 1 at the mechanical end	1.0 to 100.0	100.0	Hz	At stop	"H09_en.38" on page 842
H09.39	2009-28h	Low-frequency suppression 1 at the mechanical end	0 to 3	2	-	At stop	"H09_en.39" on page 842
H09.44	2009-2Dh	Frequency of low-frequency suppression 2 at the mechanical end	0.0 to 200.0	0.0	-	At stop	"H09_en.44" on page 843
H09.45	2009-2Eh	Response of low-frequency resonance suppression 2 at mechanical end	0.01 to 10.00	1.00	-	At stop	"H09_en.45" on page 843
H09.47	2009-30h	Bandwidth of low-frequency resonance suppression 2 at mechanical end	0.00 to 2.00	1.00	-	At stop	"H09_en.47" on page 844

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H09.49	2009-32h	Frequency of low-frequency resonance suppression 3 at the mechanical end	0.0 to 200.0	0.0	-	At stop	"H09_en.49" on page 844
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 844
H09.52	2009-35h	Bandwidth of low-frequency resonance suppression 3 at the mechanical end	0.00 to 2.00	1.00	-	At stop	"H09_en.52" on page 844

9.8 Mechanical Characteristic Analysis

Overview

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

Procedure

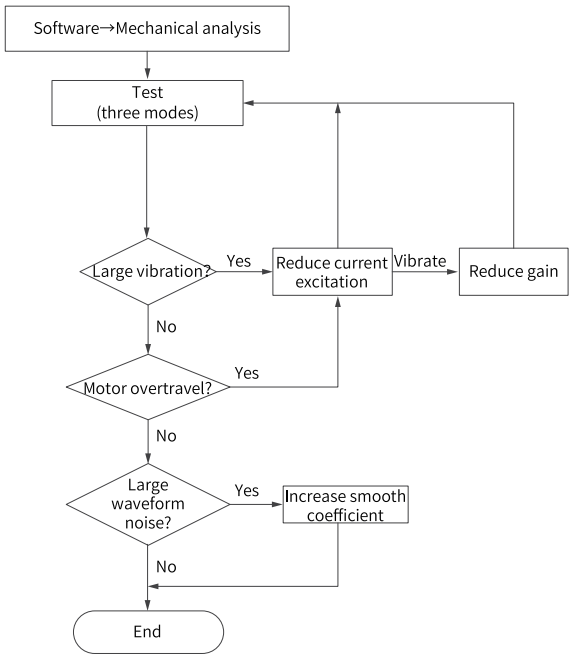


Figure 9-24 Operating procedure for mechanical characteristic analysis

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.

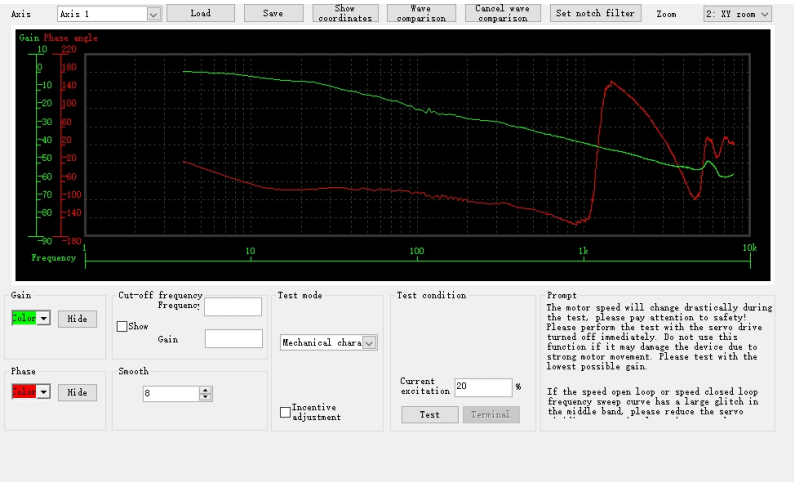


Figure 9-25 Example of the waveform obtained

An example of the waveform obtained with the mechanical characteristic analysis is shown in *"Figure 9-25 Example of the waveform obtained" on page 308*.

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**

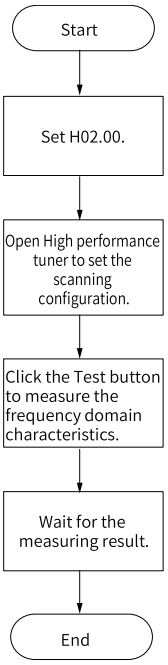


Figure 9-26 Process for generating a measurement curve

a. In the "Work Space" section, select "High performance tuner" and click "Sweep configuration".

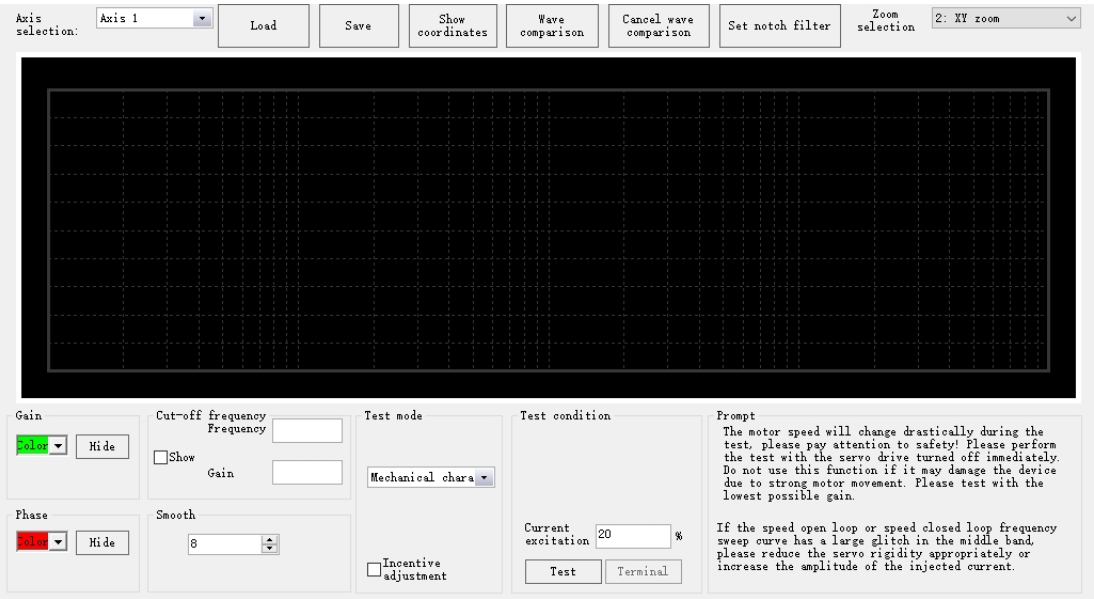


Figure 9-27 Sweep configuration

☆ Related parameters:

Parameter	Parameter name	Unit
H09.71	Low-frequency starting frequency	Hz
H09.72	Termination frequency	Hz
H09.73	Low-frequency points	-
H09.74	Excitation amplitude	%
H09.75	High-frequency 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.

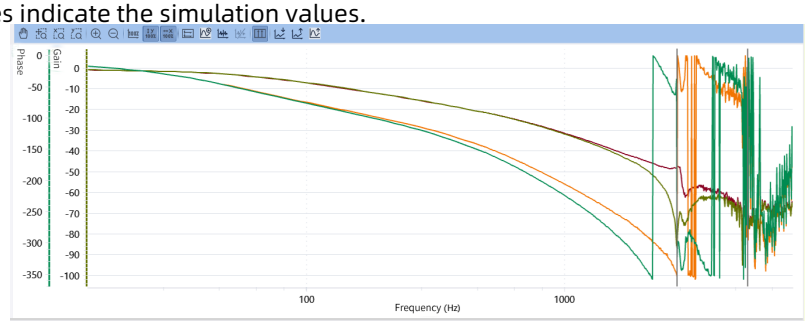


Figure 9-28 Frequency-domain curves (red and orange curves: measured values, green and brown curves: simulation values)

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**

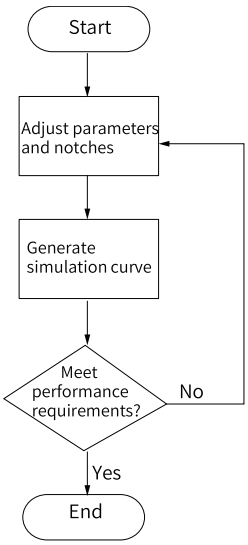


Figure 9-29 Process of loop tuning

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	Parameter name	Parameter type
H08.00	Speed loop gain	Gain
H08.01	Speed loop integral time	Gain
H08.02	Position loop gain	Gain
H08.05	Inertia ratio	Gain
H07.05	Torque reference filter	Filter
H09.77 to H09.81	Biquad filter	Filter
H09.12 to H09.23	Notch	Filter

Note

Notch filter 1 becomes a notch only when it is not enabled. It can be configured as first-order low-pass, second-order low-pass, lead-lag, or custom biquad filter.

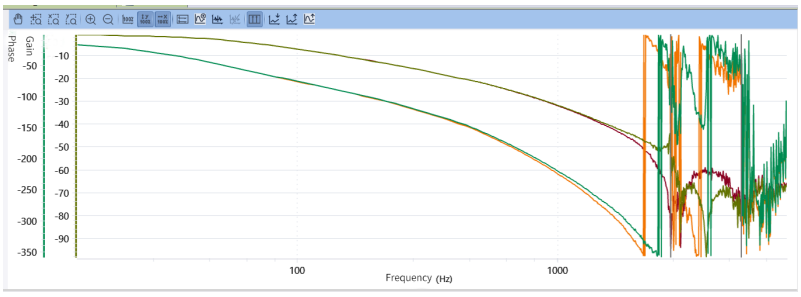


Figure 9-30 Comparison between the simulation curve of notch 2 and the measurement curve

10 Function Overview

Functions of the 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.	-
Secondary encoder		ABZ incremental pulse encoders, Inovance communication 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		Monitors the brake status in real time.	-
External braking resistor		The external braking resistor is used only when the braking capability of the built-in braking resistor is insufficient.	-
Electronic gear ratio		Input pulse can be reduced or amplified: 0.001 to 4000 × Encoder resolution ÷ 10000.	"11.9.3 Reference Frequency Division/ Multiplication (Electronic Gear Ratio)" on page 403
Status display		The servo drive status is displayed on the 5-digit 8-segment LED.	-
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.	"9.3.1 Offline inertia auto-tuning" on page 257
	Online	The host controller sends a command to make the motor rotate, and the servo drive calculates the load inertia ratio in real time.	"9.3.2 Online inertia auto-tuning" on page 260
Automatic gain tuning	Supports two auto-tuning modes: STune and ETune.	The servo drive generates a group of gain parameters based on the correct inertia ratio.	" Automatic gain tuning" on page 261

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.	"9.5.1 Basic Parameters" on page 274
	Gain switchover	Applies different gains for different status (operating or stop) of the motor. Gains can also be switched by external terminals during operation.	"9.5.2 Gain Switchover" on page 277
	Reference filter	Filters the position, speed, and torque references.	"9.5.3 Position reference filter" on page 282
	Feedforward gain	Improves the following behavior.	"9.5.4 Feedforward gain" on page 282
	PDFF control	Adjusts the speed loop control mode to improve the anti-interference capability at low frequency range.	"9.5.5 Pseudo Differential Feedforward Control" on page 285
	Torque disturbance observer	Improves the resistance against torque disturbance.	"9.5.6 Torque Disturbance Observer" on page 286
	Speed observer	The speed observer, which facilitates quick positioning, applies in applications with slight load characteristic change and constant inertia.	"9.5.7 Speed Observer" on page 287
	Model tracking	The model tracking control can improve response and shorten the positioning time. It is available only in position control mode.	"9.5.8 Model Tracking" on page 289
	Friction compensation	Performs positive/negative compensation based on the operating direction. It is active only in position control.	"9.5.9 Friction Compensation" on page 291
	Encoder scale fluctuation suppression	Prevents operation noise caused by position fluctuation or speed fluctuation in the control loop. It also suppresses fluctuations in the output caused by speed fluctuation.	"9.5.10 Encoder scale fluctuation suppression" on page 292
	Motor cogging torque ripple compensation	Reduce speed fluctuation while ensuring stable system margin.	"9.5.11 Motor Cogging Torque Ripple Compensation" on page 294
Parameter tuning in different control modes	Tunes parameter in speed, position, and torque modes.	-	"9.5.2 Gain Switchover" on page 277
Vibration suppression	Mechanical resonance suppression	Suppresses mechanical resonance that may be generated when the response speed is excessively high.	"9.7.1 Mechanical Resonance Suppression" on page 299
	Low-frequency resonance suppression at the mechanical end	Activates the filter used to suppress low-frequency resonance.	"9.7.2 Low-frequency resonance suppression at the mechanical end" on page 305

Function		Description	References
Mechanical characteristic analysis		Analyzes the resonance frequency and characteristics of the mechanical system through a PC installed with Inovance software tool.	"9.8 Mechanical Characteristic Analysis" on page 307
High-performance tuning		Analyzes the mechanical resonance point and system bandwidth to simulate the effect on loop control when filters are used and parameters are tuned.	"9.9 High-Performance Tuning" on page 309
Profile position (PP) mode		The host controller sets parameters through the bus, and the servo drive generates position references and performs positioning control.	"Profile position (PP) mode" on page 340
Profile velocity (PV) mode		The host controller sets parameters via the bus, and the servo drive generates speed references and performs speed tracing.	"Profile velocity (PV) mode" on page 349
Profile torque (PT) mode		The host controller sets parameters via the bus, and the servo drive generates torque references and performs torque output.	"Profile torque (PT) mode" on page 354
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.	"Homing Mode (HM)" on page 359
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.	"Process segment mode" on page 324
Position control mode		The servo drive works in position control mode.	-
Speed control mode		The servo drive works in speed control mode.	"Speed control mode" on page 420
Torque control mode		The servo drive works in torque control mode.	"Torque Control Mode" on page 443
Hybrid control mode	Position/Speed control switchover	Switchover between position control and speed control is implemented via external input signal.	"11.12 Hybrid Control Mode" on page 464
	Position/Torque control switchover	Switchover between speed control and torque control is implemented via external input signal.	
	Torque/Position control switchover	Switchover between torque control and position control is implemented via external input signal.	
	Torque/Speed/Position control switchover	Switchover between torque control, speed control and position control is implemented via external input signal.	
Interpolation (IP) mode		The interpolation mode can be used to achieve synchronous operations of multi-axis servo drives or single-axis servo drives.	"Interpolated Position (IP) Mode" on page 466
Position reference filter		Enables smooth acceleration and deceleration.	"11.9.4 Position Reference Filter" on page 408
Interrupt positioning		The servo drive interrupts the current position reference and executes the required displacement.	"11.15 Interrupt Positioning" on page 484
Frequency-division output function		Outputs the position reference pulses or the position pulses fed back by the encoder in the form of phase A/phase B quadrature pulses.	"11.9.6 Frequency Division Output" on page 411

Function	Description	References
Homing	The servo drive automatically searches for the mechanical home and positions the relative position between the mechanical home and the mechanical zero.	"11.14 Homing" on page 471
Zero clamp	Keeps the motor in the position locked state when the motor speed drops below a certain value in speed control mode.	"11.10.4 Zero Clamp" on page 437
DI signal assignment	Assigns functions such as S-ON to corresponding pins.	-
Forced DO	Outputs signals not related to the drive status forcibly or used to check the wiring of output signals.	"12.7 Communication-forced DO" on page 513
Touch probe	This function is the same as the position latch function.	"12.10 Touch Probe Function" on page 526
Black box	Captures the data at the moment of fault or save the data automatically under specified conditions.	"12.9 Black Box" on page 523
SEMI F47 voltage drop	Works with H0A.84 (Hold time of instantaneous stop) to keep the drive running when the power supply voltage drops.	"12.11 SEMI F47 Voltage Drop" on page 531
Accuracy compensation	Calibrates the motor physical accuracy through compensation, which is supported by DDL and DDR motors.	"12.12.1 Accuracy Compensation Function" on page 533
Gantry synchronization	Enables synchronization between two axes.	" Gantry synchronization" on page 556
Position comparison output	Outputs a DO signal with designated pulse width after the drive reaches the preset target position.	"12.8 Position comparison" on page 514
STO function	The safe torque off (STO) function brings the machine safely into a no-torque state and prevents it from unexpected start.	" STO Integration" on page 649

11 Basic Functions of the Servo Drive

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

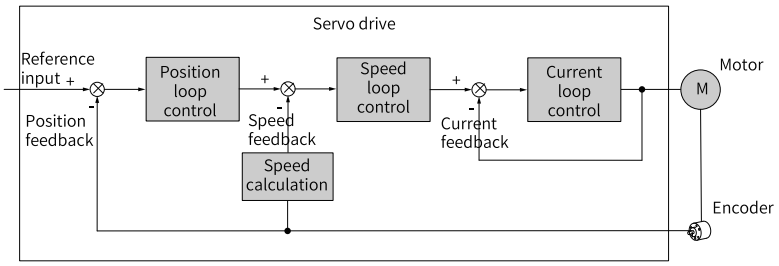


Figure 11-1 Structure of a basic servo system

As the control hub 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:
  In position control mode, the servo drive controls the motor position based on position references. In position control mode, the target position of a motor is determined by the sum of position references, and the motor speed is determined by the position reference frequency. The servo drive performs quick and accurate position control and speed control through the feedback encoder installed on the motor or an external encoder (fully closed-loop control). The position control mode mainly applies to scenarios that require positioning control, such as manipulators, surface mounted technology (SMT) machines, engraving and milling machines (pulse train references), and computer numerical control (CNC) machine tools.
- Speed control mode:
  In speed control, the device speed is controlled through speed references. In speed control mode, the servo drive performs quick and accurate speed control through the speed reference sent through communication. The speed control mode mainly applies to scenarios that require speed control or where a host controller is used for position control or the commands sent from the host controller are used as the speed references for the servo drive, such as the engraving and milling machines.
- Torque control mode:
  In torque control mode, the motor current is in linear relation with the torque. Therefore, torque control is implemented through current control. The drive controls the motor output torque based on torque references. The torque reference can be set through communication. This control mode is mainly applicable to winding and unwinding devices with strict tension requirements. In these scenarios, the torque always changes with the winding radius so that the tension will not change along with the change of the winding radius.

11.1 Setting and Display of Operation Modes

Introduction to servo operation modes

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
6060h	6060h	Servo drive mode selection	1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 7: Interpolation (IP) mode	0	-	Real time	"6060h" on page 1127
6061h	6061h	Operation mode display	1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 7: Interpolation (IP) mode	0	-	Read-only	"6061h" on page 1127

Communication cycle supported by each mode

The SV680P-INT series servo drive supports a synchronization cycle of 1 ms or an integer multiple of 1 ms. The maximum synchronization cycle is 20 ms.

11.2 Conversion Factors

The gear ratio indicates the motor displacement (in encoder unit) corresponding to the load shaft displacement of 1 reference unit.

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

Motor displacement = Load shaft displacement × 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 position factor is calculated as follows:

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

☆Related parameters

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
6091.01h	6091-01h	Motor resolution	1 to 4294967295	1	-	At stop	"6091_en.01h" on page 1136
6091.02h	6091-02h	Load shaft resolution	1 to 4294967295	1	-	At stop	"6091_en.02h" on page 1137

Calculating servo motor position factor

Take the load ball screw as an example:

Min. reference unit f_c = 1 mm

Screw lead P_B = 10 mm/r

Reduction ratio n = 5:1

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

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. This 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)

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. This 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 $_{fc}$ = 1 mm

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

Motor resolution (P) = 8388608 (PPR)

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. This 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.

11.3 Servo Drive States

Abide by the process stipulated in the CiA402 protocol when operating the SV680-INT servo drive. Otherwise, the servo drive cannot run in the designated status.

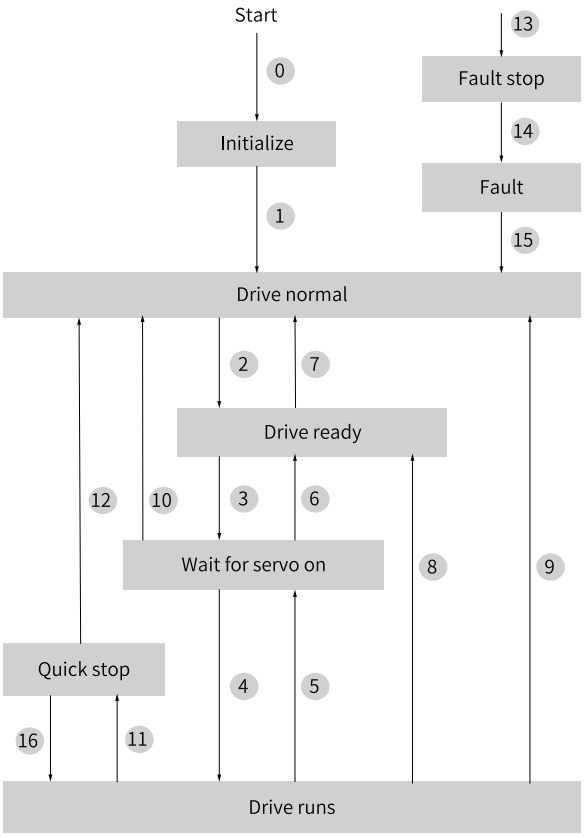


Figure 11-2 Switchover of CiA402 state machine

See the following table for descriptions of different states.

Initialization	Initialization of the 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 drive or the fault has been cleared. Parameter setting of the servo drive is allowed.
Ready to switch on	The servo drive is ready to run. Parameter setting of the servo drive is allowed.
Wait for the S-ON signal	The servo drive is waiting for the S-ON signal. Parameter setting of the servo drive is allowed.
Enable operation	The servo drive is operating properly and a certain operation mode has been enabled. The motor is energized and starts rotating when the speed reference value inputted is not 0. Only parameters whose "Setting Condition" is "During running" can be set.
Quick stop	Quick stop is activated, and the drive is in the process of quick stop. Only parameters whose "Setting Condition" is "During running" can be set.
Stop upon fault	A fault occurs, and the servo drive is in the process of stop. Only parameters whose "Setting Condition" is "During running" can be set.
Fault	The stop process is completed, and all the drive function are inhibited. Parameter setting is allowed for users to eliminate faults.

The following table describes the control commands and state 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 drive directly goes to state 13.	0x0250/0x270
2	No fault → Ready to switch on	0x0006	0x0231
3	Ready to switch on→Wait for the S-ON signal	0x0007	0x0233
4	Wait for the S-ON signal→Servo running	0x000F	0x0237
5	Servo running→Wait for the S-ON signal	0x0007	0x0233
6	Wait for the S-ON signal→Ready to switch on	0x0006	0x0231
7	Ready to switch on→No fault	0x0000	0x0250
8	Servo running→Ready to switch on	0x0006	0x0231
9	Servo running→No fault	0x0000	0x0250
10	Wait for the S-ON signal→No fault	0x0000	0x0250
11	Servo running→Quick stop	0x0002	0x0217
12	Quick stop→No fault	Quick stop mode 605Ah can be set to 0 to 3. The process is performed automatically and no control command is required.	0x0250
13	No fault → Stop upon fault	If a fault occurs in any status other than "fault", the servo drive automatically switches to the stop-upon-fault state, without the need for a control command.	0x021F
14	Stop upon fault→Fault	The stop process is automatically performed, and no control command is required.	0x0218
15	Fault→No fault	0x80 bit7 is rising edge-triggered. bit7 remains at 1, and other control commands are inactive.	0x0250
16	Quick stop→Servo running	Set 605A to a value among 5 to 7. 0x0F is sent after the stop process is completed.	0x0237

Note

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

11.3.1 Control Word 6040h

6040h **Control word**

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

Value range:

0x0 to 0xFFFF

Description:

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	Enable operation	Enable operation	1: Active; 0: Inactive
4 to 6	Operation mode specific	Operation mode specific	Related to the operation mode of the servo drive.
7	Fault Reset	Fault reset	0: Inactive 0→1: Fault reset is available only for faults and 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.

11.3.2 Status Word 6041h

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
Accessibility:	Read-only	Mapping:	TPDO

Value 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 11–1 Description of each bit of 6041h

bit	Name		Description
0	Ready to switch on	Ready to switch on	1: Active; 0: Inactive
1	Switch on	Switch on	1: Active; 0: Inactive
2	Enable operation	Operation enabled	1: Active; 0: Inactive
3	Fault	Fault	1: Active; 0: Inactive
4	Voltage enabled	Voltage enabled	1: Active; 0: Inactive
5	Quick stop	Quick stop	0: Active; 1: Inactive
6	Switch on disabled	Switch on disabled	1: Active; 0: Inactive
7	Warning	Warning	1: Active; 0: Inactive
8	Manufacturer-specific	Manufacturer-specific	Not assigned
9	Remote control	Remote	1: Active, control word activated 0: Inactive
10	Target arrival	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	Not assigned
15	HomeAttain	Home find	0: Homing not completed 1: Homing completed

Table 11–2 Descriptions of setpoints of 6041h

Binary value	Description
xxxx xxxx x0xx 0000	Not ready to switch on
xxxx xxxx x1xx 0000	Switch on disabled

Binary value	Description
xxxx xxxx x01x 0001	Ready to switch on
xxxx xxxx x01x 0011	Switched on
xxxx xxxx x01x 0111	Operation enabled
xxxx xxxx x00x 0111	Quick stop active
xxxx xxxx x0xx 1111	Fault reaction active
xxxx xxxx x0xx 1000	Fault

Note

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

11.4 Process Segment Mode

Set H02.00 (Control mode) to 7 (Position control mode) through the keypad or Inovance software tool to make the drive operate in 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 shown in the following figure.

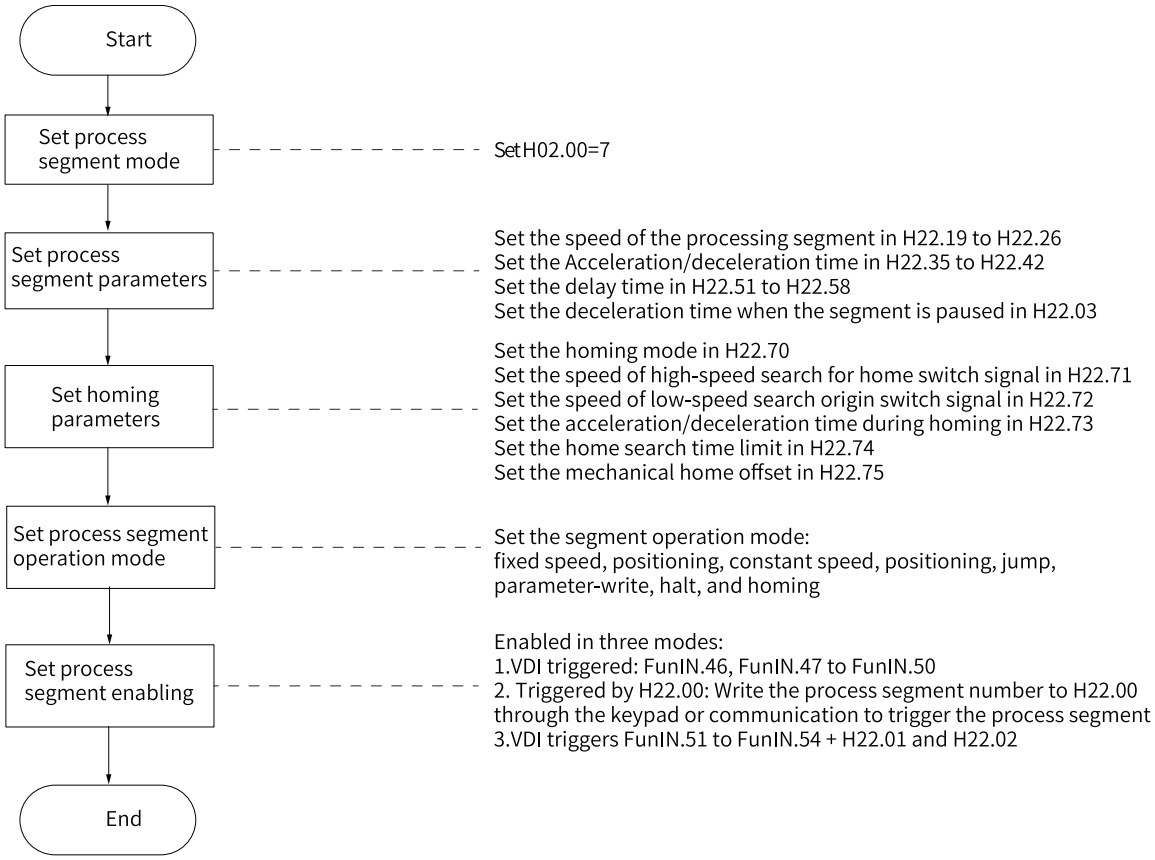


Figure 11-3 Flowchart for setting process segment mode

11.4.1 Mode Triggering

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

Trigger mode	Triggered by	Description
DI	DI: FunIN.46 (PrEnable) + FunIN.47 to 50 (PrCMD1 to 4)	Combine FunIN.47–FunIN.50 to form the process segment number to be triggered. Trigger the process segment through the rising edge of FunIN.46.
Parameter	H22.00	Write the process segment number to H22.00 through the keypad or communication to trigger the process segment.
DI + parameter	DI: FunIN.51–54 (PrEvent1–4) + H22.01/ H22.02	Set the process segment number to be triggered through H22.01 and H22.02. H22.01: DI: Triggered by the rising edge of FunIN.51... FunIN.54 H22.02: DI: Triggered by the falling edge of FunIN.51 to FunIN.54
Homing	DI: FunIN.32 (HomingStart)	Trigger the process segment through the rising edge of FunIN.32.
	H22.00=0	Parameter H22.00 = 0.
	FunIN.46 + FunIN.47–FunIN.50 (combined segment number being 0)	When the process segment is triggered by the rising edge of FunIN.46, the motor executes homing based on the set homing mode and home speed.
Halt	DI: FunIN.55 (PrSuspend)	Trigger the process segment through the rising edge of FunIN.55.
	H22.00=1000	When H22.00 is set to 1000, the process segment in progress is stopped immediately and the motor ramps to stop based on the deceleration time defined by H22.03. The motor remains enabled after stop.

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

Note

- PrEnable, PrSuspend, and 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:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H22.00	2022-01h	Process segment command trigger	0 to 1000	0	-	Real time	"H22_en.00" on page 1042
H22.01	2022-02h	Process segment triggered by the event rising edge	0 to 65535	0	-	Real time	"H22_en.01" on page 1042
H22.02	2022-03h	Process segment triggered by the event falling edge	0 to 65535	0	-	Real time	"H22_en.02" on page 1043
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 1043

Table 11–3 Description of function numbers

No.	Name	Function name	Function
FunIN.32	HomingStart	Homing	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 ineffective.
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 to PrCMD4 is shown in "Table 11-4" on page 327. 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	

No.	Name	Function name	Function
FunIN.51	PrEvent1	Event trigger process segment 1	The DI assigned with 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 11–4 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
...				
1	1	1	1	15

11.4.2 Related Parameters

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

During operation, you can select one parameter from each of the three parameter groups to generate the process segment.

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

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

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

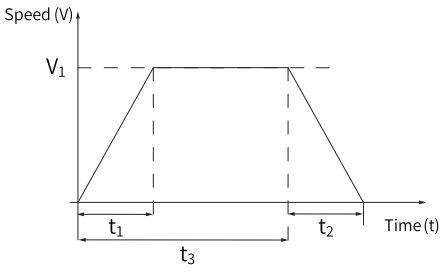


Figure 11-4 Example of the curve in fixed speed mode

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

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

The actual deceleration time t_2 is:

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

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H22.19	2022-14h	Target speed	0.1 to 6000.0	50.0	[mm/s]/[rpm]	Real time	"H22_en.19" on page 1045
H22.20	2022-15h	Target speed setpoint 1	0.1 to 6000.0	200.0	[mm/s]/[rpm]	Real time	"H22_en.20" on page 1046
H22.21	2022-16h	Target speed setpoint 2	0.1 to 6000.0	500.0	[mm/s]/[rpm]	Real time	"H22_en.21" on page 1046
H22.22	2022-17h	Target speed setpoint 3	0.1 to 6000.0	1000.0	[mm/s]/[rpm]	Real time	"H22_en.22" on page 1046
H22.23	2022-18h	Target speed setpoint 4	0.1 to 6000.0	1500.0	[mm/s]/[rpm]	Real time	"H22_en.23" on page 1046
H22.24	2022-19h	Target speed setpoint 5	0.1 to 6000.0	2000.0	[mm/s]/[rpm]	Real time	"H22_en.24" on page 1047
H22.25	2022-1Ah	Target speed setpoint 6	0.1 to 6000.0	2500.0	[mm/s]/[rpm]	Real time	"H22_en.25" on page 1047
H22.26	2022-1Bh	Target speed 7	0.1 to 6000.0	3000.0	[mm/s]/[rpm]	Real time	"H22_en.26" on page 1047
H22.35	2022-24h	Acceleration/Deceleration time	0 to 65535	50	ms	Real time	"H22_en.35" on page 1047
H22.36	2022-25h	Acceleration/Deceleration time 1	0 to 65535	200	ms	Real time	"H22_en.36" on page 1048
H22.37	2022-26h	Acceleration/Deceleration time 2	0 to 65535	500	ms	Real time	"H22_en.37" on page 1048

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H22.38	2022-27h	Acceleration/Deceleration time 3	0 to 65535	1000	ms	Real time	"H22_en.38" on page 1048
H22.39	2022-28h	Acceleration/Deceleration time 4	0 to 65535	1500	ms	Real time	"H22_en.39" on page 1048
H22.40	2022-29h	Acceleration/Deceleration time 5	0 to 65535	2000	ms	Real time	"H22_en.40" on page 1048
H22.41	2022-2Ah	Acceleration/Deceleration time 6	0 to 65535	2500	ms	Real time	"H22_en.41" on page 1049
H22.42	2022-2Bh	Acceleration/Deceleration time 7	0 to 65535	3000	ms	Real time	"H22_en.42" on page 1049
H22.51	2022-34h	Delay after completion of the process segment	0 to 65535	0	ms	Real time	"H22_en.51" on page 1049
H22.52	2022-35h	Delay 1 after completion of the process segment	0 to 65535	50	ms	Real time	"H22_en.52" on page 1049
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 1050
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 1050
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 1050
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 1050
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 1051
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 1051

11.4.3 Operation Modes

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="3">Process segment definition</th></tr>
<tr><th>bit</th><th>Description</th><th>Value</th></tr>
<tr><td>3 to 0</td><td>Mode</td><td>
<table>
<tr><th>bit3 to bit0</th><th>Process segment mode</th><th>Description</th></tr>
<tr><td>0001</td><td>Constant speed mode</td><td>-</td></tr>
<tr><td>0010</td><td>Positioning mode</td><td>Stop after positioning done</td></tr>
<tr><td>0011</td><td>Positioning mode</td><td>Executing the next segment after positioning done</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>
</table>
</td></tr>
<tr><td>7 to 4</td><td>-</td><td>-</td></tr>
<tr><td>11 to 8</td><td>-</td><td>-</td></tr>
<tr><td>15 to 12</td><td>-</td><td>-</td></tr>
<tr><td>19 to 16</td><td>-</td><td>-</td></tr>
<tr><td>23 to 20</td><td>-</td><td>-</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	-

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.

Process segment definition		
bit	Description	Value
3 to 0	-	-
7 to 4	PathNum	0: The motor stops after homing is done. 1 to 15: After homing is done, 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 done executing H22.51 to H22.58: For details, see section "H22 Process segment parameters".
27 to 24	-	-
31 to 28	-	-

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

Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H22.70	2022-47h	Homing mode of process segment	-32768 to +32767	-2	-	Real time	"H22_en.70" on page 1051
H22.71	2022-48h	Speed in high-speed searching for home switch signal	0 to 3000	100	[mm/s]/[rpm]	Real time	"H22_en.71" on page 1051
H22.72	2022-49h	Speed in low-speed searching for home switch signal	0 to 1000	10	[mm/s]/[rpm]	Real time	"H22_en.72" on page 1052
H22.73	2022-4Ah	Acceleration/Deceleration time during homing	0 to 1000	1000	ms	Real time	"H22_en.73" on page 1052
H22.74	2022-4Bh	Home search time limit	0 to 65535	10000	ms	Real time	"H22_en.74" on page 1052
H22.75	2022-4Ch	Mechanical home offset	-2147483648 to +2147483647	0	Reference unit	Real time	"H22_en.75" on page 1052
H22.79	2022-50h	Relative/Absolute homing	0 to 65535	0	-	Real time	"H22_en.79" on page 1053

☆ Related parameters:

No.	Name	Function name	Function
FunOut.16	HomeAttain	HomeAttain	Active: Homing completed in the process segment mode Inactive: Homing not completed

Constant speed mode

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

<table>
<tr><th colspan="4">Process segment definition</th></tr>
<tr><th>bit</th><th>Description</th><th colspan="2">Value</th></tr>
<tr><td>3 to 0</td><td>Mode</td><td colspan="2">1</td></tr>
<tr><td rowspan="5">7 to 4</td><td rowspan="5">Func</td><td colspan="2"><table>
<tr><th>bit</th><th>Description</th><th>Description</th></tr>
<tr><td>4</td><td>Updated immediately (ImmedUpd)</td><td>The present segment overrides the previous segment, which means the previous segment will be interrupted so as to execute present segment. See “Special mode” on page 338Special Modes for details.</td></tr>
<tr><td>5</td><td>Loading next segment (Auto)</td><td>The next process segment applies after the constant speed is reached and the Delaytime elapses.</td></tr>
<tr><td>6</td><td>Unit</td><td>0: 0.1 rpm
1: PPS (pulses/s) (reference unit)</td></tr>
<tr><td>7</td><td>-</td><td>-</td></tr>
</table></td></tr>
<tr><td>11 to 8</td><td>AccTime</td><td colspan="2" rowspan="2">Index of the acceleration/deceleration time
Index H22.35 to H22.42</td></tr>
<tr><td>15 to 12</td><td>DecTime</td></tr>
<tr><td>19 to 16</td><td>...</td><td colspan="2">-</td></tr>
<tr><td>23 to 20</td><td>DelayTime</td><td colspan="2">Index of the interval time after the process segment is done executing
Index H22.51 to H22.58</td></tr>
<tr><td>27 to 24</td><td>-</td><td colspan="2">-</td></tr>
<tr><td>31 to 28</td><td>-</td><td colspan="2">-</td></tr>
</table>

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

Where:

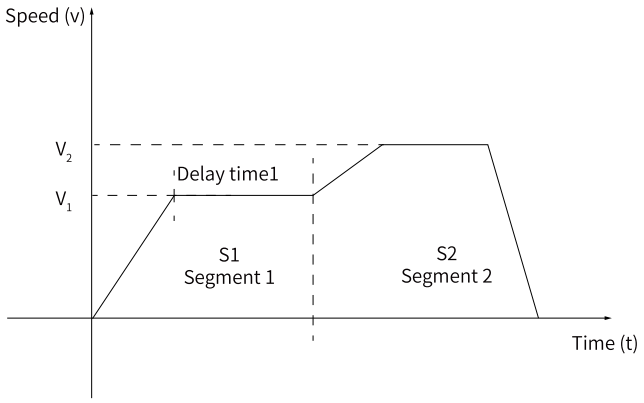


Figure 11-5 Time-speed curve

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

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

S1 represents displacement 1 and S2 represents displacement 2.

Positioning mode

Modes 2 and 3 indicate positioning mode. In mode 2, the drive stops after positioning is done. In mode 3, the next segment will be executed automatically after positioning is done.

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">Process segment definition</th></tr>
<tr><th>bit</th><th>Description</th><th>Value</th></tr>
<tr><td>3 to 0</td><td>Mode</td><td>Positioning mode 2: Stopped after positioning is done
Positioning mode 3: Executing the next segment after positioning is done</td></tr>
<tr><td>7 to 4</td><td>Func</td><td>
<table>
<tr><th>bit</th><th>Description</th><th>Description</th></tr>
<tr><td>4</td><td>Updated immediately (ImmedUpd)</td><td>The present segment overrides the previous segment, which means the previous segment will be interrupted so as to execute present segment. See “Special mode” on page 338Special Modes for details.</td></tr>
<tr><td>5</td><td>Overlap (OverLap)</td><td>The present segment can overlap with the next segment. During overlapping, the interval time of present segment is set to 0 forcibly. See “Special mode” on page 338Special Modes for details.</td></tr>
<tr><td>6</td><td rowspan="2">Position reference type (CmdType)</td><td rowspan="2">bit6 and bit7 set to 00: Absolute positioning command (Final position = Target position)
bit6 and bit7 set to 10: Incremental positioning command (Final position = Previous final position + Target position)</td></tr>
<tr><td>7</td></tr>
</table>
</td></tr>
<tr><td>11 to 8</td><td>AccTime</td><td rowspan="2">Index of the acceleration/deceleration time
Indexes H22.35 to H22.42</td></tr>
<tr><td>15 to 12</td><td>DecTime</td></tr>
<tr><td>19 to 16</td><td>SpdSet</td><td>Index of the speed setpoint
Indexes H22.19 to H22.26</td></tr>
<tr><td>23 to 20</td><td>DelayTime</td><td>Index of the interval time after the process segment is done executing
Indexes H22.51 to H22.58</td></tr>
<tr><td>27 to 24</td><td>-</td><td>-</td></tr>
<tr><td>31 to 28</td><td>-</td><td>-</td></tr>
</table>

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

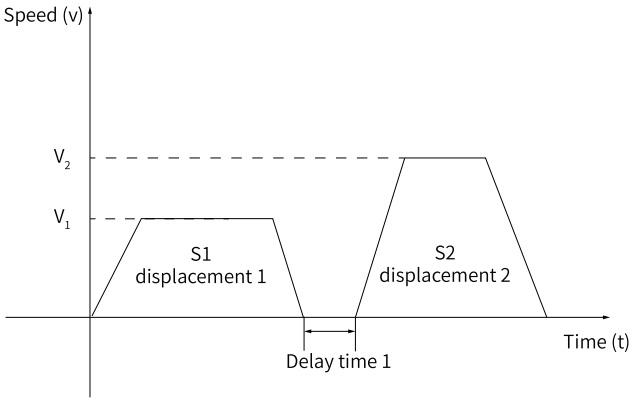


Figure 11-6 Time-speed curve

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

Segment 2: positioning mode; Mode = 2; ImmedUpd = 0; V_2: speed set for the positioning mode.

S1 represents displacement 1 and S2 represents displacement 2.

Jump mode

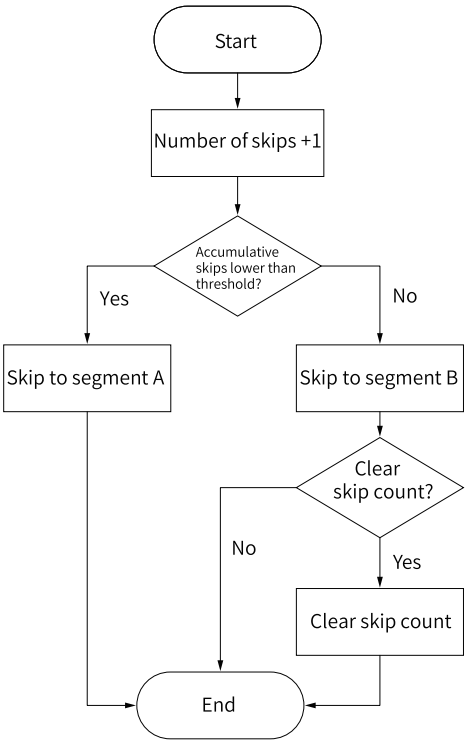
Mode 7 represents the jump mode. When the jump mode is in progress, the drive can jump to any process segment. When the target process segment exceeds the process segment range, E126.0 occurs.

Process segment definition		
bit	Description	Value
3 to 0	Mode	7
4	Updated immediately (ImmedUpd)	The present segment overrides the previous segment, which means the previous segment will be interrupted so as to execute present segment. See *" Special mode" on page 338Special Modes* for details.
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 done executing 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

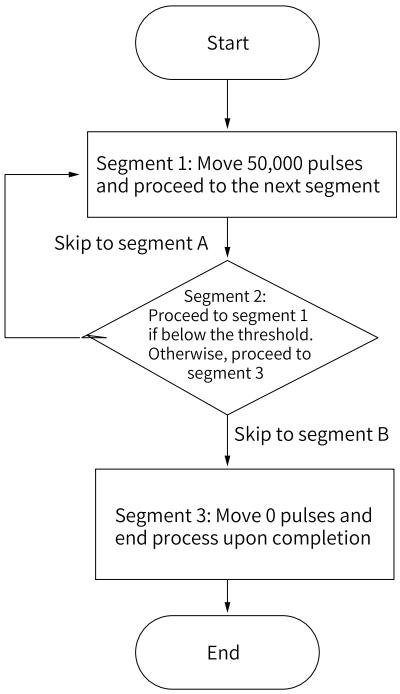
The jump operation is conditional. Every time the jump operation is executed, the jump count will be incremented by 1. When the cumulative count is lower than this cumulative number of jumps,

process segment A applies. Otherwise, process segment B applies. When jumping to process segment B, if bit9 that 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.

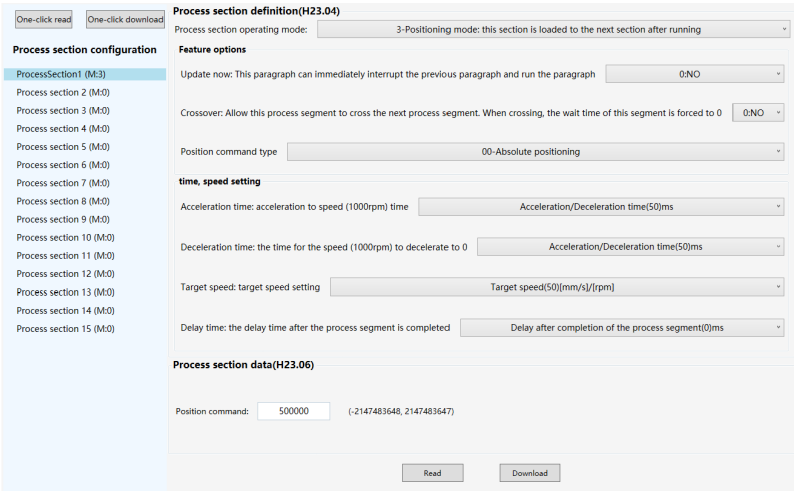


Application case

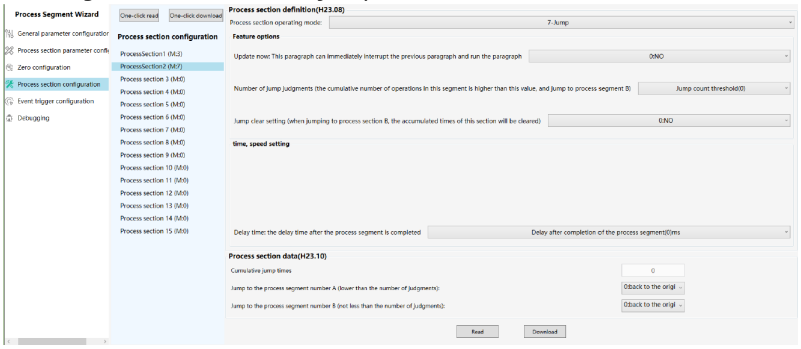
In the following example, the process segment jump function is used to achieve limited repetitive multi-position operations.



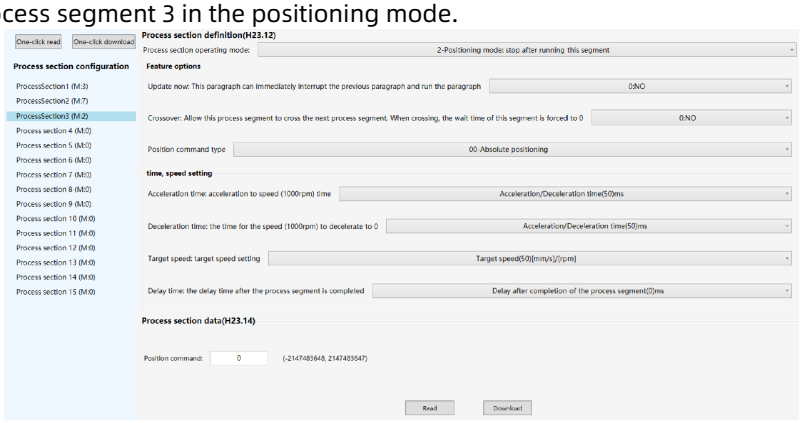
1. Configure process segment 1 as the position mode, and set 50000 pulses for forward operation.



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



3. Configure process segment 3 in the 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">Process segment definition</th></tr>
<tr><th>bit</th><th>Description</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>Description</th><th>Description</th></tr>
<tr><td>4</td><td>Updated immediately (ImmedUpd)</td><td>The present segment overrides the previous segment, which means the previous segment will be interrupted so as to execute present segment. See “Special mode” on page 338Special Modes for details.</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>The parameter No.</td></tr>
<tr><td>19 to 16
23 to 20</td><td>Group No.
(H_Grp)</td><td>The 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 done executing
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 the present operation mode immediately and ramps to stop based on the deceleration time defined by H22.03. After stop, the motor remains enabled and stays at standstill. When the process segment is triggered again, the motor resumes normal operation.

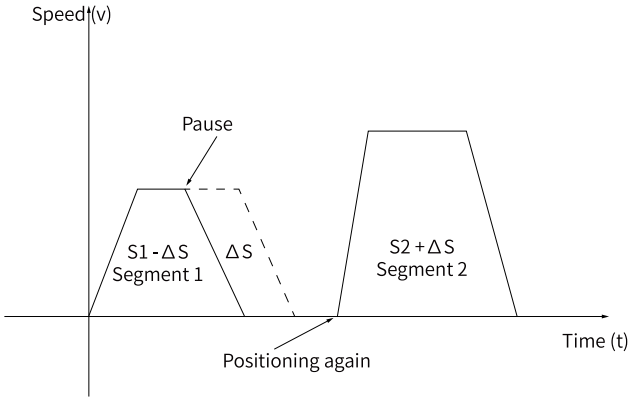


Figure 11-7 Time-speed curve

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.

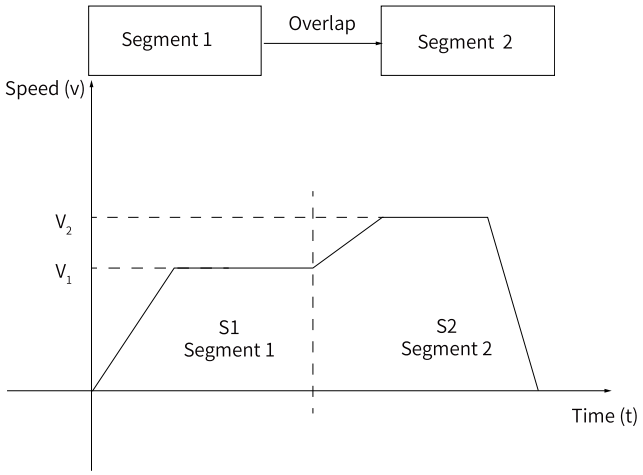


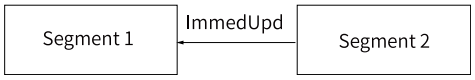
Figure 11-8 Time-speed curve

Segment 1: positioning mode; Mode = 3; OverLap = 1; V_1: speed set for the positioning mode.

Segment 2: positioning mode; ImmedUpd = 0; V_2: speed set for the positioning mode.

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

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



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

  - Internal ImmedUpd mode

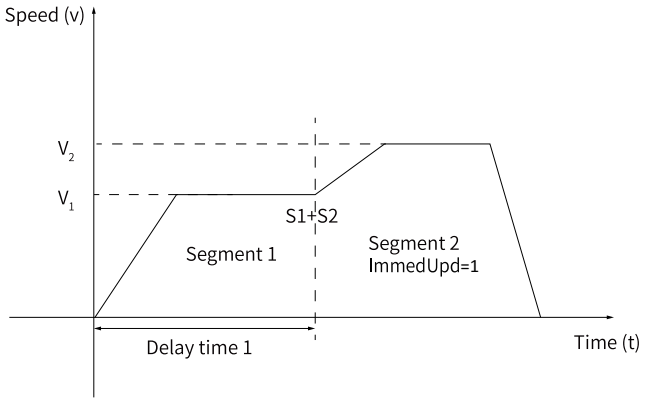


Figure 11-9 Time-speed curve

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

Segment 2: ImmedUpd = 1, V_2: speed set for segment 2

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

- External ImmedUpd mode

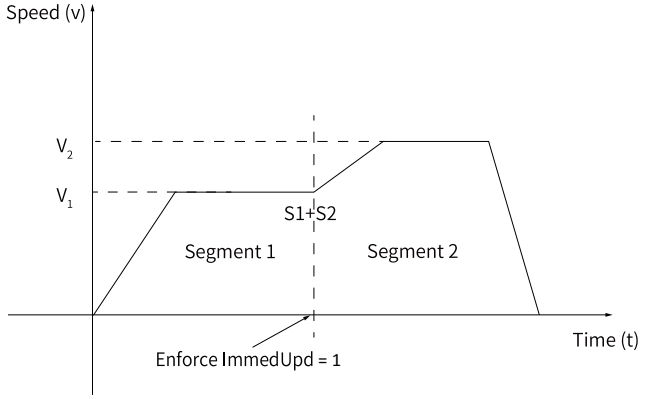


Figure 11-10 Time-speed curve

Segment 1: positioning mode; V_1: speed set for the positioning mode

Segment 2: ImmedUpd = 1, V_2: speed set for segment 2

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

Note

- The ImmedUpd function has higher priority over the overlap function, 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.

11.4.4 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):

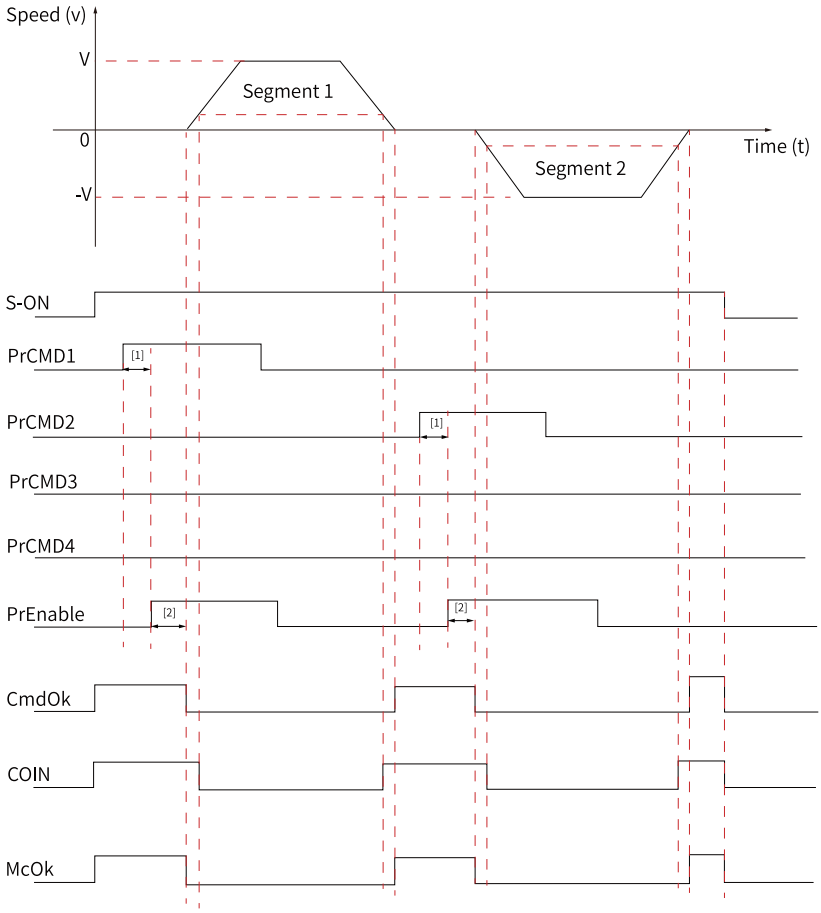


Figure 11-11 Sequence of process segment

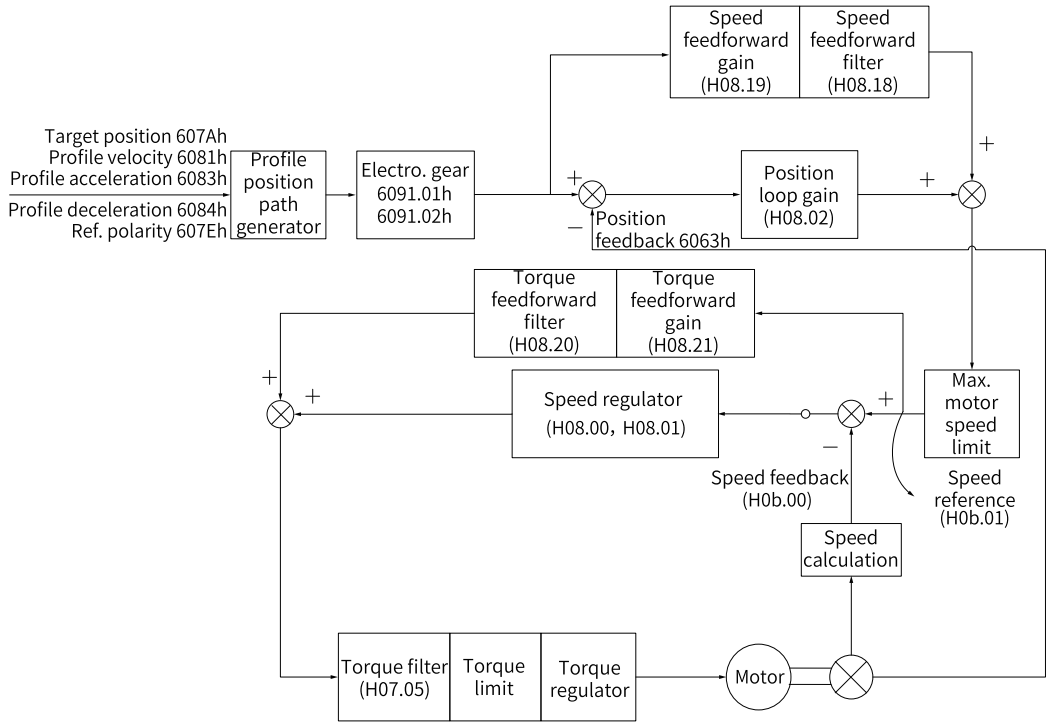
Note

- [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.

11.5 Profile Position (PP) Mode

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

11.5.1 Function block diagram



11.5.2 Configuration block diagram

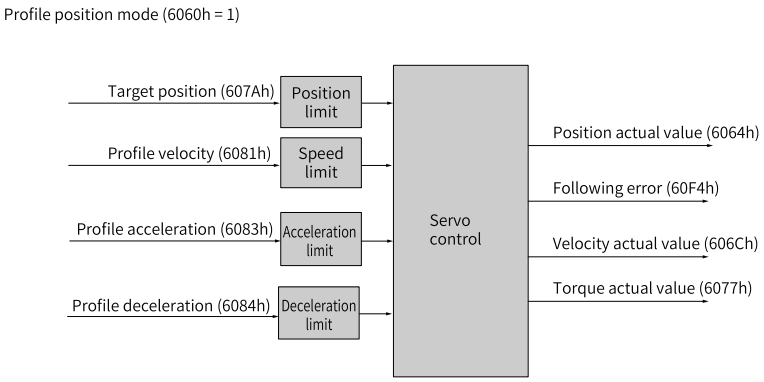


Figure 11-12 Profile position mode configuration block diagram

In profile position mode, the target position is triggered and activated based on the sequence of the new setpoint (bit4 of the control word) and setpoint acknowledge (bit12 of the status word).

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

The linkage mode of position references is determined by bit5 (Change set immediately) of the control word. When bit5 is set to 1, sequential linkage applies between position references. When bit5 is set to 0, zero-passing linkage applies between position references.

Sequential 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.

In sequential mode, the sequence diagram of bit4 of the control word (New setpoint) and bit12 of the status word (Setpoint acknowledge) is as follows.

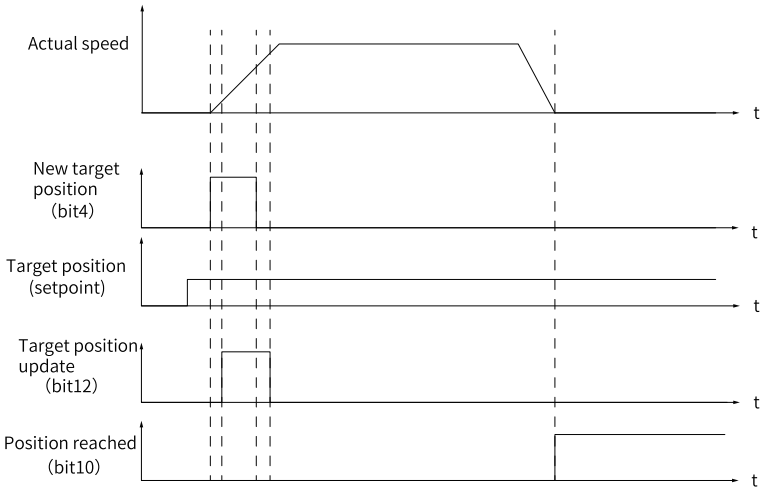
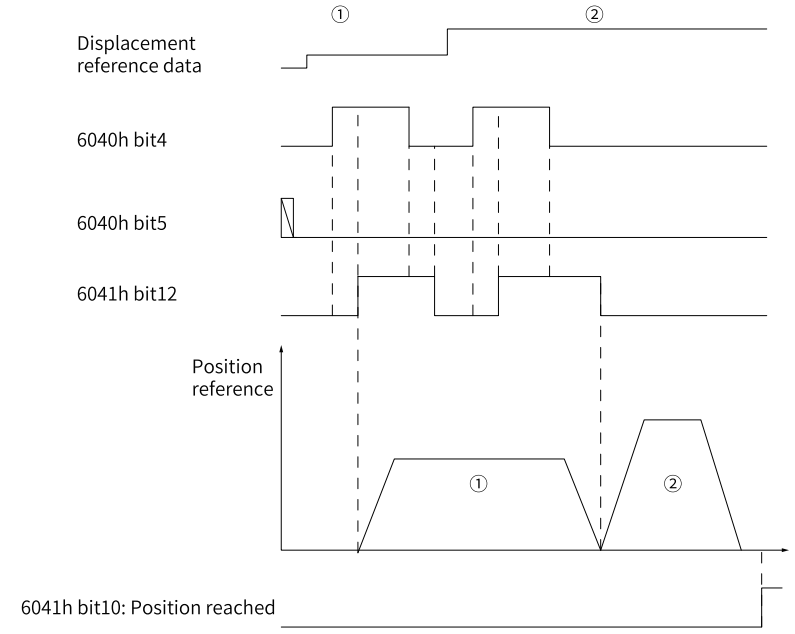


Figure 11-13 Sequence in sequential mode

Single-point mode:

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

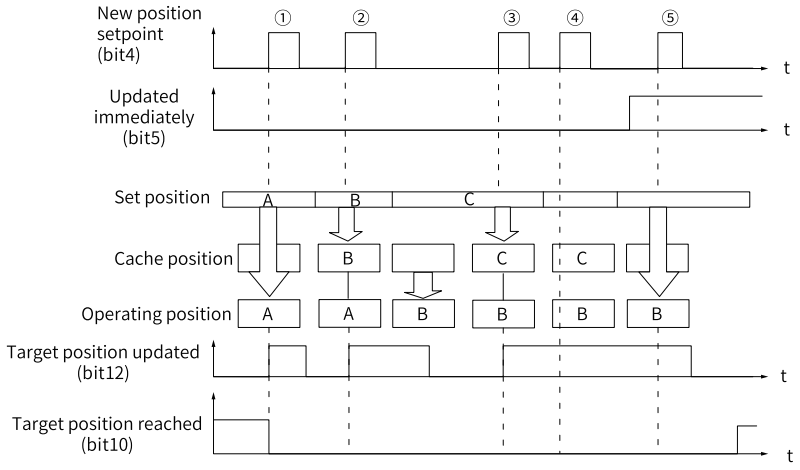
The sequence diagram of the new setpoint bit (bit4 of the control word) and the setpoint acknowledge bit (bit12 of the status word) is as follows.



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

Figure 11-14 Sequence in single-point mode

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



- ① If the cache position is empty, the set position will be immediately executed.
- ②③ If a position reference is currently under execution, the new position setpoint will be saved in the cache. After the current position reference is transmitted, 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 exhausted. In this case, you can set the attribute bit of the setpoint to 1 (Change set immediately) to activate the setpoint.

11.5.3 Recommended configuration

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

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

11.5.4 Related parameters

6040h **Control word**

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

Value range:

0x0 to 0xFFFF

Description:

Sets the control command.

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

Accessibili- Read-only Mapping: TPDO
ty:

Value 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

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	Operation enabled	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	Not assigned
9	Remote control	Remote	1: Valid, control word activated 0: Invalid
10	Target arrival	Target arrival	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	Not assigned
15	HomeAttain	Home find	0: Homing completed 1: Homing completed

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
6060h	6060h	Servo drive mode selection	1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 7: Interpolation (IP) mode	0	-	Real time	"6060h" on page 1127
6061h	6061h	Operation mode display	1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 7: Interpolation (IP) mode	0	-	Read-only	"6061h" on page 1127
6064h	6064h	Position feedback	-2147483648 to +2147483647	0	Reference unit	Read-only	"6064h" on page 1128
6065h	6065h	Threshold of excessive position deviation	0 to 4294967295	219895614	Reference unit	Real time	"6065h" on page 1128
6066h	6066h	Time to trigger excessive position deviation	0 to 65535	0	ms	Real time	"6066h" on page 1129
6067h	6067h	Position reach threshold	0 to 4294967295	46976	Reference unit	Real time	"6067h" on page 1129
6068h	6068h	Position reach window time	0 to 65535	0	ms	Real time	"6068h" on page 1129
607Ah	607Ah	Target position	-2147483648 to +2147483647	0	Reference unit	Real time	"607Ah" on page 1132
607Eh	607Eh	Reference polarity	0x0 to 0xFF	0x0	-	Real time	"607Eh" on page 1134
607Fh	607Fh	Maximum speed	0 to 4294967295	4294967295	Reference unit/s	Real time	"607Fh" on page 1134
6081h	6081h	Profile velocity	0 to 4294967295	111848106	Reference unit/s	Real time	"6081h" on page 1134
6083h	6083h	Profile acceleration	0 to 4294967295	4294967295	Reference unit/s²	Real time	"6083h" on page 1135
6084h	6084h	Profile deceleration	0 to 4294967295	4294967295	Reference unit/s²	Real time	"6084h" on page 1135

11.5.5 Related Function Settings

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

Positioning completed

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
6067h	6067h	Position reach threshold	0 to 4294967295	46976	Reference unit	Real time	"6067h" on page 1129
6068h	6068h	Position reach window time	0 to 65535	0	ms	Real time	"6068h" on page 1129

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

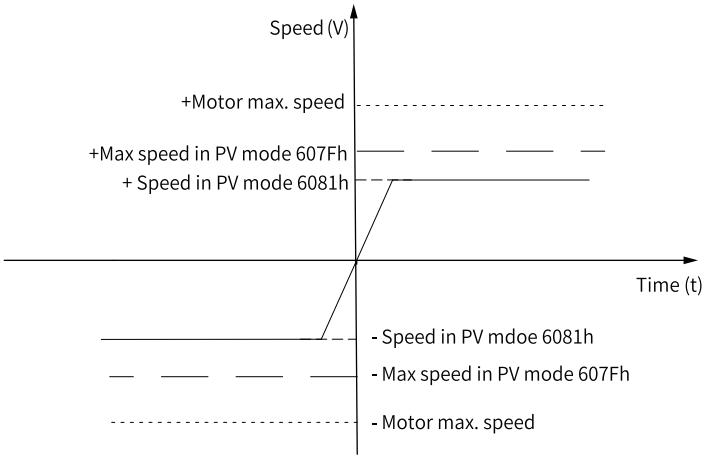
Position deviation monitoring function

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
6065h	6065h	Threshold of excessive position deviation	0 to 4294967295	219895614	Reference unit	Real time	"6065h" on page 1128
6066h	6066h	Time to trigger excessive position deviation	0 to 65535	0	ms	Real time	"6066h" on page 1129

Speed limit

In PP 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:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
607Fh	607Fh	Maximum speed	0 to 4294967295	4294967295	Reference unit/s	Real time	"607Fh" on page 1134

Acceleration and deceleration limits

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
6083h	6083h	Profile acceleration	0 to 4294967295	4294967295	Reference unit/s²	Real time	"6083h" on page 1135
6084h	6084h	Profile deceleration	0 to 4294967295	4294967295	Reference unit/s²	Real time	"6084h" on page 1135

Reference polarity

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

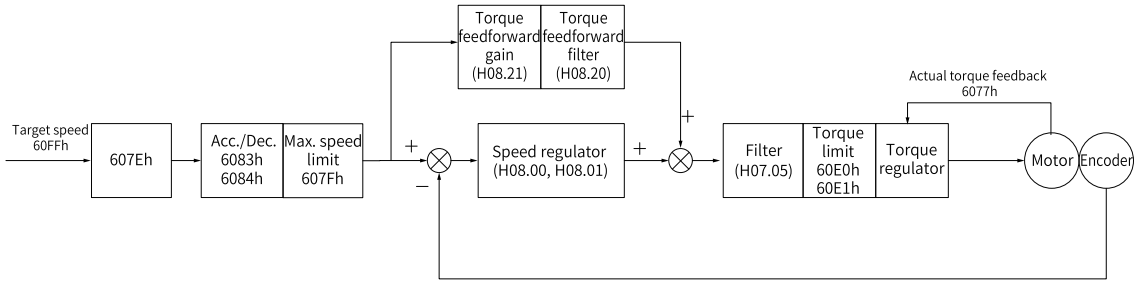
☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
607Eh	607Eh	Reference polarity	0x0 to 0xFF	0x0	-	Real time	"607Eh" on page 1134

11.6 Profile Velocity (PV) Mode

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

11.6.1 Function block diagram



11.6.2 Configuration block diagram

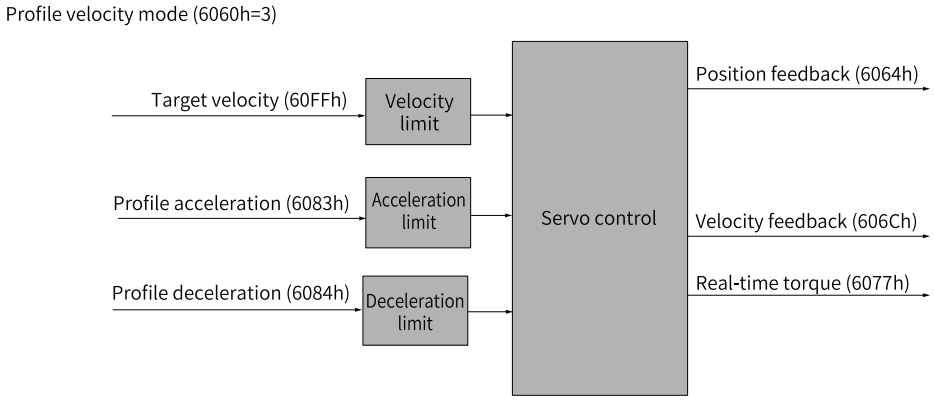


Figure 11-15 Configuration block diagram in PV mode

11.6.3 Recommended configuration

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

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

11.6.4 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
Accessibility:	Read/write	Mapping:	RPDO

Value range:

0x0 to 0xFFFF

Description:

Sets the control command.

bit	Name		Description
0	Switch on	Switch on	1: Valid; 0: Invalid
1	Enable voltage	Enable voltage	1: Valid; 0: Invalid
2	Quick stop	Quick stop	0: Valid; 1: Invalid
3	Enable operation	Operation enabled	1: Valid; 0: Invalid
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
Accessibility:	Read-only	Mapping:	TPDO

Value 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

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	Operation enabled	1: Valid; 0: Invalid
3	Fault	Fault	1: Valid; 0: Invalid
4	Voltage enabled	Voltage enabled	1: Valid; 0: Invalid

bit	Name		Description
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	Not assigned
9	Remote control	Remote	1: Valid, control word activated 0: Invalid
10	Target arrival	Target arrival	0: The target velocity is not reached. 1: The target velocity is reached.
11	Internal limit active	Internal limit active	0: Position feedback within the limit 1: Position feedback beyond the limit
12	Speed	Speed	0: Speed is not 0 1: Speed is 0
13	-	N/A	N/A
14	Manufacturer-specific	Manufacturer-specific	Not assigned
15	-	N/A	N/A

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
606Ch	606Ch	Actual speed	-2147483648 to +2147483647	0	Reference unit/s	Read-only	"606Ch" on page 1129
606Dh	606Dh	Velocity window	0 to 65535	10	rpm	Real time	"606Dh" on page 1130
606Eh	606Eh	Velocity window time	0 to 65535	0	ms	Real time	"606Eh" on page 1130
606Fh	606Fh	Zero speed signal threshold	0 to 65535	10	rpm	Real time	"606Fh" on page 1131
6070h	6070h	Velocity threshold time	0 to 65535	0	ms	Real time	"6070h" on page 1131
607Eh	607Eh	Reference polarity	0x0 to 0xFF	0x0	-	Real time	"607Eh" on page 1134
607Fh	607Fh	Maximum speed	0 to 4294967295	4294967295	Reference unit/s	Real time	"607Fh" on page 1134
6083h	6083h	Profile acceleration	0 to 4294967295	4294967295	Reference unit/s²	Real time	"6083h" on page 1135

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
6084h	6084h	Profile deceleration	0 to 4294967295	4294967295	Reference unit/s²	Real time	"6084h" on page 1135
60FFh	60FFh	PV target velocity	-2147483648 to +2147483647	0	Reference unit/s	Real time	"60FFh" on page 1146

11.6.5 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:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
606Dh	606Dh	Velocity window	0 to 65535	10	rpm	Real time	"606Dh" on page 1130
606Eh	606Eh	Velocity window time	0 to 65535	0	ms	Real time	"606Eh" on page 1130

Monitoring on zero speed

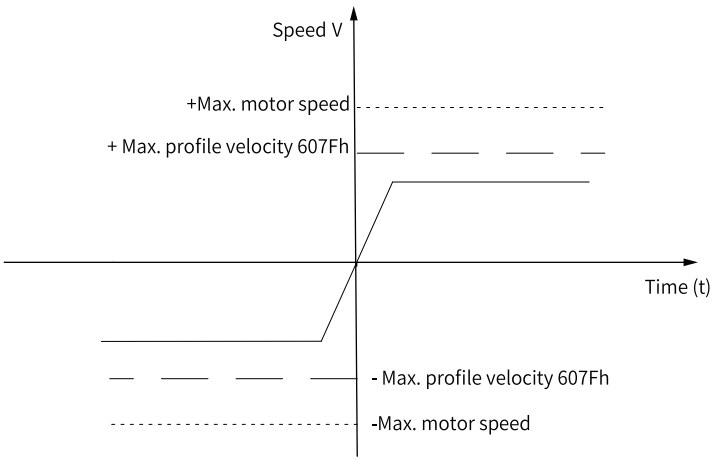
This function is used to check whether the absolute value of motor speed feedback is lower than the set threshold. If yes, the motor is considered to be close to standstill (zero speed). bit12 of 6041h is set to 1.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
606Fh	606Fh	Zero speed signal threshold	0 to 65535	10	rpm	Real time	"606Fh" on page 1131
6070h	6070h	Velocity threshold time	0 to 65535	0	ms	Real time	"6070h" on page 1131

Speed limit

In profile velocity (PV) mode, 607Fh can be used to limit the maximum speed in forward and reverse running, but its value must not exceed the maximum allowable speed of the motor.



☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
607Fh	607Fh	Maximum speed	0 to 4294967295	4294967295	Reference unit/s	Real time	"607Fh" on page 1134

Acceleration and deceleration limits

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
60C5h	60C5h	Maximum acceleration	0 to 4294967295	4294967295	Reference unit/s²	Real time	"60C5h" on page 1143
60C6h	60C6h	Max. deceleration	0 to 4294967295	4294967295	Reference unit/s²	Real time	"60C6h" on page 1143

Reference polarity

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

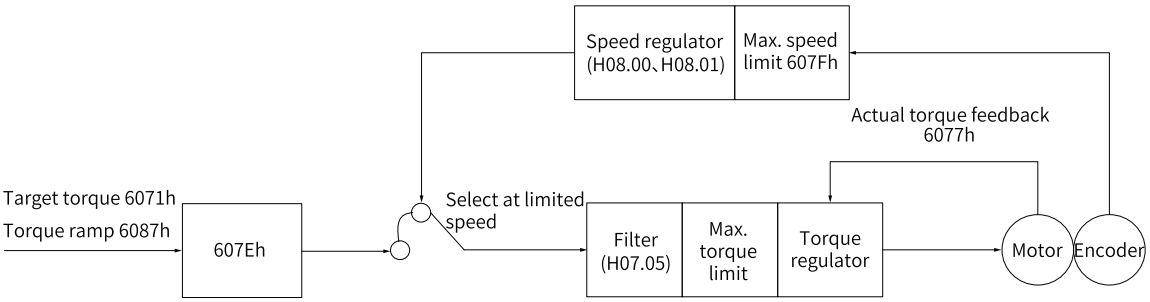
☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
607Eh	607Eh	Reference polarity	0x0 to 0xFF	0x0	-	Real time	"607Eh" on page 1134

11.7 Profile Torque (PT) Mode

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

11.7.1 Function block diagram



11.7.2 Configuration block diagram

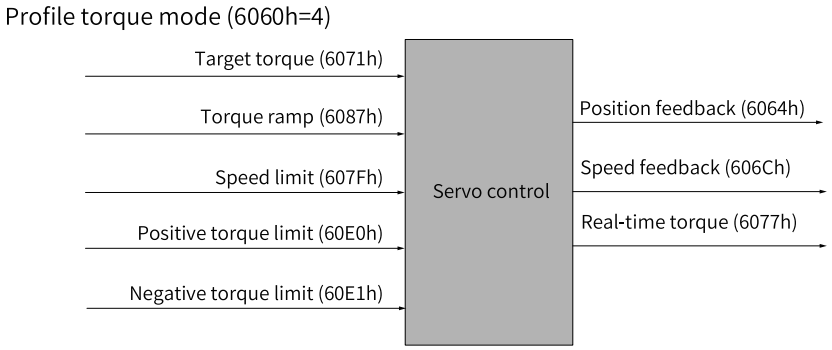


Figure 11-16 Profile torque (PT) mode

11.7.3 Recommended configuration

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

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

11.7.4 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
Accessibility:	Read/write	Mapping:	RPDO

Value range:

0x0 to 0xFFFF

Description:

Sets the control command.

bit	Name		Description
0	Switch on	Switch on	1: Valid; 0: Invalid
1	Enable voltage	Enable voltage	1: Valid; 0: Invalid
2	Quick stop	Quick stop	0: Valid; 1: Invalid
3	Enable operation	Operation enabled	1: Valid; 0: Invalid
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
Accessibility:	Read-only	Mapping:	TPDO

Value 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

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	Operation enabled	1: Valid; 0: Invalid
3	Fault	Fault	1: Valid; 0: Invalid
4	Voltage enabled	Voltage enabled	1: Valid; 0: Invalid

bit	Name		Description
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	Not assigned
9	Remote control	Remote	1: Valid, control word activated 0: Invalid
10	Target arrival	Target arrival	0: Target torque not reached 1: Target torque reached
11	Internal limit active	Internal limit active	0: Position feedback within the limit 1: Position feedback beyond the limit
12 to 14	No assignment	N/A	No assignment, always being 0
15	-	N/A	N/A

☆ Related parameters:

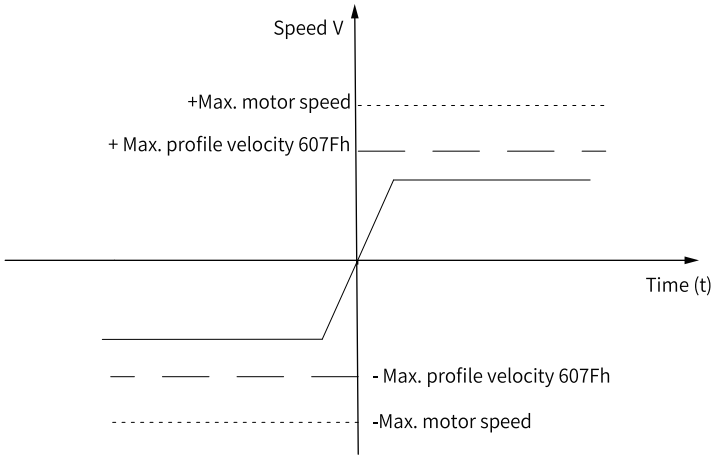
Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H07.17	2007-12h	Speed limit source	0: Internal speed limit 1: V-LMT 2: H07.19 or H07.20 as defined by DI	0	-	Real time	"H07_en.17" on page 813
6060h	6060h	Servo drive mode selection	1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 7: Interpolation (IP) mode	0	-	Real time	"6060h" on page 1127
6061h	6061h	Operation mode display	1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 7: Interpolation (IP) mode	0	-	Read-only	"6061h" on page 1127
6071h	6071h	Target torque	-4000 to 4000	0	0.10%	Real time	"6071h" on page 1131
6072h	6072h	Maximum torque	0 to 4000	3500	0.10%	Real time	"6072h" on page 1132
6074h	6074h	Torque reference	-4000 to 4000	0	0.10%	Read-only	"6074h" on page 1132
6077h	6077h	Torque actual value	-4000 to 4000	0	0.10%	Read-only	"6077h" on page 1132
607Eh	607Eh	Reference polarity	0x0 to 0xFF	0x0	-	Real time	"607Eh" on page 1134
607Fh	607Fh	Maximum speed	0 to 4294967295	4294967295	Reference unit/s	Real time	"607Fh" on page 1134
6087h	6087h	Torque ramp	0 to 4294967295	4294967295	0.1%/s	Real time	"6087h" on page 1136

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
60E0h	60E0h	Positive torque limit	0 to 4000	3500	0.10%	Real time	"60E0h" on page 1144
60E1h	60E1h	Negative torque limit	0 to 4000	3500	0.10%	Real time	"60E1h" on page 1145

11.7.5 Related Function Settings

Speed limit in torque control mode

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

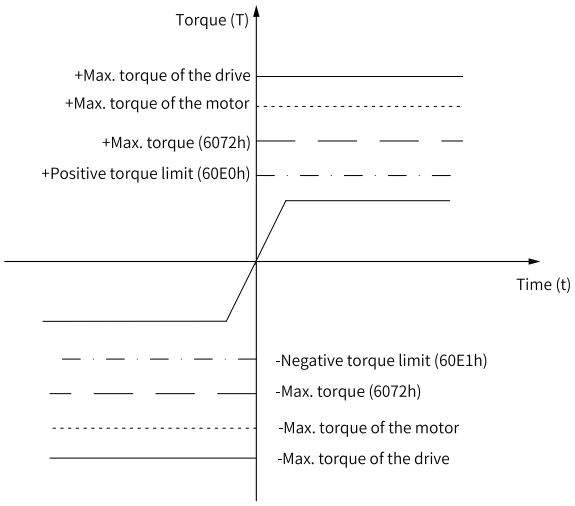


☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
607Fh	607Fh	Maximum speed	0 to 4294967295	4294967295	Reference unit/s	Real time	"607Fh" on page 1134

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:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
6072h	6072h	Maximum torque	0 to 4000	3500	0.10%	Real time	"6072h" on page 1132
60E0h	60E0h	Positive torque limit	0 to 4000	3500	0.10%	Real time	"60E0h" on page 1144
60E1h	60E1h	Negative torque limit	0 to 4000	3500	0.10%	Real time	"60E1h" on page 1145

Torque reference polarity

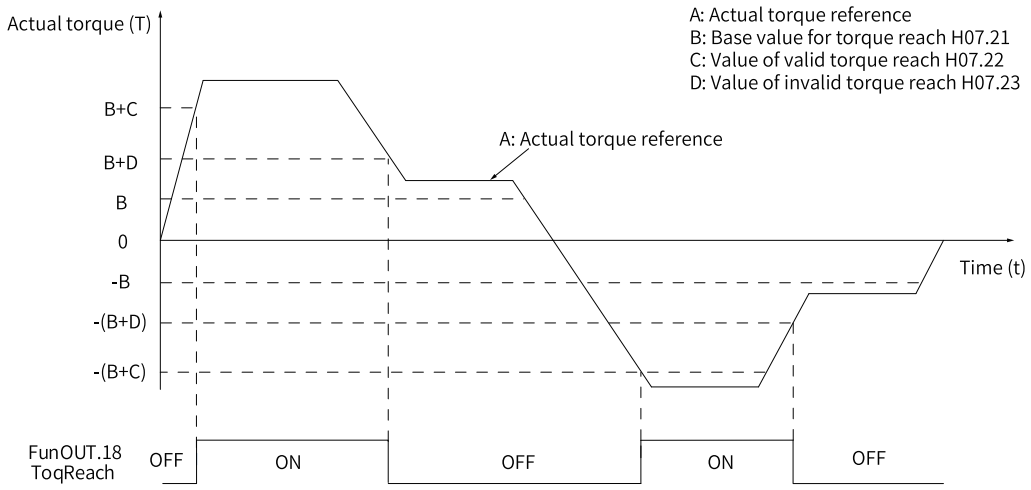
You can change the torque reference direction through setting the torque reference polarity.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
607Eh	607Eh	Reference polarity	0x0 to 0xFF	0x0	-	Real time	"607Eh" on page 1134

Monitoring on torque reach

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



- Actual torque reference (viewed in H0b.02): A
- Reference value for torque arrival (H07.21): B
- Value of valid torque arrival (H07.22:) C
- Value of invalid torque arrival (H07.23): D

C and D are offsets on the basis of B.

The torque reach DO signal can be activated only when the actual torque reference meets the following condition: |A| ≥ B + C. Otherwise, the torque reached signal remains inactive.

The torque reach signal is deactivated only when the actual torque reference meets the following condition: |A| < B + D. Otherwise, the torque reached signal remains active.

11.8 Homing Mode (HM)

This mode searches for the home and determines the position relationship between home and zero.

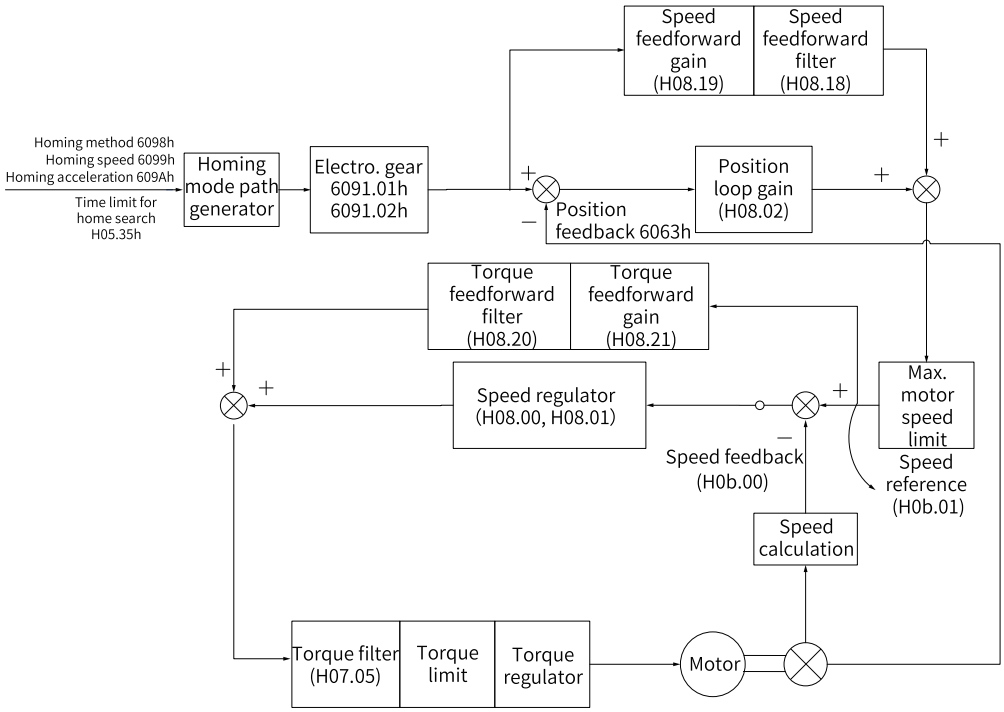
- Mechanical home: a fixed position on the machine, which corresponds to a certain home switch or the motor Z signal.
- Mechanical zero: the absolute zero point on the machine

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

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

When 607C is 0, the mechanical home overlaps with the mechanical zero.

11.8.1 Function block diagram



11.8.2 Configuration block diagram

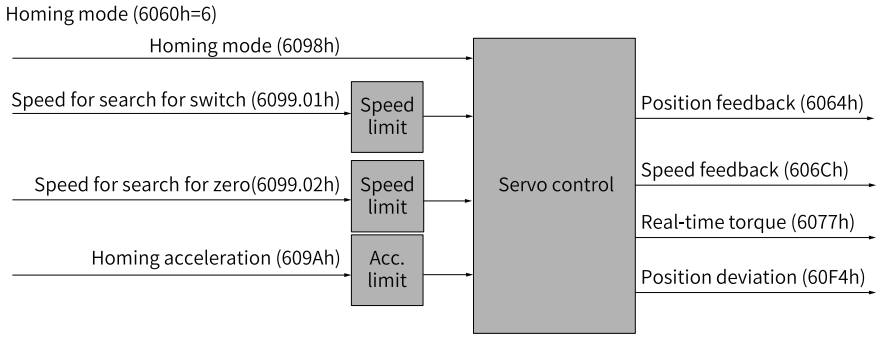


Figure 11-17 Homing mode

11.8.3 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

11.8.4 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
Accessibility:	Read/write	Mapping:	RPDO

Value range:

0x0 to 0xFFFF

Description:

Sets the control command.

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

6041h **Status word**

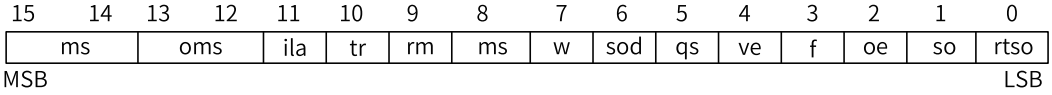
Comm. address:	6041h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only
Accessibility:	Read-only	Mapping:	TPDO

Value range:

0x0 to 0xFFFF

Description:

Indicates the servo drive status.



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

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	Operation enabled	1: Valid; 0: Invalid
3	Fault	Fault	1: Valid; 0: Invalid
4	Voltage enabled	Voltage enabled	1: Valid; 0: Invalid

bit	Name		Description
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	Not assigned
9	Remote control	Remote	1: Valid, control word activated 0: Invalid
10	Target arrival	Target arrival	1: Home is found or homing is interrupted or failed
11	Internal limit active	Internal limit active	0: Position reference within the limit 1: Position reference beyond the limit
12	Homing attained	Homing attained	0: Homing not attained 1: Homing attained
13	Homing error	Homing error	0: No error 1: Error is present
15	HomeAttain	Home find	0: Homing completed 1: Homing completed

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
6060h	6060h	Servo drive mode selection	1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 7: Interpolation (IP) mode	0	-	Real time	"6060h" on page 1127
6061h	6061h	Operation mode display	1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 7: Interpolation (IP) mode	0	-	Read-only	"6061h" on page 1127
6065h	6065h	Threshold of excessive position deviation	0 to 4294967295	219895614	Reference unit	Real time	"6065h" on page 1128
6066h	6066h	Time to trigger excessive position deviation	0 to 65535	0	ms	Real time	"6066h" on page 1129
607Ch	607Ch	Home offset	-2147483648 to +2147483647	0	Reference unit	Real time	"607Ch" on page 1133
607Fh	607Fh	Maximum speed	0 to 4294967295	4294967295	Reference unit/s	Real time	"607Fh" on page 1134
6098h	6098h	Homing method	-3 to +35	1	-	Real time	"6098h" on page 1137

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
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 1138
6099.02h	6099-02h	Speed during search for home signal	0 to 4294967295	11184810	Reference unit/s	At stop	"6099_en.02h" on page 1138
609Ah	609Ah	Homing acceleration	0 to 4294967295	4294967295	Reference unit/s²	Real time	"609Ah" on page 1139
60C5h	60C5h	Maximum acceleration	0 to 4294967295	4294967295	Reference unit/s²	Real time	"60C5h" on page 1143

11.8.5 Related Function Settings

Homing timeout

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

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.35	2005-24h	Home search time limit	0 to 65535	10000	-	Real time	"H05_en.35" on page 785

Actual position calculation method

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
607Ch	607Ch	Home offset	-2147483648 to +2147483647	0	Reference unit	Real time	"607Ch" on page 1133

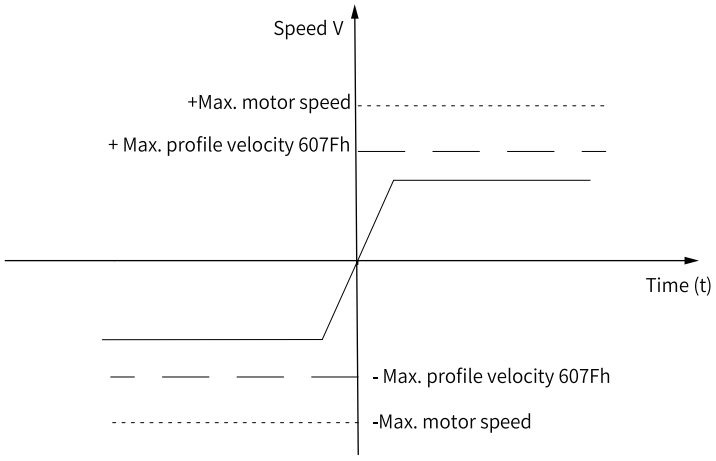
Position deviation monitoring function

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
6065h	6065h	Threshold of excessive position deviation	0 to 4294967295	219895614	Reference unit	Real time	"6065h" on page 1128
6066h	6066h	Time to trigger excessive position deviation	0 to 65535	0	ms	Real time	"6066h" on page 1129

Speed limit

In 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:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
607Fh	607Fh	Maximum speed	0 to 4294967295	4294967295	Reference unit/s	Real time	"607Fh" on page 1134

Acceleration limit

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
60C5h	60C5h	Maximum acceleration	0 to 4294967295	4294967295	Reference unit/s²	Real time	"60C5h" on page 1143

11.8.6 Homing Operation

Note

Threshold for torque homing:

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

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

6098h = 1

Home: motor Z signal

Deceleration point: negative limit switch

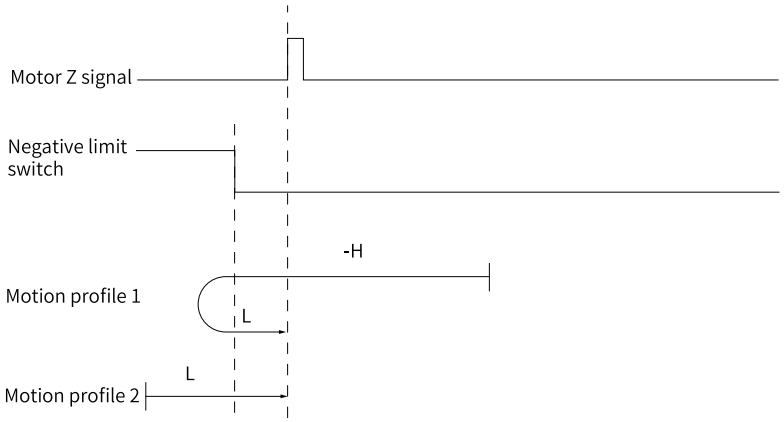


Figure 11-18 Motor operation curve and speed in mode 1

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

6098h = 2

Home: Z signal

Deceleration point: positive limit switch

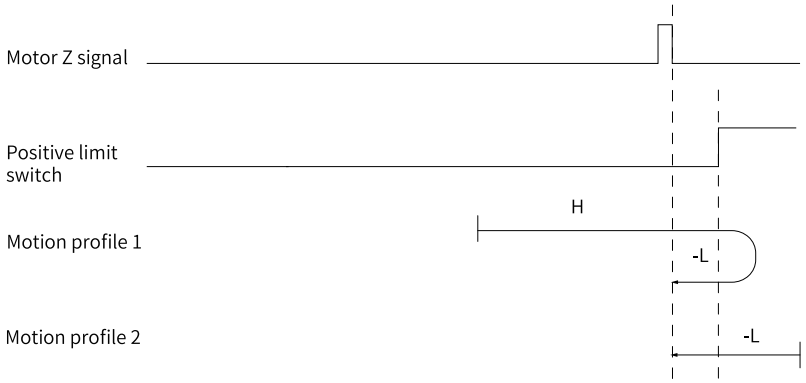


Figure 11-19 Motor operation curve and speed in mode 2

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

6098h = 3

Home: Z signal

Deceleration point: home switch (HW)

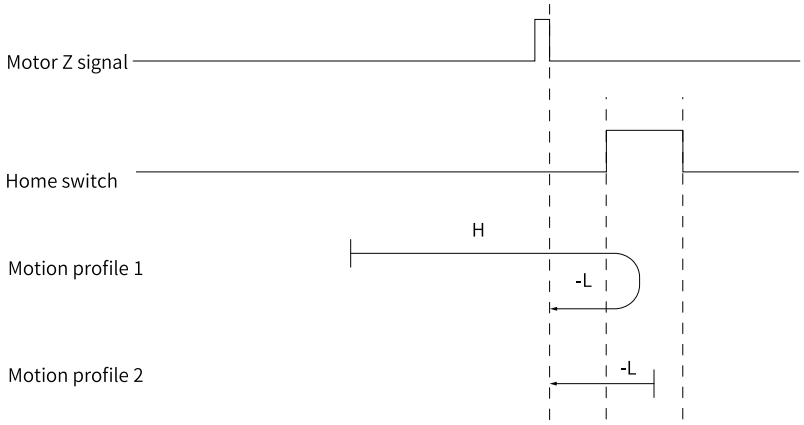


Figure 11-20 Motor operation curve and speed in mode 3

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

6098h = 4

Home: Z signal

Deceleration point: home switch (HW)

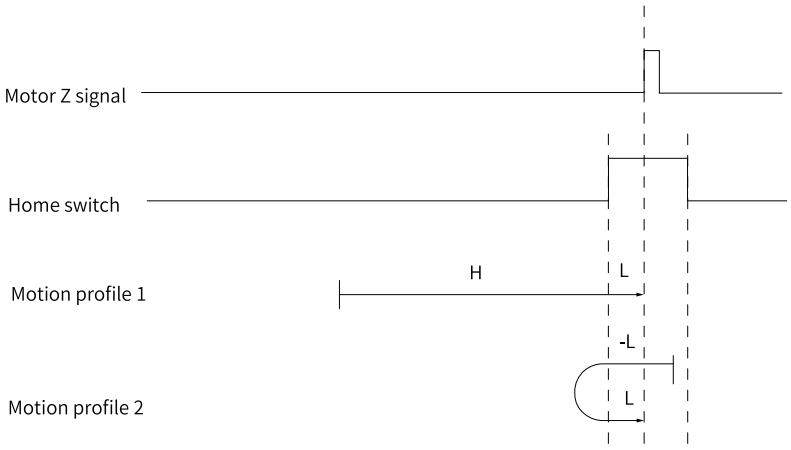


Figure 11-21 Motor running curve and speed in mode 4

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

6098h = 5

Home: Z signal

Deceleration point: home switch (HW)

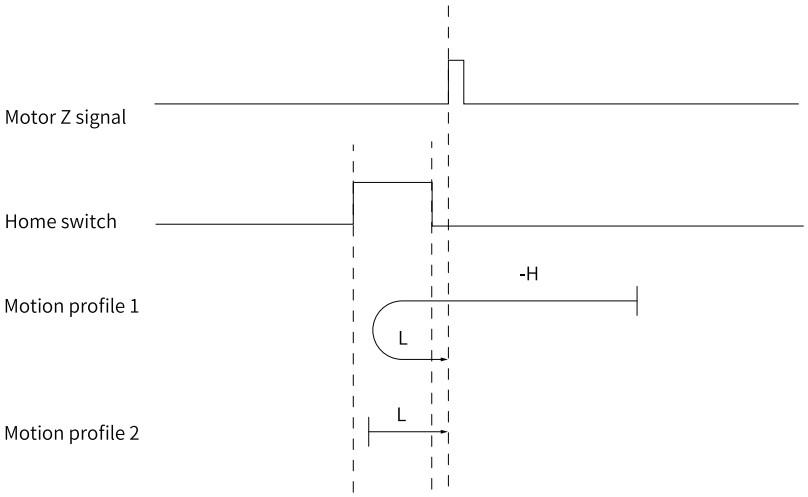


Figure 11-22 Motor running curve and speed in mode 5

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

6098h = 6

Home: Z signal

Deceleration point: home switch (HW)

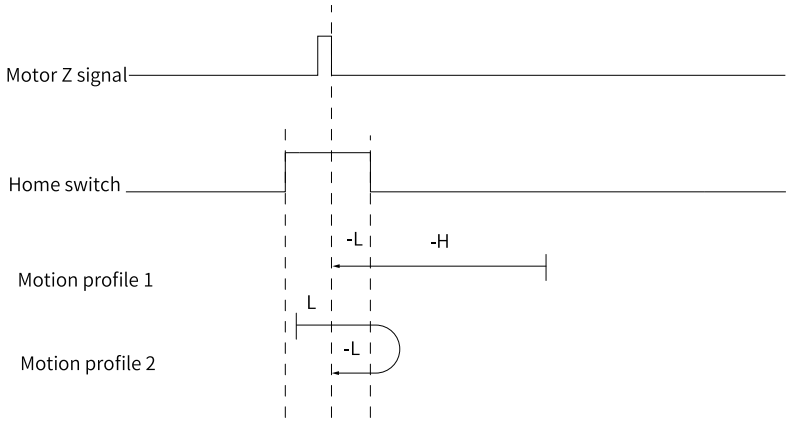


Figure 11-23 Motor running curve and speed in mode 6

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

6098h = 7

Home: Z signal

Deceleration point: home switch (HW)

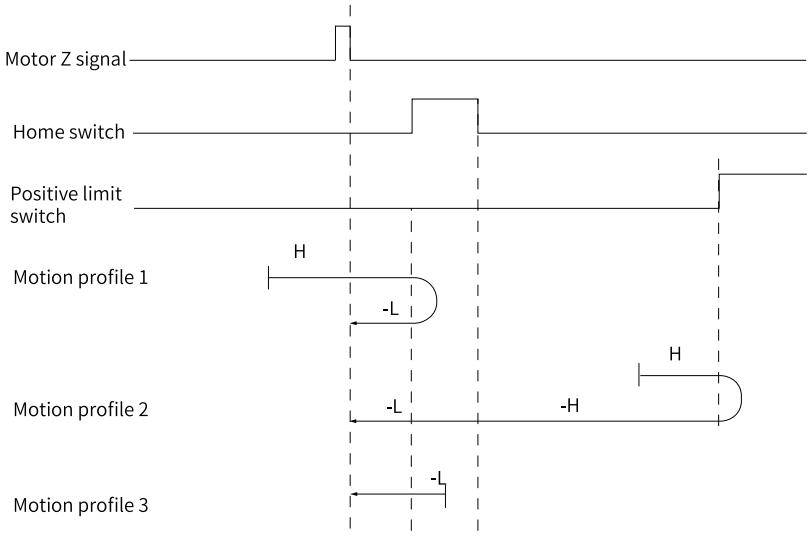


Figure 11-24 Motor operation curve and speed in mode 7

- 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 start.

6098h = 8

Home: Z signal

Deceleration point: home switch (HW)

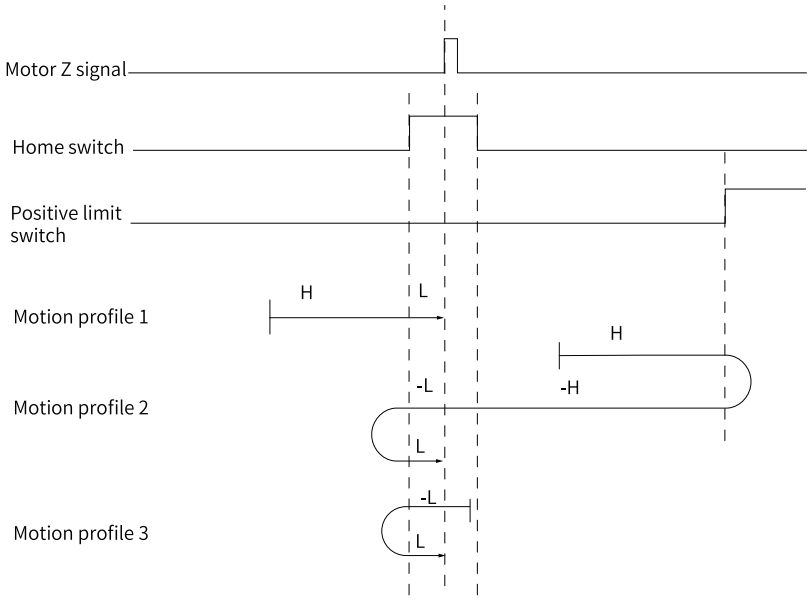


Figure 11-25 Motor running curve and speed in mode 8

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

6098h = 9

Home: Z signal

Deceleration point: home switch (HW)

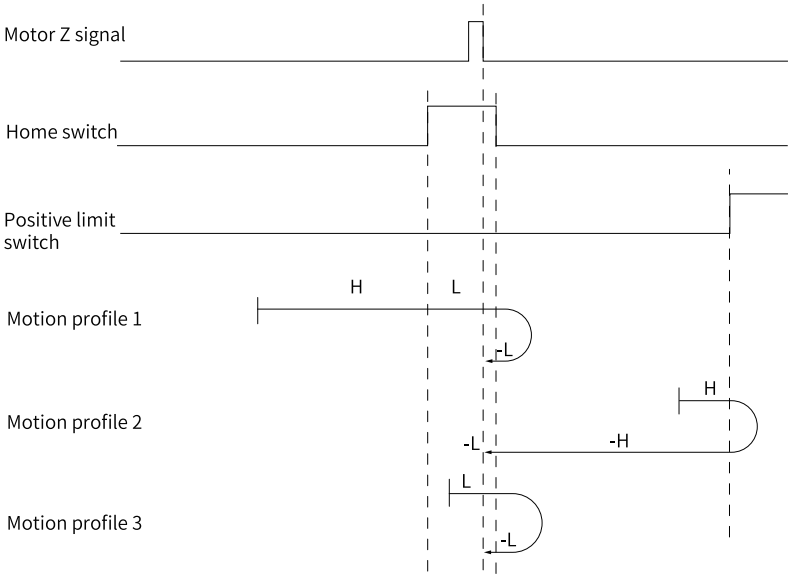


Figure 11-26 Motor running curve and speed in mode 9

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

- Motion profile 3: Deceleration point signal active at start.

6098h = 10

Home: Z signal

Deceleration point: home switch (HW)

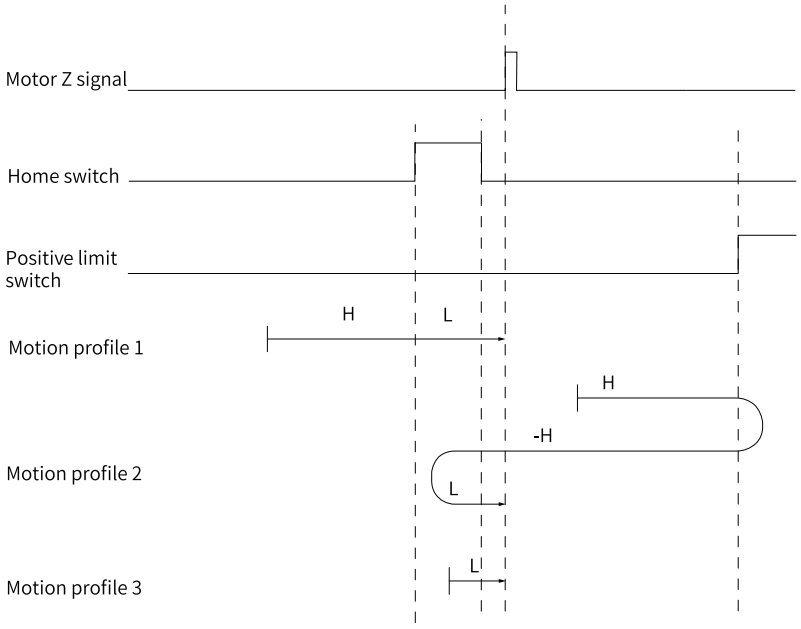


Figure 11-27 Motor running curve and speed in mode 10

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

6098h = 11

Home: Z signal

Deceleration point: home switch (HW)

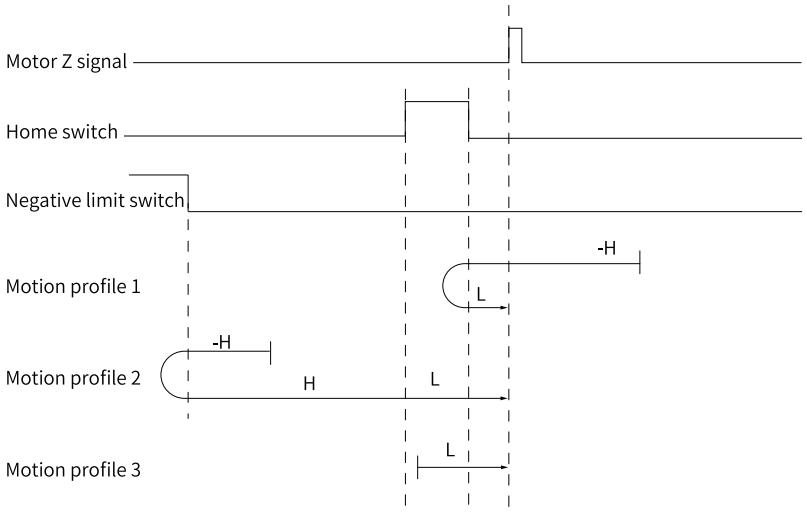


Figure 11-28 Motor running curve and speed in mode 11

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

6098h = 12

Home: Z signal

Deceleration point: home switch (HW)

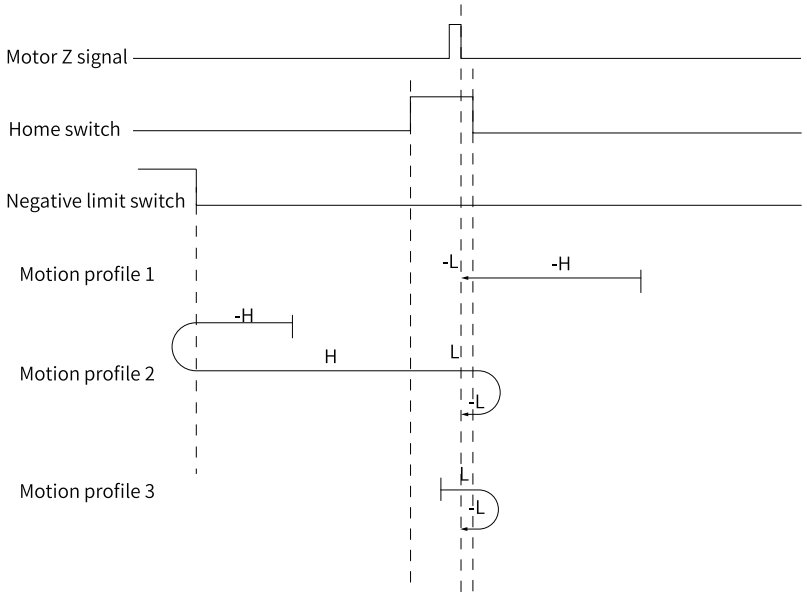


Figure 11-29 Motor running curve and speeds in mode 12

- 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 start.

6098h = 13

Home: Z signal

Deceleration point: home switch (HW)

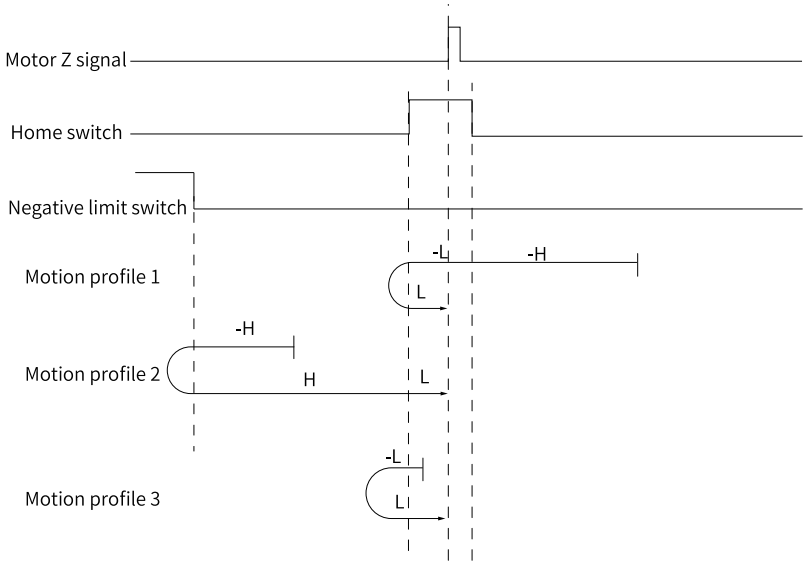


Figure 11-30 Motor running curve and speed in mode 13

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

6098h = 14

Home: Z signal

Deceleration point: home switch (HW)

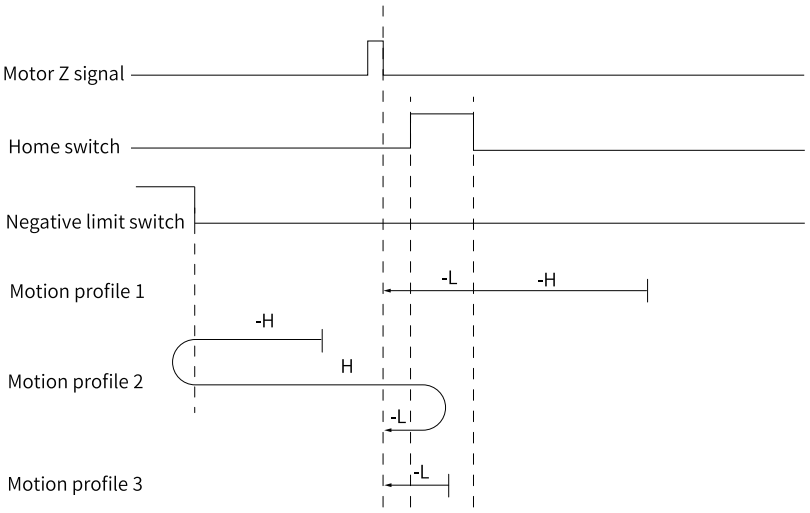


Figure 11-31 Motor running curve and speed in mode 14

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

6098h = 17

Home: negative limit switch

Deceleration point: negative limit switch

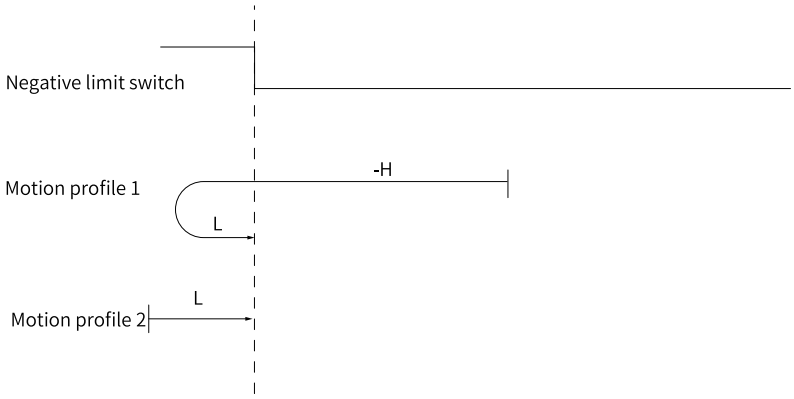


Figure 11-32 Motor running curve and speed in mode 17

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

6098h = 18

Home: positive limit switch

Deceleration point: positive limit switch

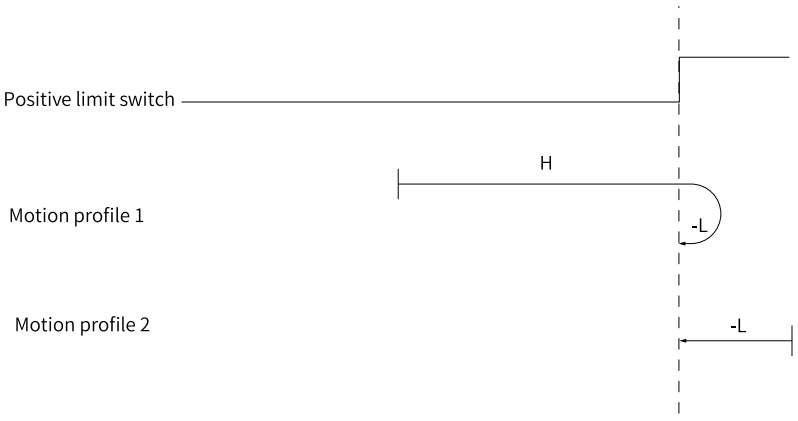


Figure 11-33 Motor running curve and speed in mode 18

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

6098h = 19

Home: home switch (HW)

Deceleration point: home switch (HW)

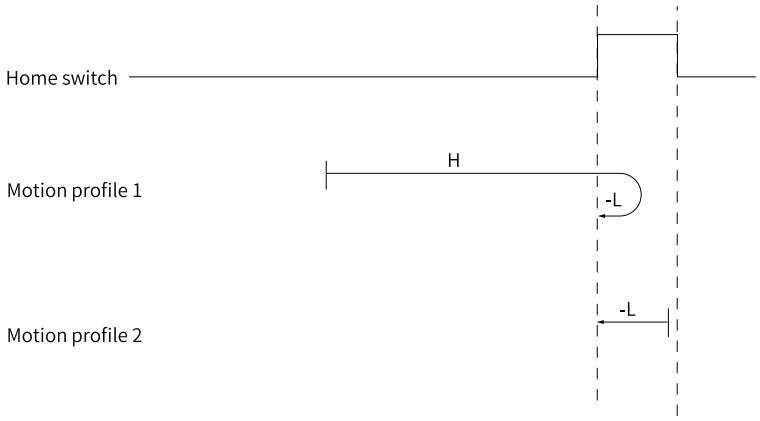


Figure 11-34 Motor running curve and speed in mode 19

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

6098h = 20

Home: home switch (HW)

Deceleration point: home switch (HW)

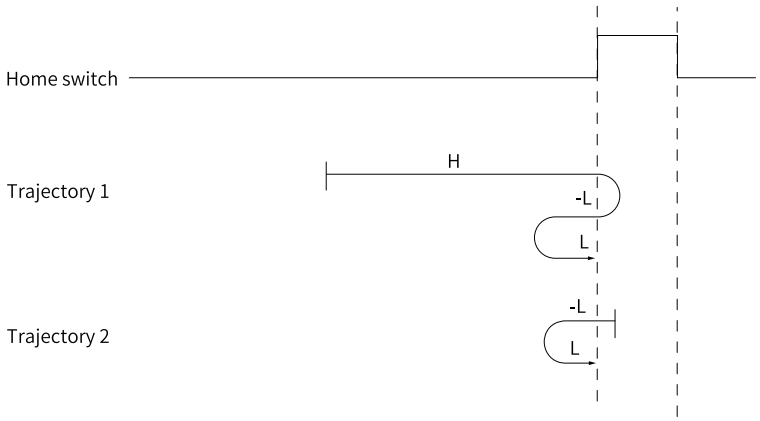


Figure 11-35 Motor running curve and speed in mode 20

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

6098h = 21

Home: home switch (HW)

Deceleration point: home switch (HW)

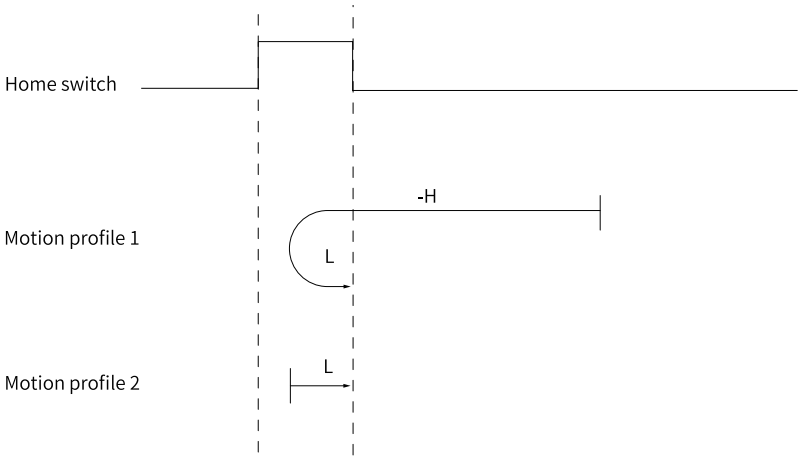


Figure 11-36 Motor running curve and speed in mode 21

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

6098h = 22

Home: home switch (HW)

Deceleration point: home switch (HW)

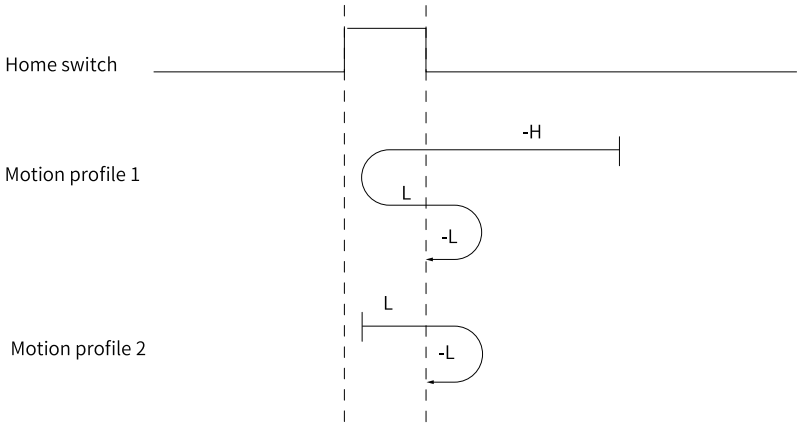


Figure 11-37 Motor running curve and speed in mode 22

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

6098h = 23

Home: home switch (HW)

Deceleration point: home switch (HW)

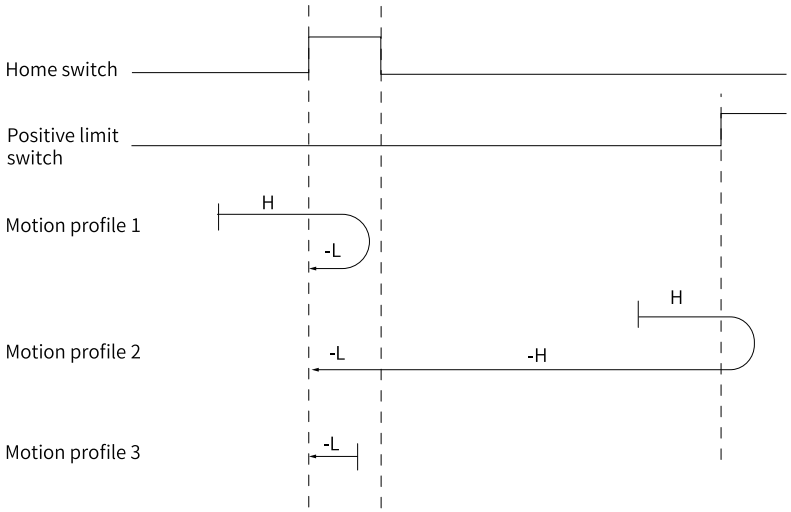


Figure 11-38 Motor running curve and speed in mode 23

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

6098h = 24

Home: home switch (HW)

Deceleration point: home switch (HW)

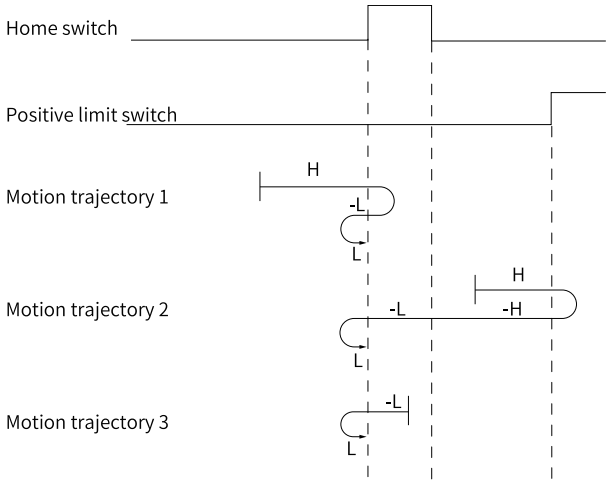


Figure 11-39 Motor running curve and speed in mode 24

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

6098h = 25

Home: home switch (HW)

Deceleration point: home switch (HW)

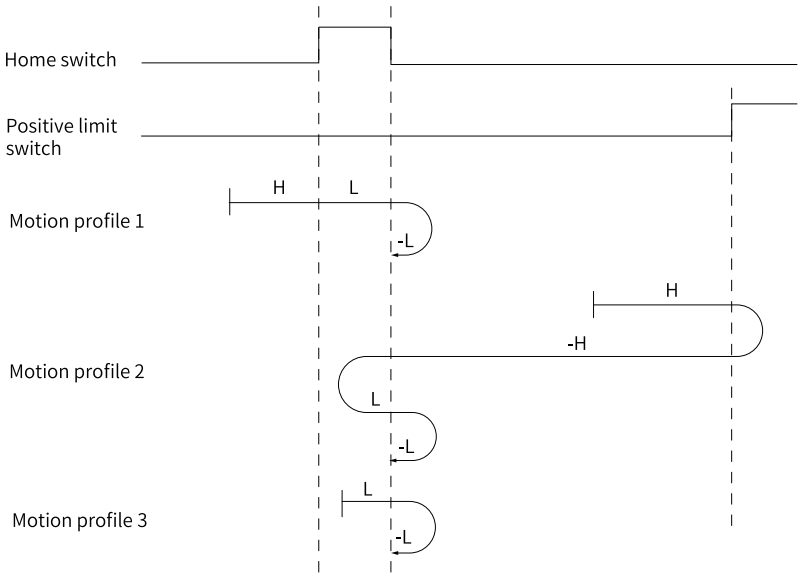


Figure 11-40 Motor running curve and speed in mode 25

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

6098h = 26

Home: home switch (HW)

Deceleration point: home switch (HW)

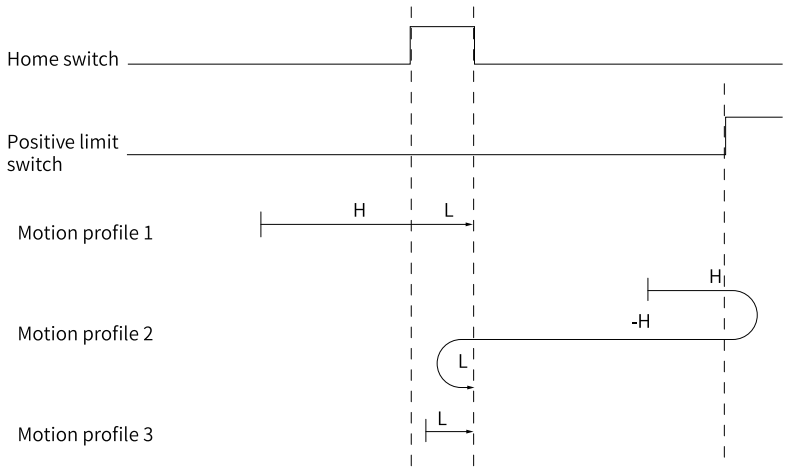


Figure 11-41 Motor running curve and speed in mode 26

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

6098h = 27

Home: home switch (HW)

Deceleration point: home switch (HW)

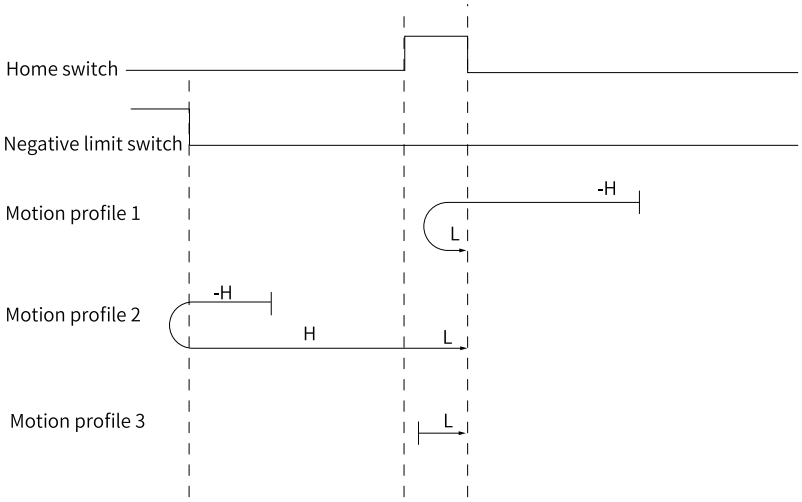


Figure 11-42 Motor running curve and speed in mode 27

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

6098h = 28

Home: home switch (HW)

Deceleration point: home switch (HW)

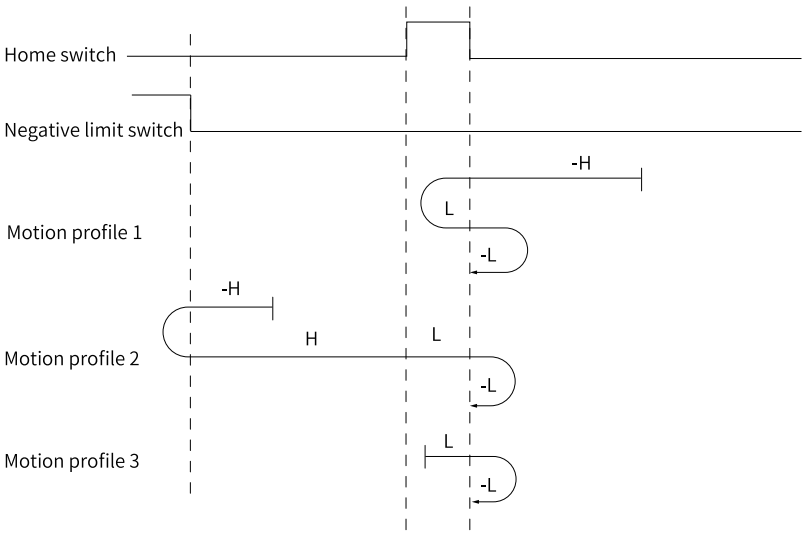


Figure 11-43 Motor running curve and speed in mode 28

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

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

6098h = 29

Home: home switch (HW)

Deceleration point: home switch (HW)

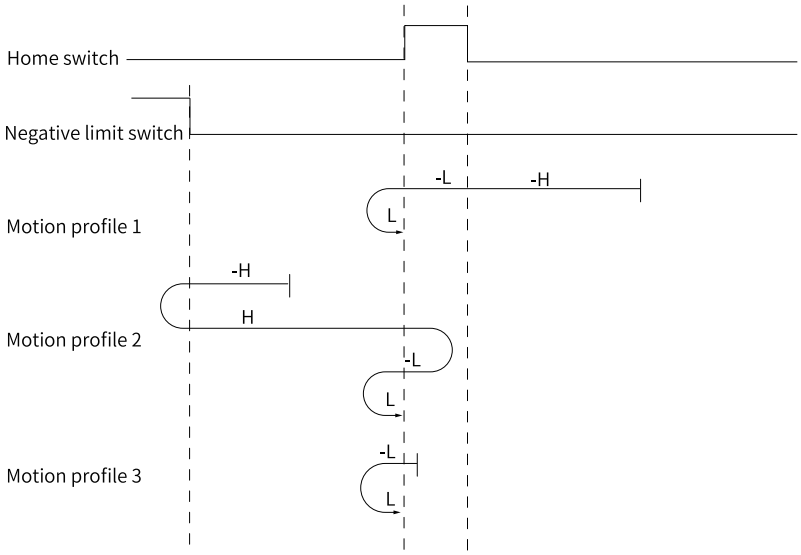


Figure 11-44 Motor running curve and speed in mode 29

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

6098h = 30

Home: home switch (HW)

Deceleration point: home switch (HW)

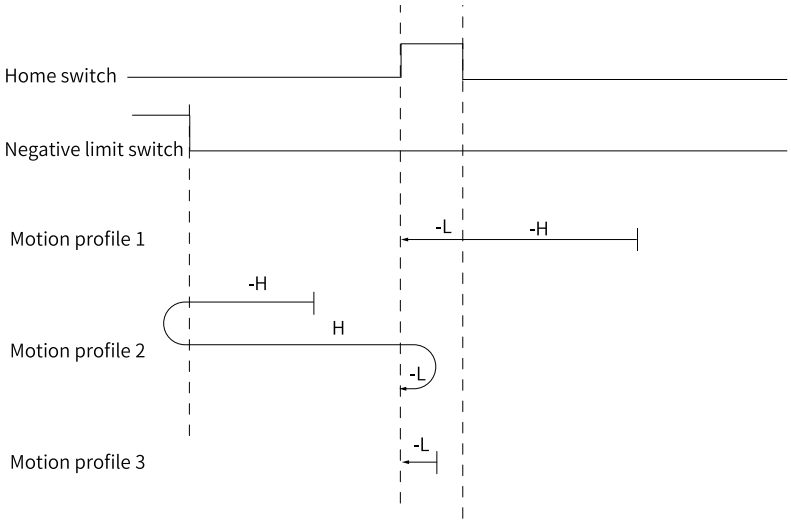


Figure 11-45 Motor running curve and speed in mode 30

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

6098h = 31/32

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

6098h = 33/34

Home: Z signal

Deceleration point: none

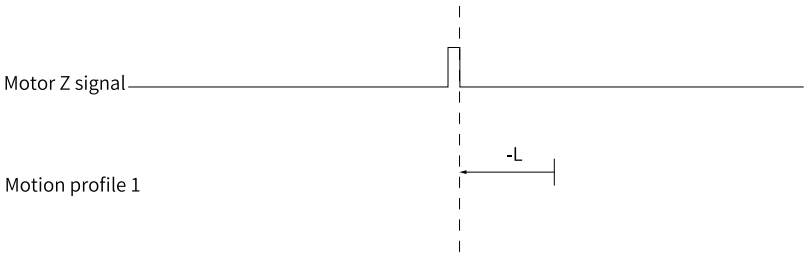


Figure 11-46 Motor running curve and speed in mode 33

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

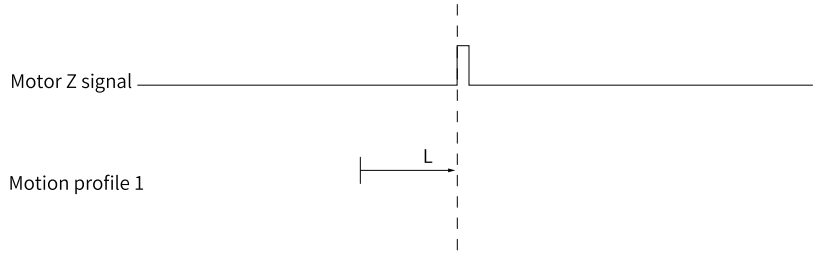


Figure 11-47 Motor running curve and speed in mode 34

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

6098h = 35

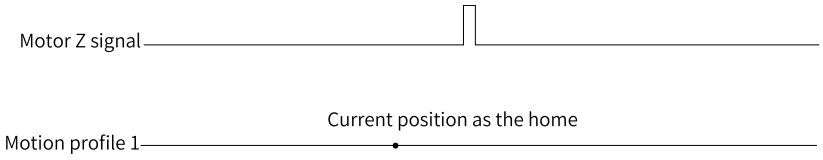


Figure 11-48 Motor running curve and speed in mode 35

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

6098h = -1

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

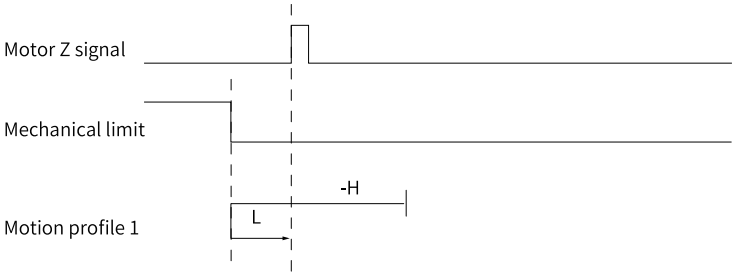


Figure 11-49 Motor running curve and speed in mode –1

6098h = -2

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

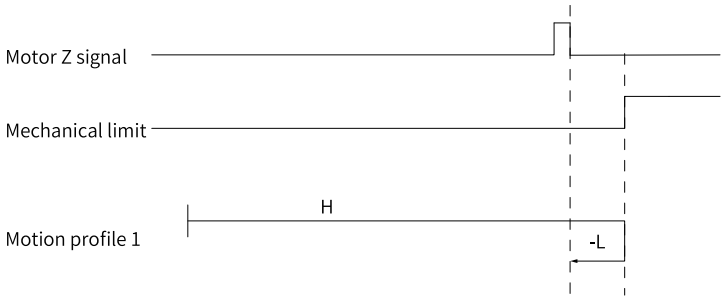


Figure 11-50 Motor running curve and speed in mode –2

6098h=-3

Home: motor Z signal

Deceleration point: none

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

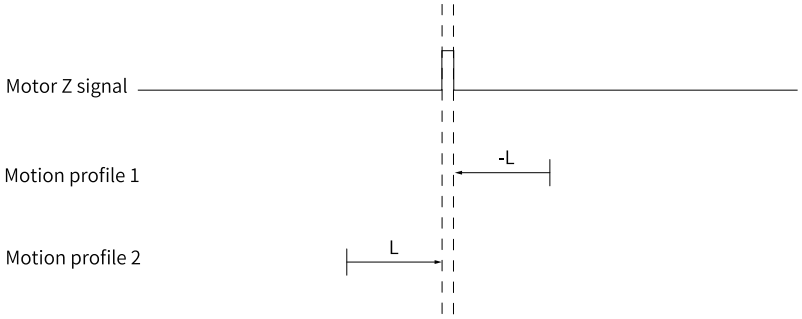


Figure 11-51 Motor running curve and speed in mode -3

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

11.9 Position Control Mode

★Terms:

- Reference unit: the minimum identifiable value input from the host controller to the drive.
- The encoder unit means the value obtained after the input reference is processed by electronic gear ratio.

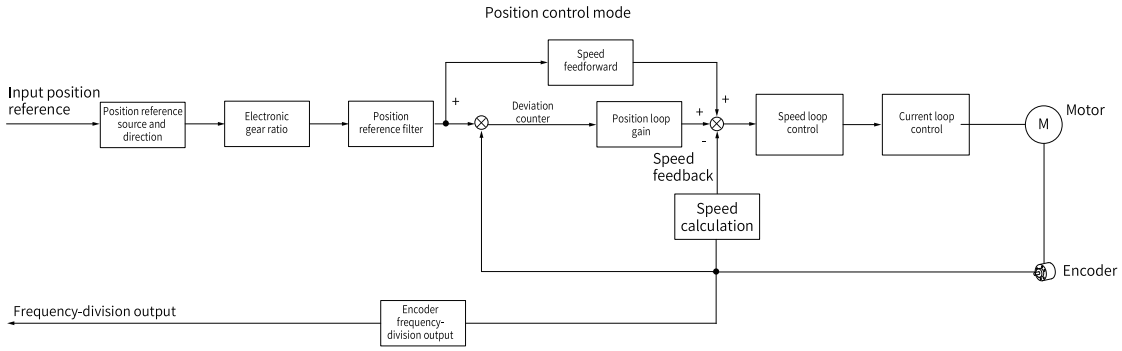


Figure 11-52 Block diagram of the position control mode

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

The following part uses the basic parameter setting to describe the position control mode.

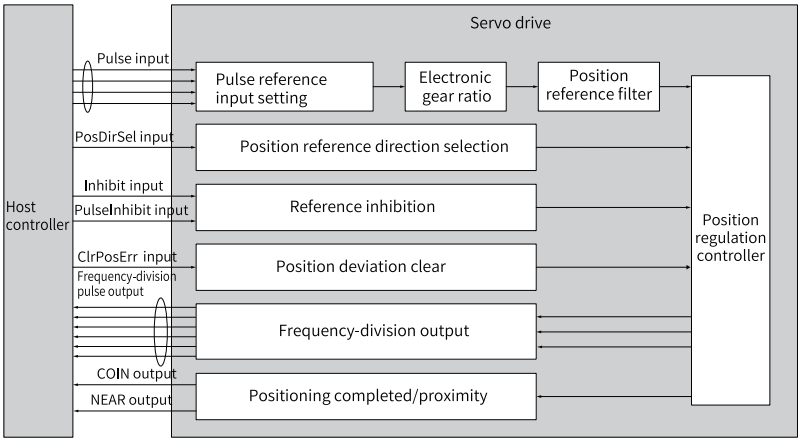


Figure 11-53 Signal exchange between the servo drive and the host controller

11.9.1 Function block diagram

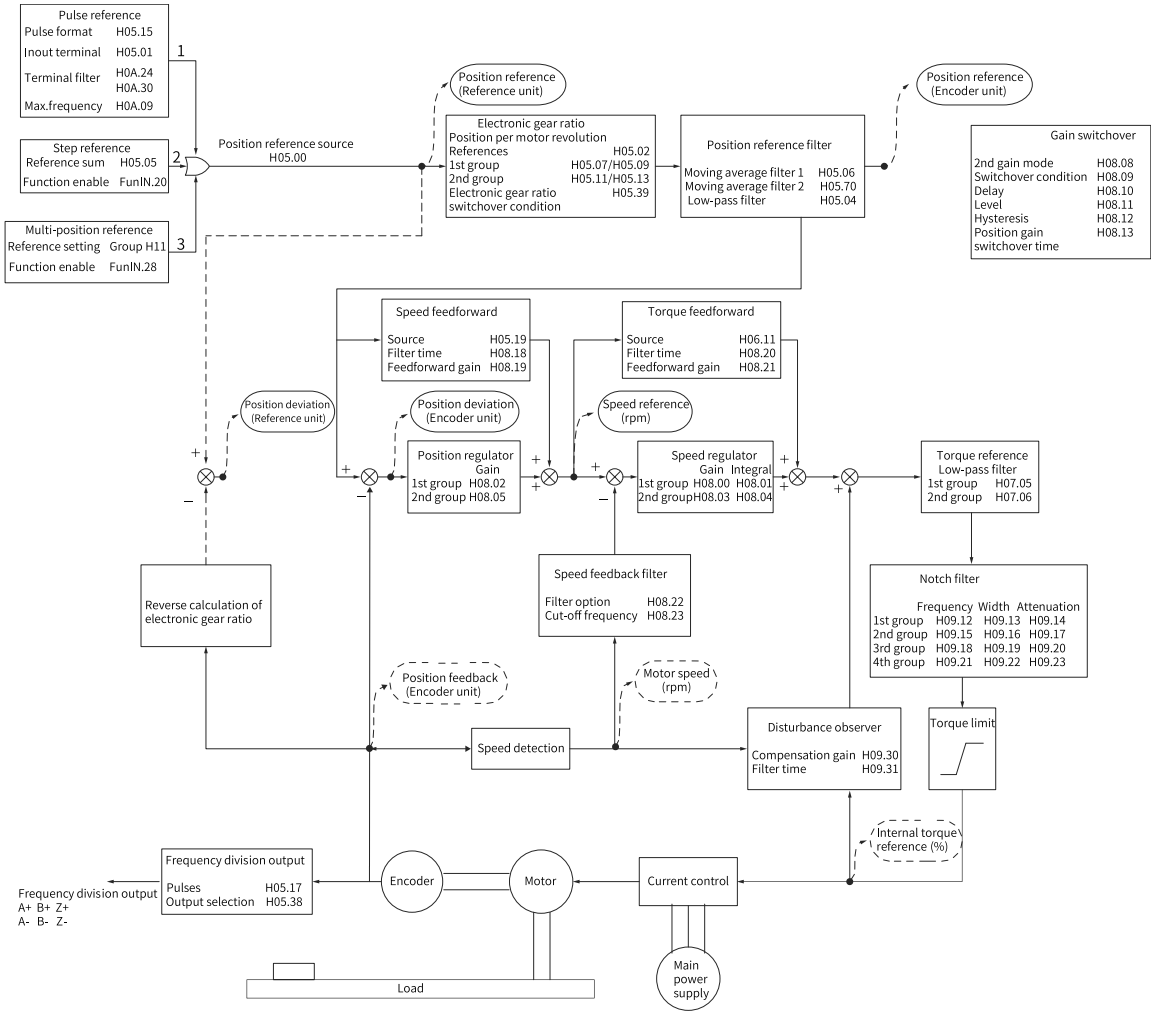


Figure 11-54 Block diagram of position control

11.9.2 Position reference input

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

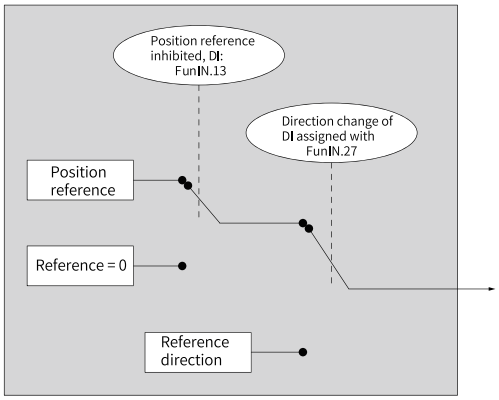


Figure 11-55 Block diagram of position reference input setting

Position reference source

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

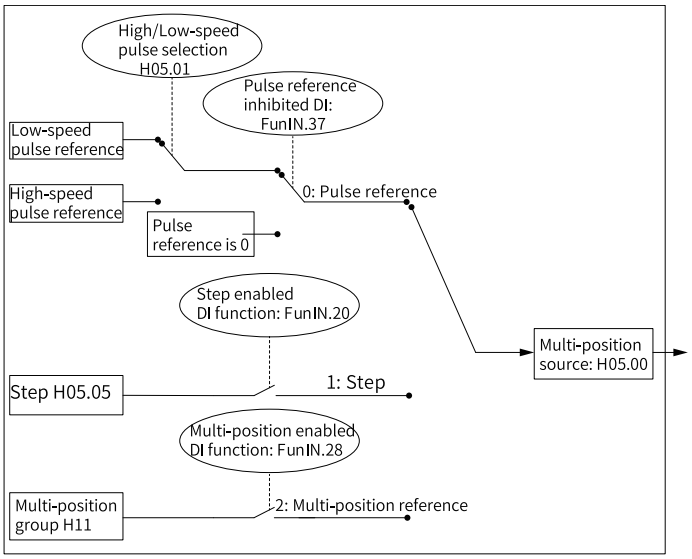


Figure 11-56 Setting of the position reference source

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.00	2005-01h	Main position reference source	0: Pulse reference 1: Step amount 2: Multi-position reference	0	-	Real time	"H05_en.00" on page 773

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

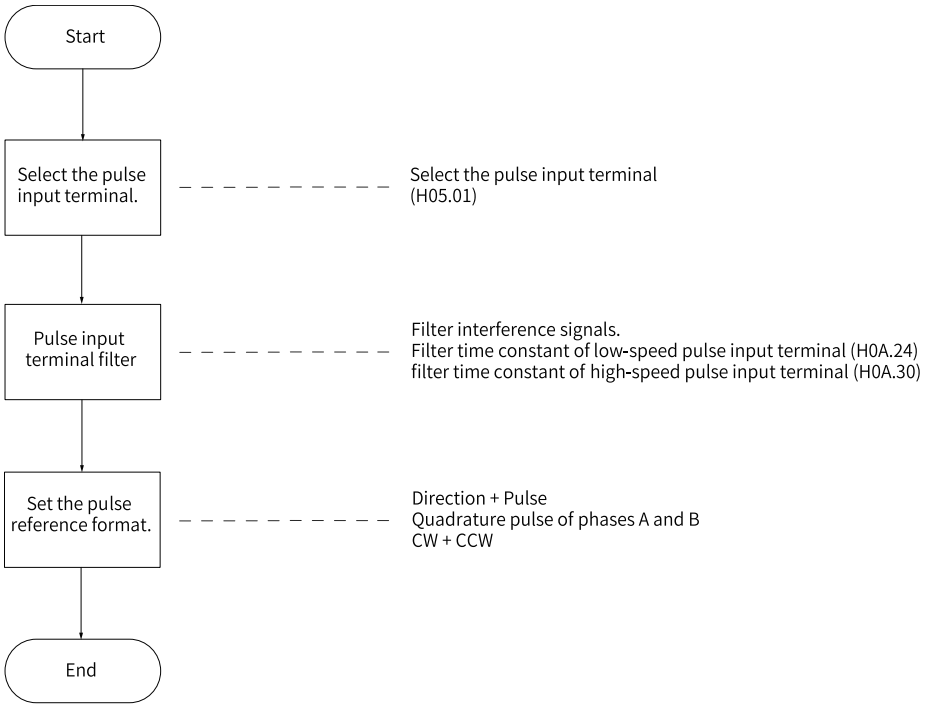
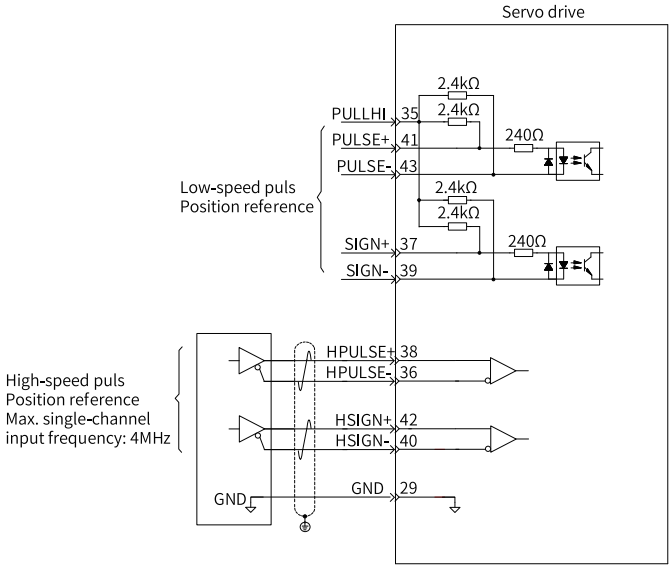


Figure 11-57 Flowchart of setting pulse reference as the source

- Pulse input terminal

  The servo drive provides two pulse input terminals.



The low-speed pulse input terminals (PULSE+, PULSE-, SIGN+, SIGN-) receive open-collector input (maximum single input frequency is 200 kpps).

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

Note

Low-speed pulses and high-speed pulses are not allowed to be connected simultaneously.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.01	2005-02h	Position pulse reference input terminal selection	0: Low speed 1: High speed	0	-	At stop	"H05_en.01" on page 773

For details on the circuit, see "6.4.4.4 Position Reference Input Signals" on page 114.

Table 11–5 Pulse input specifications

Pulse type		Maximum input frequency	Voltage	Forward current
High-speed pulse	Differential signal	4 Mpps	5 V	< 15 mA
Low-speed pulse	Differential signal	200 kpps	5 V	< 15 mA
	Open-collector signal	200 kpps	24 V	< 15 mA

- Pulse input terminal filter

  Set the filter time to filter the pulses from the low-speed/high-speed pulse input terminals to prevent motor malfunction due to interference on the servo drive.

  ☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0A.24	200 A-19h	Filter time constant of low-speed pulse input terminal	0 to 255	30	25 ns	At stop	"H0A_en.24" on page 857
H0A.30	200 A-1Fh	Filter time constant of high-speed pulse input terminal	0 to 255	2	ns	At stop	"H0A_en.30" on page 858

If the filter time constant is t_F, and the minimum width of input signals is t_{min}, the input signal and filtered signal are as shown in the following figure. The filtered signal has a t_F delay over the input signal.

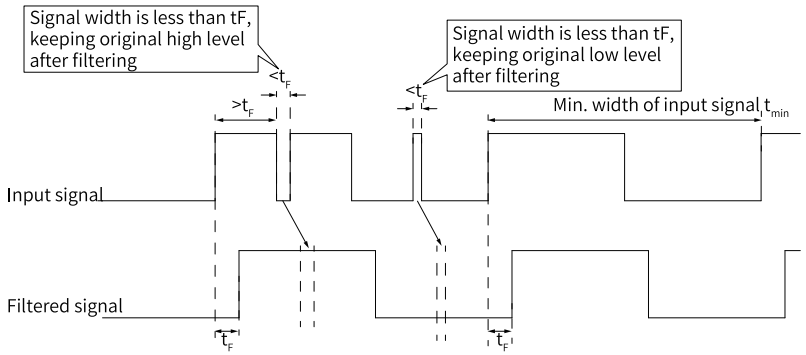


Figure 11-58 Sample signal filtering waveform

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

The recommended filter parameter setting based on the maximum frequency (minimum width) of input pulses is described in the following table.

Table 11–6 Recommended filter parameter settings

Pulse input terminal	Parameter	Maximum frequency of input pulses	Recommended filter time constant (25 ns)
Low-speed pulse input terminal	H0A.24	< 167 kpps	30
		167 kpps to 200 kpps	20
High-speed pulse input	H0A.30	200 kpps to 1 Mpps	5
		> 1 Mpps	3

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

- Pulse input format

  The servo drive supports three pulse input formats:

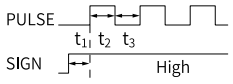
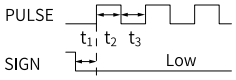
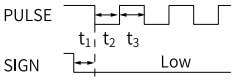
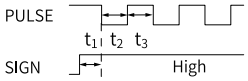
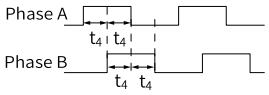
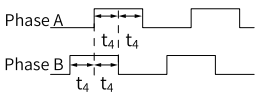
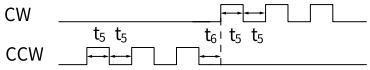
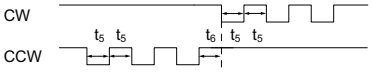
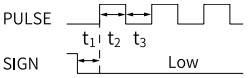
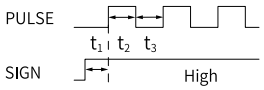
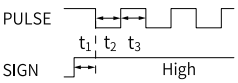
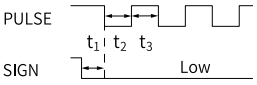
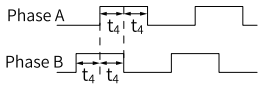
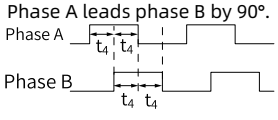
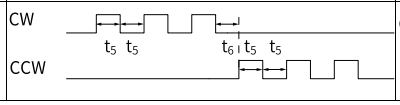
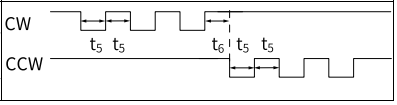
  - Direction + Pulse (positive or negative logic)
  - 2: Phase A + phase B quadrature pulse, 4-frequency multiplication
  - CW + CCW

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

  ☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.15	2005-10h	Pulse input format	0: Direction + Pulse, positive logic 1: Direction + Pulse, negative logic 2: Phase A + phase B quadrature pulse, quadrupled frequency 3: CW + CCW	0	-	At stop	"H05_en.15" on page 776

Table 11–7 Pulse forms

H02.02	H05.15	Pulse form	Signal	Diagram of forward pulses	Diagram of reverse pulses
0	0	Pulse + Direction Positive logic	PULSE SIGN		
	1	Pulse + Direction Negative logic	PULSE SIGN		
	2	Phase A + phase B quadrature pulse 4-frequency multiplication	PULSE (phase A) SIGN (phase B)	Phase A leads phase B by 90°. 	Phase B leads phase A by 90°. 
	3	CW + CCW	PULSE (CW) SIGN (CCW)		
1	0	Pulse + Direction Positive logic	PULSE SIGN		
	1	Pulse + Direction Negative logic	PULSE SIGN		
	2	Phase A + phase B quadrature pulse 4-frequency multiplication	PULSE (phase A) SIGN (phase B)	Phase B leads phase A by 90°. 	Phase A leads phase B by 90°. 
	3	CW + CCW	PULSE (CW) SIGN (CCW)		

The following table describes the maximum frequencies and widths of position pulses from different terminals.

Table 11–8 Pulse reference specifications

Input terminal	Single-channel max. input frequency (pps)	Min. time width (μs)	
High-speed pulse input	4 Mpps	t1	0.125
		t2	0.125
		t3	0.125
		t4	0.0625
		t5	0.125
		t6	0.125
Low-speed pulse input terminal	200 kpps	t1	2.5
		t2	2.5
		t3	2.5
		t4	1.25
		t5	2.5
		t6	2.5

The rising time and falling time of position pulses must be smaller than 0.1 μs.

- Pulse frequency
  Set the maximum position pulse frequency in H0A.09.
- EB01.0 (Pulse input error) occurs when the actual input pulse frequency exceeds H0A.09.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0A.09	200 A-0Ah	Max. pulse input frequency in position control	100 to 16000	16000	kHz	At stop	"H0A_en.09" on page 853

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

Caution

When the servo drive is in running state (Servo ON signal active), the motor is in locked state if the step reference function is valid and rotates if this function is invalid. After the H05.05 reference is executed, the function becomes invalid, and the motor enters the locked state.

The drive supports step operation, which means the drive can operate at a fixed speed until the set displacement is reached. The setting flowchart is shown in the following figure.

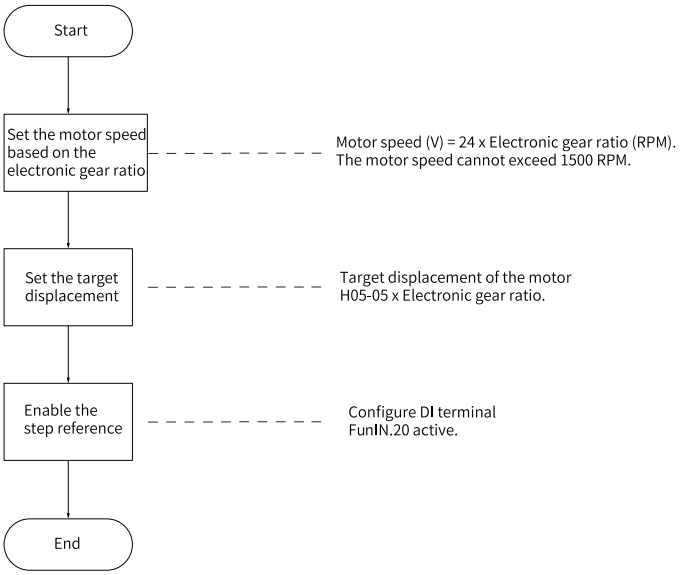


Figure 11-59 Flowchart of setting step reference as the source

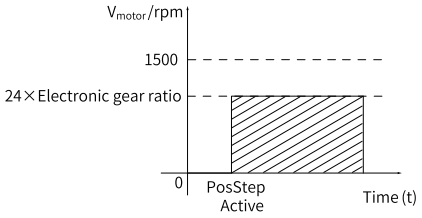


Figure 11-60 Motor operating curve (H05.00 = 1)

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

- Relationship between the motor speed and electronic gear ratio
  When the position reference source is step setting, the motor speed is set based on the electronic gear ratio. The motor speed in this case must not exceed 1500 RPM.

  V_{motor}=24 x Electronic gear ratio (I

- Motor displacement
  When the step reference is used as the position reference source, the sum of position references (reference unit) is set in H05.05. The sign of the setpoint of H05.05 determines the motor direction of rotation.

  ☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.05	2005-06h	Step size	-9999 to +9999	50	Reference unit	At stop	"H05_en.05" on page 774

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

  ☆ Related parameters:

No.	Name	Function	Description
FunIN.20	PosStep	Step reference	Servo running state: Active: The position reference defined by H05.05 is input to the servo drive, driving the motor to run. Inactive: Servo motor is in the locked state.

FunIN.20 (Step reference) is edge-triggered. After executing the step position reference, the servo motor enters the locked state. After FunIN.20 becomes active again, the servo motor executes the position reference set in H05.05.

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

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

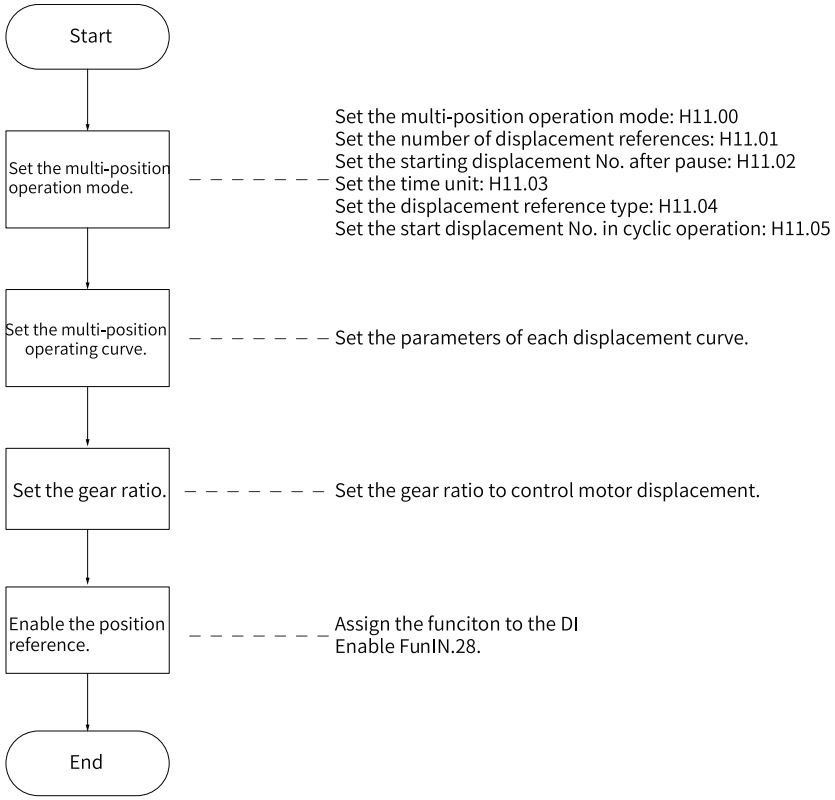


Figure 11-61 Flowchart of setting multi-position reference as the source

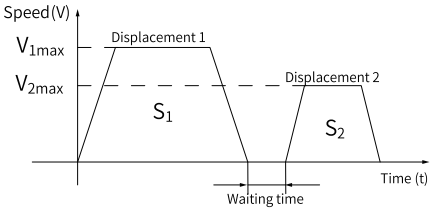
  - Multi-position running mode

    ☆ 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 915
H11.01	2011-02h	Number of position references in multi-position mode	1 to 16	1	-	At stop	"H11_en.01" on page 918
H11.02	2011-03h	Starting position number after pause	0: Continue to execute the remaining positions 1: Start from position 1	0	-	At stop	"H11_en.02" on page 918
H11.03	2011-04h	Waiting time unit	0: ms 1: s	0	-	At stop	"H11_en.03" on page 919
H11.04	2011-05h	Displacement reference type	0: Relative displacement reference 1: Absolute displacement reference	0	-	Real time	"H11_en.04" on page 919
H11.05	2011-06h	Starting position number in sequential operation	0 to 16	0	-	At stop	"H11_en.05" on page 919

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

Table 11–9 Description of individual operation

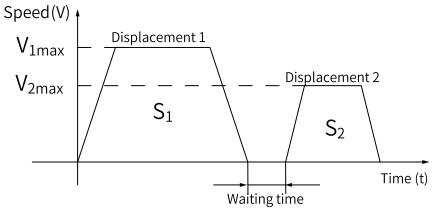
Mode description	Operating curve
• The drive stops after one cycle of operation. • The drive switches to the next position automatically. • The time interval between positions can be set as needed. • The PoslnSen (multi-position reference enable) signal is level-triggered.	 V_{1max} , V_{2max} : maximum values of the 1st and 2nd speeds S_1 , S_2 : displacements of 1st and 2nd positions • The positioning completed signal is active after each displacement is reached. • If the PoslnSen signal is switched off during running, the servo drive discards the uncompleted displacement and stops. After the stop process is completed, the positioning completion signal is active. • After the PoslnSen signal is enabled again, the drive executes the displacement defined by H11.02. • If the S-ON signal is switched off during operation, the motor stops as defined by H02.05 (Stop mode at S-ON OFF). The COIN (positioning completed) signal is deactivated after the motor stops. • When a certain displacement is in progress, the logic change of the DI assigned with FunIN.27 (PosDirSel) does not affect the operating direction in this displacement.

★Terms:

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

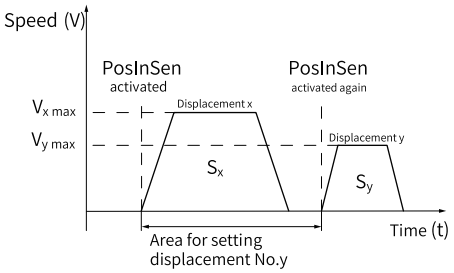
2. **Cyclic operation (H11.00 = 1)**

Table 11–10 Description of cyclic operation

Mode description	Operating curve
• The drive starts from position 1 again after each cycle of operation. • The drive switches to the next position automatically. • The time interval between positions can be set as needed. • The cyclic operation mode remains active when the FunIN.28 (Multi-position reference enable) is active. • The PoslnSen (multi-position reference enable) signal is level-triggered.	 V_{1max} , V_{2max} : maximum values of the 1st and 2nd speeds S_1 , S_2 : displacements of 1st and 2nd positions • The positioning completed signal is active after each displacement is reached. • If the PosInsen signal is switched off during operation, the drive discards the unfinished displacement and stops. The COIN (positioning completed) signal is activated after the drive stops. • After the PoslnSen signal is enabled again, the drive executes the displacement defined by H11.02. • If the S-ON signal is switched off during operation, the motor stops as defined by H02.05 (Stop mode at S-ON OFF). The COIN (positioning completed) signal is deactivated after the motor stops. • When a certain displacement is in progress, the logic change of the DI assigned with FunIN.27 (PosDirSel) does not affect the operating direction in this displacement.

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

Table 11–11 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. • When a certain displacement is in progress, the logic change of the DI assigned with FunIN.27 (PosDirSel) does not affect the operating direction in this displacement.

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

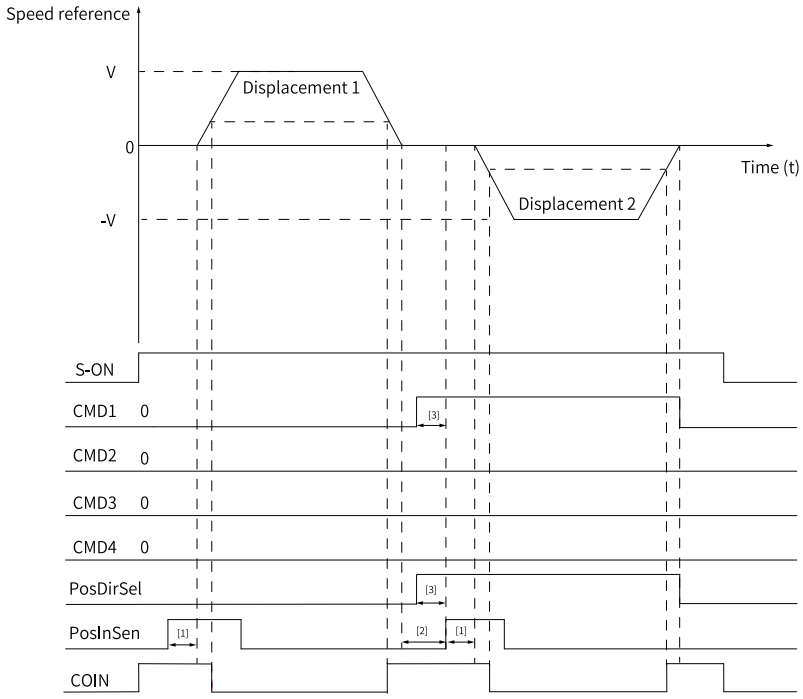


Figure 11-62 Multi-position time sequence

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:

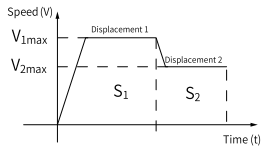
No.	Name	Function	Description
FunIN.6	CMD1	Multi-reference switchover 1	The position No. is a 4-bit binary. The relationship between the position No. and CMD1 to CMD4 is shown in *"Table 11-12" on page 397*. The DI terminal logic is level-triggered. The signal is 1 when the input level is active, and 0 when the input level is inactive.
FunIN.7	CMD2	Multi-reference switchover 2	
FunIN.8	CMD3	Multi-reference switchover 3	
FunIN.9	CMD4	Multi-reference switchover 4	

Table 11–12 Relationship between the position No. and CMD1 to CMD4

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

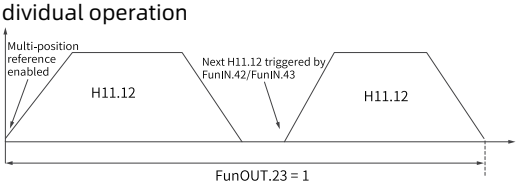
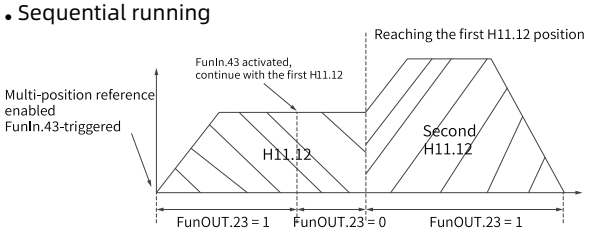
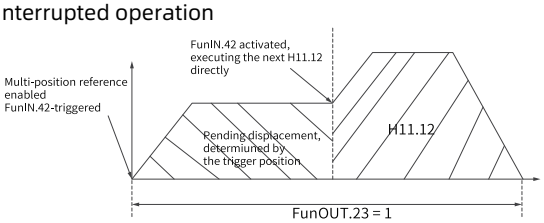
4. **Sequential operation (H11.00 = 3)**

Table 11–13 Description of sequential operation

Mode description	Operating curve
• The drive stops after one cycle of operation. • (H11.05 = 0 or H11.05 > H11.01). • The starting position after the first cycle of operation is defined by H11.05. • The drive switches to the next position automatically. • There is no waiting time between positions. • The PoslnSen (multi-position reference enable) signal is level-triggered.	 V_{1max} , V_{2max} : maximum values of the 1st and 2nd speeds S_1 , S_2 : displacements of 1st and 2nd positions • The positioning completed signal is active after each displacement is reached. • If the PosInsen signal is switched off during operation, the drive discards the unfinished displacement and stops. The COIN (positioning completed) signal is activated after the drive stops. • After the PoslnSen signal is enabled again, the drive executes the displacement defined by H11.02. • If the S-ON signal is switched off during operation, the motor stops as defined by H02.05 (Stop mode at S-ON OFF). The COIN (positioning completed) signal is deactivated after the motor stops. • When a certain displacement is in progress, the logic change of the DI assigned with FunIN.27 (PosDirSel) does not affect the operating direction in this displacement.

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

Table 11–14 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.	Name	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 920
H11.14	2011-0Fh	Maximum running speed of position 1	1 to 10000	200	[mm/s]/[rpm]	Real time	"H11_en.14" on page 920
H11.15	2011-10h	Acceleration/ Deceleration time of position 1	0 to 65535	10	ms	Real time	"H11_en.15" on page 921
H11.16	2011-11h	Waiting time after completion of position 1	0 to 10000	10	ms(s)	Real time	"H11_en.16" on page 921

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

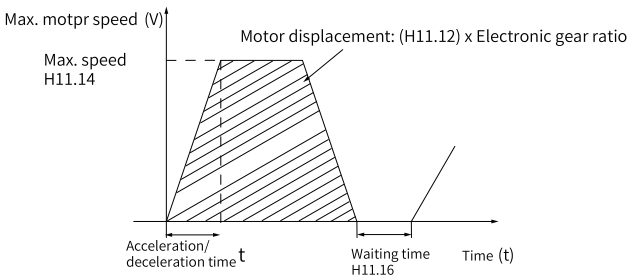


Figure 11-63 Motor running curve of 1st displacement

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

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

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

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

  ☆ Related function No.:

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

Position reference direction selection

A DI terminal is used to change the position reference direction and further the motor direction. Assign FunIN.27 (PosDirSel, position reference direction) to a DI of the drive, and set the active logic of this DI.

☆ Related parameters:

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

The actual motor direction is related to the rotating direction in H02.02, positive/negative of position reference, position reference direction (FunIN.27).

Table 11–15 Motor rotation direction

H02.02	Sign of position reference	FunIN.27	Direction of motor rotation
0	+	Inactive	Counterclockwise
0	+	Active	Clockwise
0	-	Inactive	Clockwise
0	-	Active	Counterclockwise
1	+	Inactive	Clockwise
1	+	Active	Counterclockwise
1	-	Inactive	Counterclockwise
1	-	Active	Clockwise

Position reference inhibited

The servo drive provides the position reference inhibited function (FunIN.13: Inhibit) and pulse input inhibited function (FunIN.37:PulseInhibit).

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

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

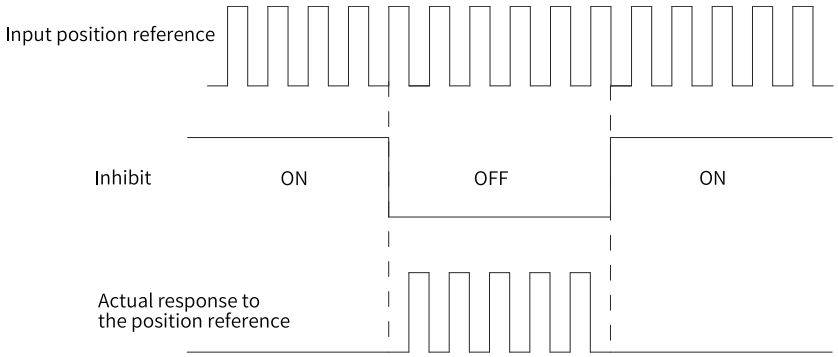


Figure 11-64 Waveform example of position reference inhibited

☆ Related function No.:

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

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

  When pulse reference inhibition is activated in position control mode, no other forms of position references are used and pulse signals are input in the pulse input terminal, the input position reference counter (H0b.13) stops counting.

  If position references in other forms are used in position control mode, the input position reference counter (H0b.13) continues counting the these position references, and these references will be executed.

  To use this function, configure a DI terminal of the servo drive with function 37 (FunIN.37: PulseInhibit, pulse input inhibited), and set the terminal logic. It is recommended to use the high-speed DI (DI7 or DI8) terminal.

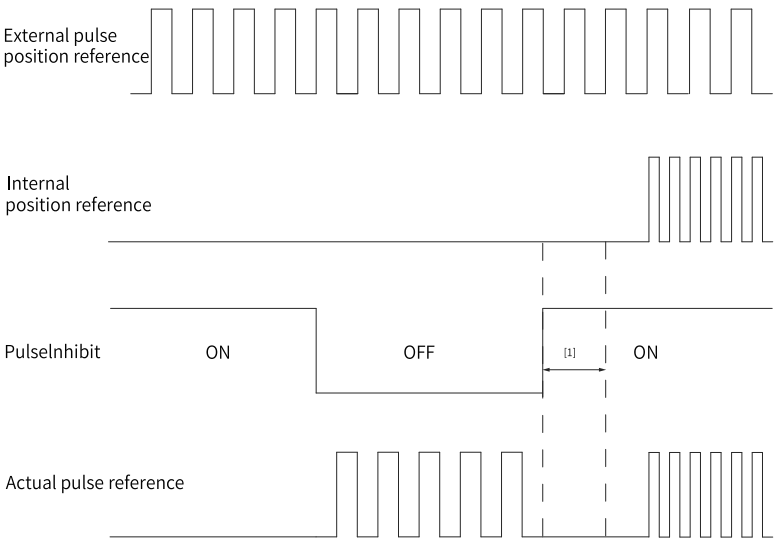


Figure 11-65 Waveform example for pulse reference inhibited

Note

[1] When a DI is used, keep an interval of at least 0.5 ms from the moment the DI logic is deactivated to the moment the internal position reference is inputted.

☆ Related function No.:

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

11.9.3 Reference Frequency Division/Multiplication (Electronic Gear Ratio)

Definition

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 it according to the following flowchart.

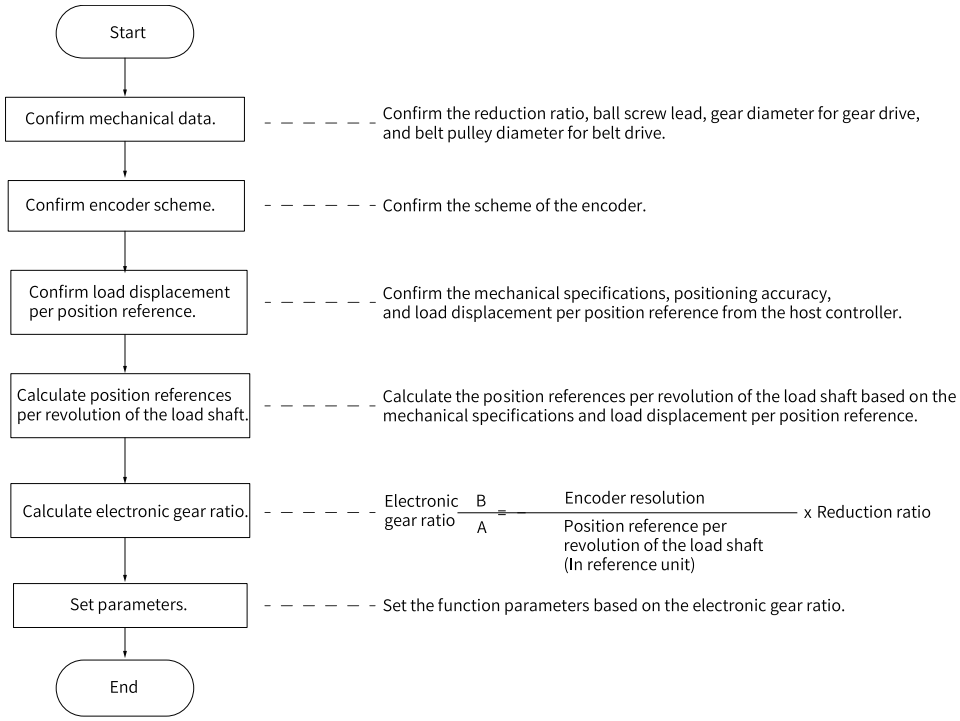


Figure 11-66 Procedure for setting the electronic gear ratio

See the following figure for how to set parameters.

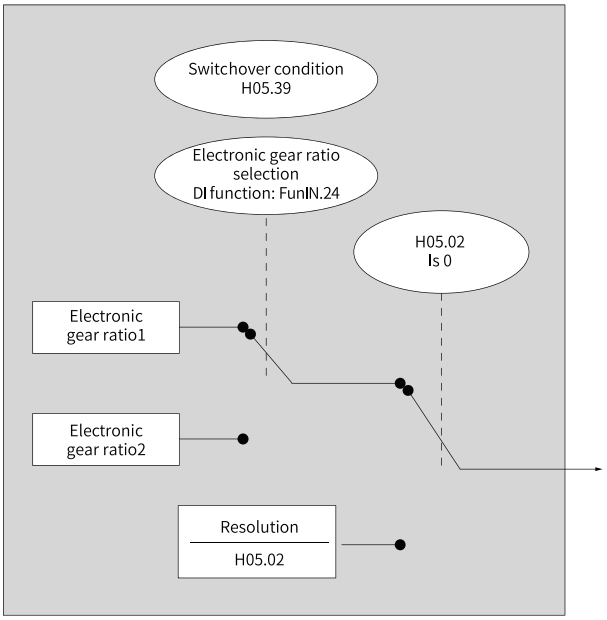


Figure 11-67 Procedure for setting the electronic gear ratio

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:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.02	2005-03h	Number of position references per motor revolution	0 to 4294967295	0	[P/N-N]/ [P/Rev]	At stop	"*H05_en.02*" on *page 773*
H05.07	2005-08h	Electronic gear ratio 1 (numerator)	1 to 1073741824	67108864	-	Real time	"*H05_en.07*" on *page 775*
H05.09	2005-0Ah	Electronic gear ratio 1 (denominator)	1 to 1073741824	10000	-	Real time	"*H05_en.09*" on *page 775*
H05.11	2005-0Ch	Electronic gear ratio 2 (numerator)	1 to 1073741824	67108864	-	Real time	"*H05_en.11*" on *page 775*
H05.13	2005-0Eh	Electronic gear ratio 2 (denominator)	1 to 1073741824	10000	-	Real time	"*H05_en.13*" on *page 776*

- Setting the electronic gear ratio switchover condition

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 a moment.
- The effective time of real-time change on the current electronic gear ratio is also restricted by the switchover conditions.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.39	2005-28h	Electronic gear ratio switchover condition	0: Switchover after position reference is kept 0 for 2.5 ms 1: Switchover in real time	0	-	At stop	"H05_en.39" on page 786

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

☆ Related parameters:

No.	Name	Function name	Function
FunIN.24	GEAR_SEL	Electronic gear ratio switchover	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 DI terminal 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	-		-

Resolution of serial encoder = 2^n(P/r), where "n" is the bits of the serial encoder.

For example, the resolution of a 26-bit serial encoder is 2^{26} (P/r), which is 67108864 (P/r).

- Calculation of electronic gear ratio

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

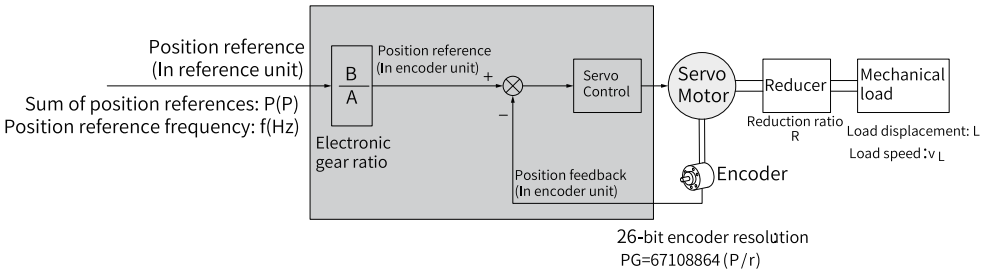


Figure 11-68 Relationship among the position reference (reference unit), load displacement, and electronic gear ratio

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

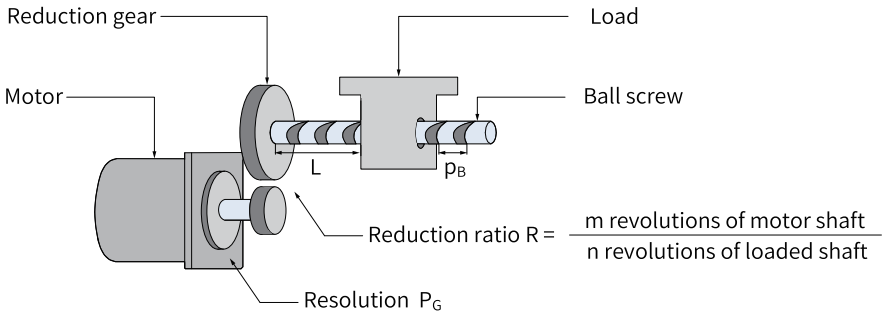


Figure 11-69 Ball screw

- Known that a pulse of the servo drive corresponds to load displacement ΔL (mm):
  When the mechanical displacement is ΔL, correspondingly the load shaft rotates $\frac{\Delta L}{p_B}$ revolutions and the motor shaft rotates $\frac{\Delta L}{p_B} \times R$ revolutions. Then:

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

  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.
  When the mechanical displacement is L, correspondingly the load shaft rotates $\frac{L}{p_B}$ revolutions and the motor shaft rotates $\frac{L}{p_B} \times R$ revolutions. Then:

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

  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:
  The load axis speed is $\frac{v_L}{p_B}$ (r/s).
  The motor speed is $v_M = \frac{v_L}{p_B} \times R$ (r/s).
  Relationship between position reference frequency, electronic gear ratio and motor speed:

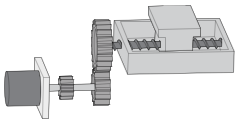
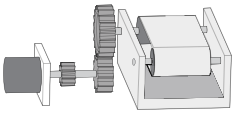
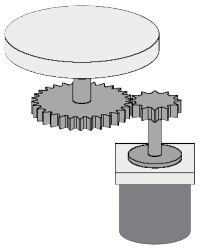
$$f \times \frac{B}{A} = v_M \times P_G$$

  Therefore, the electronic gear ratio is:

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

- Example for setting the electronic gear ratio

Table 11–16 Electronic gear ratio setting example

Item	Name	Mechanical structure		
		Transmission with ball screw	Transmission with belt pulley	Rotary load
-				
1	Mechanical parameters	Reduction ratio R: 1:1 Screw pitch: 0.01 m	Reduction ratio R: 5:1 Belt pulley diameter: 0.2 m (Circumference of belt pulley): 0.628 m	Reduction ratio (R): 10/1 Load rotation angle when the load axis rotates one revolution: 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°
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	Calculate	$\frac{B}{A} = \frac{67108864}{100} \times \frac{1}{1}$	$\frac{B}{A} = \frac{67108864}{125600} \times \frac{5}{1}$	$\frac{B}{A} = \frac{67108864}{36000} \times \frac{10}{1}$
6	Setting	H05.07=67108864 H05.09=100	H05.07=335544320 H05.09=125600	H05.07=671088640 H05.09=36000

11.9.4 Position Reference Filter

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

It is applicable to the following conditions:

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.04	2005-05h	First-order low-pass filter time constant	0.0 to 6553.5	0.0	ms	At stop	"H05_en.04" on page 773
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 774

Note

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

If the setting is excessive, the response delay may be too large. Set the filter time constant based on actual conditions.

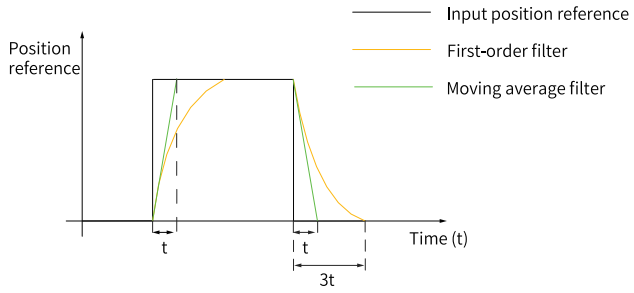


Figure 11-70 First-order filter and moving average filter of rectangular position reference

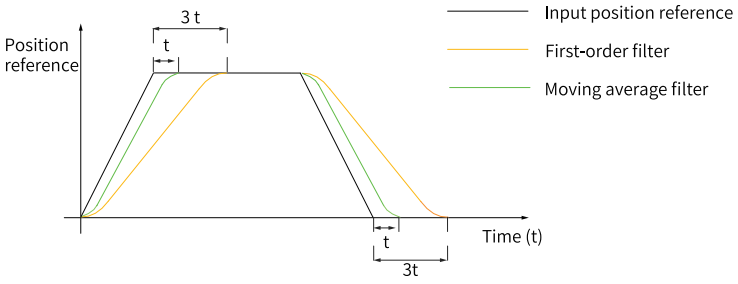


Figure 11-71 First-order filter and moving average filter of trapezoid position reference

11.9.5 Position Deviation Clearance

Position deviation = Position reference sum – Position feedback sum

This function enables the servo drive to clear the position deviation when certain conditions are met (H05.16).

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.16	2005-11h	Clear action selection	0: Position deviation cleared upon S-OFF and fault 1: Position deviation cleared upon S-OFF and fault 2: Position deviation cleared upon non-operational state or active DI function 35	0	-	At stop	"H05_en.16" on page 777

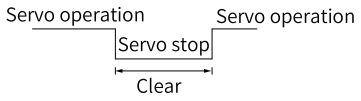
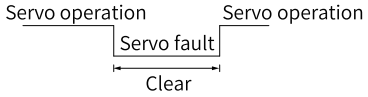
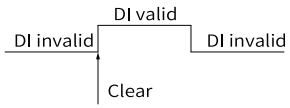
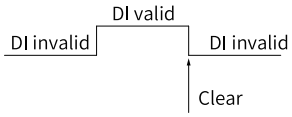
When H05.16 = 2, set a DI terminal of the servo drive with function 35 (FunIN.35:ClrPosErr, position deviation cleared), and set the terminal logic. It is recommended to use the high-speed DI (DI7 or DI8) terminal.

☆ Related parameters:

No.	Name	Function name	Function
FunIN.35	ClrPosErr	Position deviation cleared	Active: Position deviation cleared Invalid: Position deviation not cleared

Set the function as follows:

Table 11–17 Position deviation clear

Setpoint	Clear condition	Clear time
H05.16=0	Position deviation is cleared upon S-OFF or in the non-operational state.	
H05.16=1	Position deviation is cleared upon S-OFF or a fault.	
H05.16=2	Position deviation is cleared upon S-OFF or active DI function 35 (ClrPosErr, clear position deviation).	 (Rising edge-triggered)
		 (Falling edge-triggered)

11.9.6 Frequency Division Output

Caution

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

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

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

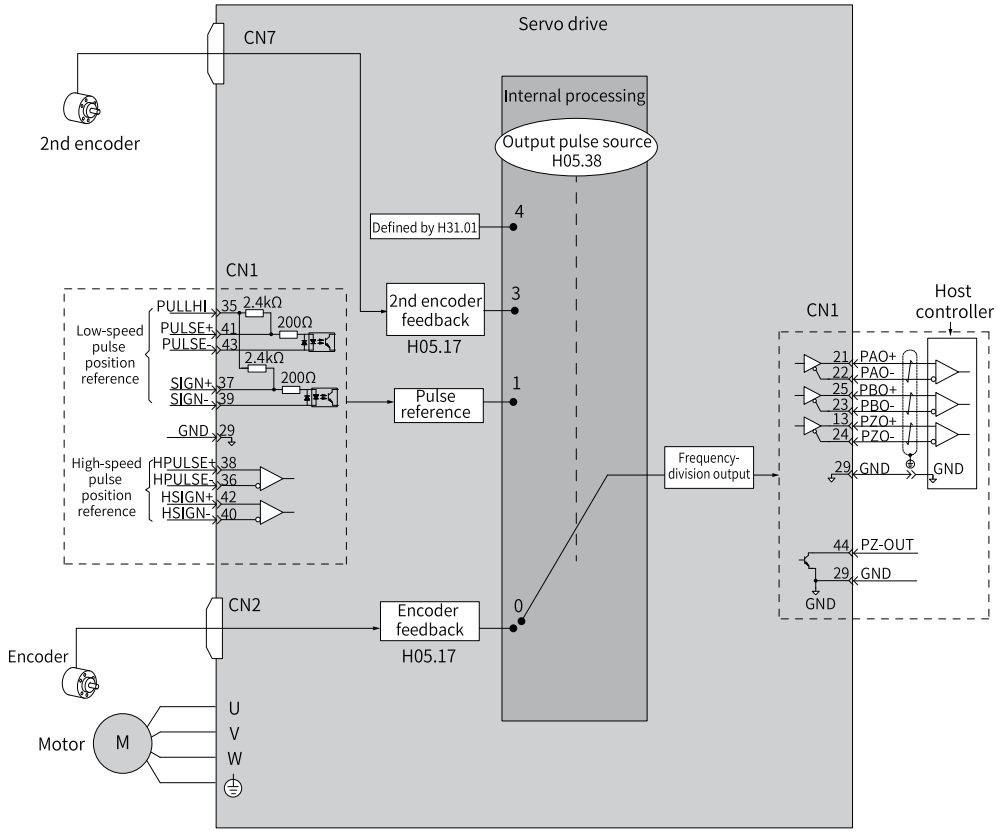


Figure 11-72 Schematic diagram of frequency-division output

- 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:

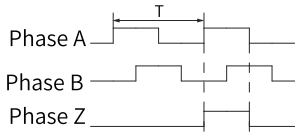
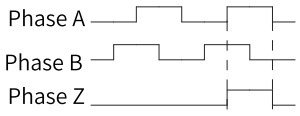
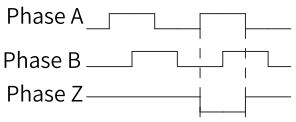
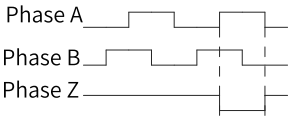
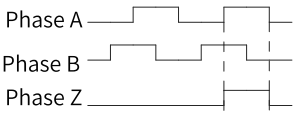
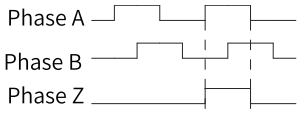
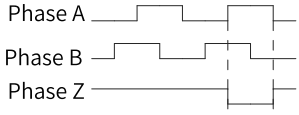
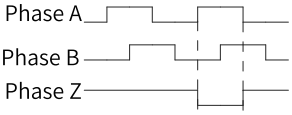
- Phase A pulses: PAO+ and PAO-, differential output, maximum output pulse frequency: 4 Mpps
- Phase B pulses: PBO+ and PBO-, differential output, maximum output pulse frequency: 4 Mpps
- Phase Z pulses: PZO+ and PZO-, differential output, maximum output pulse frequency: 4 Mpps
- PZ-OUT, GND, open-collector 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 11–18 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 740
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 778
H05.38	2005-27h	Frequency-division output source	0: Encoder frequency-division output 1: Pulse reference synchronous output 2: Frequency-division output inhibited 3: Second encoder frequency-division output 4: H31.01	0	-	Real time	"H05_en.38" on page 785
H05.41	2005-2Ah	Z pulse output polarity	bit0: Frequency-division Z output polarity 0: Positive (high level upon active Z pulse) 1: Negative (low level upon active Z pulse) bit1: 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	0x1	-	At stop	"H05_en.41" on page 787

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

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

The following figure shows the schematic diagram.

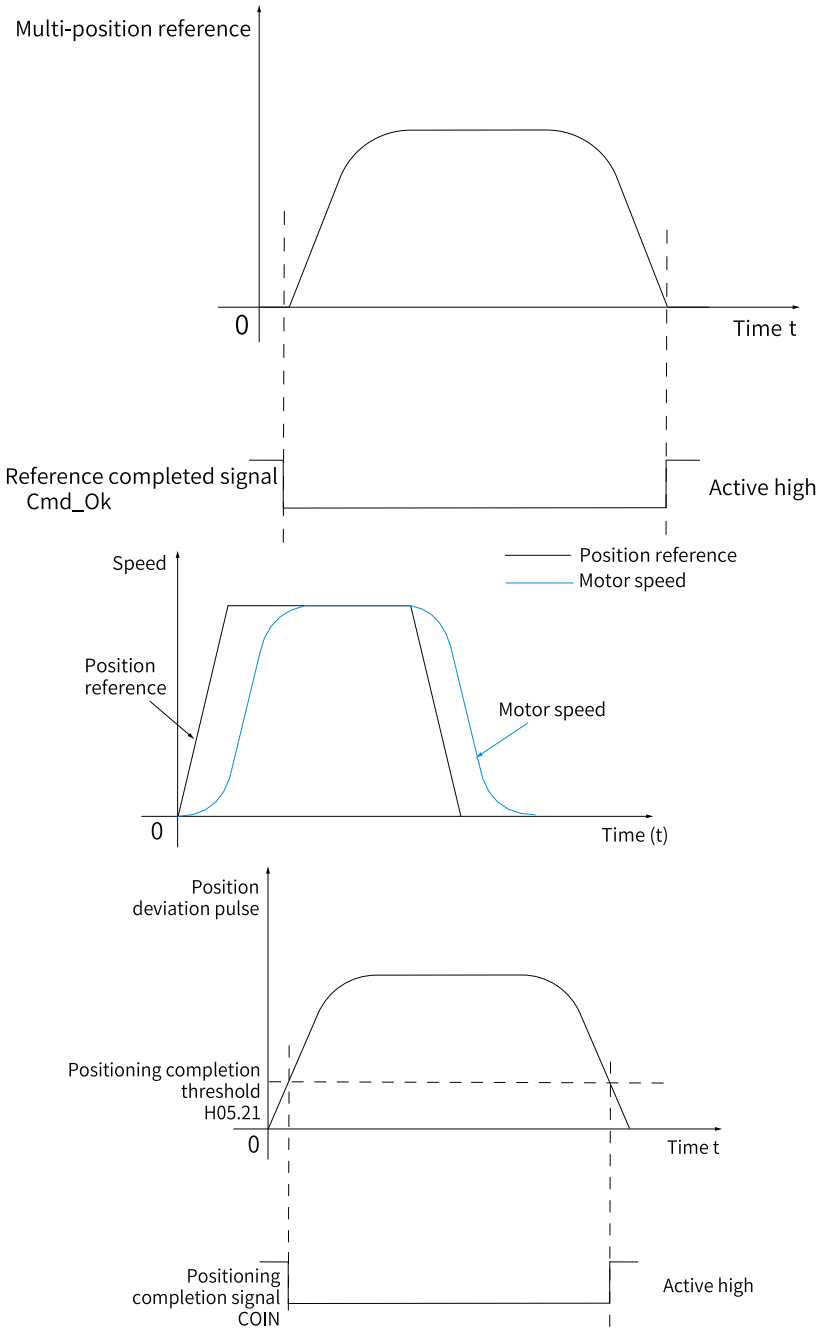


Figure 11-73 Diagram of positioning completed function

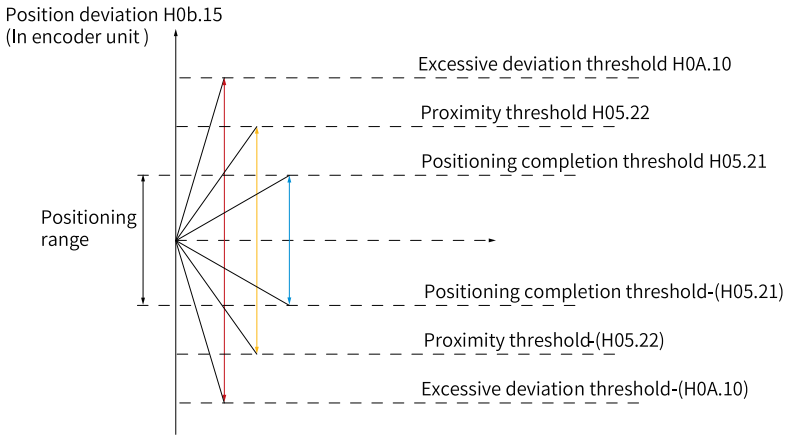
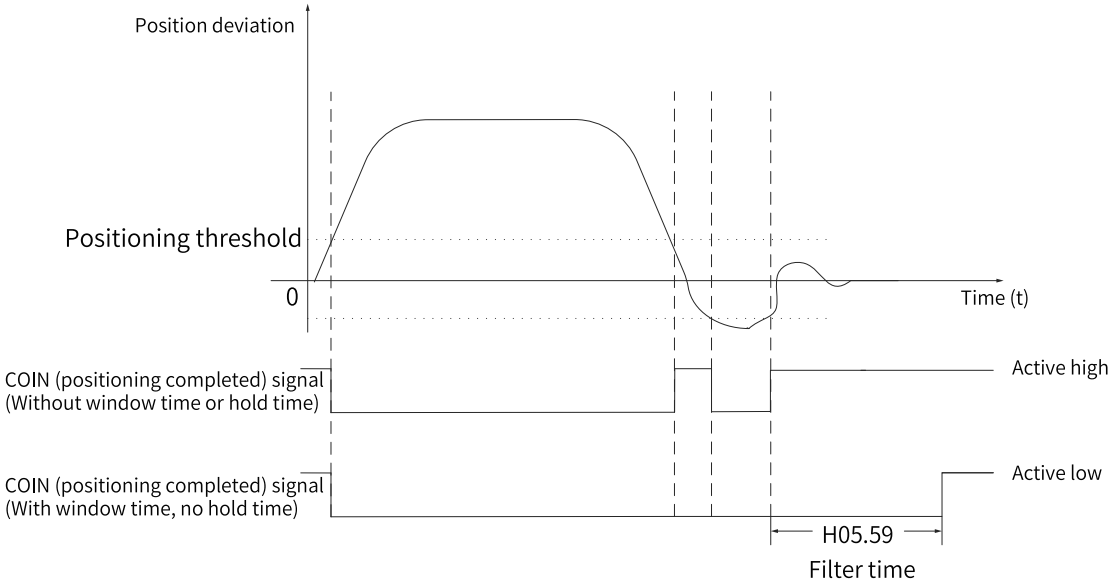


Figure 11-74 Position deviation-related signals

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 using the positioning completed or near function, set the output condition, deviation threshold, time window, and holding time. The following figure shows the schematic diagram of positioning completed time window and holding time.



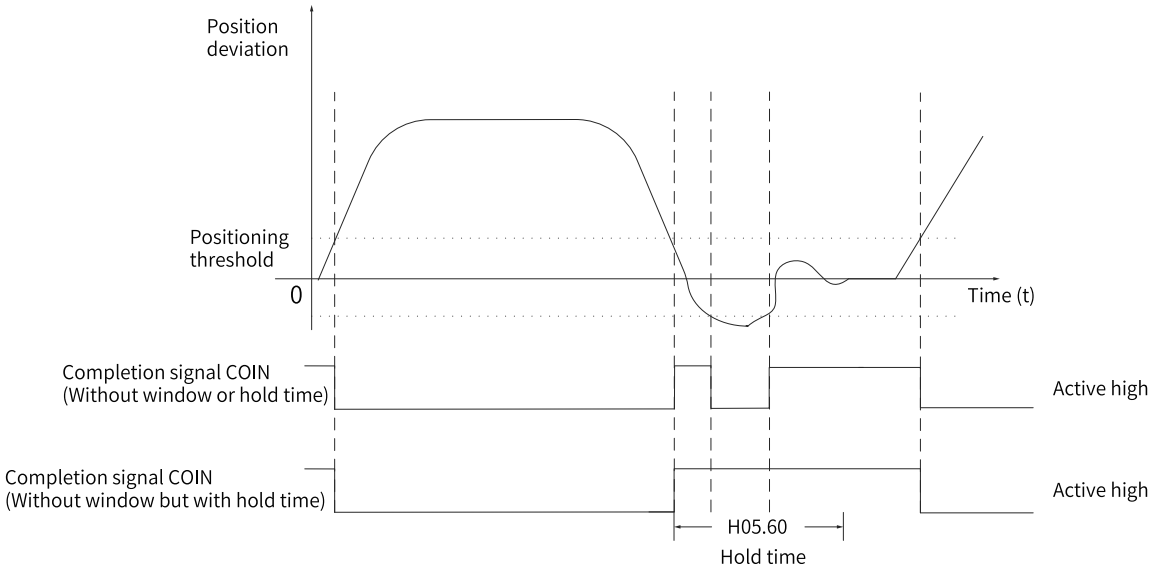


Figure 11-75 Diagram of positioning completed time window and holding time

When the retention function for positioning completed output is used, the value 0 indicates that the positioning completed signal remains active until the moment when the position reference is received for the next time.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	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: Absolute position deviation lower than the setpoint of H05.21 and the filtered position reference being 0 2: Absolute position deviation kept lower than H05.21 and unfiltered position reference being 0 3: Absolute position deviation kept lower than H05.21 and unfiltered position reference being 0 If the positioning hold time keeps being within the time defined by H05.60 and the position reference is 0, the positioning completion signal will be output. After the positioning hold time defined by H05.60 elapses, whether the positioning completion signal is outputted depends on the non-filtered position reference and absolute value of position deviation. 4: Absolute position deviation lower than the setpoint of H05.21 and the filtered position reference being 0 If the positioning hold time keeps being within the time defined by H05.60 and the position reference is 0, the positioning completion signal will be output. After the positioning hold time defined by H05.60 elapses, whether the positioning completion signal is output depends on the filtered position reference and absolute value of position deviation. 5: The absolute position deviation is lower than the H05.21, with zero speed signal ON and position reference being 0. 6: The absolute position deviation is lower than H05.21, with zero speed signal ON and filtered position reference being 0. 7: Positioning completion is judged after the delay defined by H05.60 elapses, with unfiltered position reference being 0. The positioning completion signal ON is output when the non-filtered position reference is 0 and the absolute position deviation is lower than H05.21.	0	-	Real time	"H05_en.20" on page 778

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.20	2005-15h	Condition for positioning completed signal output	8: Positioning completion is judged after the delay defined by H05.60 elapses and the filtered position reference is 0. The positioning completion signal ON is output when the filtered position reference is 0 and the absolute position deviation is lower than H05.21. 9: Positioning completion is judged after the delay defined by H05.60 elapses when the non-filtered position reference is 0 and the absolute value of position deviation is lower than H05.21. The positioning completion signal ON is output when the non-filtered position reference is 0 and the absolute position deviation is lower than H05.21. 10: Positioning completion is judged after the delay defined by H05.60 elapses when the filtered position reference is 0 and absolute position deviation is lower than H05.21. The positioning completion signal ON is output when the filtered position reference is 0 and the absolute position deviation is lower than H05.21.	0	-	Real time	
H05.21	2005-16h	Threshold of positioning completion	1 to 65535	46976	Encoder unit	Real time	"H05_en.21" on page 780
H05.22	2005-17h	Threshold of proximity	1 to 65535	65535	Encoder unit	Real time	"H05_en.22" on page 781
H05.59	2005-3Ch	Positioning window time	0 to 30000	0	ms	Real time	"H05_en.59" on page 792
H05.60	2005-3Dh	Hold time of positioning completion	0 to 30000	0	ms	Real time	"H05_en.60" on page 792
H0A.17	200 A-12h	Reference pulse selection	0: Pulse unit1 : Reference unit	0	-	At stop	"H0A_en.17" on page 855

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:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.60	2005-3Dh	Hold time of positioning completion	0 to 30000	0	ms	Real time	"H05_en.60" on page 792

☆ Related parameters:

No.	Name	Function name	Function
FunOut.5	COIN	Positioning completed	Active: The absolute position deviation meets the threshold defined by H05.21 in position control mode, indicating positioning is done. Invalid: In position control mode, the servo drive is performing positioning.
FunOut.6	NEAR	Target position approached	Active: The absolute position deviation meets the condition defined by H05.22, indicating the servo drive is close to the target position. Invalid: In position control mode, the servo drive is performing positioning.
FunOUT.22	CmdOk	Internal command completed	Active: The transmission of the multi-position reference or interrupt positioning reference is done 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 done 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.

11.10 Speed Control Mode

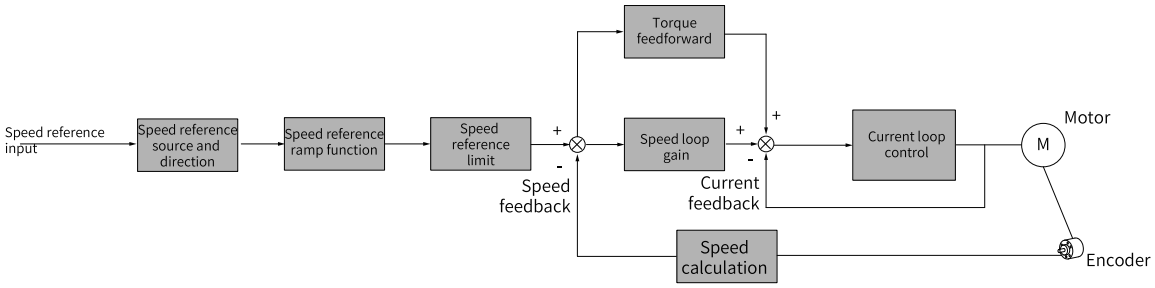


Figure 11-76 Block diagram of speed control

Set H02.00 (Mode selection) to 0 (Speed mode) through the operating panel or Inovance servo commissioning software to enable the speed control mode. Set the servo drive parameters based on the mechanical structure and specifications. The following part uses the basic parameter setting to describe the speed control mode.

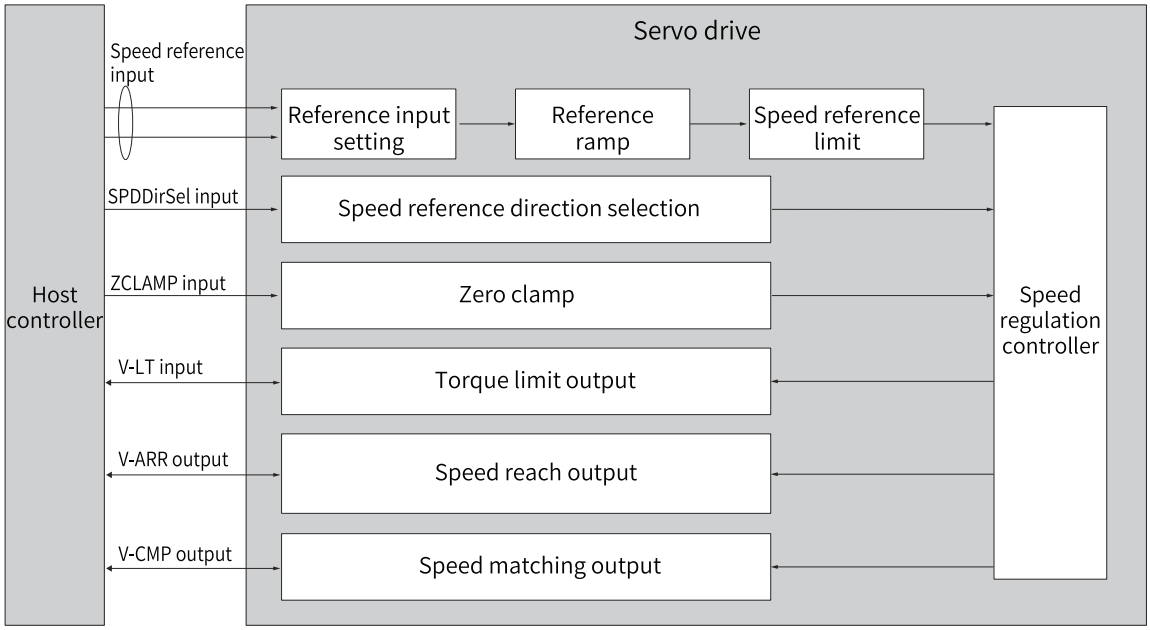


Figure 11-77 Signal exchange between the servo drive and the host controller

11.10.1 Function block diagram

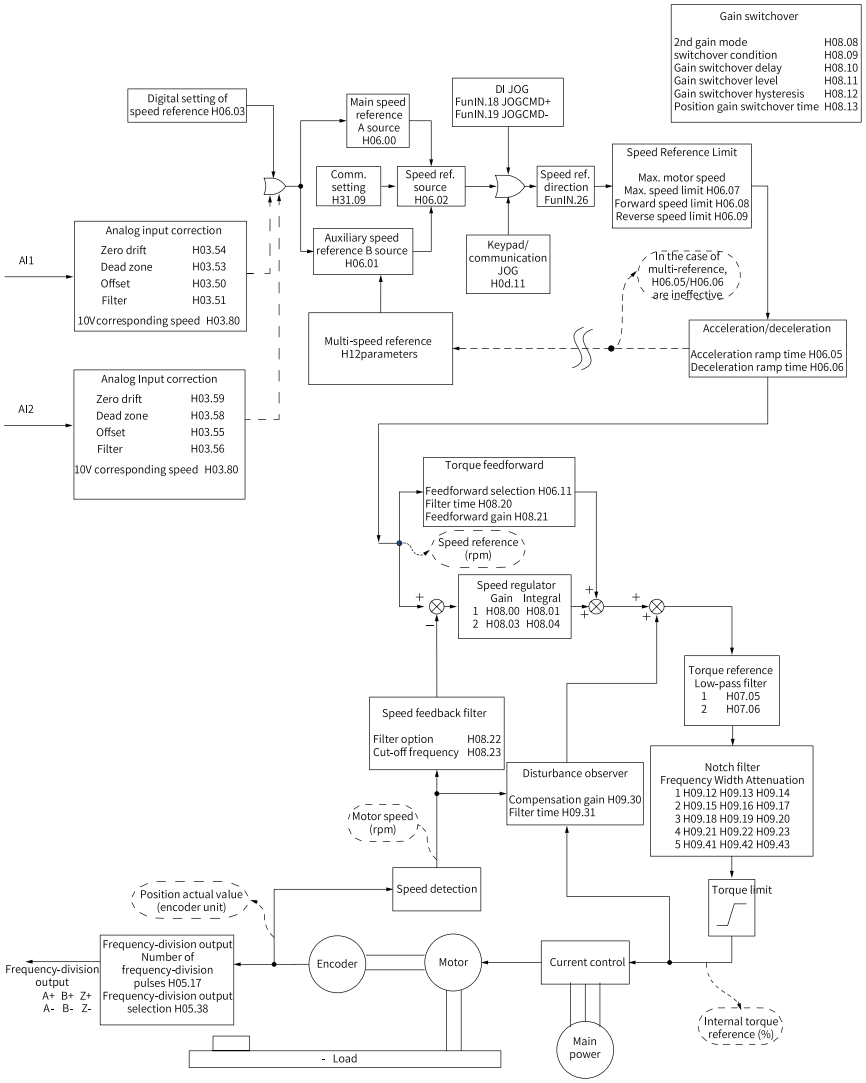


Figure 11-78 Block diagram of speed control parameters

11.10.2 Speed Reference Input

Speed reference source

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

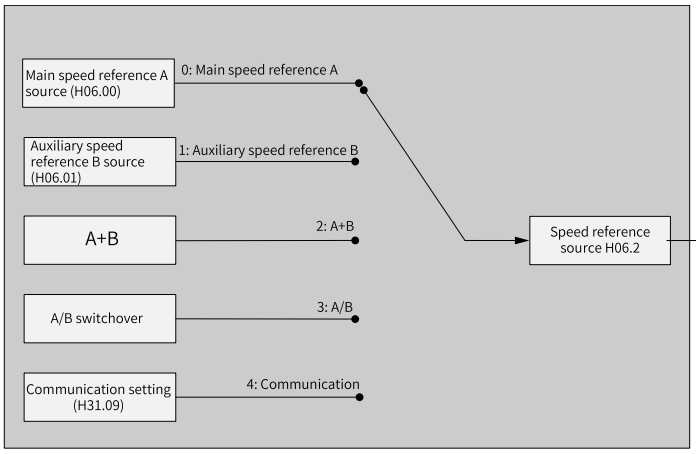


Figure 11-79 Speed reference source

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	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 795

- **Source of main speed reference A**

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

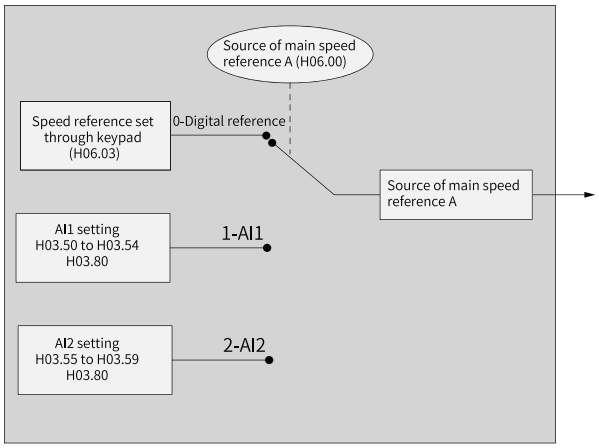


Figure 11-80 Source of main speed reference A

☆ Related parameters:

  - **Digital setting**

    The speed reference is set in H06.03.

    ☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	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 795

- **Analog voltage setting**

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

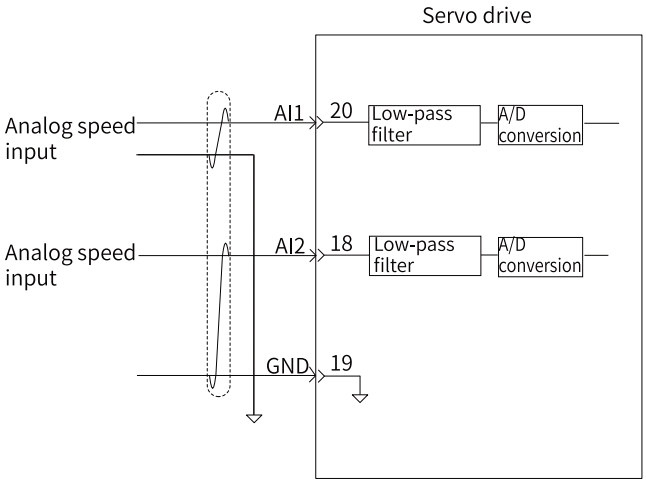
  Analog voltage input terminal:

  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:



  Procedure:

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

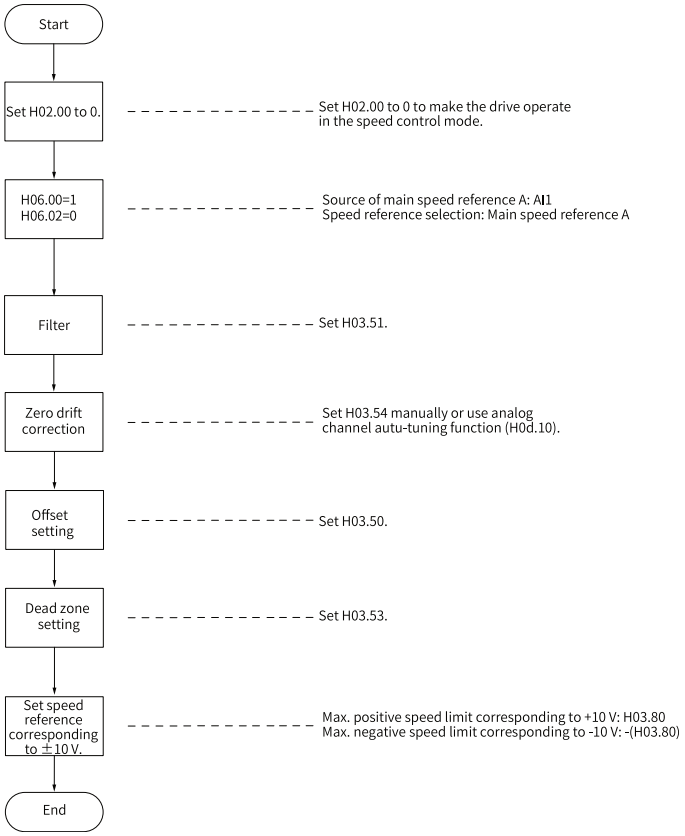


Figure 11-81 Flowchart of setting speed reference by analog voltage

Terms:

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

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

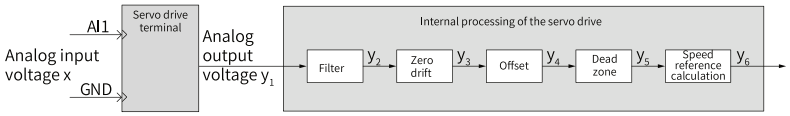


Figure 11-82 AI processing of servo drive

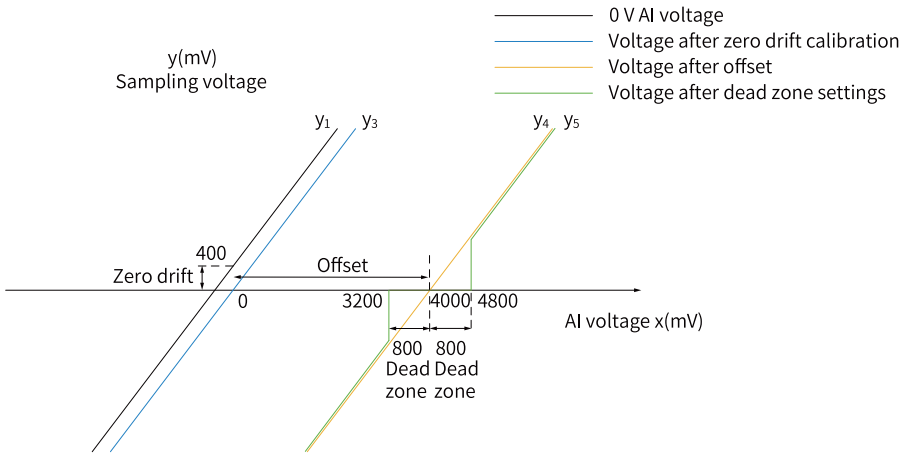


Figure 11-83 Example of sampling voltage and AI processing of servo drive

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

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

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

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

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

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

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

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

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

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

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

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

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

- **Speed reference calculation**

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

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

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

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

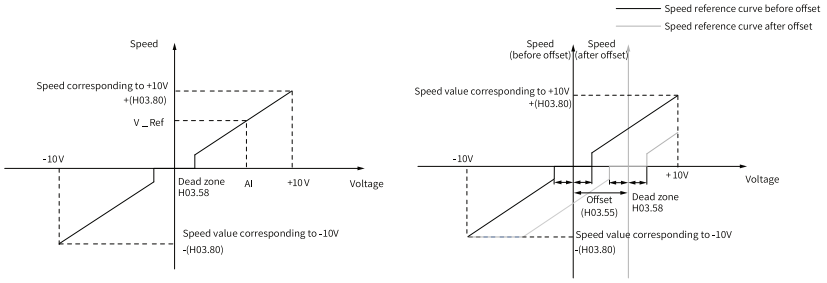


Figure 11-84 AI1 without offset (left) & AI1 after offset (right)

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	Value range	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 758
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 759
H03.53	2003-36h	Voltage-type AI1 dead zone	0.0 to 1000.0	10.0	mV	Real time	"H03_en.53" on page 759
H03.54	2003-37h	Voltage-type AI1 zero drift	-500.0 to +500.0	0.0	mV	Real time	"H03_en.54" on page 759
H03.55	2003-38h	Voltage-type AI2 offset	-5000 to +5000	0	mV	Real time	"H03_en.55" on page 759
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 760

Parameter	Comm. address	Parameter name	Value range	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 760
H03.59	2003-3Ch	Voltage-type AI2 zero drift	-500.0 to +500.0	0.0	mV	Real time	"H03_en.59" on page 760
H03.80	2003-51h	Speed corresponding to analog 10 V	0 to 10000	3000	[mm/s]/ [rpm]	At stop	"H03_en.80" on page 763
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 892

- **Speed analog in dead zone with linearization mode**

  The dead zone mode is supported. In this mode, the motor starts operation from zero speed when the voltage value exceeds the dead zone.

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

  After you set the zero drift, offset, and dead zone, set the sampling voltage in H03.80. The value represents the speed reference at 10 V (10000 mV) in other modes.

  In the following figure, the gray line represents a general mode, and the green line represents the dead zone with linearization mode.

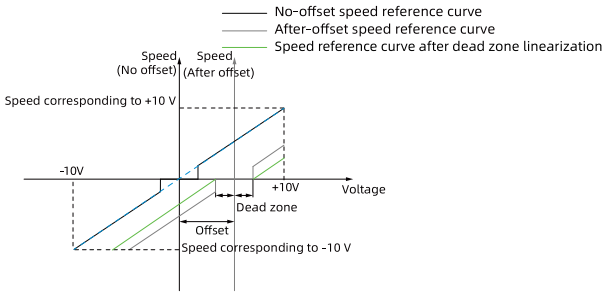


Figure 11-85 AI1 in a general mode and dead zone mode

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

$$y_6 = \begin{cases} 0 & B-C \le x \le B+C \\ x-(B+C) & B+C \le x \le 10000 \\ x-(B-C) & -10000 \le x \le B-C \end{cases}$$

Where, B represents offset and C represents dead zone.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H03.49	2003-32h	AI1/AI2 dead zone mode	0: a general mode 1: dead zone mode	0	-	At stop	"H03_en.49" on page 758

- **Source of auxiliary speed reference B**

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

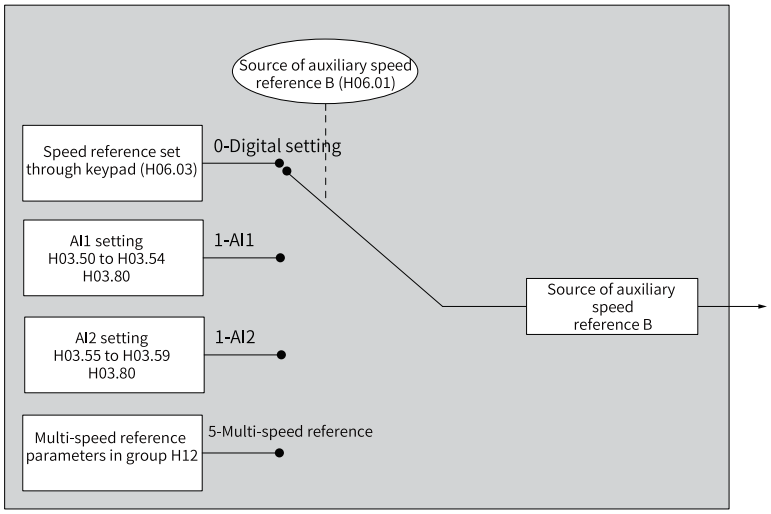


Figure 11-86 Source of auxiliary speed reference B

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	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 794

The digital setting mode is the same as H06.00. The following part describes how to set auxiliary speed reference B via multi-speed reference.

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

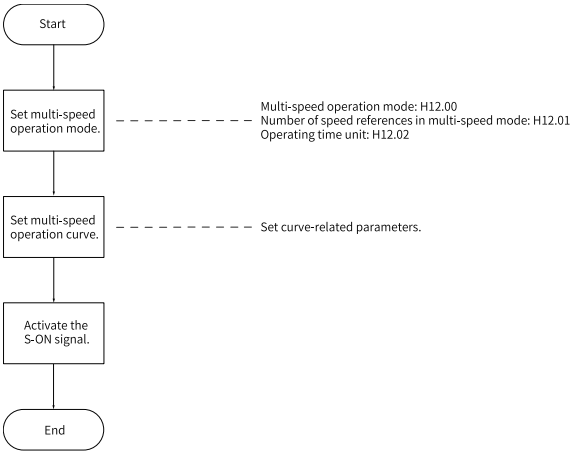


Figure 11-87 Multi-speed reference setting flowchart

1. Setting of multi-speed running mode

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	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 935
H12.01	2012-02h	Number of speed references in multi-speed mode	1 to 16	16	-	At stop	"H12_en.01" on page 937
H12.02	2012-03h	Operation time unit	0: s 1: min	0	-	At stop	"H12_en.02" on page 938

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

☆ Related parameters:

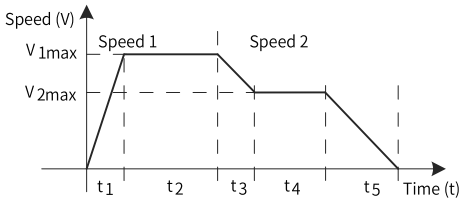
No.	Name	Function name	Function
FunIN.5	DIR-SEL	Multi-reference direction	Inactive: Reference direction by default Active: Opposite to the reference direction

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 11–19 Description of individual operation

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

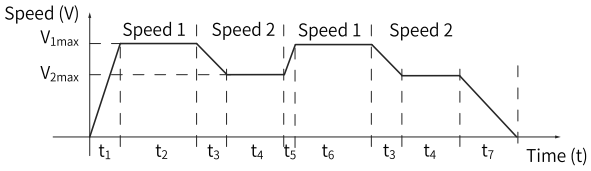
★Terms:

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

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

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

Table 11–20 Description of cyclic operation

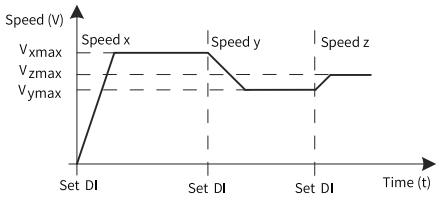
Mode description	Operating curve
• The drive starts from position 1 again after each cycle of operation. • The drive switches to the next position automatically. • The cyclic running state remains if the servo ON signal is active.	 • V_{1max} , V_{2max} : maximum values of the 1st and 2nd speeds • Operating 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 11–21 Descriptions of DI-based operation

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

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

☆ Related parameters:

No.	Name	Function name	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 11-22" on page 432*. The value of CMD is 1 upon active DI level and 0 upon inactive DI level.
FunIN.7	CMD2	Multi-reference switchover 2	
FunIN.8	CMD3	Multi-reference switchover 3	
FunIN.9	CMD4	Multi-reference switchover 4	

Table 11–22 Relationship between the segment No. and CMD1 to CMD4

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

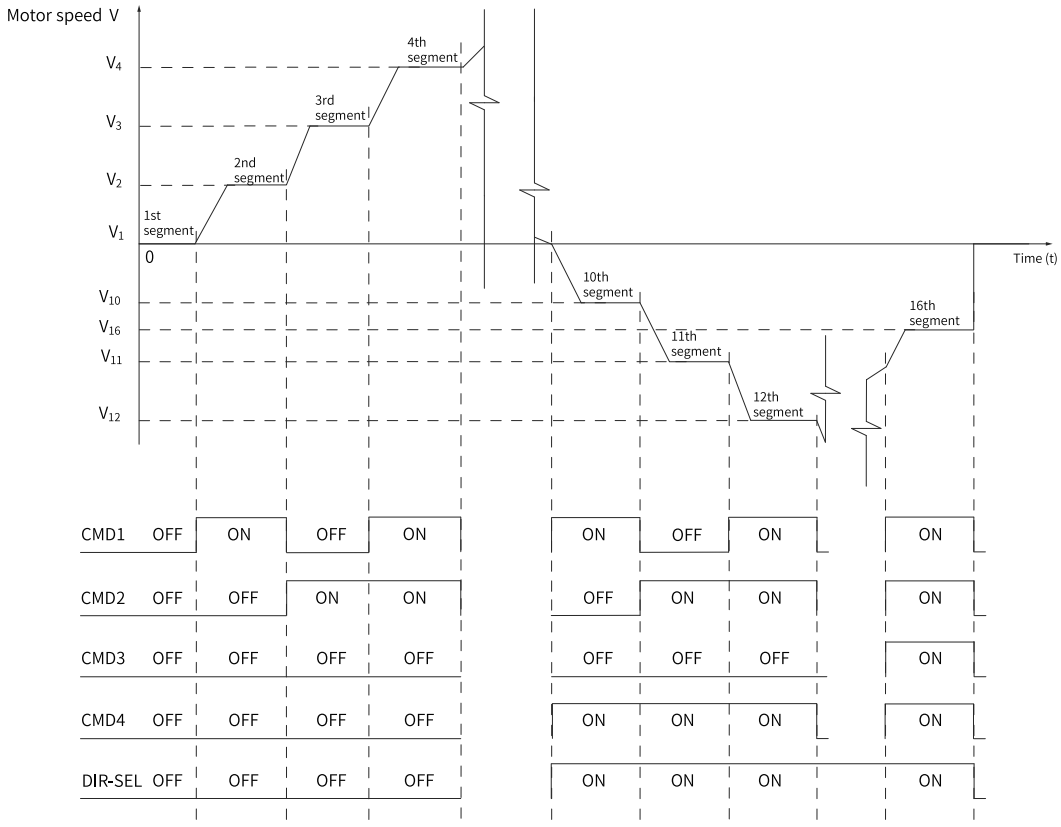


Figure 11-88 Example of curve of a certain speed in multi-speed reference

2. Setting the multi-speed curve

The following takes the 1st speed as an example.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	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 938
H12.04	2012-05h	Deceleration time 1	0 to 65535	10	ms	Real time	"H12_en.04" on page 938
H12.09	2012-0Ah	Acceleration time 4	0 to 65535	150	ms	Real time	"H12_en.09" on page 940
H12.10	2012-0Bh	Deceleration time 4	0 to 65535	150	ms	Real time	"H12_en.10" on page 940
H12.20	2012-15h	1st speed reference	-10000 to 10000	0	[mm/s]/[rpm]	Real time	"H12_en.20" on page 940

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H12.21	2012-16h	Operation time of the 1st speed reference	0.0 to 6553.5	5.0	s(m)	Real time	"H12_en.21" on page 941
H12.22	2012-17h	1st speed rise/drop and curve smoothing parameter time	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 941

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

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

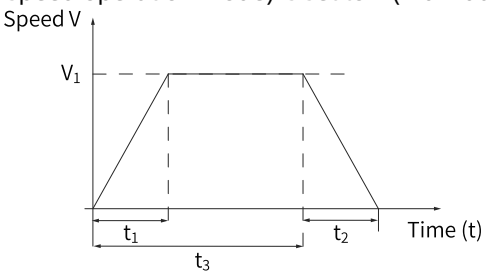


Figure 11-89 Example of curve of a certain speed in multi-speed reference

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

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

The actual deceleration time t_2 is:

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

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

- **A/B switchover**

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

☆ Related parameters:

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

- **Communication**

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

  ☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	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 1067

Speed reference direction

A DI terminal with FunIN.26 (SPDDirSel, speed reference direction selection) is used to change the speed reference direction. The input signal of this DI determines the speed reference direction.

☆ Related parameters:

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

The actual motor direction is determined by the rotation direction specified in parameter H02.02, speed reference direction, and DI switchover of speed reference direction (FunIN.26).

Table 11–23 Actual motor rotation direction in the speed control mode

H02.02	Sign of speed reference	FunIN.26	Direction of motor rotation
0	+	Inactive	Counterclockwise
0	+	Active	Clockwise
0	-	Inactive	Clockwise
0	-	Active	Counterclockwise
1	+	Inactive	Clockwise
1	+	Active	Counterclockwise
1	-	Inactive	Counterclockwise
1	-	Active	Clockwise

11.10.3 Ramp Function

The ramp function is used to smooth the acceleration rate of speed references based on acceleration/deceleration time settings.

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

Caution

- When the speed reference source is digital setting, analog voltage setting or jog speed, the acceleration time and deceleration time are set through parameters H06.05 and H06.06.
- When the speed reference source is multi-speed reference, the acceleration time and deceleration time are set in parameter group H12. For details, see section "H12 Multi-speed references".

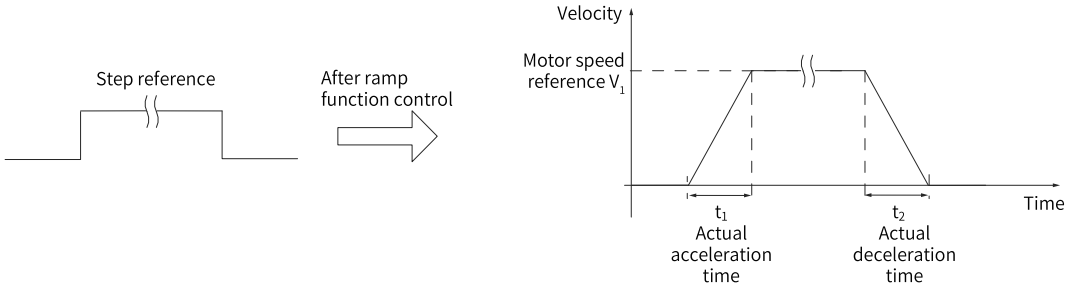


Figure 11-90 Ramp function diagram

- 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 of calculating the actual ramp-up/down time are as follows:

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

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H06.05	2006-06h	Acceleration ramp time of speed reference	0 to 65535	0	ms	Real time	"H06_en.05" on page 796
H06.06	2006-07h	Deceleration ramp time of speed reference	0 to 65535	0	ms	Real time	"H06_en.06" on page 796

11.10.4 Zero Clamp

Caution

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

In 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. If the signal of the DI terminal with FunIN.12 (ZCLAMP) is inactive, the zero speed clamp function is disabled.

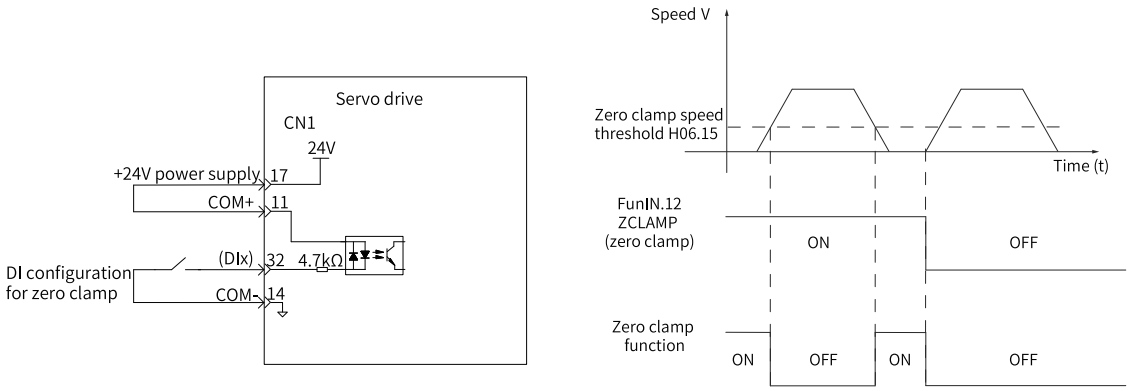


Figure 11-91 Wiring and waveform of zero clamp

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H06.15	2006-10h	Speed threshold for zero clamp	0 to 10000	10	[mm/s]/[rpm]	Real time	"H06_en.15" on page 798

☆ Related parameters:

No.	Name	Function name	Description
FunIN.12	ZCLAMP	Zero speed clamp	Invalid: Zero clamp disabled Valid: Zero clamp enabled

11.10.5 Speed Reference Limit

Caution

When the actual speed of the motor exceeds H0A.08 (Overspeed threshold), E500.0 (Motor overspeed) is reported. For details about H0A.08, see *" H0A_en.08" on page 853*. The speed reference limit must be lower than the value of H0A.08.

In speed control mode, the speed reference can be limited. The sources of speed reference limit include:

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

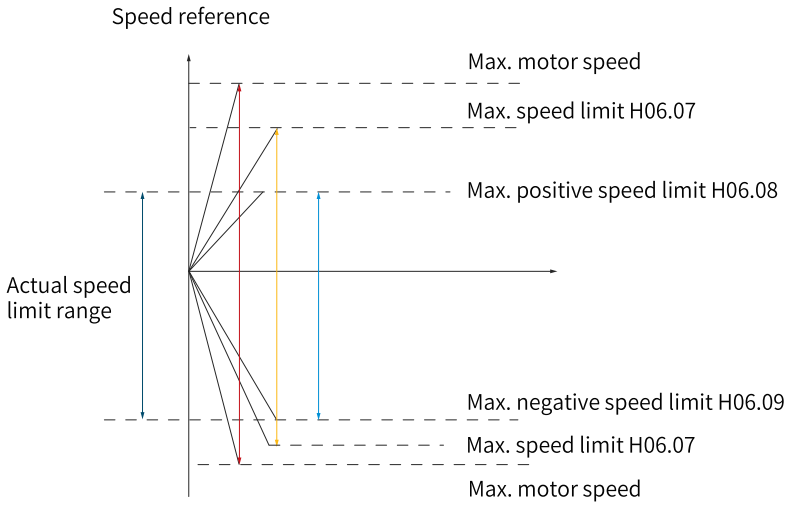


Figure 11-92 Example of speed reference limit

The actual motor rotational speed amplitude meets the following requirements:

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	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 796
H06.08	2006-09h	Positive speed limit	0 to 10000	7000	[mm/s]/[rpm]	Real time	"H06_en.08" on page 797
H06.09	2006-0Ah	Negative speed limit	0 to 10000	7000	[mm/s]/[rpm]	Real time	"H06_en.09" on page 797

11.10.6 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 rotation speed), the motor is acknowledged to be rotating. At this moment, the servo drive outputs the motor rotation signal (FunOUT.2: TGON) to confirm that motor has rotated. When the absolute value of the filtered actual motor speed is lower than the value of H06.16, the motor is not rotating.

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

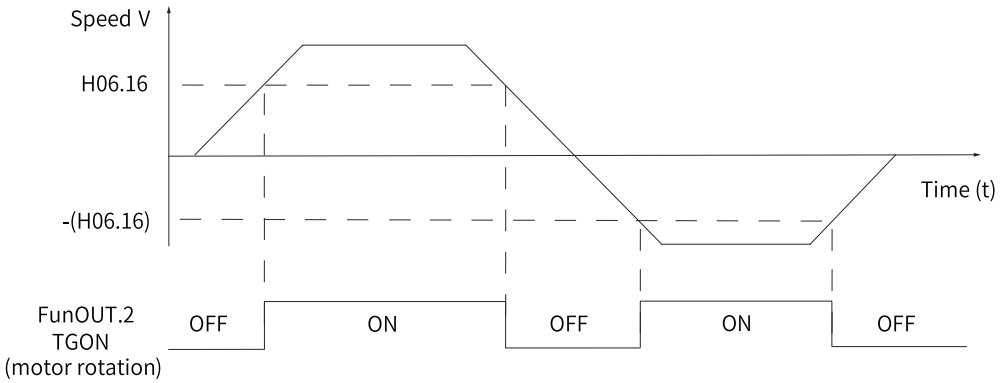


Figure 11-93 Motor rotation signal waveform

Note

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H06.16	2006-11h	Threshold of motor rotation state	0 to 1000	20	[mm/s]/[rpm]	Real time	"H06_en.16" on page 799

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

☆ Related parameters:

No.	Name	Function name	Description
FunOUT.2	TGON	Motor rotation	Inactive: The absolute value of filtered motor speed is lower than the setpoint of H06.16. Active. The absolute value of filtered motor speed reaches the setpoint of H06.16.

Speed matching DO signal [P]

A delay of 10 rpm is present in the speed matching signal.

When the absolute value of the difference between the motor speed after filter and the speed reference satisfies the setting of H06.17, the actual motor speed is considered to reach the speed reference. At this moment, the servo drive outputs the speed matching signal (FunOUT.4: V-CMP). When the absolute value of the difference between the motor speed after filter and the speed reference exceeds the setting of H06.17, the speed consistent signal is inactive.

If the servo drive is not in running status or in speed control, the speed consistent signal (FunOUT.4: V-CMP) is always inactive.

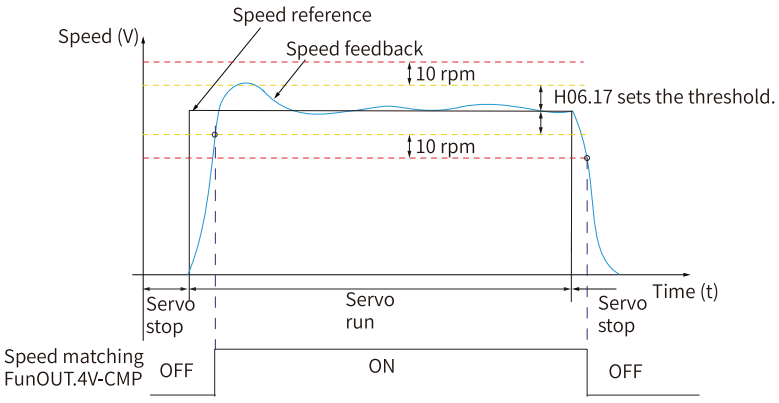


Figure 11-94 Speed matching signal waveform

Note

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H06.17	2006-12h	Threshold of speed consistency signal	0 to 100	10	[mm/s]/[rpm]	Real time	"H06_en.17" on page 799

Set a DO terminal of the servo drive with function 4 (FunOUT.4:V-CMP, speed consistent) and set the terminal logic.

☆ Related parameters:

No.	Name	Function name	Description
FunOUT.4	V-Cmp	Speed consistent	Inactive: The absolute difference between the filtered actual motor speed and the speed reference is higher than the value of H06.17. Active: The absolute difference between the filtered actual motor speed and the speed reference is lower than or equal to the value of H06.17.

Speed reached DO signal [P]

A delay of 10 rpm is present in the speed reach signal. When the absolute value of the motor speed after filter exceeds H06.18 + 10 rpm, the motor speed is considered to reach the desired value. At this moment, the servo drive outputs the speed arrival signal (FunOUT.19: V-Arr). On the contrary, when the absolute value of filtered motor speed is lower than H06.18 - 10 rpm, the speed reach signal is inactive.

Judgment on the speed reached signal (FunOUT.19: V-Arr) is not influenced by the servo drive status and control mode.

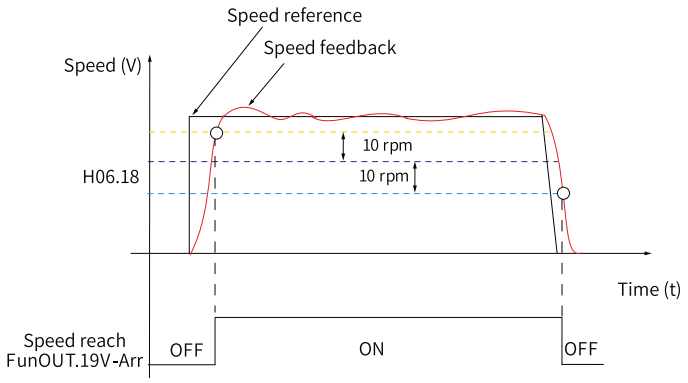


Figure 11-95 Speed reached signal waveform

Note

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H06.18	2006-13h	Threshold of speed arrival signal	20 to 10000	1000	[mm/s]/ [rpm]	Real time	"H06_en.18" on page 799

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

☆ Related parameters:

No.	Name	Function name	Description
FunOUT.19	V-Arr	Speed reached	Inactive: The absolute value of filtered motor speed feedback exceeds H06.18. Active: The absolute value of filtered motor speed feedback is lower than or equal to the value of H06.18.

Zero speed DO signal

A delay of 10 rpm is present in the zero speed signal. The drive outputs zero speed (FunOUT.3: ZERO) signal only when the absolute value of actual motor speed is lower than the threshold defined by H06.19. On the contrary, when the absolute value of actual motor speed is higher than H06.19 + 10 rpm, the motor is in the rotational state and the V-Zero (zero speed) signal is inactive.

Judgment on the zero speed signal (FunOUT.3: ZERO) is not influenced by the servo drive status and control mode.

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

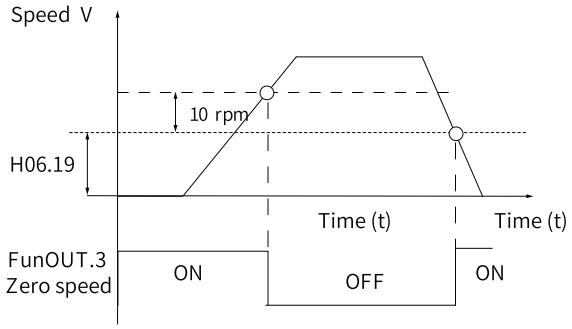


Figure 11-96 Zero speed signal waveform

Note

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H06.19	2006-14h	Threshold of zero speed output signal	1 to 10000	10	[mm/s]/[rpm]	Real time	"H06_en.19" on page 799

Set a DO terminal of the servo drive with function 3 (FunOUT.3: ZERO, zero speed) and set the terminal logic.

☆ Related parameters:

No.	Name	Function name	Description
FunOUT.3	ZERO	Zero speed signal	Inactive: The difference between motor speed feedback and the reference value is higher than the setpoint of H06.19. Active: The difference between motor speed feedback and the reference value is lower than or equal to the value of H06.19.

11.11 Torque Control Mode

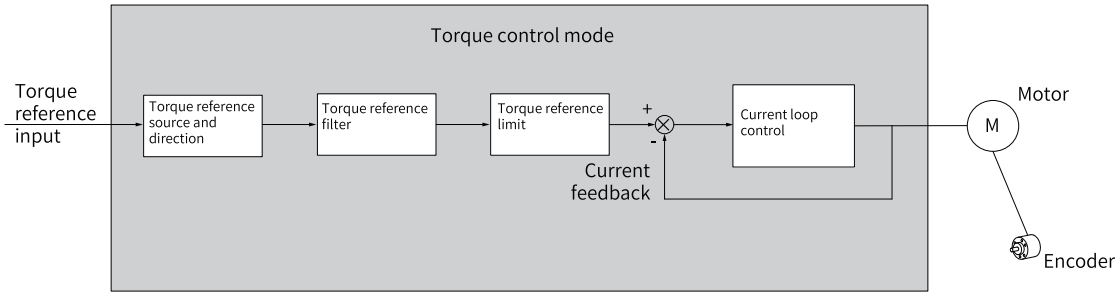


Figure 11-97 Torque control block diagram

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 torque control mode. Set the servo drive parameters based on the mechanical structure and specifications. The following part uses the basic parameter setting to describe the torque control mode.

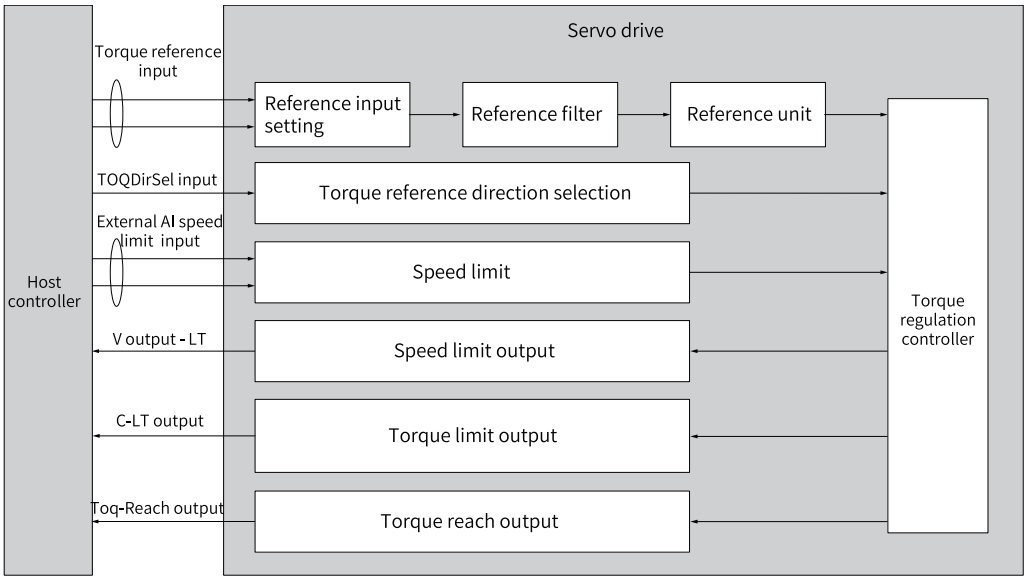


Figure 11-98 Signal exchange between the servo drive and the host controller

11.11.1 Function block diagram

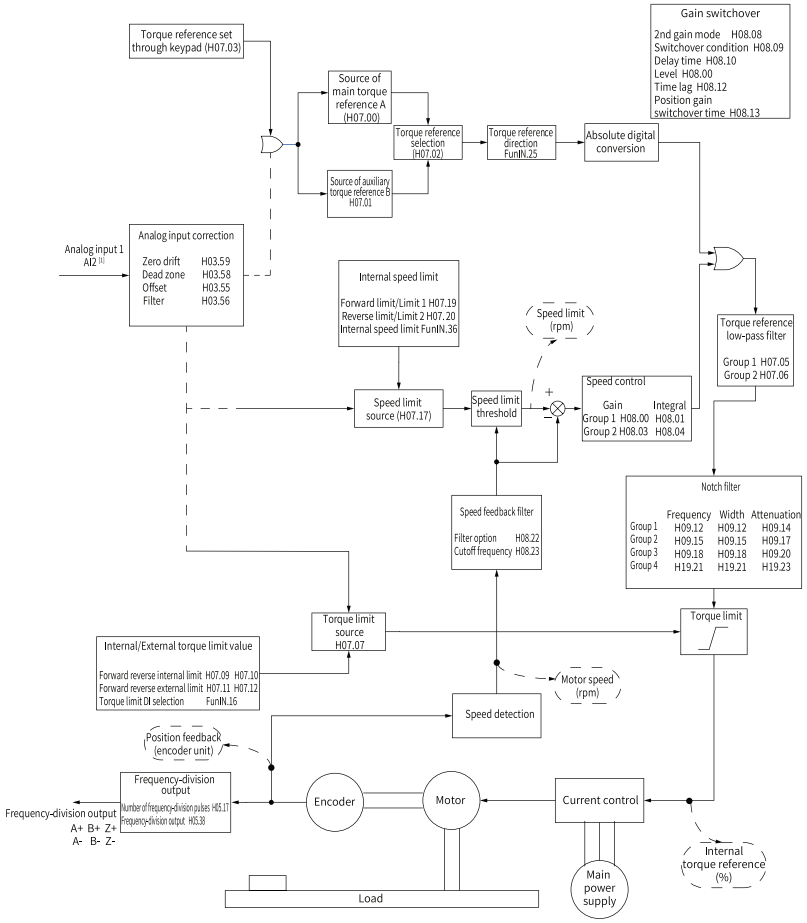


Figure 11-99 Block diagram of torque control

Note

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

11.11.2 Torque Reference Input

Torque reference source

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

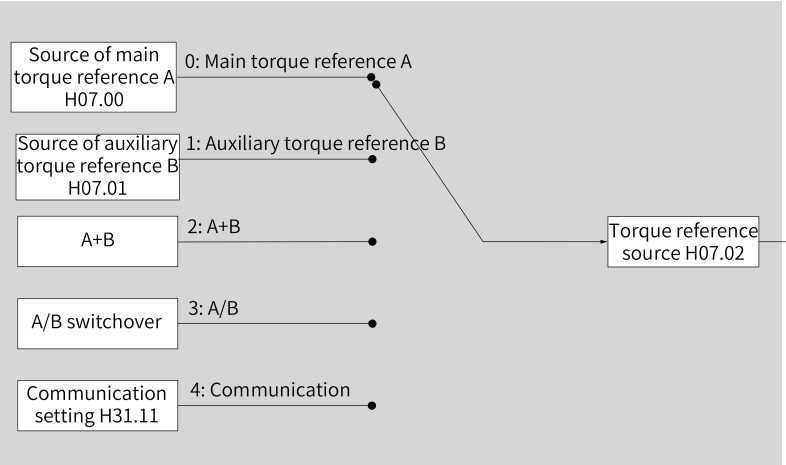


Figure 11-100 Selection of torque reference source

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	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 810

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

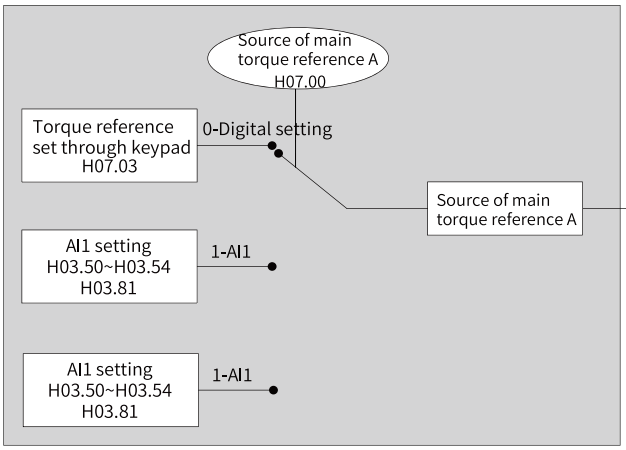


Figure 11-101 Description of main torque reference A sources

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H07.00	2007-01h	Sources of main torque reference A	0: H07.03 1: AI1 2: AI2	0	-	At stop	"H07_en.00" on page 809

- **Digital setting**

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

  ☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	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 810

- **Analog voltage setting**

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

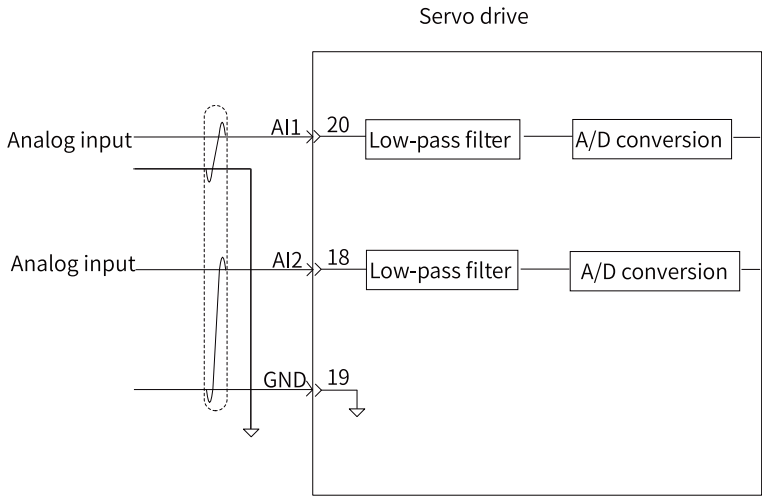
  Analog voltage input terminal:

  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:



Procedure:

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

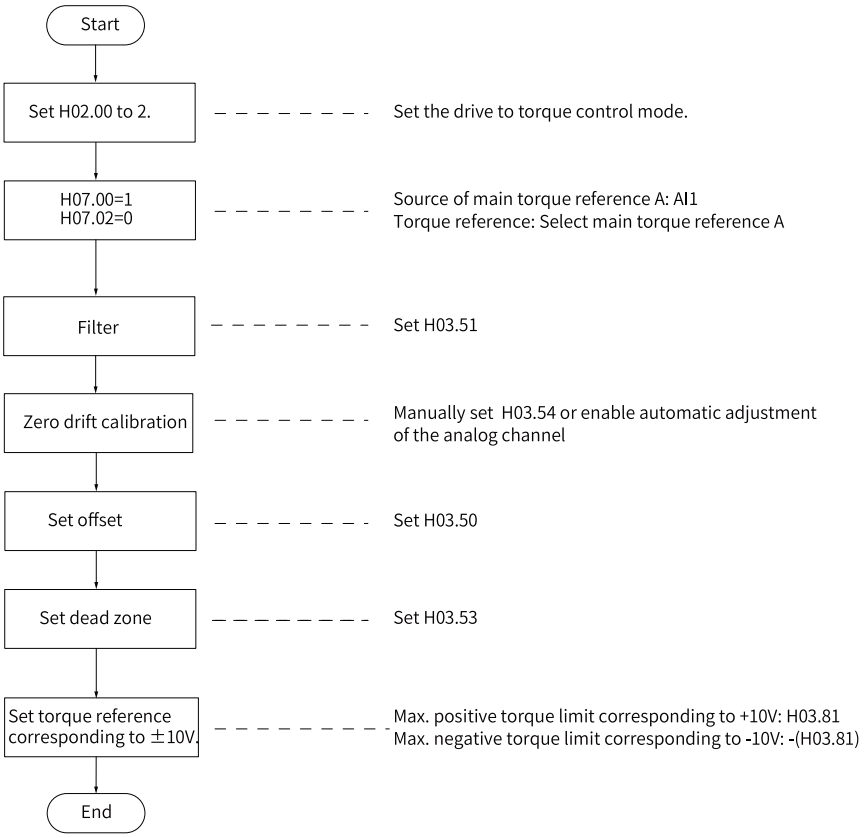


Figure 11-102 Flowchart of setting torque reference by analog voltage

★Terms:

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

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

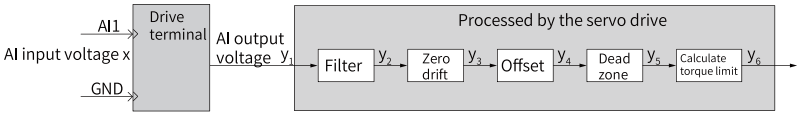


Figure 11-103 AI processing of servo drive

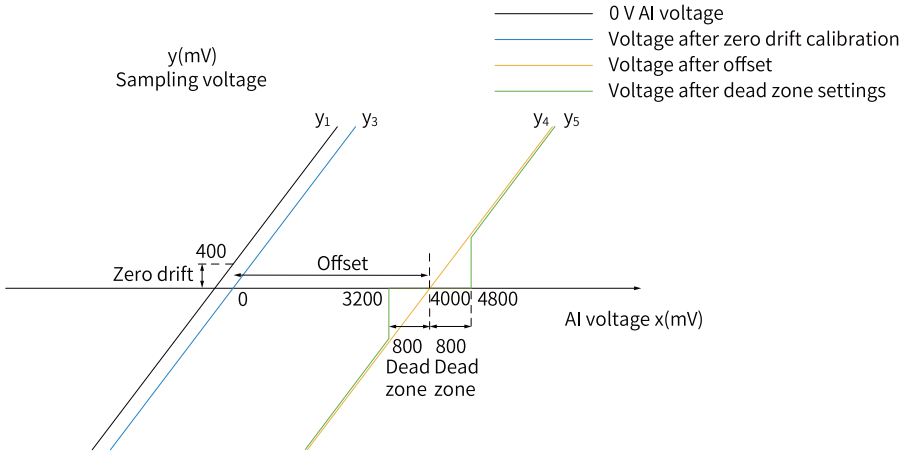


Figure 11-104 Example of sampling voltage and AI processing of servo drive

- **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.

- **Set zero drift correction**
  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:

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

- **Calculate torque reference**

  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.

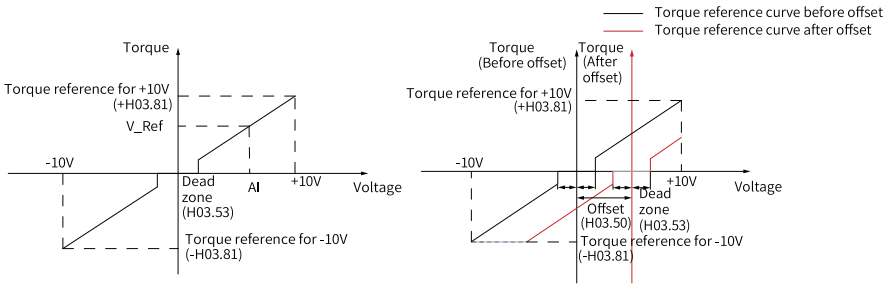


Figure 11-105 AI1 without offset (left) and AI1 after offset (right)

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

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

Where, B represents offset and C represents dead zone.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	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 758
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 759

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H03.53	2003-36h	Voltage-type AI1 dead zone	0.0 to 1000.0	10.0	mV	Real time	"H03_en.53" on page 759
H03.54	2003-37h	Voltage-type AI1 zero drift	-500.0 to +500.0	0.0	mV	Real time	"H03_en.54" on page 759
H03.55	2003-38h	Voltage-type AI2 offset	-5000 to +5000	0	mV	Real time	"H03_en.55" on page 759
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 760
H03.58	2003-3Bh	Voltage-type AI2 dead zone	0.0 to 1000.0	10.0	mV	Real time	"H03_en.58" on page 760
H03.59	2003-3Ch	Voltage-type AI2 zero drift	-500.0 to +500.0	0.0	mV	Real time	"H03_en.59" on page 760
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 763
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 892

- **Torque analog in dead zone with linearization mode**

  The dead zone mode is supported for torque analog, which is same as that for speed analog. In this mode, the motor starts operation from zero torque when the voltage value exceeds the dead zone.

  The following figure takes AI1 as an example to describe the analog setting of the torque reference in dead zone mode.

  After you set the zero drift, offset, and dead zone, set the sampling voltage in H03.80. The value represents the torque reference at 10 V (10000 mV) in other modes.

  In the following figure, the red line represents a general mode, and the green line represents the dead zone with linearization mode.

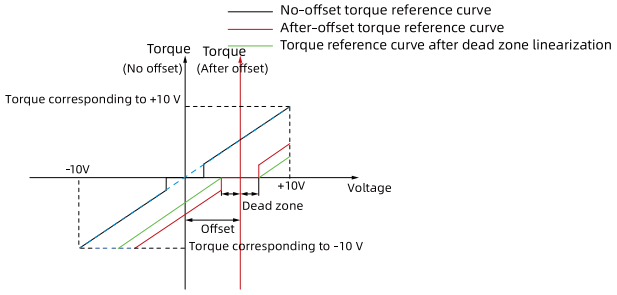


Figure 11-106 AI1 in a general mode and dead zone mode

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

$$y_6 = \begin{cases} 0 & B-C \le x \le B+C \\ x-(B+C) & B+C \le x \le 10000 \\ x-(B-C) & -10000 \le x \le B-C \end{cases}$$

Where, B represents offset and C represents dead zone.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H03.49	2003-32h	AI1/AI2 dead zone mode	0: a general mode 1: dead zone mode	0	-	At stop	"H03_en.49" on page 758

- **Sources of auxiliary torque reference B**
  The source of auxiliary torque reference B is set in the same way as the source of main torque reference A. For descriptions of related parameters, see "Description" on page 727.
- **A/B switchover**
  When setting H07.02 (Torque reference source) to 3 (Switched between A and B), you need to assign FunIN.4 (DI-SEL) to the corresponding DI. The input signal of this DI determines which source (A or B) is active.

  ☆ Related parameters:

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

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

  ☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	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 1067

Torque reference direction

A DI terminal with FunIN.25 (TOQDirSel, torque reference direction selection) is used to change the torque reference direction.

☆ Related parameters:

No.	Name	Function name	Description
FunIN.25	ToqDirSel	Torque reference direction	Inactive: The actual torque reference direction is the same as the set direction. Active: The actual torque reference direction is opposite to the set direction.

The actual motor direction is related to the rotating direction in H02.02, positive/negative of torque reference, and torque reference direction (FunIN.25).

Table 11–24 Actual direction of rotation in torque control mode

H02.02	Torque reference direction	FunIN.25	Direction of motor rotation
0	+	Inactive	Counterclockwise
0	+	Active	Clockwise
0	-	Inactive	Clockwise
0	-	Active	Counterclockwise
1	+	Inactive	Clockwise
1	+	Active	Counterclockwise
1	-	Inactive	Counterclockwise
1	-	Active	Clockwise

11.11.3 Torque reference filter

Caution

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

In position, speed, torque, and hybrid control modes, the servo drive smoothens torque references through the low-pass filter to reduce vibration.

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

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H07.05	2007-06h	Torque reference filter time constant 1	0.00 to 30.00	0.50	ms	Real time	"H07_en.05" on page 811
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 811

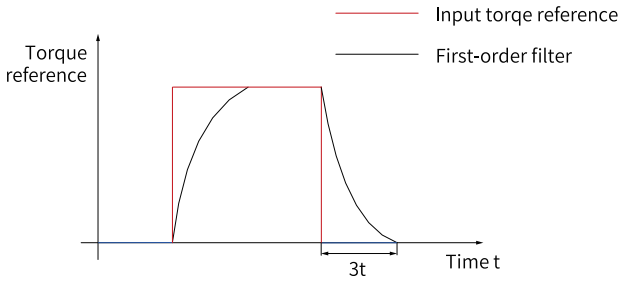


Figure 11-107 Rectangular torque reference first-order filter

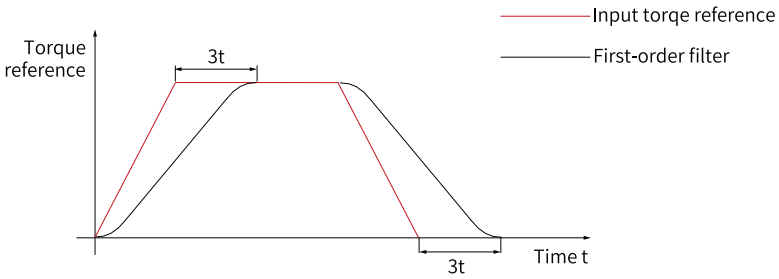


Figure 11-108 Trapezoid torque reference first-order filter

Note

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

11.11.4 Torque Reference Limit

Caution

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

Torque references are limited to protect the servo drive and motor.

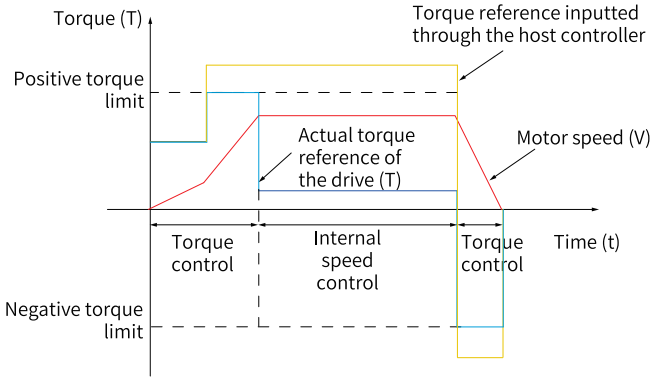


Figure 11-109 Torque reference and torque limit

When the absolute value of the torque reference input from the host controller or output by the speed regulator is higher than the absolute value of the torque reference limit, the actual torque

reference of the drive is limited to the torque reference limit. Otherwise, the torque reference input from the host controller or output by the speed regulator is used.

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

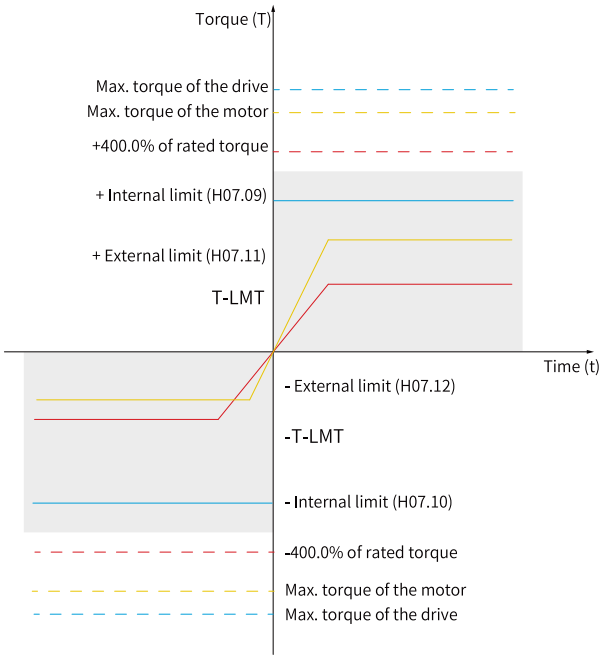


Figure 11-110 Torque limit example

Setting the torque limit source

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

After the torque limit is set, the servo drive torque reference is restricted to within the torque limit. After the torque reference reaches the limit, the motor runs according to the torque limit. The torque limit must be set according to the load conditions. If the setting is very small, it may cause longer acceleration/deceleration time of the motor, and the actual motor speed may not reach the required value at constant speed running.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H07.07	2007-08h	Torque limit source	0: Positive/Negative internal torque limit 1: Internal or external limit as defined by DI 2: T_LMT 3: T_LMT or external limit as defined by DI (FunIN.16 or FunIN.17) 4: T_LMT or internal limit (FunIN.16 or FunIN.17) as defined by DI	0	-	Real time	"H07_en.07" on page 811

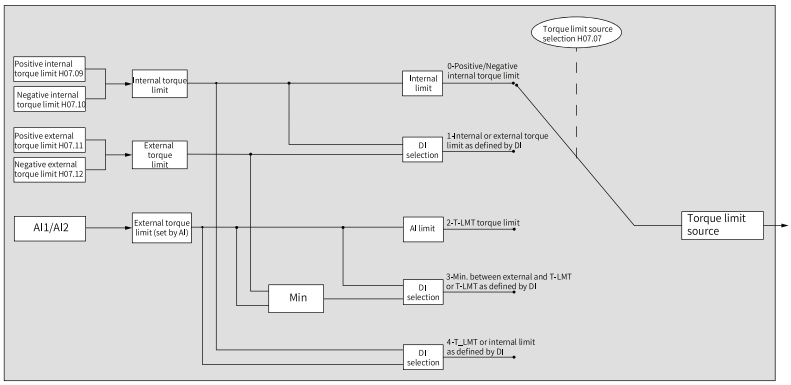


Figure 11-111 Torque limit source

The following figures show the torque limit curve when the absolute torque reference input from the host controller is larger than the torque limit.

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

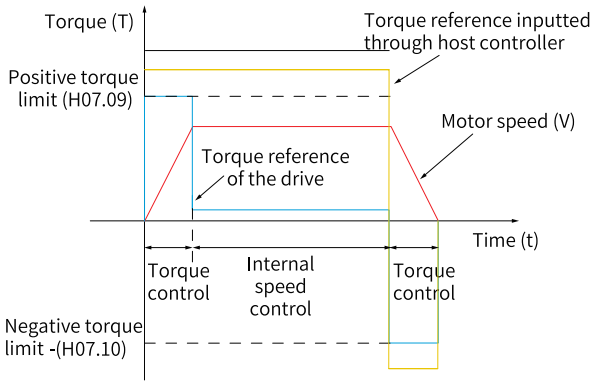


Figure 11-112 Torque limit curve (H07.07 = 0)

- 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).

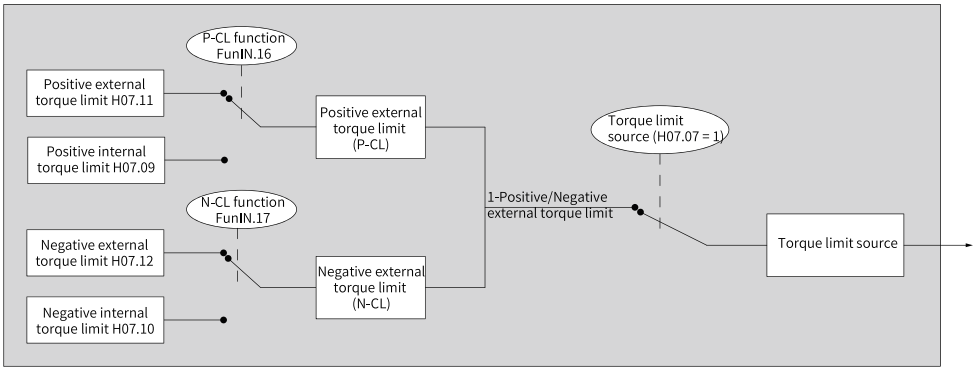
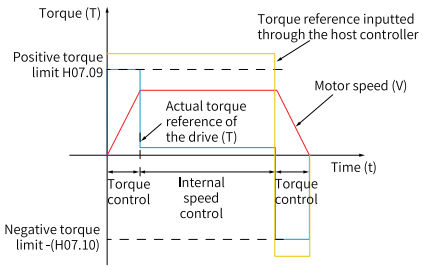
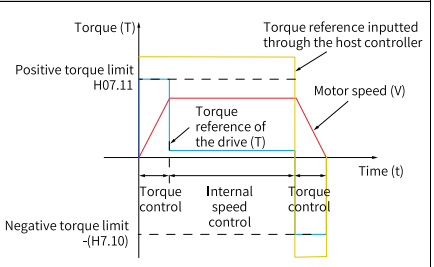
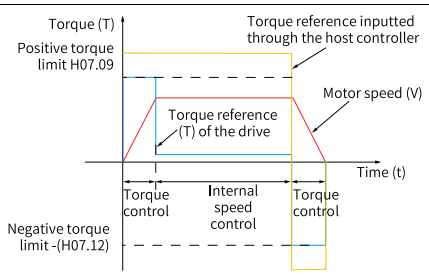
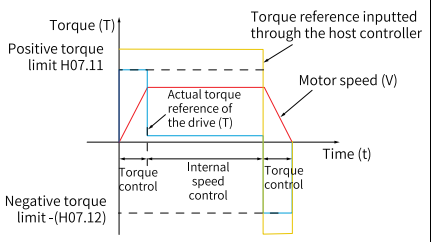


Figure 11-113 Torque limit source (H07.07 = 1)

Table 11–25 Description of H07.07 = 1

State of DI signal		P-CL	
		OFF	ON
N-CL	OFF		
	ON		

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

☆ Related parameters:

No.	Name	Function name	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: Valid: Positive external torque limit enabled Invalid: Positive internal torque limit enabled
FunIN.17	N-CL	Negative external torque limit	The torque limit source is switched based on H07.07 (Torque limit source). H07.07 = 1: Valid: Negative external torque limit enabled Invalid: Negative internal torque limit enabled

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H07.09	2007-0Ah	Positive internal torque limit	0.0 to 400.0	350.0	%	Real time	"H07_en.09" on page 812
H07.10	2007-0Bh	Negative internal torque limit	0.0 to 400.0	350.0	%	Real time	"H07_en.10" on page 812

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H07.11	2007-0Ch	Positive external torque limit	0.0 to 400.0	350.0	%	Real time	"H07_en.11" on page 812
H07.12	2007-0Dh	Negative external torque limit	0.0 to 400.0	350.0	%	Real time	"H07_en.12" on page 813

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

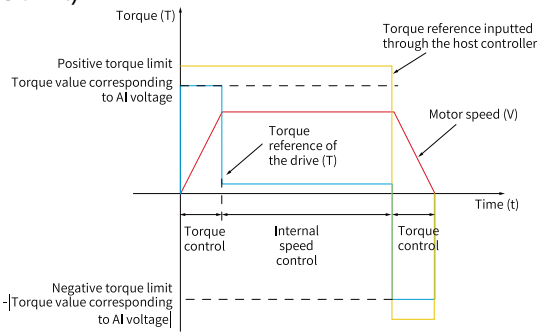


Figure 11-114 AI torque limit curve

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

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

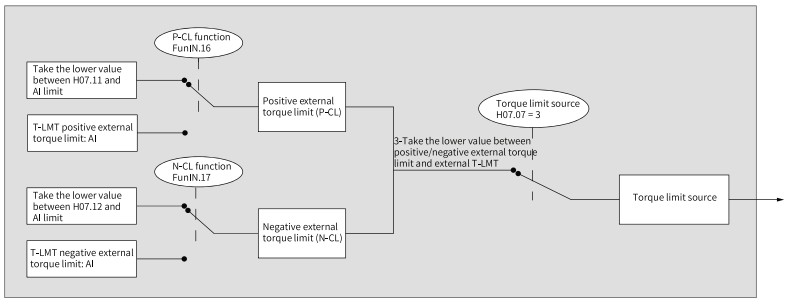
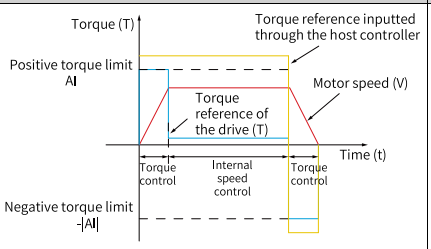
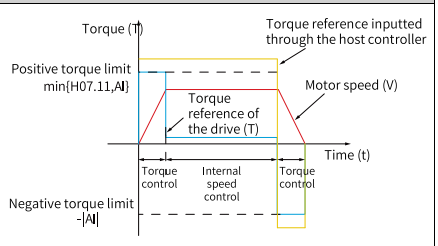
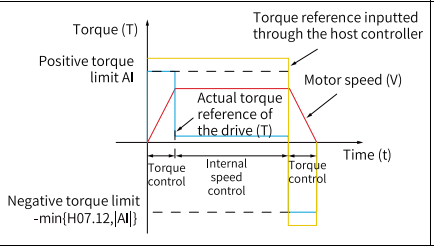
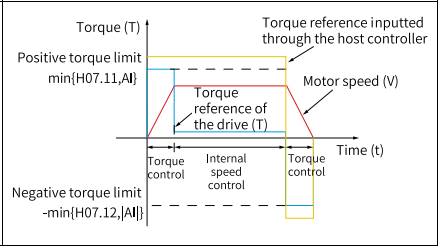


Figure 11-115 Torque limit source (H07.07 = 3)

Table 11–26 Description of H07.07 = 3

<table>
<tr><th colspan="2" rowspan="2">State of DI signal</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>

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

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

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

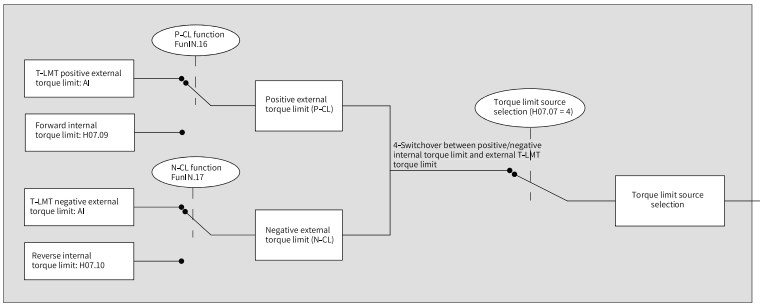
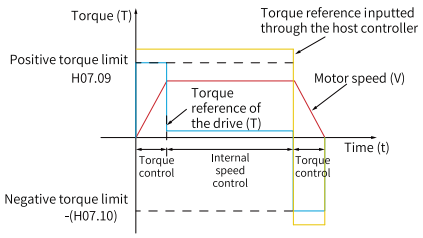
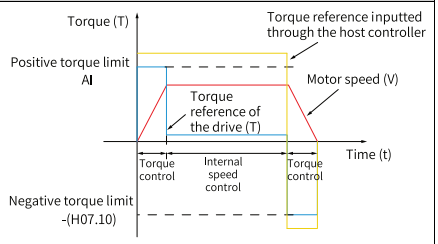
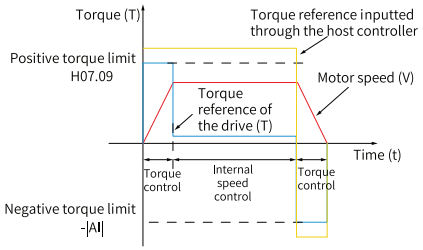
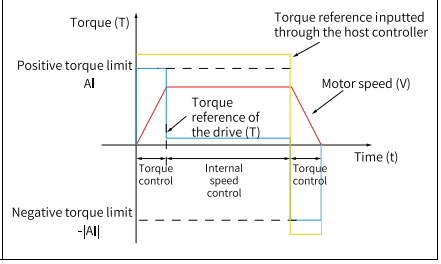


Figure 11-116 Torque limit source (H07.07 = 4)

Table 11–27 Description of H07.07 = 4

State of DI signal		P-CL	
		OFF	ON
N-CL	OFF		
	ON		

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H07.09	2007-0Ah	Positive internal torque limit	0.0 to 400.0	350.0	%	Real time	"H07_en.09" on page 812
H07.10	2007-0Bh	Negative internal torque limit	0.0 to 400.0	350.0	%	Real time	"H07_en.10" on page 812
H07.11	2007-0Ch	Positive external torque limit	0.0 to 400.0	350.0	%	Real time	"H07_en.11" on page 812
H07.12	2007-0Dh	Negative external torque limit	0.0 to 400.0	350.0	%	Real time	"H07_en.12" on page 813

Setting the torque limit DO source [P]

When the torque reference reaches the torque limit, the servo drive outputs the torque limit signal to the host controller. Set a DO terminal of the servo drive with function 7 (FunOUT.7: C-LT, torque limit) and set the terminal logic.

☆ Related parameters:

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

11.11.5 Speed Limit in Torque Control

In the torque control mode, if the torque reference is larger than the load torque on mechanical side, the motor keeps accelerating, which may causes overspeed and damages the machine. Therefore, the motor speed must be limited to protect the machine.

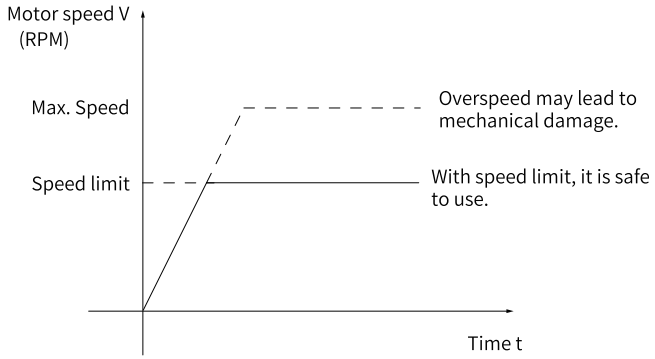


Figure 11-117 Speed limit in the torque control mode

Setting 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 is restricted to within the speed limit. After reaching the speed limit, the motor keeps constant-speed running at the speed limit value. The speed limit must be set according to the load conditions.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H07.17	2007-12h	Speed limit source	0: Internal speed limit 1: V-LMT 2: H07.19 or H07.20 as defined by DI	0	-	Real time	"H07_en.17" on page 813

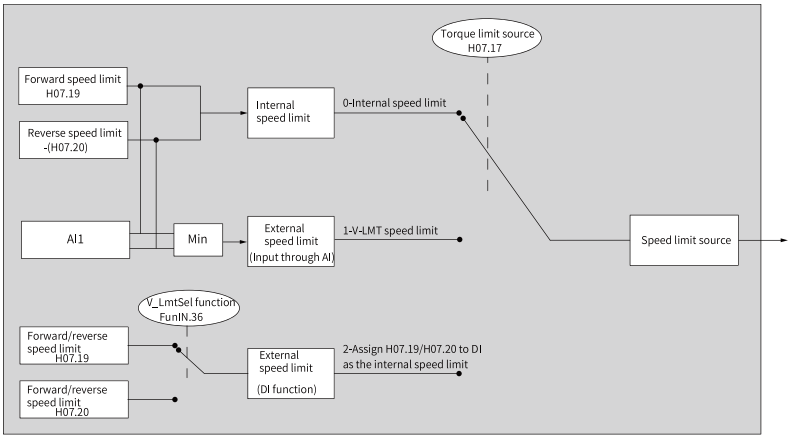


Figure 11-118 Speed limit source

- H07.17 = 0 (Internal speed limit)
  The speed limit is determined only by H07.19 (Positive speed limit) and H07.20 (Negative speed limit).

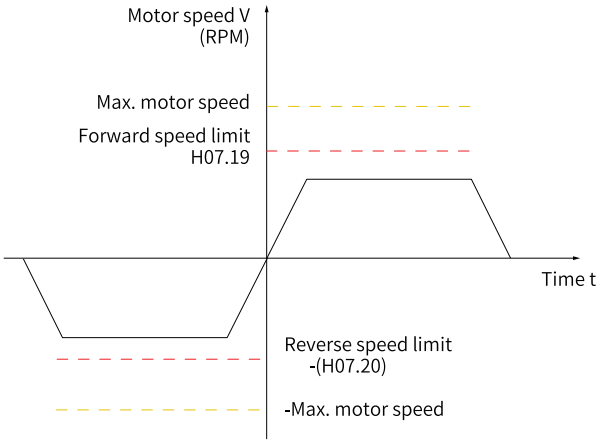


Figure 11-119 Speed limit curve (H07.17 = 0)

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

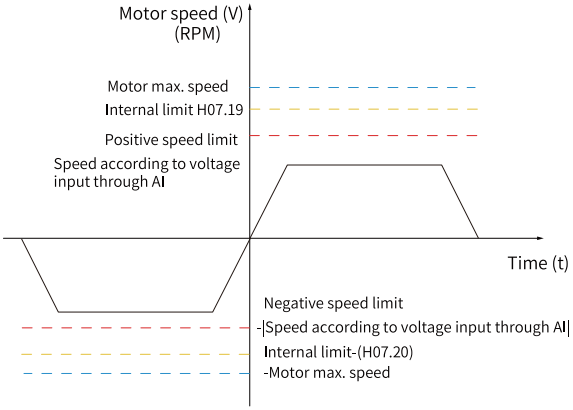


Figure 11-120 Speed limit curve (H07.17 = 1)

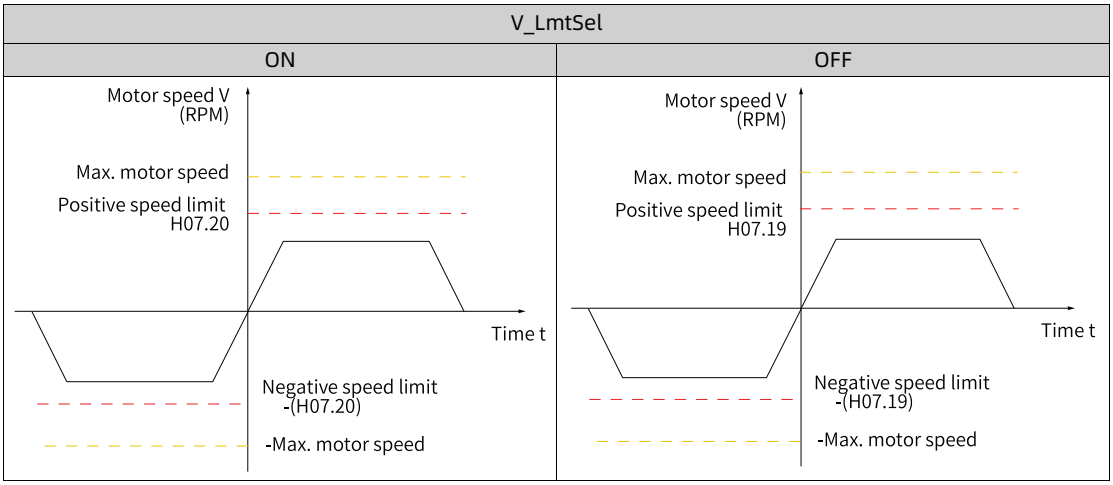
- H07.17 = 2 (H07.19 or H07.20 used as speed limit as defined by DI)
  H07.19 or H07.20 is used as the speed limit based on the logic of the DI.

  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:

No.	Name	Function name	Description
FunIN.36	V_LmtSel	Internal speed limit source	Inactive: H07.19 used as positive/negative internal speed limit Active: H07.20 used as positive/negative internal speed limit

Table 11–28 Speed limit description



☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H07.19	2007-14h	Positive speed limit/Speed limit 1 in torque control	0 to 10000	3000	[mm/s]/[rpm]	Real time	"H07_en.19" on page 814
H07.20	2007-15h	Negative speed limit/Speed limit 2 in torque control	0 to 10000	3000	[mm/s]/[rpm]	Real time	"H07_en.20" on page 814

Setting the speed limit DO source [P]

In torque control mode, the servo drive outputs the V- LT (FunOUT.8: speed limit) signal to the host controller when the absolute value of the motor speed remains above the speed limit in the period defined by H07.40. If any of the conditions is not met, the speed limit signal is invalid.

The speed limit signal (FunOUT.8:V-LT) is judged only in torque mode and servo running state.

Set a DO terminal of the servo drive with function 8 (FunOUT.8:V-LT) and set the terminal logic.

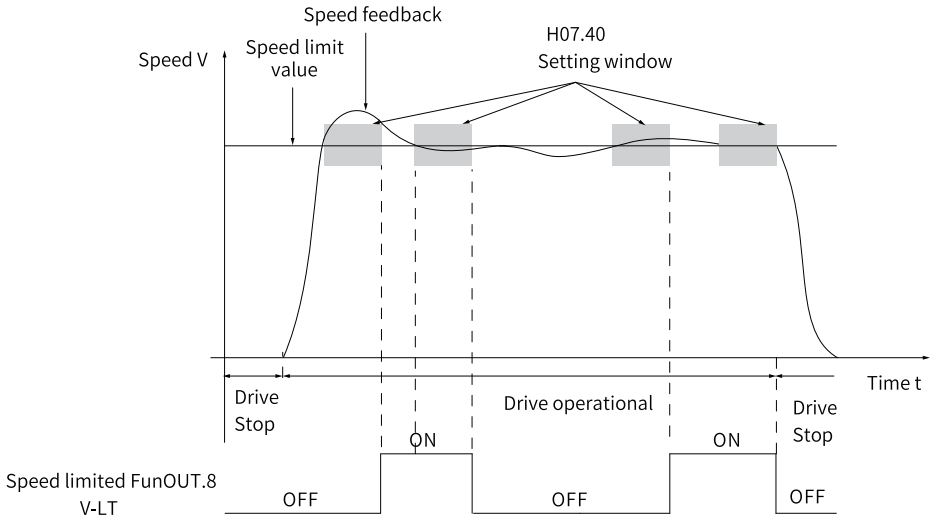


Figure 11-121 Example of speed limit DO waveform

☆ Related parameters:

No.	Name	Function name	Description
FunOUT.8	V-LT	Speed limit	Inactive: The motor speed does not reach the speed limit. Valid: The motor speed reaches the speed limit and speed loop built internally based on the speed limit

11.11.6 Torque reached output

This function is used to determine whether the actual torque reference reaches the setting range. When the actual torque reference reaches the threshold, the servo drive outputs the related DO signal (FunOUT.18: ToqReach, torque reached) to the host controller.

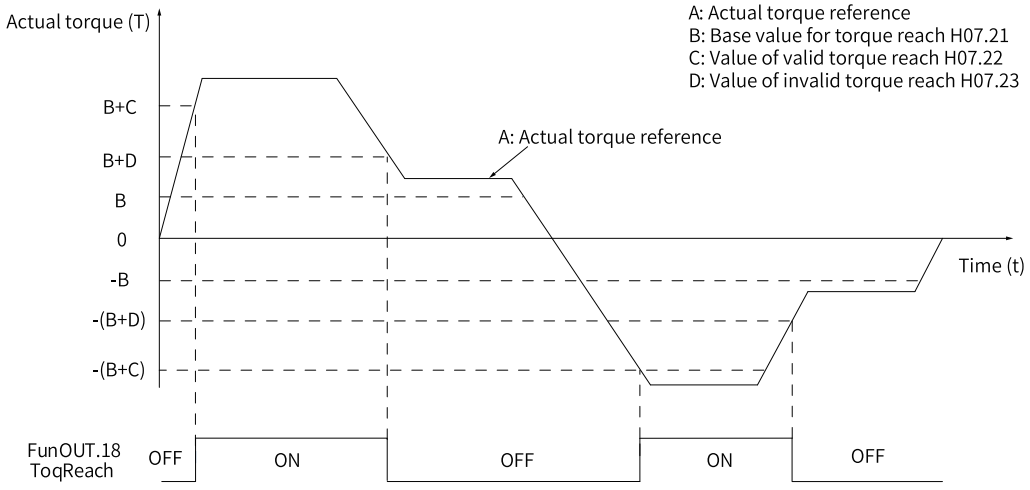


Figure 11-122 Example of torque reached output waveform

- Actual torque reference (viewed in H0b.02): A
- Base value for torque reach (H07.21): B.
- Threshold of valid torque reach H07.22: C

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

C and D are offsets on the basis of B.

The torque reach DO signal can be activated only when the actual torque reference meets the following condition: |A| ≥ B + C. Otherwise, the torque reached signal remains inactive.

The torque reach signal is deactivated only when the actual torque reference meets the following condition: |A| < B + D. Otherwise, the torque reached signal remains active.

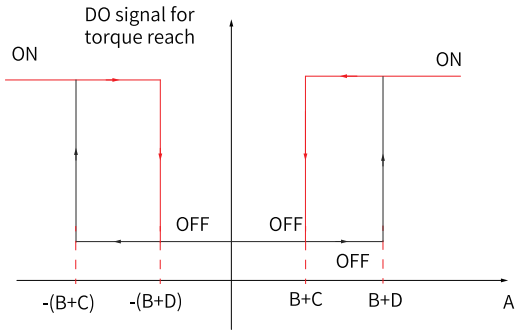


Figure 11-123 Torque reached output active description

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H07.21	2007-16h	Base value for torque arrival	0.0 to 400.0	0.0	%	Real time	"H07_en.21" on page 814
H07.22	2007-17h	Threshold of active torque arrival	0.0 to 400.0	20.0	%	Real time	"H07_en.22" on page 814
H07.23	2007-18h	Threshold of inactive torque arrival	0.0 to 400.0	10.0	%	Real time	"H07_en.23" on page 815

To use the torque reached function, set a DO terminal of the servo drive with function 18 (FunOUT.18: ToqReach, torque reached) and set the terminal logic.

☆ Related parameters:

No.	Name	Function name	Description
FunOUT.18	ToqReach	Torque arrival	Active: The absolute value of the torque reference reaches the setpoint. Inactive: The absolute value of the torque reference is lower than the setpoint.

11.12 Hybrid Control Mode

The hybrid control mode means that the servo drive can switch between different control modes when the S-ON signal is active and the servo status is "run". Switchover between the following modes is supported:

- Torque control mode → Speed control mode
- Speed control mode → Position control mode
- Torque control mode → Position control mode
- Speed control mode → Position control mode → Torque control mode

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H02.00	2002-01h	Control mode selection	0: Speed control mode 1: Position control mode 2: Torque control mode 3: Torque/Speed control mode 4: Speed/Position control mode 5: Torque/Position control mode 6: Torque/Speed/Position compound mode 7: Process segment 8: CANopen mode	1	-	At stop	*" H02_en.00" on page 739*

Set the servo drive parameters of different control modes based on the mechanical structure and specifications. For details, see *" H02_en.00" on page 739*.

When H02.00 is set to 3, 4, or 5, assign a DI with FunIN.10 (M1_SEL, mode switchover 1) and set the active logic of this DI. When H02.00 is set to 6, assign two DIs with FunIN.10 (Mode switchover 1) and FunIN.11 (Mode DI 2) and set the active logic of these two DIs.

☆ Related parameters:

No.	Name	Function name	Function
FunIN.10	M1_SEL	Mode switchover 1	Defines the present control mode during compound control when the servo drive is in the "run" state, as shown in *"Table 11-29" on page 465*.
FunIN.11	M2_SEL	Mode switchover 2	Defines the present control mode during compound control when the servo drive is in the "run" state, as shown in *"Table 11-30" on page 466*.

Table 11-29 Servo drive control mode

H02.00	M1_SEL terminal logic	Control mode
3	Inactive	Torque mode
	Active	Speed mode
4	Inactive	Speed mode
	Active	Position mode
5	Inactive	Torque mode
	Active	Position mode

Table 11–30 Servo drive control mode

H02.00	M2_SEL terminal logic	M1_SEL terminal logic	Control mode
6	-	Active	Position mode
	Active	Inactive	Speed mode
	Inactive	Inactive	Torque mode

Note

It is recommended to switch from other control modes to the position control mode only in the zero speed state.

11.13 Interpolated position (IP) mode

The interpolation mode can be used to achieve synchronous operations of multi-axis servo drives or single-axis servo drives. When the servo drive is not enabled, after the host controller sets the interpolation cycle, the displacement curve is planned in advance according to actual application requirements. When the servo drive is running, different absolute position points on the displacement curve are periodically sent to the slave. The slave synchronously receives the displacement reference, subdivides and evenly transmits the displacement reference increment based on the position loop control cycle. Position control, speed control, and torque control are performed by the servo drive.

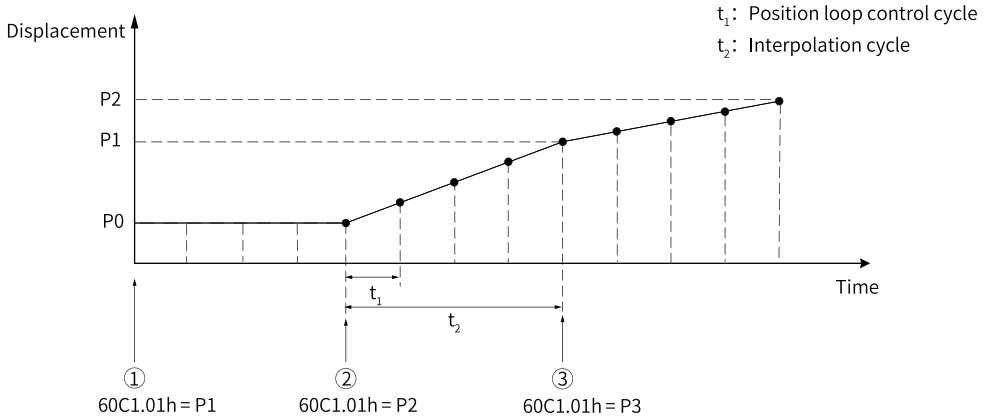
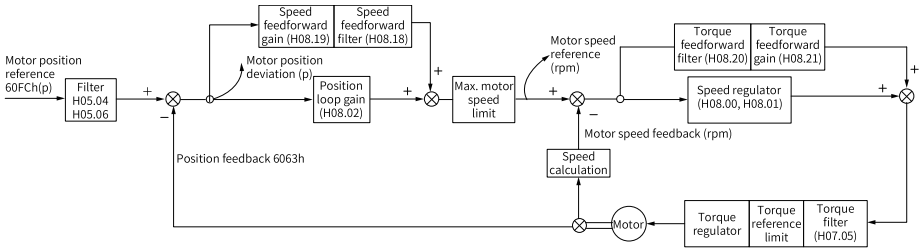


Figure 11-124 Motor displacement profile in single-axis linear interpolation

Note

- 1: The current absolute position of the servo motor is P0. After receiving the first absolute position reference P1, the servo motor starts to plan the first displacement curve.
- 2: The current absolute position of the servo motor is P0. The servo motor starts to move towards the first absolute position P1. After receiving the second absolute position reference P2, the servo motor starts to plan the second displacement curve.
- 3: The servo motor reaches the first absolute position P1 and starts to move towards the second absolute position P2. After receiving the third absolute position reference P3, the servo motor starts to plan the third displacement curve.
- t_1 : Position loop control cycle, which is defined by the servo drive
- t_2 : Interpolation cycle, which can be defined through the object dictionary 60C2h The SV680-INT series servo drive supports a synchronization cycle of 1 ms to 20 ms. Synchronization cycles beyond this range will be restricted by this range.
- P0/P1/P2: absolute position. An absolute position reference is sent through 60C1.1h. The interpolation mode supports absolute position references only.
- The displacement reference increments in each synchronization cycle are P1-P0 and P2-P1.
- When using the interpolation mode, set the position loop period to 1 k.
- The displacement reference increments in each synchronization cycle are P1-P0 and P2-P1.

11.13.1 Function Block Diagram



11.13.2 Configuration Block Diagram

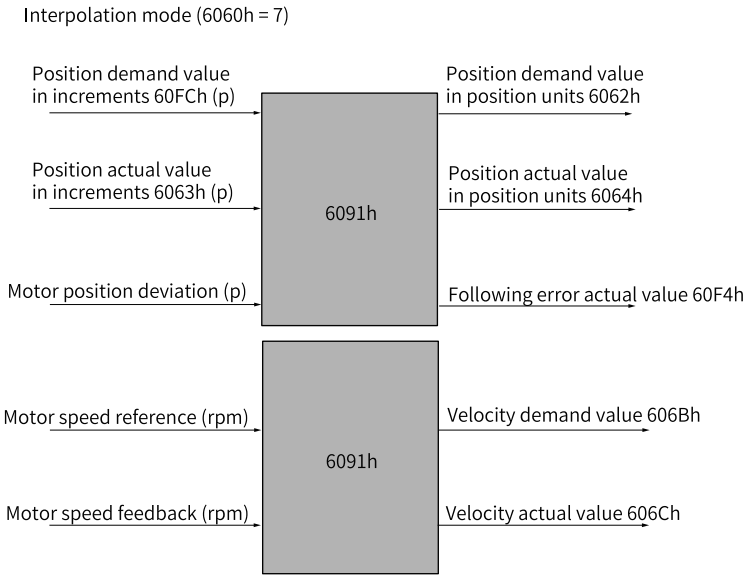


Figure 11-125 IP mode configuration

11.13.3 Recommended Configuration

Basic configuration:

RPDO	TPDO	Remarks
6040h: control word	6041h: status word	Mandatory
60C1.01h: target position	6064h: position actual value	Mandatory
6060h: modes of operation	6061h: modes of operation display	Optional

11.13.4 Related parameters

The control word 6040h in IP mode is described as follows:

6040h **Control word**

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

Value range:

0x0 to 0xFFFF

Description:

Sets the control command.

bit	Name	Setpoint	Description
0 to 3	-	See the relationship between status switching and control commands.	See the object dictionary.
4	Interpolation mode enable	-	0: Interpolation interrupted 1: Interpolation enabled bit4 must remain 1 during interpolation. bit12 of 6041h can be used as a feedback indicating whether the interpolation mode is activated.
5 and 6	N/A	-	-
7 to 15	-	See the relationship between status switching and control commands.	See the object dictionary.

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

Accessibili- Read-only Mapping: TPDO
ty:

Value 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

bit	Name	Setpoint	Description
0 to 9	-	See the relationship between status switching and control commands.	See the object dictionary.
10	Target reached	-	0: Target position not reached 1: Target position reached
11	Software internal limit reached	-	0: The actual position value does not reach the software position limit. 1: The actual position value reaches the software position limit.
12	Interpolation mode activated	-	0: Interpolation is not activated. 1: Interpolation is activated.
13	Position deviation	-	0: Acceptable position deviation 1: Excessive position deviation
14	N/A	-	-
15	HomeAttain	-	0: Homing not performed or completed. 1: Homing is complete and the reference point is found.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
6060h	6060h	Servo drive mode selection	1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 7: Interpolation (IP) mode	0	-	Real time	"6060h" on page 1127
6061h	6061h	Operation mode display	1: Profile position (PP) mode 3: Profile velocity (PV) mode 4: Profile torque (PT) mode 6: Homing (HM) mode 7: Interpolation (IP) mode	0	-	Read-only	"6061h" on page 1127
6064h	6064h	Position feedback	-2147483648 to +2147483647	0	Reference unit	Read-only	"6064h" on page 1128

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
6066h	6066h	Time to trigger excessive position deviation	0 to 65535	0	ms	Real time	"6066h" on page 1129
607Fh	607Fh	Maximum speed	0 to 4294967295	4294967295	Reference unit/s	Real time	"607Fh" on page 1134
60C1.01h	60C1-01h	Interpolation displacement	-2147483648 to +2147483647	0	Reference unit	Real time	"60C1_en.01h" on page 1142
60C2.01h	60C2-01h	Interpolation period time constant	1 to 20	1	-	Real time	"60C2_en.01h" on page 1142
6081h	6081h	Profile velocity	0 to 4294967295	111848106	Reference unit/s	Real time	"6081h" on page 1134
6083h	6083h	Profile acceleration	0 to 4294967295	4294967295	Reference unit/s²	Real time	"6083h" on page 1135
6084h	6084h	Profile deceleration	0 to 4294967295	4294967295	Reference unit/s²	Real time	"6084h" on page 1135

11.13.5 Related Function Settings

Positioning completed

Positioning completed: When position deviation fulfills the set condition, the positioning process is completed. In this case, the servo drive sets bit10 of the status word 6041h, and the host controller, once receives the signal, acknowledges that positioning has been completed.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
6067h	6067h	Position reach threshold	0 to 4294967295	46976	Reference unit	Real time	"6067h" on page 1129
6068h	6068h	Position reach window time	0 to 65535	0	ms	Real time	"6068h" on page 1129

Detection on excessive position deviation

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
6065h	6065h	Threshold of excessive position deviation	0 to 4294967295	219895614	Reference unit	Real time	"6065h" on page 1128

Reference polarity

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
607Eh	607Eh	Reference polarity	0x0 to 0xFF	0x0	-	Real time	"607Eh" on page 1134

11.14 Homing

Caution

- The homing signal is shielded when the position change on fly or multi-position function is running.
- To use the homing function, ensure H11.00 is not set to 5 as the setpoint 5 indicates enhanced axis control mode, in which the homing function is shielded.
- Do not set H05.30=6 or H05.30=8 during motor operation upon receiving references; otherwise speed fluctuations will occur.

Function description

- Home (or mechanical home) refers to the position of the home switch or Z signal. It is defined by parameter H05.31 (Homing mode).
- Zero point refers to the positioning target point, which equals home + offset. It is defined by parameter H05.36. When H05.36 (Mechanical home offset) is set to 0, the zero position coincides with the home.

Homing function: When the S-ON signal is active in position control mode, the servo motor proactively searches for the zero position and completes positioning if the homing function is triggered.

During the homing operation, the servo drive shields the other position references (including the homing reference triggered again). After the homing operation is completed, the servo drive can respond to other position references.

This function includes two actions:

- Home attaining: After receiving the homing signal, the servo drive proactively locates the relative position between the motor shaft and the preset mechanical home reference point. The

drive finds the home and then moves through the offset from the home reference point to the zero point. The homing mode usually applies in initial searching for the zero position.

- Electric home attaining: After finding the absolute zero position, the servo drive moves a certain displacement from the current position.

After the homing operation is completed (including home attaining and electric home attaining), the absolute motor position (H0b.07) is the same as the mechanical home offset (H05.36).

After the homing operation is completed, the servo drive outputs the home attaining completed signal (FunOUT.16: HomeAttain) or electric home attaining completed signal (FunOUT.17: ElecHomeAttain). After receiving this signal, the host controller confirms that the homing operation is completed. These two signals are irrelevant to the servo mode and running state.

Table 11–31 Comparison between homing and electrical homing

Action	Homing mode (H05.30)	Homing direction, deceleration point, and home	Trigger signal	Total motor displacement
Homing	0	-	-	-
	1	Determined by H05.31	HomingStart	Determined by the mechanical home coordinate and offset displacement
	3		Enable servo	
	4		Enable servo	
	6	-	-	-
	8	-	-	-
Electrical homing	2	The homing direction is consistent with the motor displacement sign (+/-). The deceleration point or home signal is not needed.	HomingStart	(H05.36 - H0b.07) × Electronic gear ratio
	5		Enable servo	

Homing

Caution

- Do not set H05.30=6 or H05.30=8 during motor operation upon receiving references. Otherwise, speed fluctuations will occur.
- Set mechanical limit switches before enabling the homing function. For homing upon hit-and-stop, set the offset to a value within the travel range to prevent the machine from collision due to high-speed operation during homing.
- When the motor hits the limit switch during homing, the drive reports E950.0 (Forward overtravel) or E952.0 (Reverse overtravel), and the motor, if H05.40 is set to 0 or 1, stops in the stop mode defined by H02.07.

The following part takes an example to describe homing attaining:

- Forward, home switch as deceleration point and home (H05.31 = 0)
- Reverse, home switch as deceleration point and home (H05.31 = 1)
- Forward, Z signal as deceleration point and home (H05.31 = 2)
- Reverse, Z signal as deceleration point and home (H05.31 = 3)
- H05.31 = 4: Forward direction, deceleration point being home switch signal and home being motor Z signal

- Reverse, home switch as deceleration point and Z signal as home (H05.31 = 5)
- H05.31 = 6: Forward direction, deceleration point and home being forward limit switch signal
- Reverse, negative limit switch as deceleration point and home (H05.31 = 7)
- Forward, positive limit switch as deceleration point and Z signal as home (H05.31 = 8)
- Reverse, negative limit switch as deceleration point and Z signal as home (H05.31 = 9)
- Forward, mechanical limit position as deceleration point and home (H05.31 = 10)
- Reverse, mechanical limit position as deceleration point and home (H05.31 = 11)
- Forward, mechanical limit position as deceleration point and Z signal as home (H05.31 = 12)
- Reverse, mechanical limit position as deceleration point and Z signal as home (H05.31 = 13)
- Forward single-turn homing (H05.31 = 14)
- Reverse single-turn homing (H05.31 = 15)
- Single-turn nearby homing (H05.31 = 16)

Note

In the following figures, "H" represents the high speed defined in 6099.01h, "L" represents the low speed defined in 6099.02h, and "-" indicates reverse run.

- Forward, home switch as deceleration point and home (H05.31 = 0)

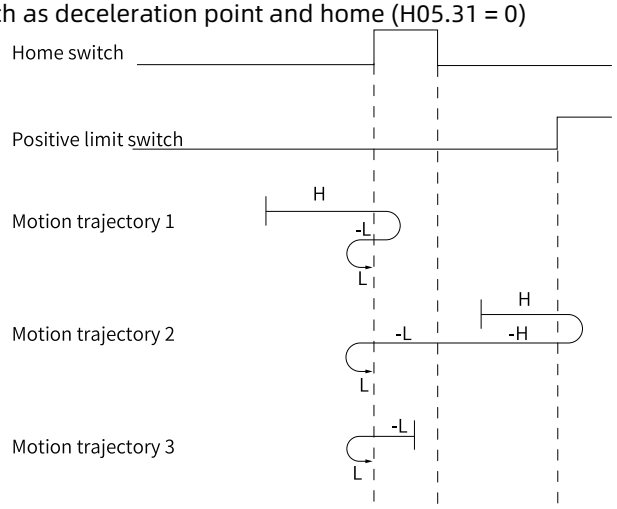


Figure 11-126 Motor running curve and speed in mode 0

  - Motion profile 1: The home switch (deceleration point) signal is active when the motor starts running, with the positive limit switch not triggered in the whole process.
  - Motion profile 2: The home switch (deceleration point) signal is inactive when the motor starts to run, with the positive limit switch triggered.
  - Motion profile 3: The home switch (deceleration point) signal is active when the motor starts running, with the positive limit switch not triggered in the whole process.

- Reverse, home switch as deceleration point and home (H05.31 = 1)

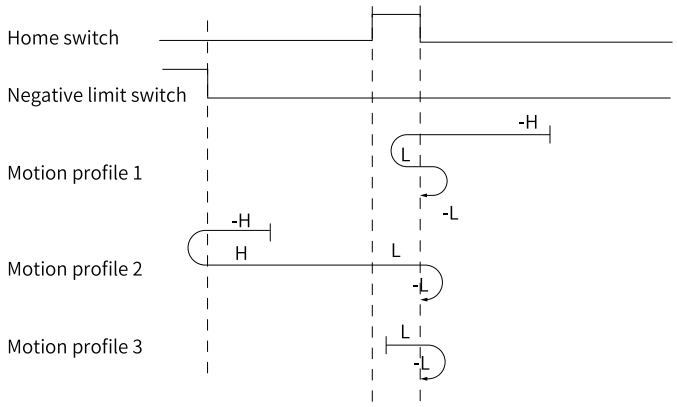


Figure 11-127 Motor operation curve and speed in mode 1

- Motion profile 1: The home switch (deceleration point) signal is active when the motor starts running, with the positive limit switch not triggered in the whole process.
- Motion profile 2: The home switch (deceleration point) signal is inactive when the motor starts running, with the negative limit switch triggered.
- Motion profile 3: The home switch (deceleration point) signal is active when the motor starts running, with the negative limit switch not triggered in the whole process.

- Forward, Z signal as deceleration point and home (H05.31 = 2)

Caution

Note: In Modes 2 and 3 (H05.31 = 2 or 3) where the motor Z signal acts as the home and deceleration point, the actual stop position of the motor may not be on the rising edge on the same side of the motor Z signal. A deviation of ±1 pulse (in encoder unit) may be present in the stop position.

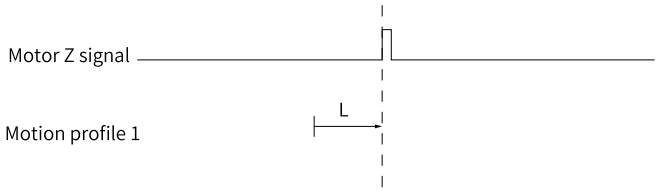


Figure 11-128 Motor operation curve and speed in mode 2

- Motion profile 1: The Z signal is inactive when the motor starts running, with the positive limit switch not triggered in the whole process.

- Reverse, Z signal as deceleration point and home (H05.31 = 3)

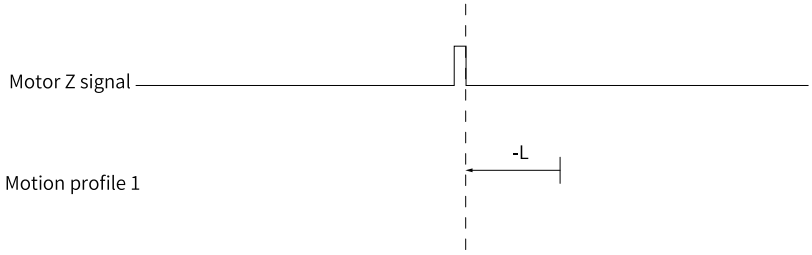


Figure 11-129 Motor operation curve and speed in mode 3

- Motion profile 1: The Z signal is inactive when the motor starts running, with the negative limit switch not triggered in the whole process.

- H05.31 = 4: Forward direction, deceleration point being home switch signal and home being motor Z signal

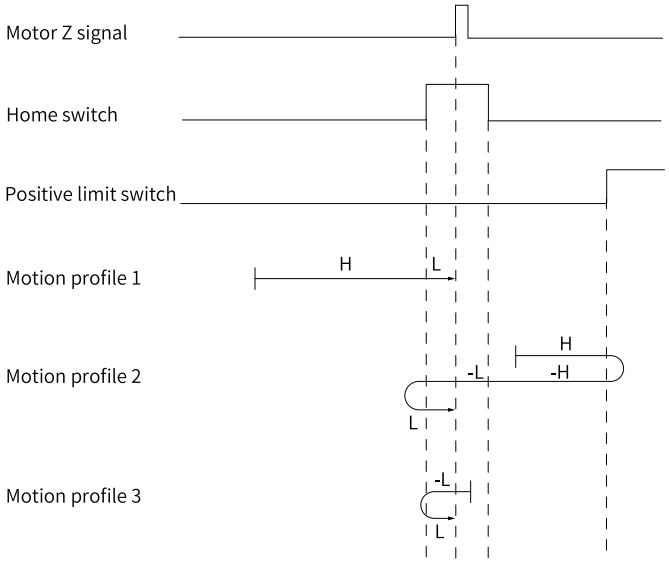


Figure 11-130 Motor running curve and speed in mode 4

- Motion profile 1: The home switch signal is inactive when the motor starts running, with the positive limit switch not triggered in the whole process.
- Motion profile 2: The home switch signal is inactive when the motor starts running, with the positive limit switch triggered.
- Motion profile 3: The home switch signal is active when the motor starts running, with the positive limit switch not triggered in the whole process.

- Reverse, home switch as deceleration point and Z signal as home (H05.31 = 5)

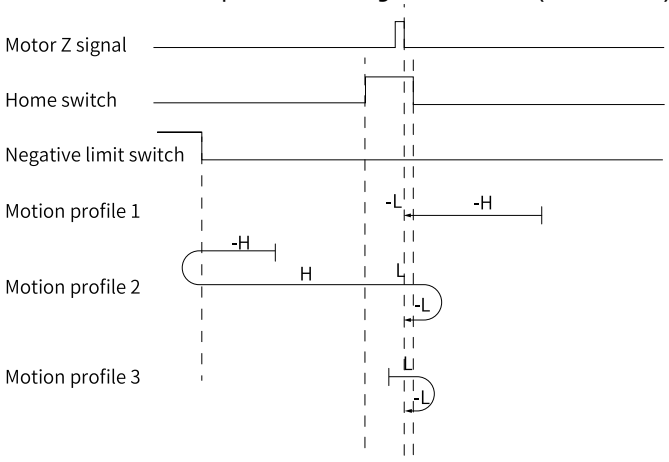


Figure 11-131 Motor running curve and speed in mode 5

- Motion profile 1: The home switch signal is inactive when the motor starts running, with the positive limit switch not triggered in the whole process.
- Motion profile 2: The home switch signal is inactive when the motor starts running, with the positive limit switch triggered.

- Motion profile 3: The home switch signal is active when the motor starts running, with the negative limit switch not triggered in the entire process.

- H05.31 = 6: Forward direction, deceleration point and home being forward limit switch signal

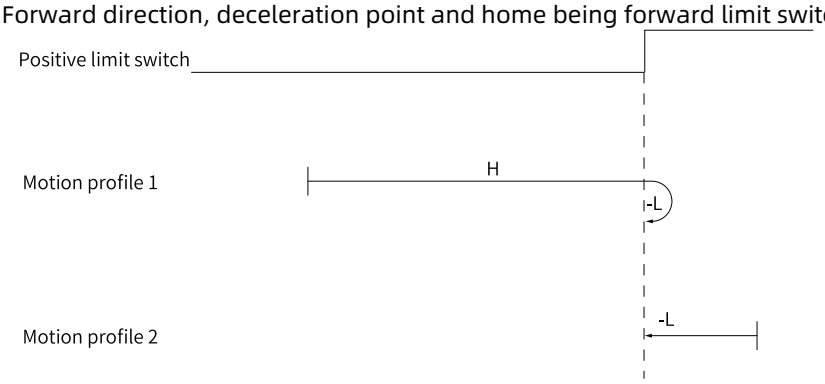


Figure 11-132 Motor running curve and speed in mode 6

- Motion profile 1: The positive limit switch signal is inactive when the motor starts running.
- Motion profile 2: The positive limit switch signal is active when the motor starts running.

- Reverse, negative limit switch as deceleration point and home (H05.31 = 7)

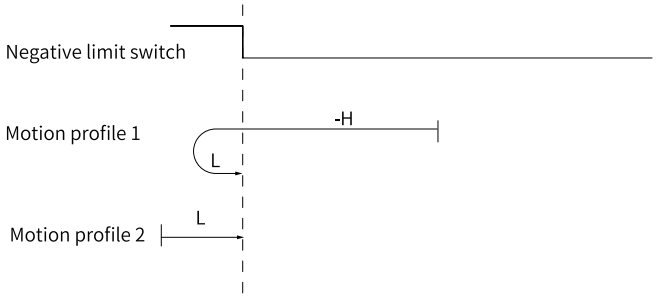


Figure 11-133 Motor operation curve and speed in mode 7

- Motion profile 1: The negative limit switch signal is inactive when the motor starts running.
- Motion profile 2: The negative limit switch signal is active when the motor starts running.

- Forward, positive limit switch as deceleration point and Z signal as home (H05.31 = 8)

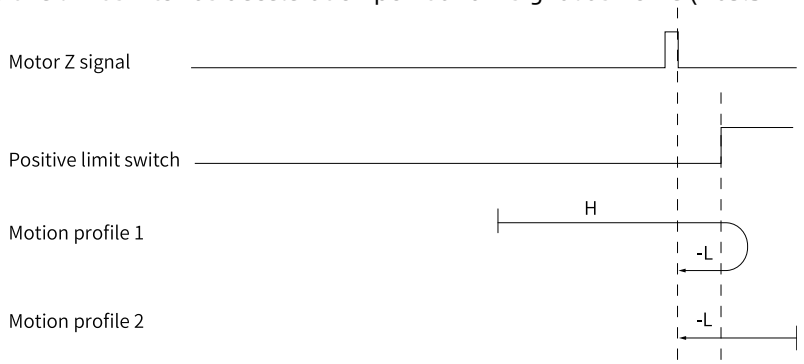


Figure 11-134 Motor running curve and speed in mode 8

- Motion profile 1: The positive limit switch signal is inactive when the motor starts running.
- Motion profile 2: The positive limit switch signal is active when the motor starts running.

- Reverse, negative limit switch as deceleration point and Z signal as home (H05.31 = 9)

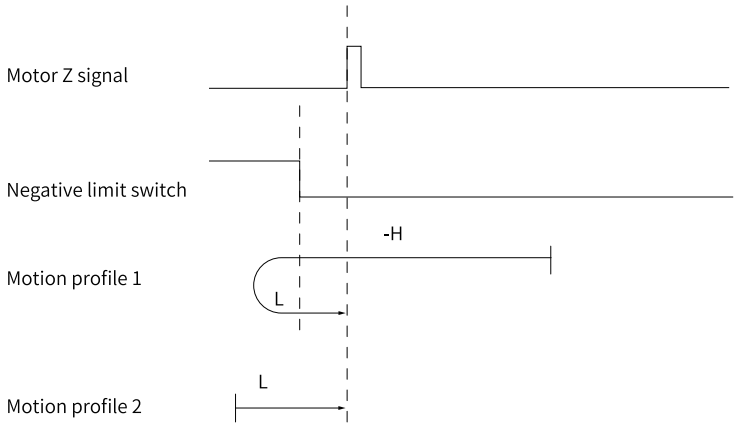


Figure 11-135 Motor running curve and speed in mode 9

- Motion profile 1: The negative limit switch signal is inactive when the motor starts running.
- Motion profile 2: The negative limit switch signal is active when the motor starts running.

- Forward, mechanical limit position as deceleration point and home (H05.31 = 10)

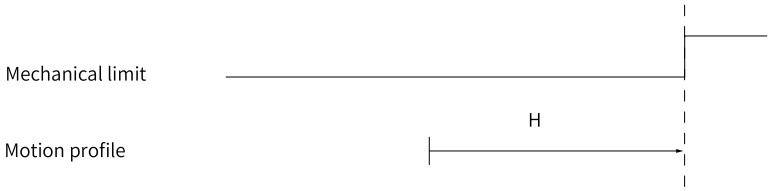


Figure 11-136 Motor running curve and speed in mode 10

- Motion profile: The positive limit switch signal is inactive when the motor starts running.

- Reverse, mechanical limit position as deceleration point and home (H05.31 = 11)

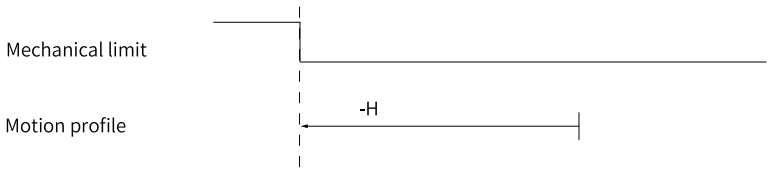


Figure 11-137 Motor running curve and speed in mode 11

- Motion profile: The negative limit switch signal is inactive when the motor starts running.

- Forward, mechanical limit position as deceleration point and Z signal as home (H05.31 = 12)

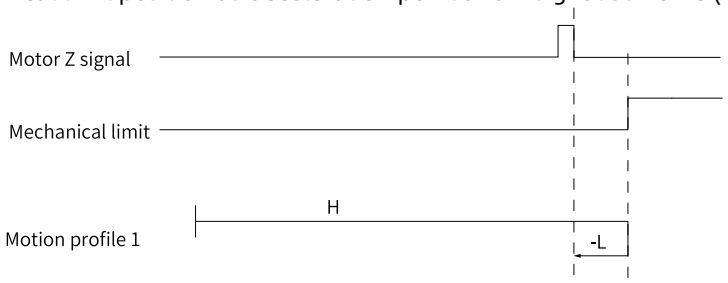


Figure 11-138 Motor running curve and speeds in mode 12

- Motion profile 1: The positive limit switch signal is inactive when the motor starts running.

- Reverse, mechanical limit position as deceleration point and Z signal as home (H05.31 = 13)

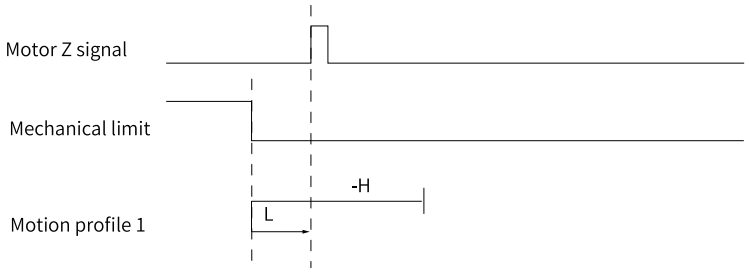


Figure 11-139 Motor running curve and speed in mode 13

- Motion profile 1: The negative limit switch signal is inactive when the motor starts running.

- Forward single-turn homing (H05.31 = 14)

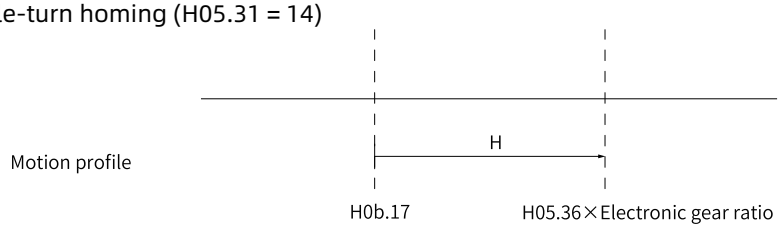


Figure 11-140 Motor running curve and speed in mode 14

- Motion profile: The positive limit switch signal is inactive when the motor starts running.

Note

- When H05.31=14/15/16, the single-turn homing is only effective in absolute position single-turn mode (H02.01 = 4).
- If the home offset is set (H05.36 ≠ 0) and the mechanical home does not coincide with the mechanical zero (H05.40 = 0 or 2), the motor keeps running until H0b.07 = H05.36, and the absolute position defined by H0b.07 is cleared.
- If the home offset is set (H05.36 ≠ 0) and the mechanical home coincides with the mechanical zero (H05.40 = 1 or 3), the motor keeps running until H0b.07 = 0.

- Reverse single-turn homing (H05.31 = 15)

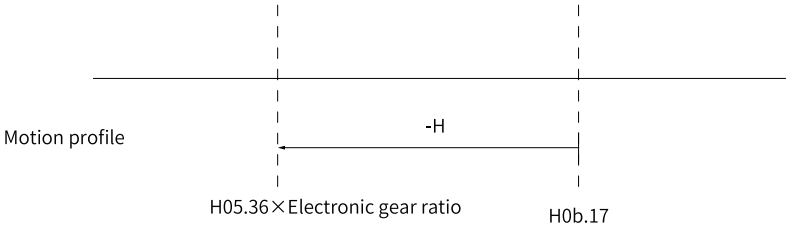


Figure 11-141 Motor running curve and speed in mode 15

- Motion profile: The negative limit switch signal is inactive when the motor starts running.

Note

- When H05.31=14/15/16, the single-turn homing is only effective in absolute position single-turn mode (H02.01 = 4).
- If the home offset is set (H05.36 ≠ 0) and the mechanical home does not coincide with the mechanical zero (H05.40 = 0 or 2), the motor keeps running until H0b.07 = H05.36, and the absolute position defined by H0b.07 is cleared.
- If the home offset is set (H05.36 ≠ 0) and the mechanical home coincides with the mechanical zero (H05.40 = 1 or 3), the motor keeps running until H0b.07 = 0.

- Single-turn nearby homing (H05.31 = 16)

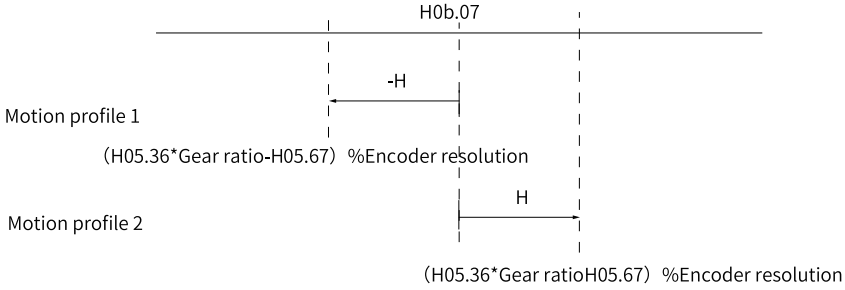


Figure 11-142 Motor running curve and speed in mode 16

- Motion profile 1: The positive limit switch signal is inactive when the motor starts running.
- Motion profile 2: The negative limit switch signal is inactive when the motor starts running.

Note

- When H05.31=14/15/16, the single-turn homing is only effective in absolute position single-turn mode (H02.01 = 4).
- If the home offset is set (H05.36 ≠ 0) and the mechanical home does not coincide with the mechanical zero (H05.40 = 0 or 2), the motor keeps running until H0b.07 = H05.36, and the absolute position defined by H0b.07 is cleared.
- If the home offset is set (H05.36 ≠ 0) and the mechanical home coincides with the mechanical zero (H05.40 = 1 or 3), the motor keeps running until H0b.07 = 0.

Evaluation condition for torque homing: After the motor reaches the hard limit, and the torque feedback reaches the limit value defined in H05.58 (mechanical torque limit, in 0.1%), the first Z signal in the reverse direction is searched for and regarded as the home after the motor stops.

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

The mechanical zero position is obtained after homing is done. In this case, you can make the motor move from current position (H0b.07) to the designated position (H05.36) by setting H05.36.

In electrical homing mode, the motor runs at the speed defined by H05.32 in the direction defined by the sign (+/-) of the displacement value. The total displacement is determined by the difference between H05.36 and H0b.07. The motor stops immediately after the displacement reference is done executing.

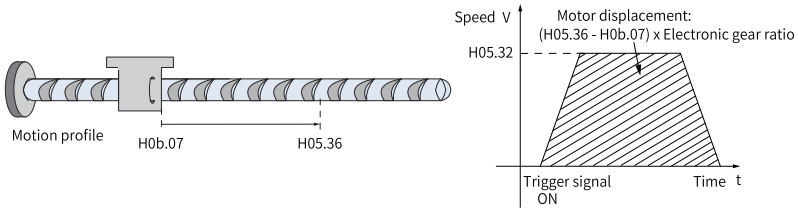
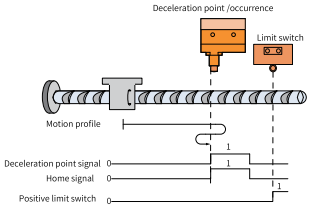
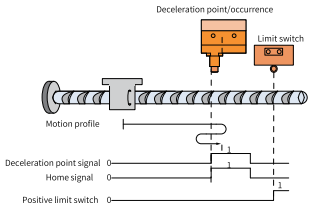
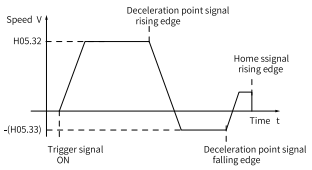
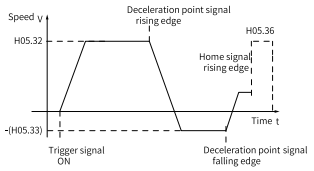


Figure 11-143 Motor running curve and speed of electrical homing

Mechanical home and mechanical zero

The following takes "H05.30 = 0" as an example to describe the difference between mechanical home and mechanical zero.

Table 11–32 Difference between mechanical home and mechanical zero

Mechanical zero different from mechanical Home Reference Point	Mechanical Zero Same As Mechanical Home Reference Point
If the home offset is present (H05.36 ≠ 0) and the mechanical home differs from the mechanical zero (H05.40 = 0 or 2), the motor stops immediately after reaching the rising edge of the home signal during acceleration or forward operation at constant speed. After stop, the motor absolute position (H0b.07) is changed to the setpoint of H05.36 (Mechanical home offset) forcibly.	If the home offset is present (H05.36 ≠ 0) and the mechanical home coincides with the mechanical zero (H05.40 = 1 or 3), the motor continues running after reaching the rising edge of the home switch signal during acceleration or forward operation at constant speed until the absolute position (H0b.07) reaches the setpoint of H05.36 (Mechanical home offset).
	
	

Configuring parameters

- Setting the homing mode

  ☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.30	2005-1Fh	Homing enable selection	0: Disabled 1: Homing enabled through the HomingStart signal input from DI 2: Electrical homing enabled through the HomingStart signal input from DI 3: Homing started immediately upon power-on 4: Homing executed immediately 5: Electrical homing started 6: Current position as home 8: D-triggered position as home	0	-	Real time	"H05_en.30" on page 782
H05.31	2005-20h	Mode of home return	0: Forward, home switch as deceleration point and home 1: Reverse, home switch as deceleration point and home 2: Forward, Z signal as deceleration point and home 3: Reverse, motor Z signal as deceleration point and home 4: Forward, home switch as deceleration point and Z signal as home 5: Reverse, home switch as deceleration point and Z signal as home 6: Forward, positive limit switch as deceleration point and home 7: Reverse, negative limit switch as deceleration point and home 8: Forward, positive limit switch as deceleration point and Z signal as home 9: Reverse, negative limit switch as deceleration point and Z signal as home 10: Forward, mechanical limit position as deceleration point and home 11: Reverse, mechanical limit position as deceleration point and home 12: Forward, mechanical limit position as deceleration point and Z signal as home 13: Reverse, mechanical limit position as deceleration point and Z signal as home 14: Forward single-turn homing 15: Reverse single-turn homing 16: Nearby single-turn homing	0	-	Real time	"H05_en.31" on page 783

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.40	2005-29h	Mechanical home offset and action upon overtravel	0: H05.36 as the coordinate after homing, reverse homing applied after homing triggered again on overtravel 1: H05.36 as the relative offset after homing, reverse homing applied after homing triggered again on overtravel 2: H05.36 as the coordinate after homing, reverse homing auto-applied on overtravel 3: H05.36 as the relative offset after homing, reverse homing auto-applied on overtravel	0	-	Real time	"H05_en.40" on page 786

- Setting the homing running curve

  If the home switch signal is turned on after the deceleration signal becomes active but deceleration is insufficient, the positioning may be inaccurate. Take the displacement required by deceleration into account before setting the deceleration point and homing signal input position. The acceleration/deceleration time during homing (H05.34) also affect the positioning stability.

  ☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.32	2005-21h	Speed in high-speed searching for home switch signal	0 to 3000	100	[mm/s]/[rpm]	Real time	"H05_en.32" on page 784
H05.33	2005-22h	Speed in low-speed searching for home switch signal	0 to 1000	10	[mm/s]/[rpm]	Real time	"H05_en.33" on page 784
H05.34	2005-23h	Acceleration/Deceleration time during homing	0 to 1000	1000	ms	Real time	"H05_en.34" on page 784
H05.35	2005-24h	Home search time limit	0 to 65535	10000	-	Real time	"H05_en.35" on page 785
H05.36	2005-25h	Mechanical home offset	-2147483648 to +2147483647	0	Reference unit	Real time	"H05_en.36" on page 785

  ☆ Related parameters:

No.	Name	Function name	Function
FunIN.31	HomeSwitch	Home switch	Active: Current position as home Set the logic of the DI terminal with this function to high/low-level triggered according to the output of the host controller. See the following table.
FunIN.32	HomingStart	Homing	Active: Homing enabled (The HomingStart signal cannot be triggered repeatedly during homing.) Inactive: Homing inhibited
FunIN.41	HomingRecord	DI-triggered point as the home	The edge-triggered position is taken as the home.
FunOut.16	HomeAttain	HomeAttain	Active: Homing completed in position control mode Inactive: Homing not completed
FunOut.17	ElecHomeAttain	Electrical homing completed	Valid: Electrical home attaining completed in position control mode Invalid: Electrical home attaining not completed

Logic of DI with HomeSwitch	Actual valid level
0 (Low level)	Low level
1 (High level)	High level

Sequence

- H05.30 = 1 or 2

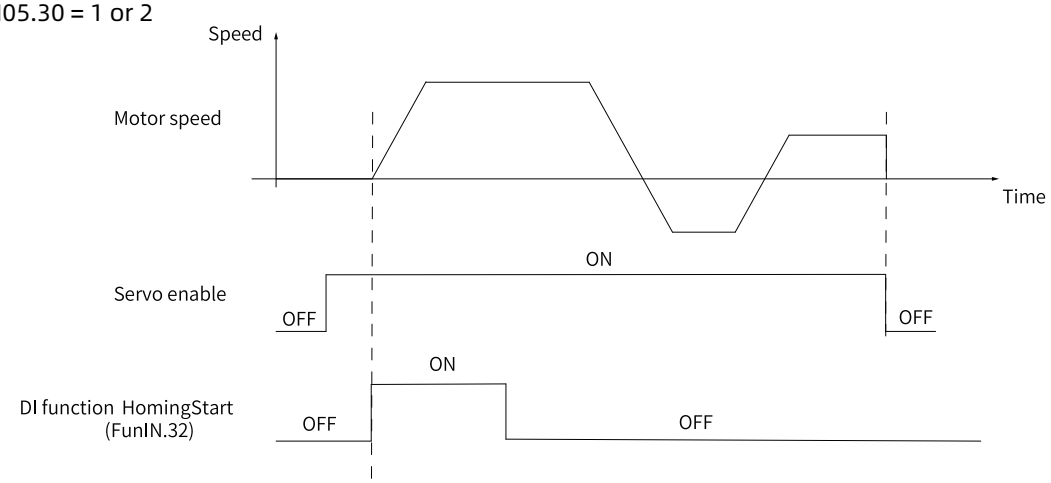


Figure 11-144 Example of time sequence diagram

  - Switch on the S-ON signal first and then the HomingStart signal.
  - During homing, the S-ON signal remains active and the change of the HomingStart signal is shielded.
  - During homing, the motor stops if the S-ON signal is switched off. To enable homing again, switch on the S-ON signal first and then the HomingStart signal.
  - If E601.0 (Homing timeout) occurs, the motor stops, but the S-ON signal remains active. In this case, trigger the HomingStart signal again to reset E601.0, and execute homing again.
  - The homing operation can be triggered repeatedly.

- H05.30 = 3

- The homing operation is executed only when the S-ON signal is switched on for the first time after power-on.
- The motor stops when E601.0 (Homing timeout) occurs. To reset E601.0, deactivate the S-ON signal.
- The homing operation can only be triggered again at next power-on.

- H05.30 = 4 or 5
  - The homing operation is executed immediately after the S-ON signal is switched on upon power-on.
  - If the S-ON signal is deactivated during homing, the motor stops immediately. To trigger homing again, activate the S-ON signal again.
  - When E601.0 (Homing timeout) occurs, H05.30 is set to 0 and the motor stops. To reset E601.0, deactivate the S-ON signal. To perform homing again, reset H05.30. After homing is done, H05.30 is set to 0. To perform homing again, set H05.30 again.
- H05.30 = 6
  - To take the current position as the home and achieve home offset (H05.40 = 0 or 2, H05.36 ≠ 0), set H05.36 and H05.40 first, and then set H05.30 to 6. Otherwise, H0b.07 retains the previous value of H05.36 rather than the one set currently.
  - After homing is done, H05.30 will be set to 0. To enable homing again, re-write H05.36 and set H05.30 to 6.
- H05.30 = 8
  - To take the DI-triggered position as the home, assign FunIN.41 to a DI first and set the current position as the home.
  - To enable home offset (H05.40 = 0 or 2, H05.36 ≠ 0), set H05.36 and H05.40 first, and then set H05.30 to 6. Otherwise, H0b.07 retains the previous value of H05.36 rather than the one set currently.

11.15 Interrupt Positioning

Caution

The interrupt positioning signal cannot be triggered during homing.

Function description

If interrupt positioning is triggered in position control mode, the servo drive halts the current operation and turns to executing the pre-set position reference. To be specific, when the servo ON signal is active in position control mode, if this function is enabled, the servo motor runs the position reference for position change on fly in the original direction (before the function is triggered).

When interrupt positioning is in progress, the servo drive does not respond to any other internal/external position references (including another interrupt positioning command). In this case, the input position reference counter (H0b.13) counts only the interrupt positioning reference. After

interrupt positioning is done, the servo drive may or may not respond to the position references depending on the setpoint of H05.29 (Interrupt positioning clear signal). The position references received during interrupt positioning are invalid.

After the running of this function is complete, the servo drive outputs the position change on fly completed signal (FunOUT.15:XintCoin) and positioning completed signal (FunOUT.5:COIN) signal simultaneously. After receiving the position change on fly completed signal, the host controller confirms that the running of this function is complete. The output of the position change on fly completed signal is irrelevant to the S-ON signal and DI8 terminal logic.

This function takes effect on the following conditions:

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

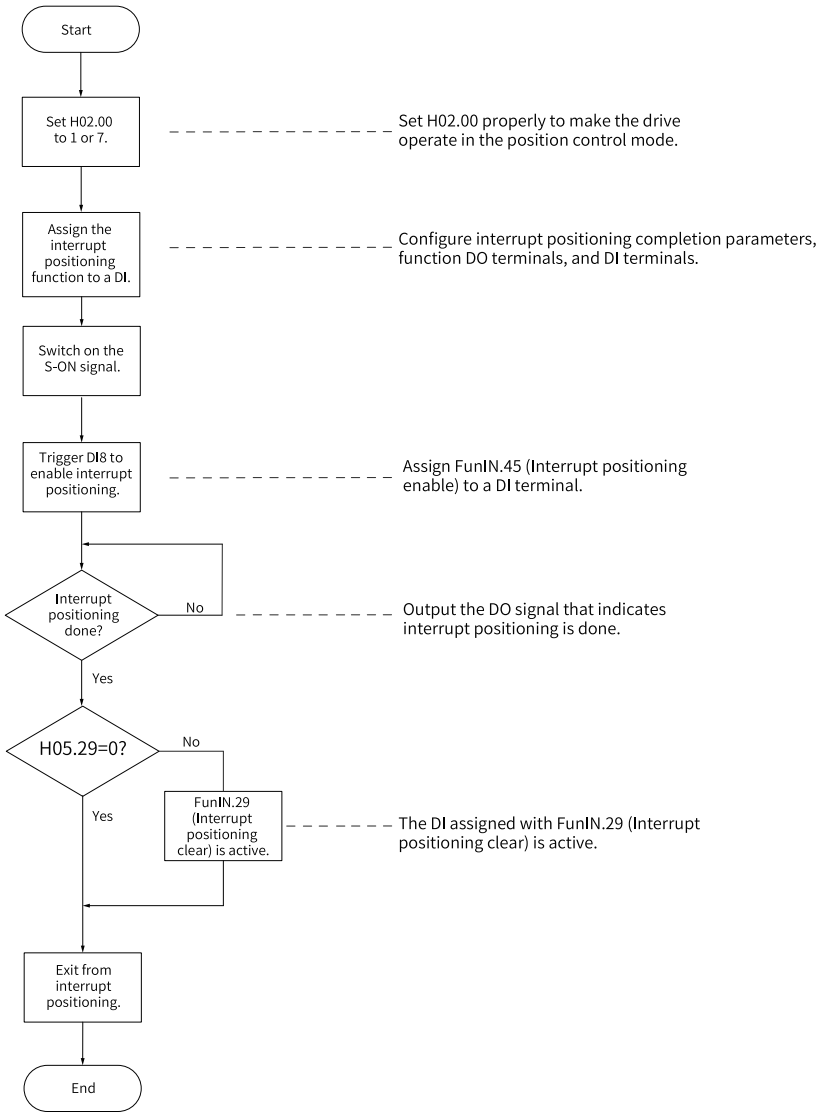


Figure 11-145 Setting flowchart of interrupt positioning

Configuring parameters

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.24	2005-19h	Displacement of interrupt positioning	-1073741824 to 1073741824	10000	Reference unit	Real time	"H05_en.24" on page 781
H05.26	2005-1Bh	Constant operating speed in interrupt positioning	0 to 10000	200	[mm/s]/[rpm]	Real time	"H05_en.26" on page 781
H05.27	2005-1Ch	Acceleration/Deceleration time of interrupt positioning	0 to 65535	10	ms	Real time	"H05_en.27" on page 782
H05.29	2005-1Eh	Interrupt positioning cancellation signal	0: Disable 1: Enable	1	-	Real time	"H05_en.29" on page 782

☆ Related parameters:

No.	Name	Function name	Function
FunIN.29	XintFree	Interrupt positioning clear	Active: The interrupt positioning state is cleared, which means the servo drive can respond to other position references. Inactive: The interrupt positioning signal is retained, and the servo drive does not respond to other position references.
FunIN.33	XintInHibit	Interrupt positioning inhibited	Active: Interrupt positioning inhibited Invalid: Interrupt positioning allowed
FunIN.45	XintEn	Interrupt positioning enable	Active: Interrupt positioning enabled Inactive: Interrupt positioning disabled The DI assigned with FunIN.45 (Interrupt positioning enable) is used to trigger interrupt positioning.
FunOut.15	XintCoin	Interrupt positioning completed	Active: In position control mode, interrupt positioning is completed. Inactive: In position control mode, interrupt positioning is not completed.

When DI7 is assigned with FunIN.45, the active logic of DI7 is as follows:

Table 11–33 Active logic of DI7 during interrupt positioning

H03.15	Active Logic of DI7
0	Low level triggered
1	High level triggered

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

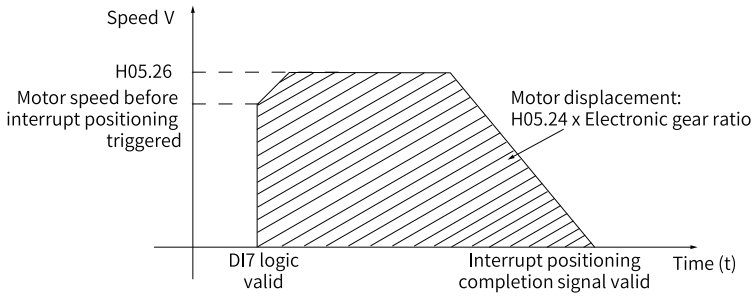


Figure 11-146 Motor running curve of interrupt positioning

Table 11–34 Motor speed for interrupt positioning

H05.26	Motor speed (rpm) before triggering interrupt positioning	Interrupt positioning status	Constant operating speed in interrupt positioning
0	< 10	Inactive	-
	≥ 10	Active	Motor speed before interrupt positioning is triggered
1 to 6000	-	Active	H05.26

12 Common Functions

12.1 Absolute System

12.1.1 Overview

- For 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 SV680-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, speed, 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 when power is restored, eliminating the need to repeat mechanical homing operations. Set H02.01 (Absolute system selection) according to the actual applicable 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 12–1 Absolute modes supported by the motor for SV680-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	√	√	√	√
DDR 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.

12.1.2 Related Parameters

Absolute encoder system settings

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H00.00	2000-01h	Motor code	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	14102	-	At stop	"H00_en.00" on page 727
H00.08	2000-09h	Bus encoder type	0 to 65535	0	-	At stop	"H00_en.08" on page 729

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H02.01	2002-02h	Absolute system selection	0: Incremental mode 1: Absolute position linear mode 2: Absolute position rotation mode 3: Absolute position linear mode (without encoder overflow alarm) 4: Absolute position single-turn mode	0	-	At stop	"H02_en.01" on page 739

Note

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

Encoder feedback data

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0b.70	200b-47h	Number of the absolute encoder revolutions	-32768 to +32767	0	Rev	Read-only	"H0b_en.70" on page 884
H0b.71	200b-48h	Position of absolute encoder within one turn	0 to 2147483647	0	Encoder unit	Read-only	"H0b_en.71" on page 884
H0b.77	200b-4Eh	Encoder position (32 low-order bits)	0 to 4294967295	0	Encoder unit	Read-only	"H0b_en.77" on page 885
H0b.79	200b-50h	Encoder position (32 high-order bits)	-2147483648 to +2147483647	0	Encoder unit	Read-only	"H0b_en.79" on page 885

Absolute position linear mode

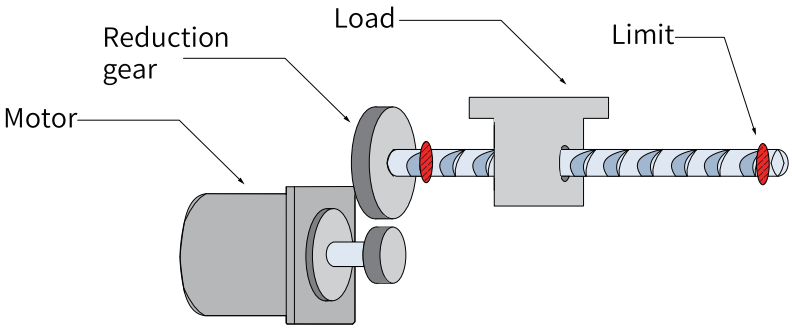


Figure 12-1 Application of the linear mode of the servo motor

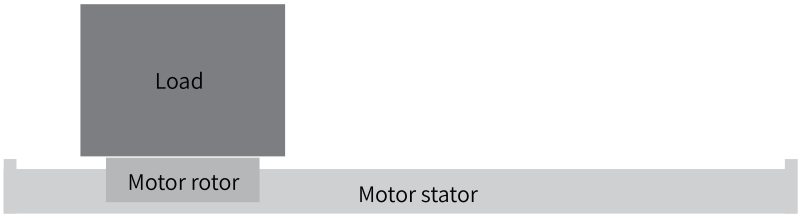


Figure 12-2 Application of the linear mode of the servo motor

V680-INT is compatible with DDL motors and BiSS-C and EnDat 2.2 encoders, and is applicable to the Absolute position linear mode.

If the electronic gear ratio is B ÷ A, the mechanical absolute position (H0b.58 and H0b.60) is P_M, then the following formula applies: H0b.07 (Absolute position counter) = $P_M \div (B \div A)$. H0b.07 indicates present mechanical absolute position (in reference unit).

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.36	2005-25h	Mechanical home offset	-2147483648 to +2147483647	0	Reference unit	Real time	"H05_en.36" on page 785
H05.46	2005-2Fh	DI selection of multi-turn frequency-division Z starting point	0: No selection 1: DI1 2: DI2 3: DI3 4: DI4 5: DI5 6: DI6 7: DI7 8: DI8	0	-	Real time	"H05_en.46" on page 789

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0b.07	200b-08h	Absolute position counter	-2147483648 to +2147483647	0	Reference unit	Read-only	"H0b_en.07" on page 872
H0b.58	200b-3Bh	Mechanical absolute position (32 low-order bits)	0 to 4294967295	0	Encoder unit	Read-only	"H0b_en.58" on page 882
H0b.60	200b-3Dh	Mechanical absolute position (32 high-order bits)	-2147483648 to +2147483647	0	Encoder unit	Read-only	"H0b_en.60" on page 883

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.

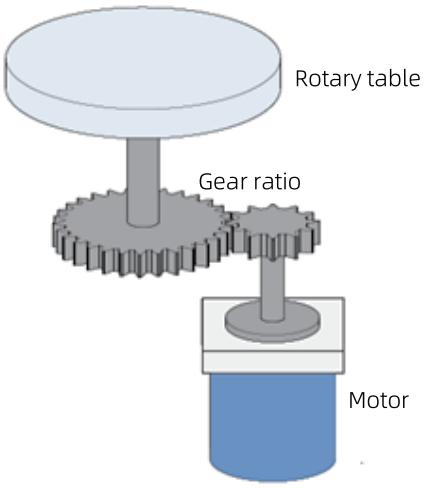
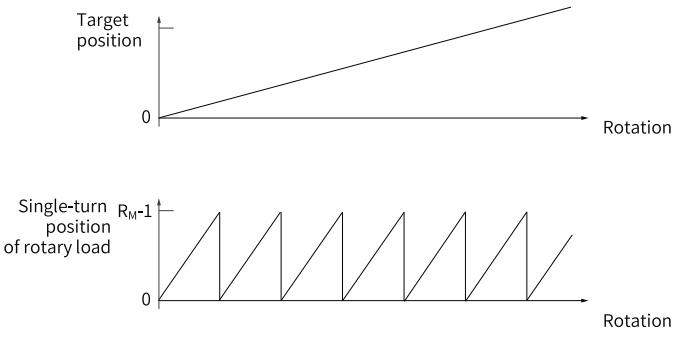
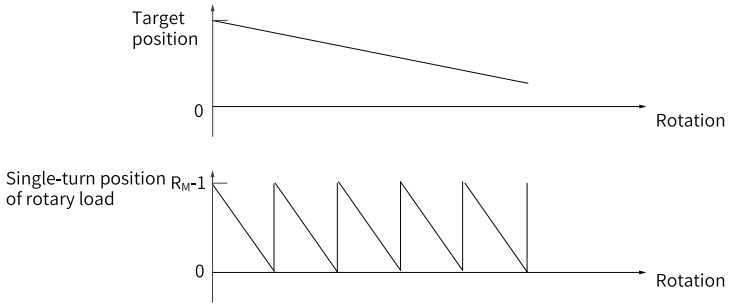


Figure 12-3 Application of the linear mode

The single-turn position range of the rotary load is 0 to (R_M - 1) (R_M: Encoder pulses per load revolution). When the gear ratio is 1:1, the variation law of the target position and the single-turn position of the rotary load during forward operation is shown as follows.



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

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

Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H05.50	2005-33h	Mechanical gear ratio in absolute position rotation mode (numerator)	1 to 65535	1	-	At stop	"H05_en.50" on page 790
H05.51	2005-34h	Mechanical gear ratio in absolute position rotation mode (denominator)	1 to 65535	1	-	At stop	"H05_en.51" on page 791
H05.52	2005-35h	Pulses per revolution of the load in absolute position rotary mode (low-order 32 bits)	0 to 4294967295	0	Encoder unit	At stop	"H05_en.52" on page 791
H05.54	2005-37h	Pulses per revolution of the load in absolute position rotary mode (high-order 32 bits)	0 to 4294967295	0	Encoder unit	At stop	"H05_en.54" on page 791

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0b.81	200b-52h	Single-turn position of the rotating load (low-order 32 bits)	0 to 4294967295	0	Encoder unit	Read-only	"H0b_en.81" on page 885
H0b.83	200b-54h	Single-turn position of the rotating load (32 high-order bits)	-2147483648 to +2147483647	0	Encoder unit	Read-only	"H0b_en.83" on page 886
H0b.85	200b-56h	Single-turn position of the rotary load (reference unit)	0 to 4294967295	0	Reference unit	Read-only	"H0b_en.85" on page 886

Single-turn absolute mode

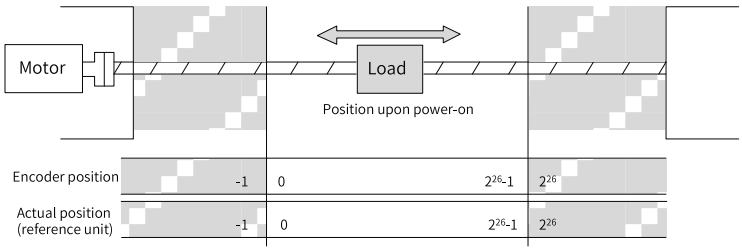
This mode applies to scenarios where the load travel range is within the single-turn range of the encoder. In this case, the absolute encoder does not need a battery because it only records the single-turn data.

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

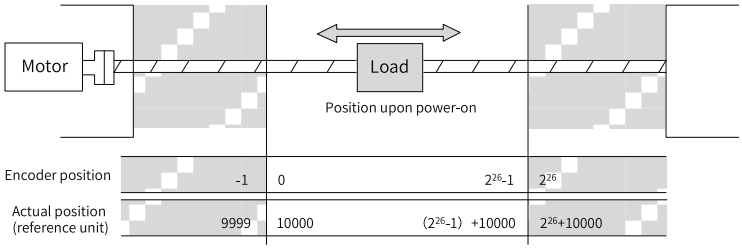
  When H05.36 (Mechanical home offset) is set to 0, the target position range is 0 to (2^{26} - 1).

  After homing is done, 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:



12.1.3 Precautions for Using the Battery Box

This section applies only to Inovance servo motors.

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

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

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

1. Power on the servo drive and make it remain in the non-operational state.
2. Replace the battery.
3. After the servo drive resets E730.0 automatically, if no other alarms occur, continue to operate the servo drive.

Note

- If you replace the battery after powering off the servo drive, E731.0 (Encoder battery failure) will occur at next power-on, leading to an abrupt change in the multi-turn data. In this case, set H0d.20 to 1 to reset the encoder fault. Then perform the homing operation again.
- Ensure the maximum motor speed does not exceed 6000 rpm upon power-down of the servo drive. This is to enable the encoder to record the position accurately.
- Keep the battery in environments within the required ambient temperature range and ensure the battery is in reliable contact and carries sufficient power capacity. Otherwise, encoder data loss may occur.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0d.20	200d-15h	Absolute encoder reset	0: No operation 1: Reset fault 2: Reset fault and multi-turn data 3: Reset Inovance 2nd encoder fault 4: Reset Inovance 2nd encoder fault and multi-turn data	0	-	At stop	"H0d_en.20" on page 894

Note

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

12.2 Full Closed-loop

Note

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

12.2.1 Fully Closed-loop Parameter Settings

After setting the basic gain parameters, verify that the servo drive operates properly without over-shoot and stops without generating unexpected noise. When the 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 signal), Inovance communication encoders, BiSS-C encoders, SSI encoders, and EnDat 2.2 encoders. Among these, BiSS-C, SSI, and EnDat 2.2 encoders are not supported for fully closed-loop rotary motor applications.
- 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:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0F.01	200F-02h	Fully closed-loop encoder application mode	0: Standard operating direction 1: Reverse operating direction	0	-	Real time	*" H0F_en.01" on page 903*

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

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

Caution

- Perform necessary inspections before a motor trial run. See *SV680P-INT Series Servo Drive Quick Start Guide* for details.
- Set H0F-01 to a proper value. If H0F-01 is set improperly, runaway accidents 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 that the motor has rotated for a full turn. Then, calculate the variation of H0F.20 (Feedback pulse counter of external encoder), and incorporate this value into H0F.04.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	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 904*

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 the 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 the inner loop and H05.11/H05.13 for the outer loop.

See *"11.2 Conversion Factors" on page 317* for how to set the electronic gear ratio. Assume that, for a fully closed-loop device, the external mechanical displacement corresponding to each X_1 pulse reference sent by the host controller is Y_1.

Then, perform the following operations:

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

b. Step 2: Make the host controller send X_2 pulses. The external mechanical displacement measured is Y_2.

In this case, 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) to define the position deviation threshold at which the servo drive detects fault EB02.0, indicating that the position deviation is excessive. The unit is one reference unit (same as one external encoder unit).

  ☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0F.08	200F-09h	Excessive deviation threshold in compound control mode	0 to 2147483647	1000	-	Real time	"H0F_en.08" on page 905

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 run by the motor per deviation clear in compound control mode.

  ☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	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 905

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

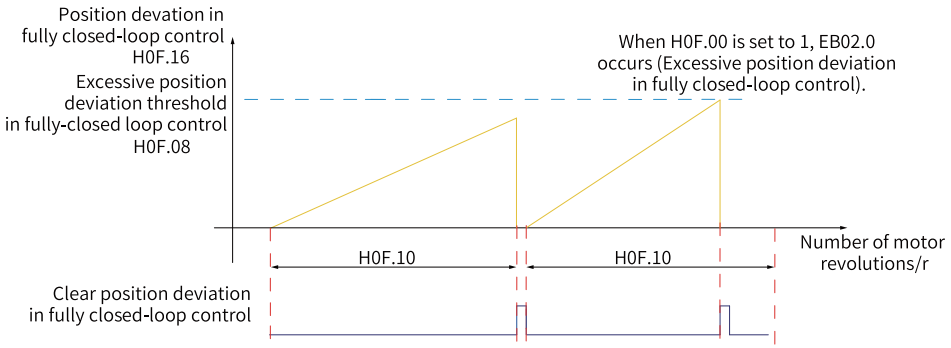


Figure 12-4 Position deviation cleared in fully closed-loop mode

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, a fault will be reported. If not, the servo drive clears the deviation after the motor rotates for more than 50 revolutions, and then starts monitoring again.

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

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0F.13	200F-0Eh	Compound vibration suppression filter time	0.0 to 6553.5	0.0	ms	At stop	"H0F_en.13" on page 905

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.

- Source of touch probe Z signal in fully closed-loop mode
  ☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0F.25	200F-1Ah	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 907

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.

12.2.2 Encoder Parameter Settings

12.2.2.1 BiSS-C encoder

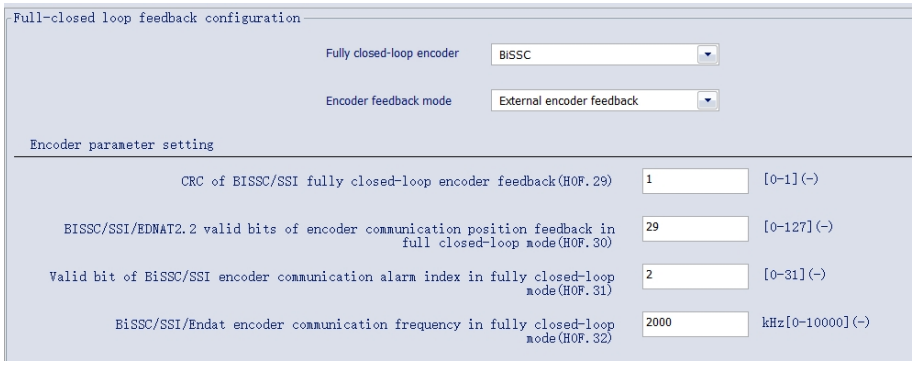
Configuration example

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 *"8.5.2.5 FAQ About Encoder Configuration" on page 209*.

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 *"8.5.2.5 FAQ About Encoder Configuration" on page 209*.

12.2.2.2 SSI encoder

Configuration example

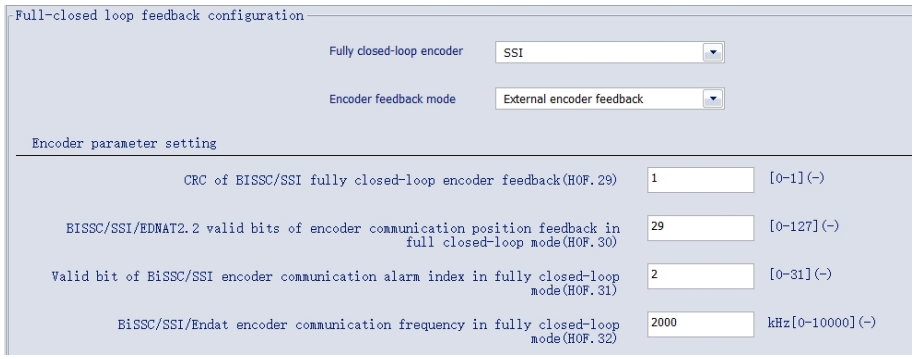
1. Connect the SSI encoder to the CN7 terminal and connect a 23-bit Inovance encoder to the CN2 terminal.
2. Obtain the encoder parameters from the encoder guide, for example:

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 *"8.5.2.5 FAQ About Encoder Configuration" on page 209*.

12.2.2.3 EnDat Encoder

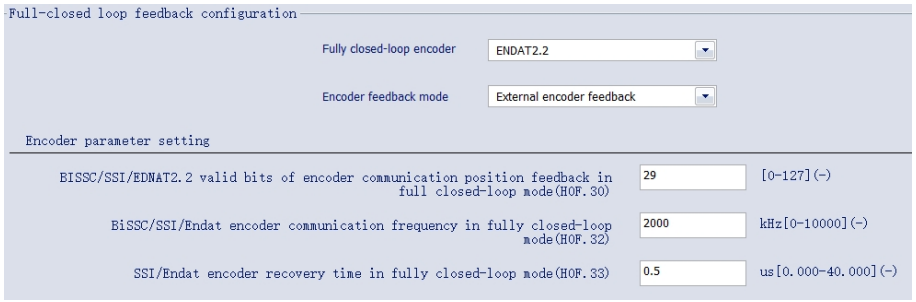
Configuration example

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 *"8.5.2.5 FAQ About Encoder Configuration" on page 209*.

12.2.3 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:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H03.02	2003-03h	DI1 function selection	0: No assignment 1: S-ON 2: Alarm reset signal 3: Gain switchover switch 4: Main/Auxiliary command switchover 5:Multi-reference direction 6: Multi-reference switchover CMD1 7: Multi-reference switchover CMD2 8: Multi-reference switchover CMD3 9: Multi-reference switchover CMD4 10: Mode switchover M1-SEL 11: Mode switchover M2-SEL 12: Zero clamp enable signal 13: Position reference inhibited 14: Positive limit switch 15: Negative limit switch 16: Forward external torque limit 17: Reverse external torque limit 18: Forward jog 19: Reverse jog 20: Step enable 21: Handwheel override signal 1 22: Handwheel override signal 2 23: Handwheel enable signal 24: Electronic gear selection 25: Torque reference direction 26: Speed reference direction 27: Position reference direction 28: Multi-position reference enable 29: Interrupt positioning cancel signal 31: Home switch 32: Homing enable 33: Interrupt positioning inhibited 34: Emergency stop 35: Position deviation cleared 36: Internal speed limit source 37: Pulse reference inhibited 38: Touch probe 1 39: Touch probe 2 40: Multiple-speed reference enabled 41: Current position as home	14	-	Real time	"H03_en.02" on page 752

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H03.02	2003-03h	DI1 function selection	42: Axis control command executed immediately 43: Axis control command not executed immediately 44: Positioning and command completed signal clear 45: Interrupt positioning enable 46: Process segment enable 47: Process segment command switchover 1 48: Process segment command switchover 2 49: Process segment command switchover 3 50: Process segment command switchover 4 51: Event trigger process segment 1 52: Event trigger process segment 2 53: Event trigger process segment 3 54: Event trigger process segment 4 55: Process segment pause 56: Gantry torque alignment 57: Enable gantry alignment by signal 58: Clear gantry alignment by DI signal 59: Enable gantry synchronization	14	-	Real time	"H03_en.02" on page 752
H0F.00	200F-01h	Encoder feedback mode	0: Internal encoder feedback 1: External encoder feedback 2: Inner/Outer loop switchover	0	-	Real time	"H0F_en.00" on page 902

Note

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

12.3 Software Limit

Function overview

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

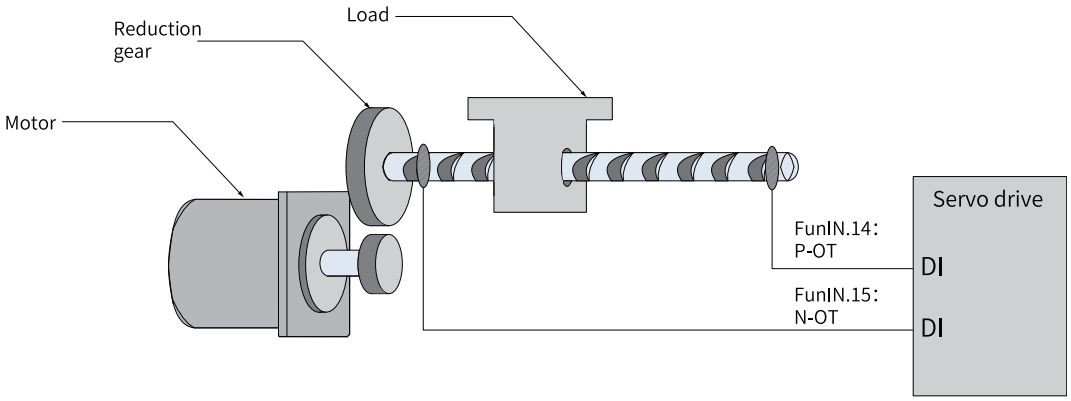


Figure 12-5 Installation of limit switches

The software limit is implemented through a comparison between the internal position feedback and the specified limit value. If the specified limit value is exceeded, the servo drive reports an alarm and stops immediately. The software limit is available both in absolute position mode and incremental position mode. To use the software limit in incremental position mode, set H0A.01 (Software position limit) to 2 (Enabled after homing) first, and then perform homing upon power-on before applying the software limit.

Table 12–2 Comparison between the hardware limit and software limit

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

Related objects

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0A.00	200A-01h	Power input phase loss protection	0: Enable 1: Disable	0	-	Real time	"H0A_en.00" on page 852
H0A.41	200A-2Ah	Positive software position limit	-2147483648 to +2147483647	2147483647	Encoder unit	At stop	"H0A_en.41" on page 860
H0A.43	200A-2Ch	Negative software position limit	-2147483648 to +2147483647	-2147483648	Encoder unit	At stop	"H0A_en.43" on page 860

Communication mode:

- When H0A.01 is set to 0 (Disable absolute position limit), the software limit is disabled.
- When H0A.01 is set to 1 (Enable absolute position limit), the software limit is enabled immediately upon power-on. 607D.01h (Minimum position limit) and 607D.02h (maximum position limit) are used by the function. Ensure the value of 607D.01h (Minimum position limit) is lower than or equal to 607D.02h (Maximum position limit). If 607D.01h (Minimum position limit) is set to a value larger than 607D.02h (Maximum position limit), EE09.0 (Software position limit setting error) is reported.
- If H0A.01 is set to 2 (Enable absolute position limit after homing), the software limit is not enabled after homing upon power-on. When the value of the absolute position counter is larger than the value of 607D.02h (Maximum position limit) after homing, E950.0 (Forward overtravel warning) occurs and the drive stops accordingly. When the value of the absolute position counter is smaller than the value of 607D.01h (Minimum position limit) after homing, E952.0 (Reverse overtravel warning) occurs and the drive stops accordingly.

Non-communication mode:

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

Note

Ensure the value of 607Ch (Home offset) is within the software position limit. Otherwise, the servo drive reports EE09.1.

12.4 Software reset

Function overview

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

Related objects

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0d.00	200d-01h	Software reset	0: No operation 1: Software reset	0	-	At stop	"H0d_en.00" on page 890

12.5 Motor Protection

Motor overload protection

The motor generates heat continuously due to thermal effect of the current after power-on. The heat is then dissipated to the surroundings. The servo drive provides motor overload protection to protect the motor against damage due to high temperature when the heat generated exceeds the heat released. 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 the following situations, modify H0A.04 based on the actual heating condition.

- The motor works in environments with high temperature.
- The servo motor keeps cyclic running in scenarios of short time single 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:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0A.04	200A-05h	Motor overload protection gain	50 to 300	100	-	Real time	"H0A_en.04" on page 853
H0A.26	200A-1Bh	Motor overload mask	0: Show motor overload alarm (E909.0) and fault (E620.0) 1: Hide motor overload alarm (E909.0) and fault (E620.0)	0	-	Real time	"H0A_en.26" on page 857

Locked rotor over-temperature protection

The servo drive provides over-temperature protection to protect the motor against damage due to high temperature caused by serious motor heating when the duration of rotor locked (the motor speed is almost 0 and the actual current is very large) exceeds the allowable time. The motor is capable of operating upon stall for 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).



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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0A.32	200A-21h	Over-temperature protection time window upon stall	10 to 65535	200	ms	Real time	"H0A_en.32" on page 858
H0A.33	200A-22h	Over-temperature protection selection upon stall	0: Disable 1: Enable	1	-	Real time	"H0A_en.33" on page 859

Motor overspeed protection

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

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

Caution

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

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0A.08	200A-09h	Overspeed threshold	0 to 20000	0	[mm/s]/[rpm]	Real time	"H0A_en.08" on page 853
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 854

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

12.6 DI filter time

Function overview

The drive provides eight physical DI terminals, in which DI1 to DI6 are normal DI terminals, and DI7 to DI8 are high-speed DI terminals. Assign the function of interrupt positioning to DI7 or DI8 to guarantee precision.

When regular functions (touch probe and interrupt position functions excluded) are assigned to DIs, the filter time of these DIs is set in H03.60...H03.67. 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. When a high-speed DI is DI with the interrupt positioning function, the filter time of this DI is defined by H0A.19. Ensure the effective level hold time of the high-speed DI is longer than the filter time.

Related objects

The drive provides two high-speed DIs with input signal frequency up to 4 kHz. When the DI signal is being disturbed, set the filter time in H0A.19 and H0A.20.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H03.60	2003-3Dh	DI1 filter time	0.00 to 500.00	3.00	ms	Real time	"H03_en.60" on page 761
H03.61	2003-3Eh	DI2 fitter time	0.00 to 500.00	3.00	ms	Real time	"H03_en.61" on page 761
H03.62	2003-3Fh	DI3 filter time	0.00 to 500.00	3.00	ms	Real time	"H03_en.62" on page 761
H03.63	2003-40h	DI4 fitter time	0.00 to 500.00	3.00	ms	Real time	"H03_en.63" on page 761
H03.64	2003-41h	DI5 filter time	0.00 to 500.00	3.00	ms	Real time	"H03_en.64" on page 762
H03.65	2003-42h	DI6 filter time	0.00 to 500.00	3.00	ms	Real time	"H03_en.65" on page 762
H03.66	2003-43h	DI7 filter time	0.00 to 500.00	0.00	ms	Real time	"H03_en.66" on page 762
H03.67	2003-44h	DI8 filter time	0.00 to 500.00	3.00	ms	Real time	"H03_en.67" on page 762
H0A.19	200A-14h	Filter time constant of touch probe 1	0.00 to 6.30	2.00	μs	Real time	"H0A_en.19" on page 856
H0A.20	200A-15h	Filter time constant of probe 2	0.00 to 6.30	2.00	μs	Real time	"H0A_en.20" on page 856

12.7 Communication-forced DO

Function overview

When CANopen switches to the operational (OP) status, the forced DO function is determined by 60FE.01h and 60FE-02h. In the non-operational (non-OP) status (including CAN network), the following two DO options are available by default:

- Status unchanged: The servo status switches to the non-OP status and the forced DO status stays unchanged.
- No output upon disconnection: No forced DO is generated when the servo drive is in the non-OP status.

Related objects

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H04.23	2004-18h	Communication-forced DO logic in non-operational state	bit0: DO1 0: Status unchanged 1: No output bit1: DO2 0: Status unchanged 1: No output bit2: DO3 0: Status unchanged 1: No output bit3: DO4 0: Status unchanged 1: No output bit4: DO5 0: Status unchanged 1: No output	0	-	Real time	"H04_en.23" on page 770

Setting method

1. Assign DO function 31 to the DO to be controlled forcibly by CiA402 protocol, 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/02h as RPDO, and operate on bit16 to bit20 to control the DO.

12.8 Position comparison

Function overview

Position comparison works by comparing the instantaneous position feedback with the value pre-saved in the data array. When a match is found, it outputs a DO signal with pulse width settable or an ABZ/OCZ signal. Position comparison is applicable to high-speed motion axes because comparison actions are implemented by FPGA, removing the risk of software communication delay between processors.

Note

1. During position comparison, the position comparison function is executed again when any of the comparison start point, stop point, and comparison mode are modified.
2. When you use the position comparison output function, it is recommended to set the logic of position comparison DO to 0-Normally Open (NO).

- Set the DO logic to 0-NO (the corresponding DO optocoupler switches from OFF to ON upon position comparison traversal) to achieve a response of 10 μs.
- Set the DO logic to 1-Normally Closed (NC) (the corresponding DO optocoupler switches from ON to OFF upon position comparison traversal) to achieve a response within 300 μs.

The following table describes the specifications of position comparison output.

Specifications of position comparison output		Function overview
Trigger output	Output port	DO or ABZ/OCZ signals.
	Logic	The effective level of DO is defined by the DO logic in group H04.
		The effective level of ABZ/OCZ output is defined by H18.06.
	Pulse width	The pulse output width is defined by H18.05.
	Delay compensation	Defined by H18.14 and used to compensate for hardware output delay.
Comparison source	Motor encoder feedback	Supported
	Pulse feedback fully closed-loop (ABZ)	Supported
	Communication-type fully closed-loop	Supported
Comparison value	Number of comparison points	40 points, signed 32-bit integer
Comparison attribute	Attribute of comparison point	Defines the attribute of the comparison point.
		Defines the output terminal for comparison.

Related objects

When position comparison is enabled, you can assign FunOUT.25 (Position comparison) to any one of the two DOs. The DO you select will be used to output the position comparison output signal. You can also use the ABZ/OCZ signal as the position comparison output terminal by setting H18.16.

Position comparison output parameters:

Parameter	Name	Description
H18: Position comparison output		
H18.00	Position compare output enable	0: Disable 1: Enable (rising edge triggered)
H18.01	Position compare 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: 19-bit 6: 18-bit 7: 17-bit
H18.03	Position compare mode	0: Single-shot compare mode 1: Cyclic compare mode 2: Fixed cyclic comparison

Parameter	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 compare 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 status of position compare	0: No comparison; n: Waiting for the comparison point N
H18.10	Real-time position of position compare	Displays the current comparison position value. Value range: -2^{31} to (2^{31} - 1)
H18.12	Zero offset of position compare	Defines the offset value after current position is taken as the zero point. Value range: -2^{31} to 2^{31} - 1
H18.14	Position compare output delay compensation	Comparison delay compensation time: -12 μs to +12 μs
H18.15	Fixed cyclic cycle count	1–65535
H18.16	ABZ output function setting	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
H18.17	Fixed mode completion count	Value range: 0 to 65535

Note

[1]: When the source of position comparison is full closed-loop feedback, it is only effective for Inovance encoders.

Parameter	Name	Description
H19: Target position parameters		
H19.00	Target value of position compare 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 of position comparison point 1 bit0: 1: Output DO active signal if current position changes from "less than" to "more than" the comparison point 0: None bit1: 1: Output DO active signal if current position changes from "more than" to "less than" the comparison point 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 enable 0: None bit13: 1: Frequency-division B output enable 0: None bit14: 1: Frequency-division C output enable 0: None bit15: 1: Frequency-division OCZ output enable 0: None
H19.03	Target value of position compare 2	Defines the target value of position comparison 2. Value range: -2^{31} to $2^{31} - 1$
H19.05	Property value of position compare 2	Defines the attribute value of position comparison 2. Value range: Same as H19.02
...	...	...
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

How it works

1. How it works

Position comparison works by comparing the instantaneous position feedback with the value pre-saved in the data array. When a match is found, it outputs 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 compare value 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 SV680-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.

- Single-shot compare mode
  In individual comparison mode, when comparison of the end point is completed, the comparison function is automatically switched off and the current comparison value is cleared. The comparison function can be enabled again only when the position comparison switch is switched on again.

  The real-time position feedback in the single-shot compare mode is an absolute value, which means it is an accumulative value based on the preceding compare point. Such value will not be automatically cleared.
- Cyclic comparison mode
  In cyclic comparison mode, position comparison will not be switched off when the comparison end point is reached, and current position comparison value will be reset as the start point for position comparison. After comparison of each point is done, the real-time position feedback (H18.10) will be cleared and counted again for cyclic comparison. In cyclic comparison mode, the target position is a relative (incremental) value. Each time a comparison point is reached, the real-time position feedback is cleared and counted again for comparison with the new target.
- Fixed cyclic compare mode
  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 compare output width

When the position comparison conditions are fulfilled, the servo drive outputs DO active level signal. The width of the active level signal can be set in H18.05 (value range: 1 to 2047 × 0.1 ms).

When the DO output is active, the compare logic is suspended and no compare will be performed. In this case, ensure the operating time between two target points is higher than the DO output width.

- 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 compare point. For example, if the start point is set to 5, position compare starts from the 5th target position.
- End point for comparison
  The end point indicates the position of the last compare point. For example, if the end point is set to 7, the compare stops or restarts from the start point after the 7th target position is done comparing.
- Zero offset of position compare
  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).

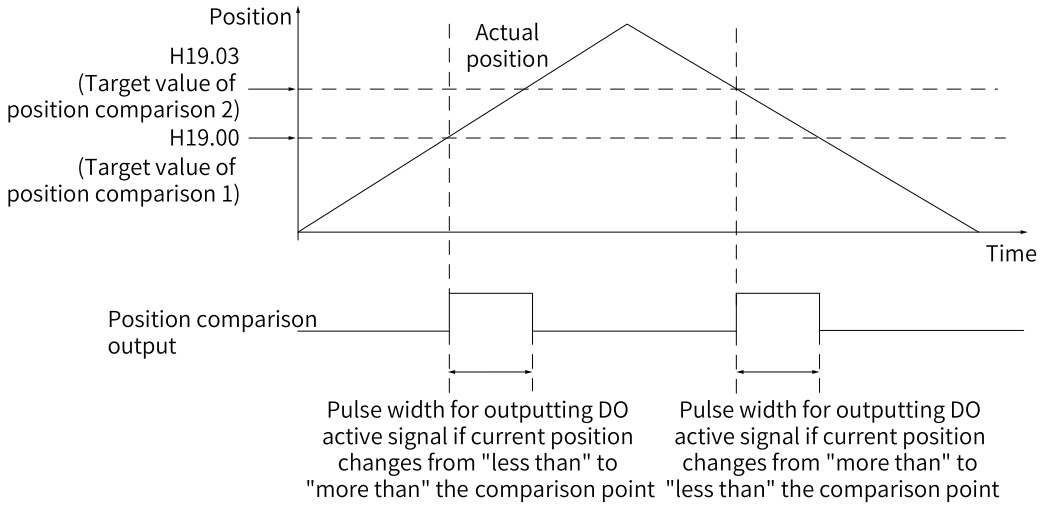
Note

Check whether zero offset needs to be set before enabling position comparison output. Otherwise, comparison error may occur.

---

2. How it works

- When the position feedback of the encoder passes the target position comparison points, the output width of the output terminal is defined by H18.05 (Position comparison output width).

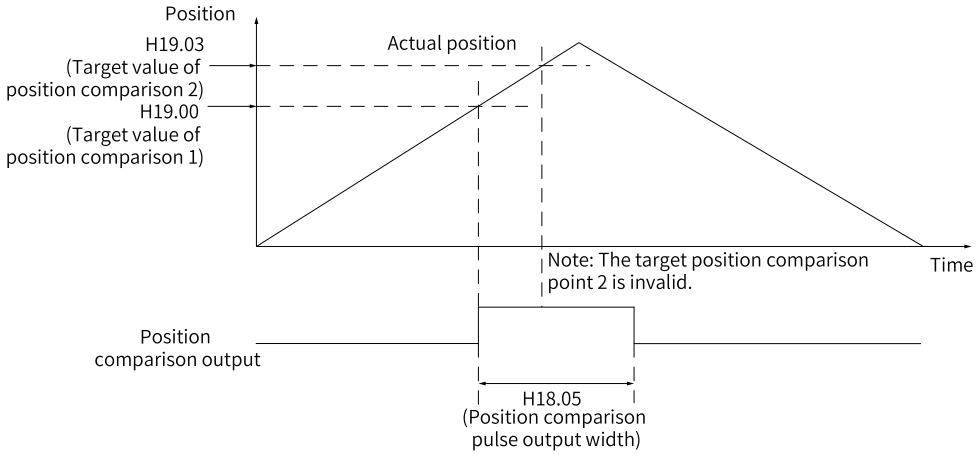


When the attribute of the comparison point is set to "bit0 = 1" (Output DO active signal if current position changes from "less than" to "more than" the comparison point), the DO outputs the position comparison signal when the axis passes the target position comparison point with position changing from "less than" to "more than" the comparison point position.

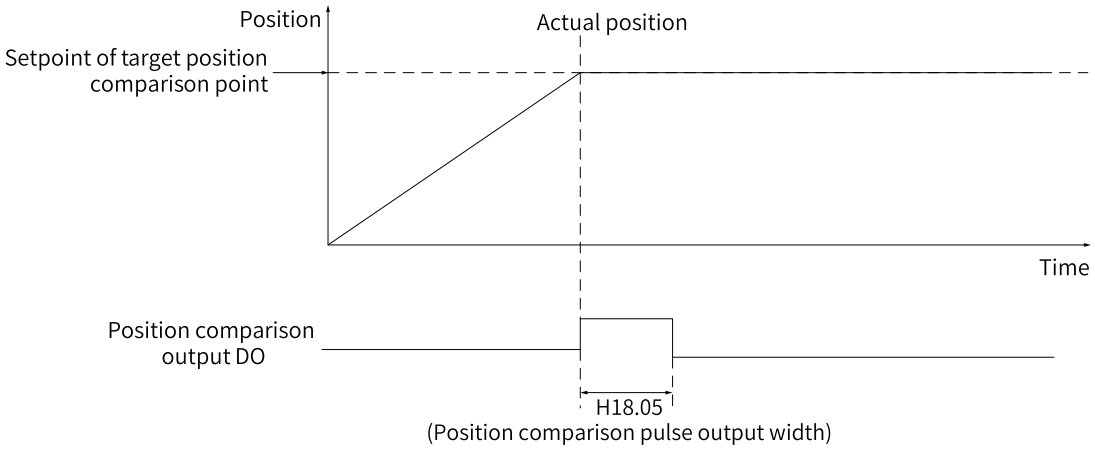
When the attribute of the comparison point is set to "bit1 = 1" (Output DO active signal if current position changing from "more than" to "less than" the comparison point), the DO outputs the position comparison signal when the axis passes the target position comparison point with position changing from "more than" to "less than" the comparison point position.

When the attribute of the comparison point is set to "bit0/bit1 = 1" (Output DO active signal in both situations), the DO outputs the position comparison signal when the position feedback passes the target position comparison point.

- When multiple position comparison values are set, no comparison will be performed once the position comparison output terminal is active. Therefore, ensure the operating time between two position comparison points is larger than the pulse output width.
  As shown in the following figure, comparison is not performed when the position changing from "more than" to "less than" the comparison point position. This is because the operating time between the two comparison points is lower than the pulse output width.



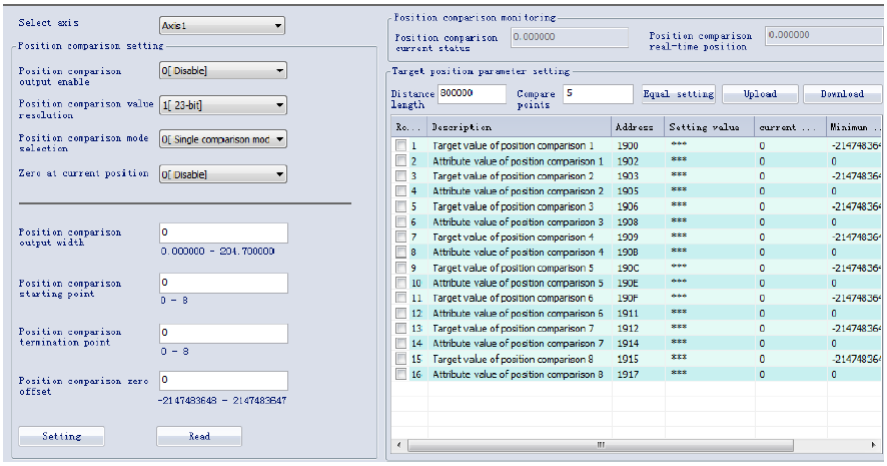
- Only one pulse will be outputted when the stop position is the same with the target value of position comparison, See the following figure.



3. Interface of the software tool

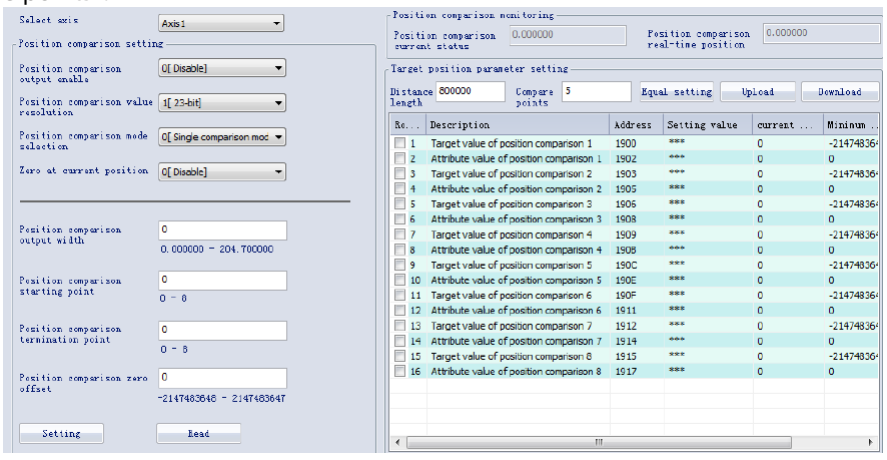
- Single-shot comparison mode

a. Set "Position comparison mode selection" to 0 (Single position comparison mode).



b. Target position parameter setting: Set "Distance length" (total operating distance) and "Compare points".

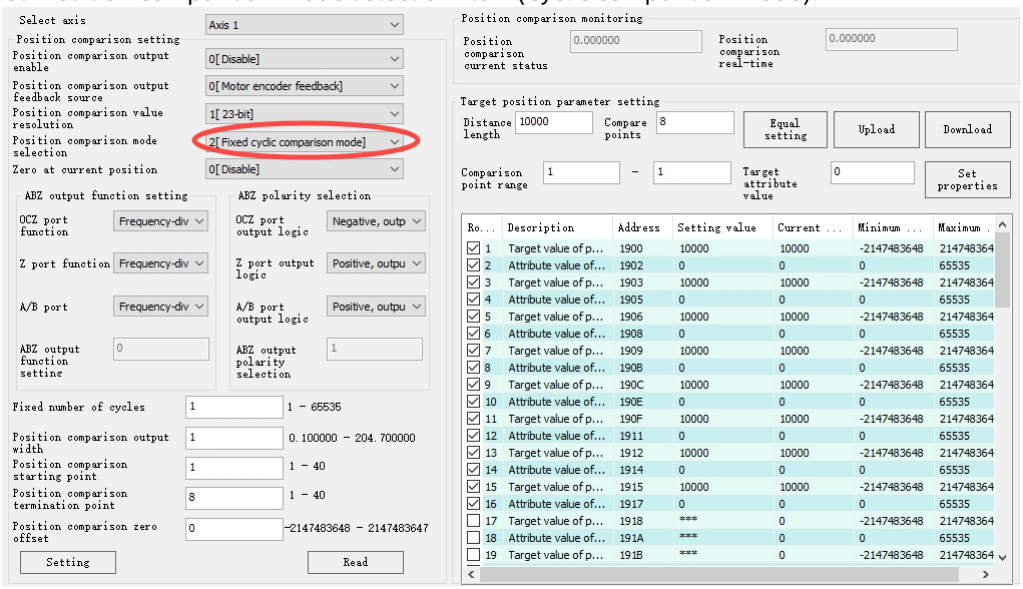
c. After clicking Equal setting, the target value of the first point is updated to "Distance length × 1 ÷ Compare points", the target value of the second point is updated to "Distance length × 2 ÷ Compare points", and the target value of the Nth point is updated to "Distance length × N ÷ Compare points".



When H18.00 (Position comparison output selection) changes from 0 to 1 (Enable rising edge-triggered), H18.09 (Current state of position comparison) changes from 0 to 1 and the first target position value will be compared. When H18.10 (Real-time position feedback) reaches the value of the first target position, H18.09 changes from 1 to 2, and so on.

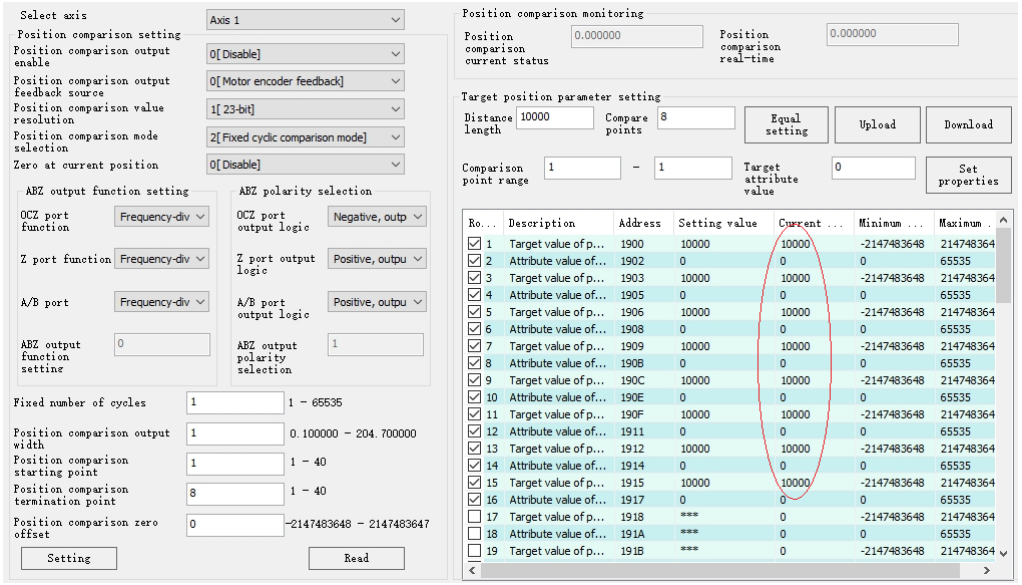
- Cyclic comparison mode/Fixed cyclic comparison mode

a. Set "Position comparison mode selection" to 1 (Cyclic comparison mode).



b. Target position parameter setting: Set "Distance length" (distance between two adjacent points) and "Compare points" (points to be compared cyclically)

c. After clicking "Equal setting", the target values of the 1st point to the Nth point are updated to equal interval distance values.



When H18.00 (Position comparison output selection) changes from 0 to 1 (Enable rising edge-triggered), H18.09 (Current state of position comparison) changes from 0 to 1 and the first target position value will be compared. When H18.10 (Real-time position feedback) reaches the value of the first target position, H18.09 changes from 1 to 2, and so on.

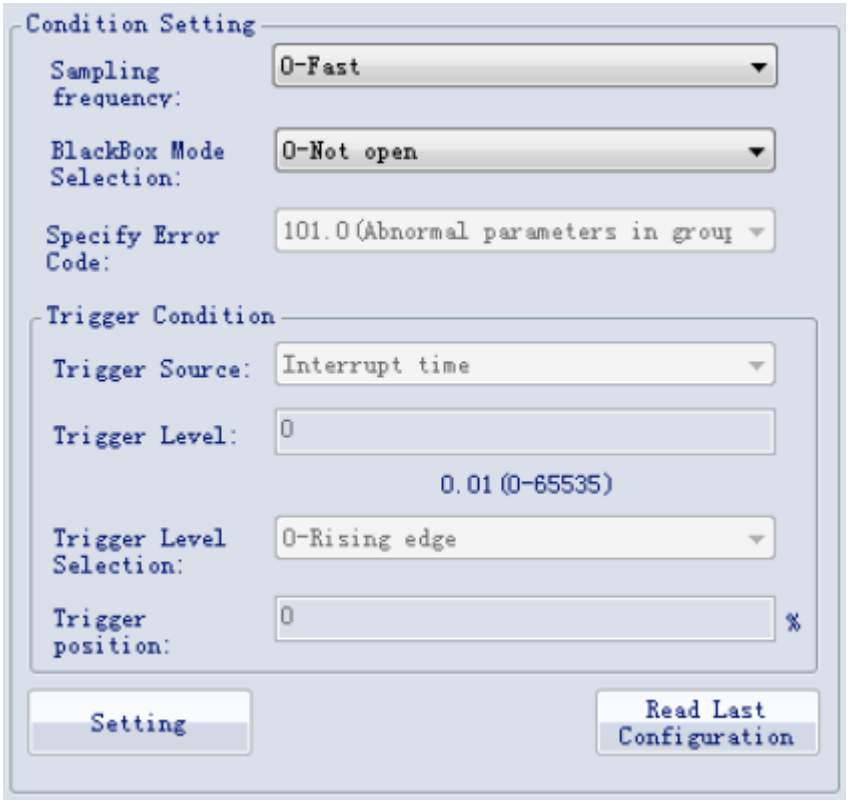
12.9 Black Box

Function overview

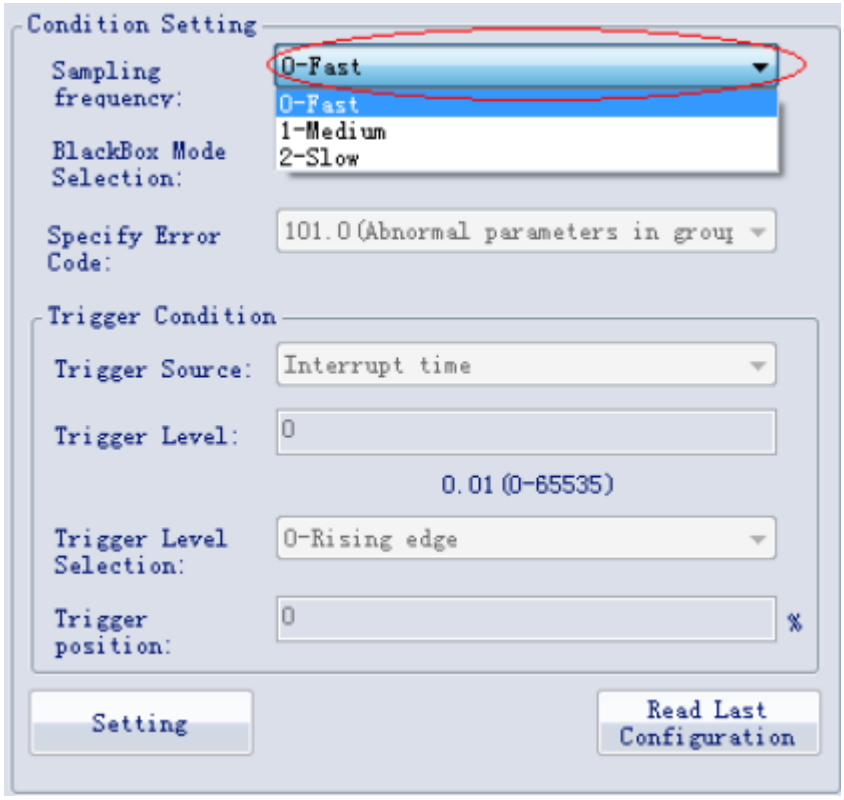
The black box function is used to capture and save the data generated upon occurrence of faults or under designated conditions. Such data can be read and uploaded by users through the software tool to facilitate troubleshooting. You can set H32.45 to configure the black box channel, facilitating root 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 function 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.

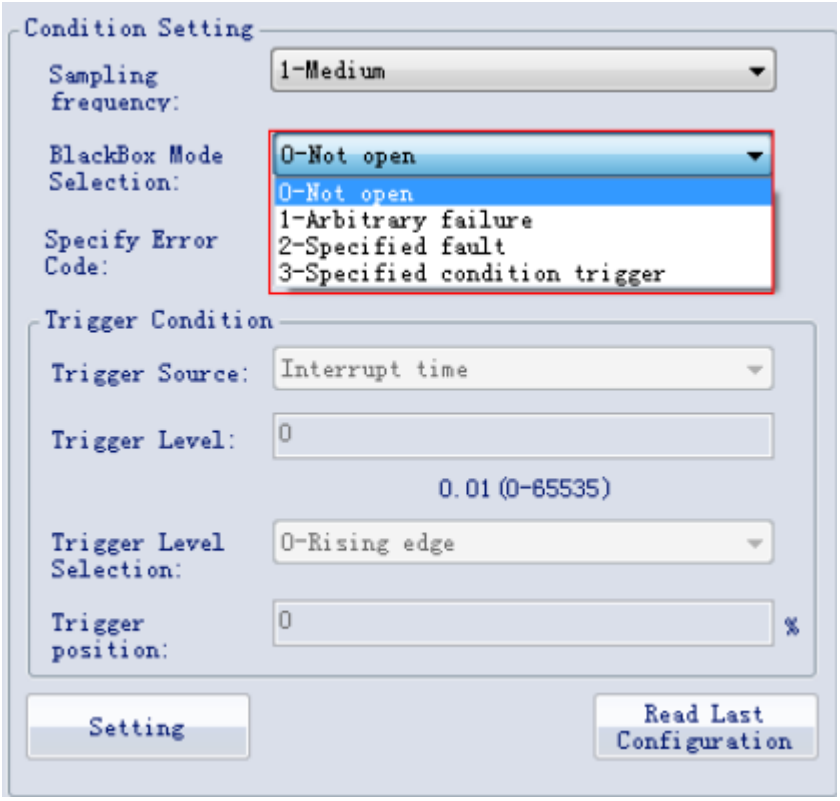
Triggering the black box



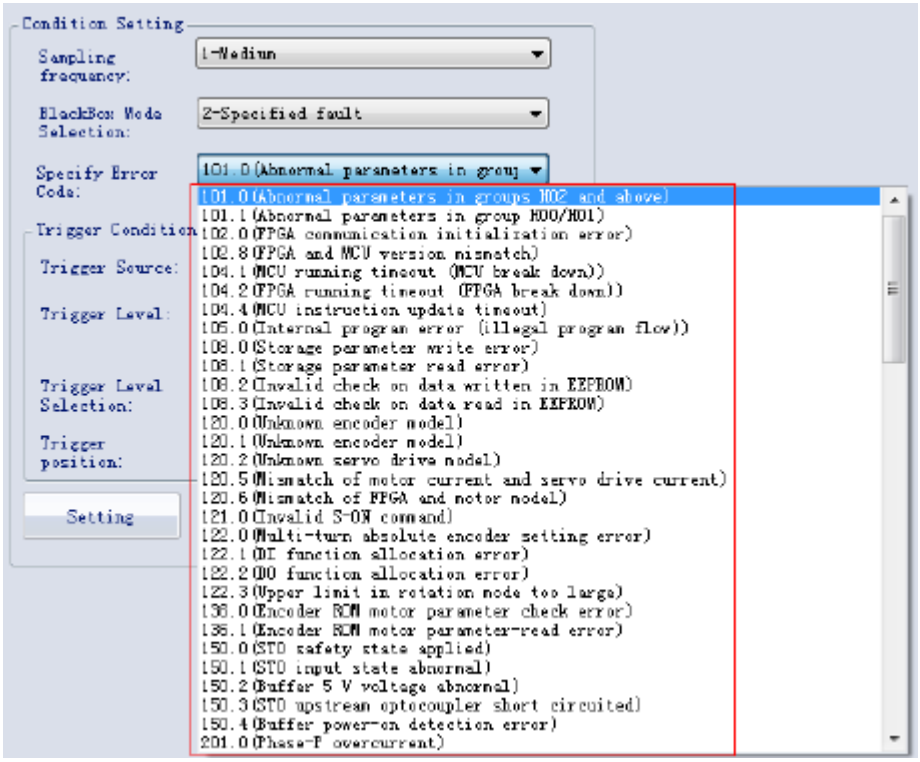
1. Sampling frequency: including three sampling frequencies, namely 16k (fast), 8k (medium), and 1k (slow).



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.



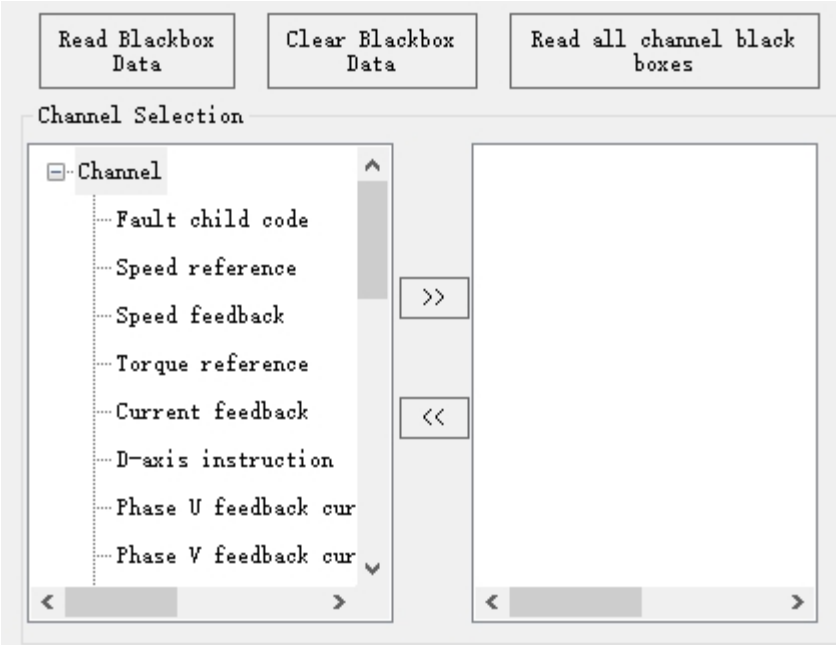
4. The Trigger Condition includes Trigger Source, Trigger Level, and Trigger Level Selection, as shown below.



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 of all the channels by clicking "Read all", and then click "Save" to save the waveform files.



12.10 Touch Probe Function

Function overview

The touch probe function is the same as the position latch function. Position feedback sources include motor position and full closed-loop feedback. This feature latches the position information (reference unit) when an DI signal or Z signal changes.

SV680-INT provides two touch probes for recording the positions of two probe signals at the rising edge and falling edge, which means four positions can be latched.

When a DI is used to trigger the touch probe, the relationship between the DI logic and the touch probe edge is shown in the following table. The touch probe is supported only by high-speed DIs.

Table 12–3 Description of bit3 of H0A.40

bit3 of H0A.40	Touch probe edge	DI logic	DI switch
0	Rising edge	Normally open (NO)	OFF→ON
		Normally closed (NC)	ON→OFF
	Falling edge	Normally open (NO)	ON→OFF
		Normally closed (NC)	OFF→ON
1	Rising edge	NO/NC	OFF→ON
	Falling edge	NO/NC	ON→OFF

When a DI is used to trigger the touch probe, you can set the filter window of the touch probe signal in H0A.19 and H0A.20.

The DI touch probe supports hardware action delay compensation to compensate for the precision loss incurred by ON/OFF delay of the DI. Related parameters are shown in the following table.

Parameter		Description
H0A.40	bit1	Touch probe rising edge compensation: 1: Enabled, 0: Disabled
	bit2	Touch probe falling edge compensation: 1: Enabled, 0: Disabled
H0A.53		DI probe DI ON compensation time (DI OFF→ON)
H0A.54		DI probe DI OFF compensation time (DI ON→OFF)

To shorten the hardware delay to about 7 μs, it is recommended to set the touch probe latch through the ON-edge of the DI.

There are three Z touch probe triggers: motor Z signal, frequency-division output Z signal, and fully closed-loop Z signal, as shown in the following table.

Feedback source	Parameter	Description
Motor encoder	H05.41.bit2 = 0, motor Z signal	The Z touch probe is triggered by the motor Z signal.
	H05.41.bit2 = 1, frequency-division output Z signal	The Z touch probe is triggered by the frequency-division output Z signal, including the multi-turn Z signal.
Fully closed-loop feedback	H0F.25 = 0, motor Z signal	When there is no Z signal input in the pulse-type fully closed-loop mode, you can trigger the touch probe through the motor Z signal to latch external position feedback.
	H0F.25 = 1, fully closed-loop Z signal	When there is Z signal input in the pulse-type fully closed-loop mode, you can trigger the touch probe latch function through the fully closed-loop Z signal.

Related objects

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
60B8h	60B8h	Touch probe mode	0x0 to 0xFFFF	0x0	-	Real time	"60B8h" on page 1139
60B9h	60B9h	Probe status	0x0 to 0xFFFF	0x0	-	Read-only	"60B9h" on page 1140
60BAh	60BAh	Position value at probe 1 rising edge	-2147483648 to +2147483647	0	Reference unit	Read-only	"60BAh" on page 1141
60BBh	60BBh	Position value at probe 1 falling edge	-2147483648 to +2147483647	0	Reference unit	Read-only	"60BBh" on page 1141
60BCh	60BCh	Position value of probe 2 rising edge	-2147483648 to +2147483647	0	Reference unit	Read-only	"60BCh" on page 1142
60BDh	60BDh	Position value of probe 2 falling edge	-2147483648 to +2147483647	0	Reference unit	Read-only	"60BDh" on page 1142
60D5h	60D5h	Touch probe 1 rising edge counter	0x0 to 0xFFFF	0x0	-	Read-only	"60D5h" on page 1144

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
60D6h	60D6h	Touch probe 1 falling edge counter	0x0 to 0xFFFF	0x0	-	Read-only	"60D6h" on page 1144
60D7h	60D7h	Touch probe 2 rising edge counter	0x0 to 0xFFFF	0x0	-	Read-only	"60D7h" on page 1144
60D8h	60D8h	Touch probe 2 falling edge counter	0x0 to 0xFFFF	0x0	-	Read-only	"60D8h" on page 1144

Procedure

Example:

Use DI5 to trigger the touch probe. Background: touch probe 1 rising edge, continuous latching

Perform the following steps:

1. Set the function of DI5 (H03.10 = 38). Set the DI5 logic to NO (H03.11 = 0).
2. Set the touch probe function in 60B8h.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
60B8h	60B8h	Touch probe mode	0x0 to 0xFFFF	0x0	-	Real time	"60B8h" on page 1139

Assignment of each bit of the touch probe function (60B8h) is shown in the following table.

bit	Name	Description
0	Touch probe 1 enable: 0: Disable 1: Enable	bit 0 to bit 5: settings related to touch probe 1 When a DI is used to trigger the touch probe function, the DI source cannot be changed once the touch probe function is enabled. For absolute encoders, Z signal refers to the zero point of the single-turn motor position feedback.
1	Touch probe 1 trigger mode 0: Single trigger mode (Latches the position at the first trigger event.) 1: Continuous trigger mode	
2	Touch probe 1 trigger signal selection 0: DI signal 1: Z signal	
3	N/A	
4	Touch probe 1 rising edge 0: Latching at rising edge disabled 1: Latching at rising edge enabled	
5	Touch probe 1 falling edge 0: Latching at falling edge disabled 1: Latching at falling edge enabled	
6 to 7	N/A	-

bit	Name	Description
8	Touch probe 2 enable: 0: Disable 1: Enable	bit 8 to bit 13: settings related to touch probe 2
9	Touch probe 2 trigger mode 0: Single trigger mode (Latches the position at the first trigger event.) 1: Continuous trigger mode	
10	Touch probe 2 trigger signal selection 0: DI signal 1: Z signal	
11	N/A	
12	Touch probe 2 rising edge 0: Latching at rising edge disabled 1: Latching at rising edge enabled	
13	Touch probe 2 falling edge 0: Latching at falling edge disabled 1: Latching at falling edge enabled	
14 to 15	N/A	-

In this example, 60B8h is set to 0x0013.

3. Read the touch probe status in 60B9h.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
60B9h	60B9h	Probe status	0x0 to 0xFFFF	0x0	-	Read-only	"60B9h" on page 1140

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

bit	Name	Description
0	Touch probe 1 enable: 0: Disable 1: Enable	bit 0 to bit 2: status of touch probe 1
1	Touch probe 1 latching on a rising edge 0: No rising edge value latched 1: Rising edge value latched	
2	Touch probe 1 latching on a falling edge 0: No falling edge value latched 1: Falling edge value latched	
3 to 5	N/A	-
6 to 7	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 enable: 0: Disable 1: Enable	bit 8 to bit 10: status of touch probe 2
9	Touch probe 2 latching on a rising edge 0: No rising edge value latched 1: Rising edge value latched	
10	Touch probe 2 latching on a falling edge 0: No falling edge value latched 1: Falling edge value latched	
11 to 13	N/A	-
14 to 15	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.

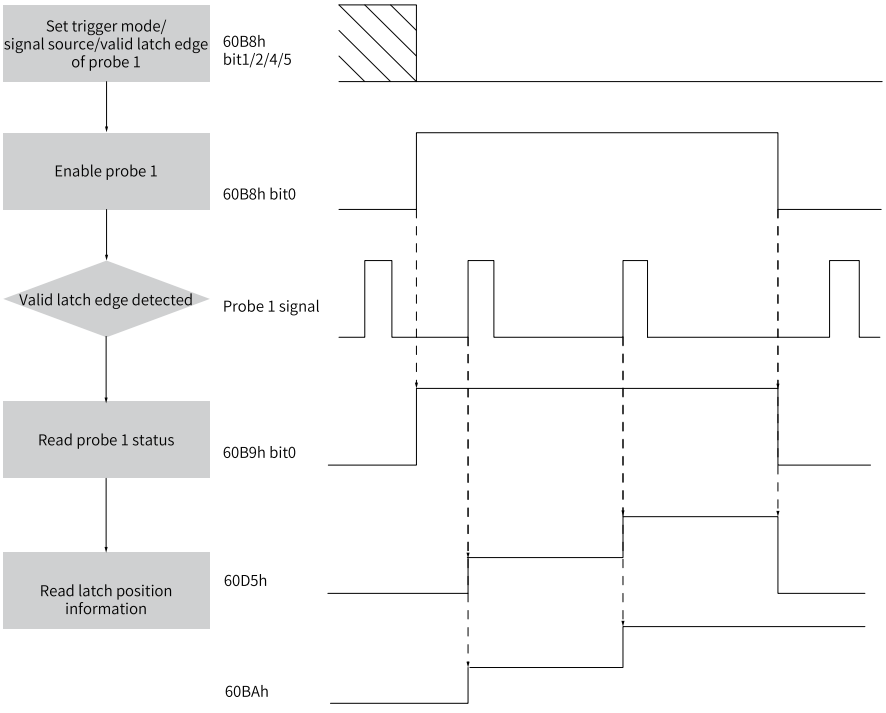


Figure 12-6 Procedure for using the touch probe

12.11 SEMI F47 Voltage Drop

Function overview

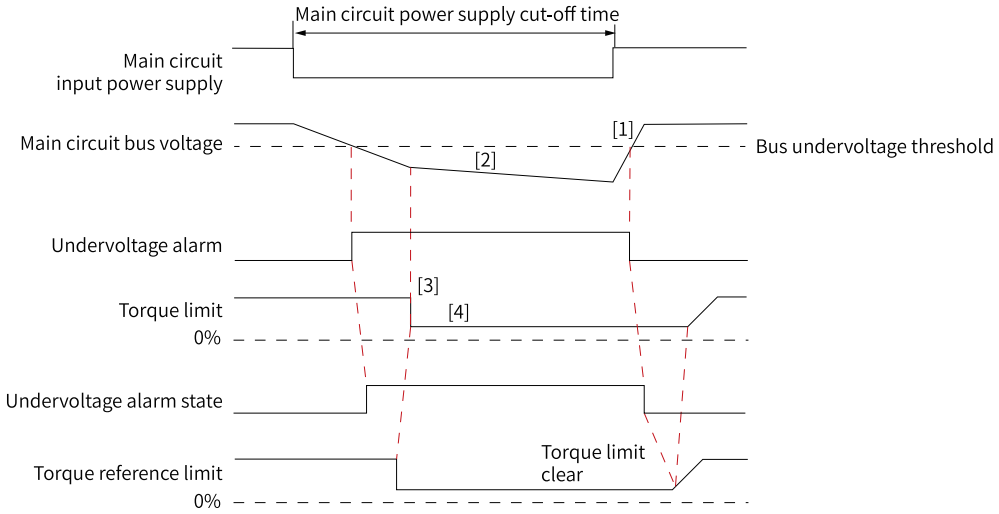
When the DC voltage of the main circuit of the drive is lower than the undervoltage threshold due to instantaneous power failure or temporary low power supply voltage of the main circuit, the E971.0 alarm is reported, and the output current is limited. The E971.0 alarm can be muted by setting bit1 of H0A.88.

With combination of this function and H0A.84 (instantaneous power outage holding time), the drive can continue to run when the power supply voltage decreases, and it will not stop because of alarm.

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 alarm of undervoltage E971.0, the host controller limits the torque, and removes torque limit after receiving E971.0 alarm release signal.



Note

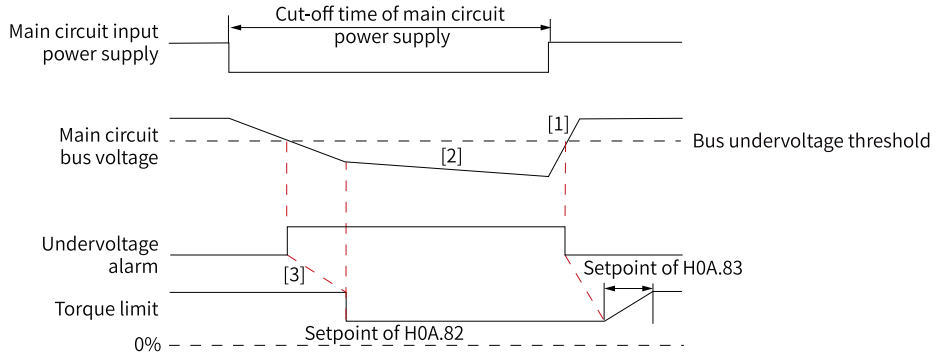
- [1]: After the main circuit power supply is restored, the bus voltage of the main circuit rises.
- [2]: By limiting the output torque, you can reduce the bus voltage of the main circuit gently.
- [3]: Torque limiting starts.
- [4]: Limit torque after an undervoltage warning is received.

  - When H07.07 = 0:
    The forward torque limit is H07.09 and the negative torque limit is H07.10.
  - When H07.07 is set to 1, the torque reference limit is determined by the logic of the external DI signal.
    The positive torque limit is selected between H07.09 (Positive internal torque limit) and H07.11 (Positive external torque limit). The negative torque limit is selected between H07.10 (Negative internal torque limit) and H07.12 (Negative external torque limit).

- When H07.07 = 2, 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 inactive, and the forward limit is determined by AI input. DI-PCL (Forward External Torque Limit) is active, and the forward limit is determined by the smaller one between H07.11 and the torque corresponding to AI input voltage.

  DI-NCL (Reverse External Torque Limit) is inactive, and the reverse limit is determined by AI input. DI-NCL (Reverse External Torque Limit) is active, and the reverse limit is determined by the smaller one between H07.12 and the torque corresponding to AI input voltage.
- When H07.07 = 4:
  - DI-PCL (Forward External Torque Limit) is inactive, and the forward limit is determined by H07.09. DI-PCL (Forward External Torque Limit) is active, and the forward limit is determined by AI input voltage;
  - DI-PCL (Reverse external torque limit) is inactive, and the reverse limit is determined by H07.10; DI-PCL (Forward external torque limit) is active, and the reverse limit is determined by AI input voltage.

- **When executed by the drive (H0A.81 = 2)**
  According to the undervoltage E971.0 alarm, apply the torque limit inside the servo drive. After receiving the undervoltage alarm clear signal, the torque limit value is controlled in the servo drive according to the set time.



Note

- [1]: After the main circuit power supply is restored, the bus voltage of the main circuit rises.
- [2]: By limiting the output torque, you can reduce the bus voltage of the main circuit gently.
- [3]: Torque limiting starts.

- **The E971.0 undervoltage alarm is not detected (H0A.81 = 0)**
  Voltage drop does not trigger the E971. 0 alarm, but the E410.0 alarm.

Related parameters

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0A.81	200 A-52h	Voltage drop protection enable	0: No operation1 : Host controller executes torque limit 2: Servo executes torque limit	0	-	At stop	"H0A_en.81" on page 867
H0A.82	200 A-53h	Voltage drop torque limit	0.0 to 100.0	50.0	%	Real time	"H0A_en.82" on page 868
H0A.83	200 A-54h	Torque limit cancellation time	0 to 1000	100	ms	Real time	"H0A_en.83" on page 868
H0A.84	200 A-55h	Hold time of instantaneous power failure	20 to 50000	1000	ms	Real time	"H0A_en.84" on page 868

Note

- This function is suitable for instantaneous power outage with the voltage and time specified by SEMI F47. If the voltage and time beyond this range, a standby power supply is needed.
- When the power supply of the main circuit is restored, use the torque limit of the host controller or servo drive to set the torque, so as to avoid the output torque being greater than the commanded acceleration torque.
- When used on vertical axes, do not limit the torque below the holding torque.
- This function is to limit the torque within the capacity of the powered off servo drive, and is not applicable to all load conditions or operating conditions. The parameter to be set may vary with the actual device.
- After you set H0A.84, the time from disconnecting the power supply to stopping the motor power will become longer. You can power off the motor immediately through the input and output of servo ON input signal.

12.12 Accuracy Compensation

12.12.1 Accuracy Compensation Function

The accuracy compensation function is applicable only to DDL and DDR motors.

Precision mechanical and electrical applications, such as silicon crystals, semiconductors, and test and package, require a high absolute control accuracy. 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 only use the position information fed back by the encoder as the basis for motor position control, which means incorrect position feedback can result in inaccurate absolute control of the direct-drive motor.

Therefore, the SV680-INT series servo drive is equipped with the accuracy compensation function for calibrating the physical accuracy of the motor, as shown in "Figure 12-7" on page 534 .

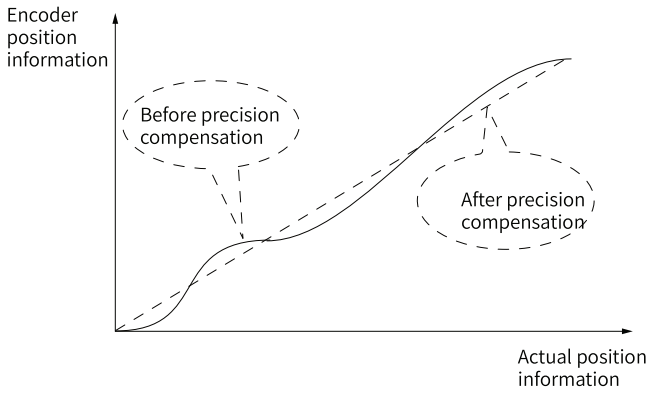


Figure 12-7 Accuracy compensation effect

Basic principle: The accuracy error compensation table is obtained 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. The accuracy compensation data table acquisition stage involves the linear motor ①, encoder ②, drive ③, controller ④, PC ⑤, and laser interferometer and matching measurement lens, as shown in *"Figure 12-8" on page 535* .

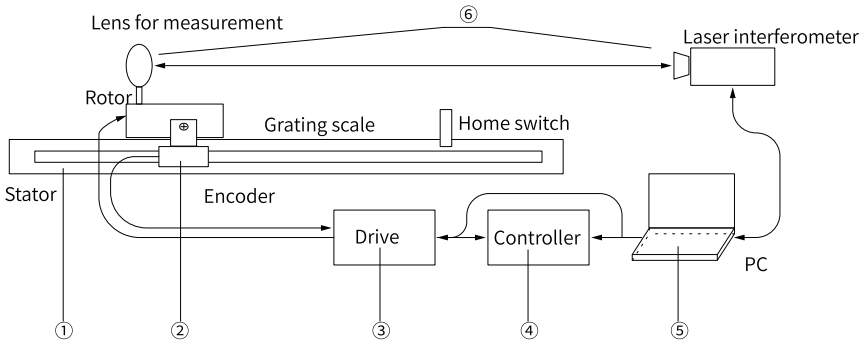


Figure 12-8 Structure of accuracy compensation table acquisition

2. The accuracy compensation control application stage involves the encoder ①, linear motor ②, drive ③, and controller ④, as shown in *"Figure 12-9" on page 535* .

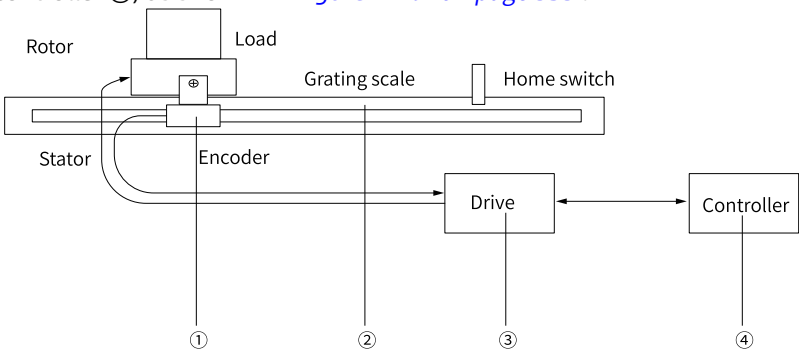


Figure 12-9 Structure of linear motor operation accuracy compensation

---

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 get the accuracy compensation data table for subsequent accuracy compensation control. The schematic diagram and flowchart are shown in *"Figure 12-10" on page 535* and *"Figure 12-11" on page 536* .

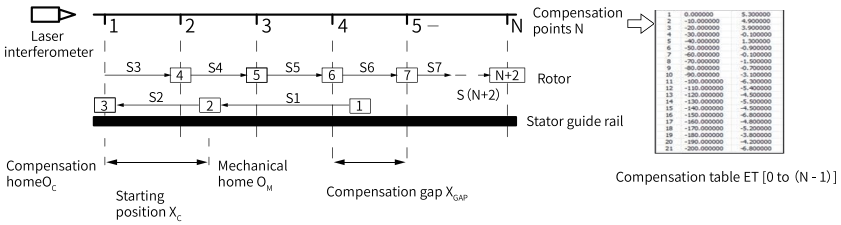


Figure 12-10 Schematics for accuracy compensating table acquisition

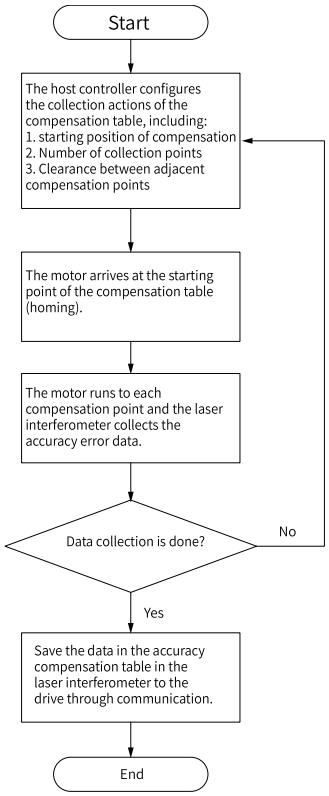
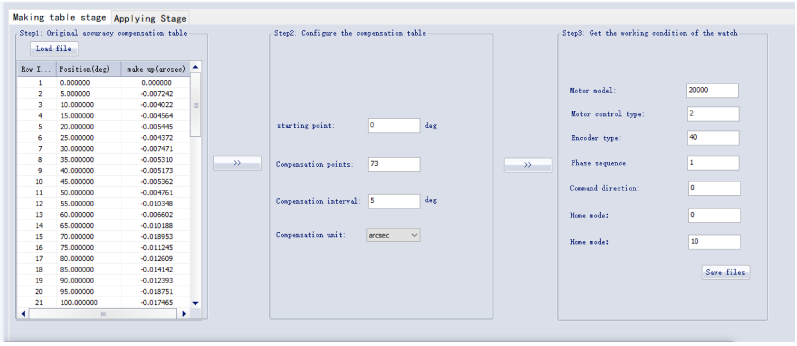


Figure 12-11 Flowchart for accuracy compensating table acquisition

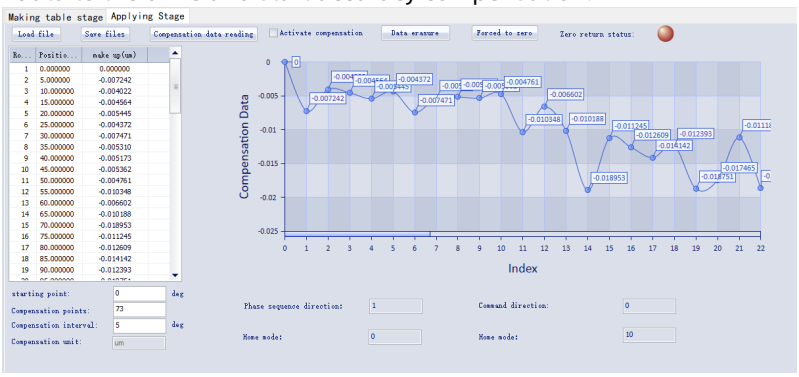
The following shows detailed procedure.

- 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: Controller that used to control the linear motor to run from the mechanical home O_M to the compensation home O_C.(the base point of the compensation coordinate system), with the moving distance being the start position X_{OCOM} of the compensation point.
- S3: Laser interferometer that used to perform base point calibration at the compensation home O_C and obtain the error compensation at the first compensation point. After the preceding operation is done, the controller controls the linear motor to run to the next compensation point acquisition position according to the compensation interval X_{GAP}.
- S4 to S (N+2): Laser interferometer that used to get the current compensation point compensation error data After the preceding operation is done, the controller continues to control the linear motor to run to the next position according to the compensation interval X_{GAP}. This process is repeated until the desired compensation points N is obtained, which form the compensation table ET [0 to (N - 1)].
- S (N+3): Open the applicable software tool and connect the drive, then click "Accuracy compensation > Making table stage" and operate as shown below to pre-process the accuracy compensation error table obtained by the laser interferometer.

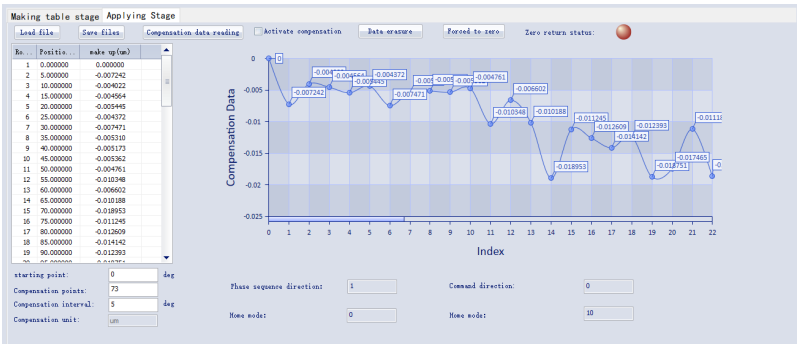


Application stage (accuracy compensation table sent to the drive and enabled)

- S1: Open the applicable software tool and connect the drive, then click "Accuracy compensation > Making table stage" and 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 is shown below.



- S2: Once 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 done, 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 jumps 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 12–4 DDL/DDR accuracy compensation application with BiSS-C/SSI/EnDat 2.2 encoder

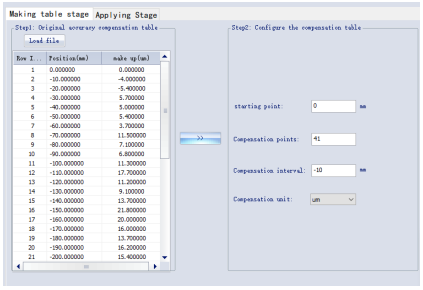
Comparison with the DDL motor equipped with ABZ incremental encoder (TTL signal)	
Preparation	Same as those described in section "Preparation".
Table stage	• Homing not required • The start position is the absolute position value of the starting point of the laser interferometer. 
Application stage	The accuracy compensation table received by the drive is activated automatically at next power-on, without the need for homing.

Table 12–5 Application of the DDR motor with ABZ incremental encoder (TTL signal) or Inovance incremental encoder

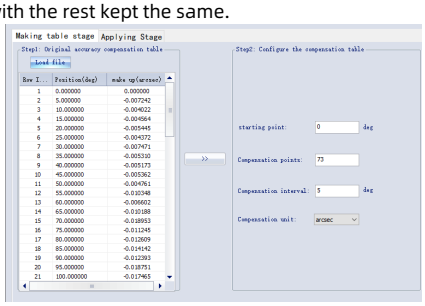
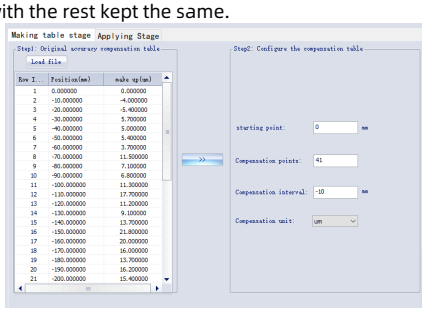
Comparison with the DDL motor equipped with ABZ incremental encoder (TTL signal)	
Preparation	The laser interferometer changes from distance measurement to angle measurement.
Table stage	The unit changes to deg and arcsec, with the rest kept the same. 
Application stage	Same as those described in section "Preparation".

Table 12–6 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 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 as those described in section "Preparation".

Note

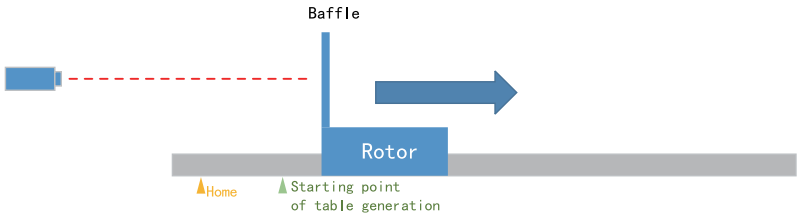
- The accuracy compensation function has the same accuracy compensation effect for frequency-division output.
- In DDR application mode, the maximum angle corresponding to the compensation points is allowed to be less than one revolution (that is, the calibration points × calibration interval ≤ 360 degrees), but it cannot be higher than one revolution. Otherwise, logic confusion can occur.

12.12.2 Application Cases

This example provides a configuration method. Adjust the parameters according to actual accuracy requirements.

Case 1

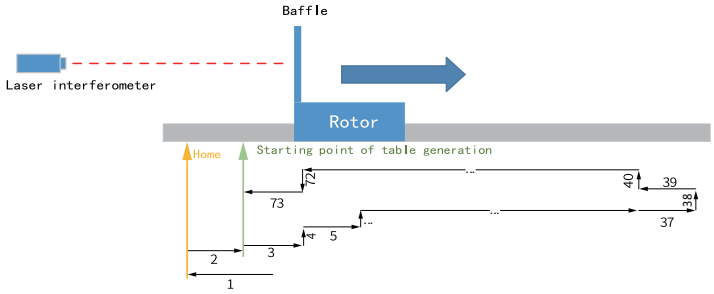
Assume that the effective stroke of a linear motor rotor is 1 m, the resolution of a quadrature pulse encoder is 0.1 μm/pulse, the home locates near the limit switch at the left limit position (forward when from left to right), and the starting position of table generation is 10 cm near the forward direction of the home, then the following formula apply when table generation is required every 5 cm from the starting position.



Calculating the home offset: 10 cm = 100000 μm = 100000 μm ÷ (0.1 μm ÷ pulses) = 1000000 pulses

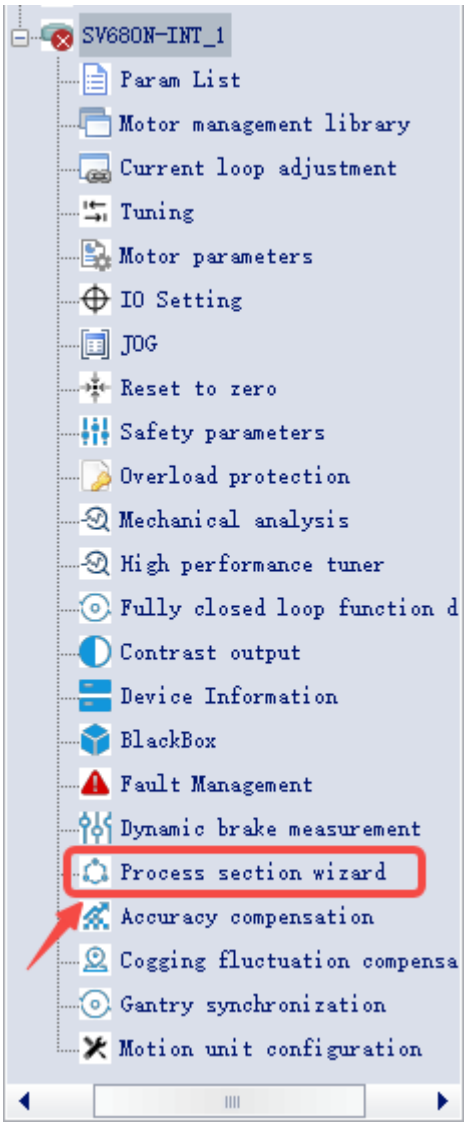
Segments of table generation: (1m - 0.1m) ÷ 0.05 m =18 segments

Calculating the increment of single-segment operation: 5 cm = 50000 μm = 50000 μm ÷ (0.1 μm ÷ pulses) = 500000 pulses

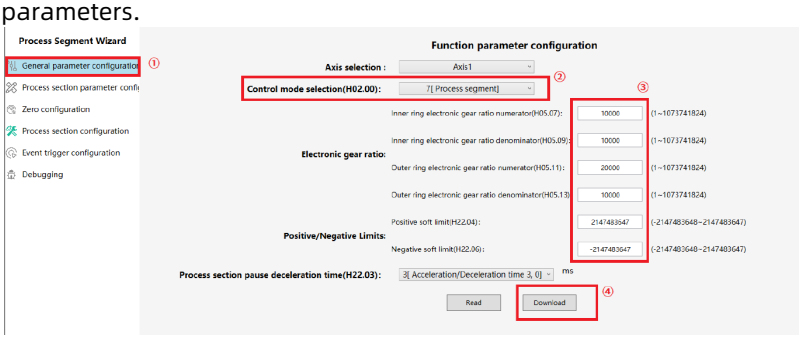


Procedure for setting accuracy compensation table generation

1. Complete the operation in process segment mode.

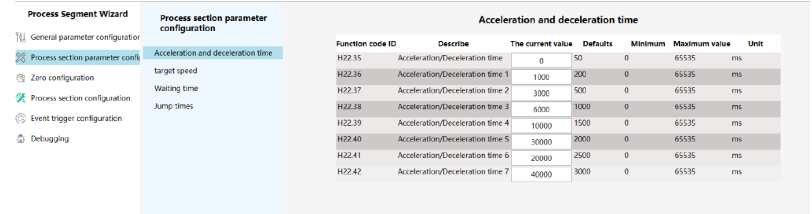


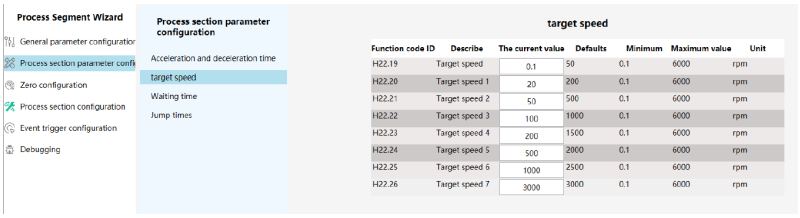
2. Set the basic parameters.



3. Set process segment parameters according to actual conditions.

   a. Use the default values of acceleration and target speed, and click "Jump count".

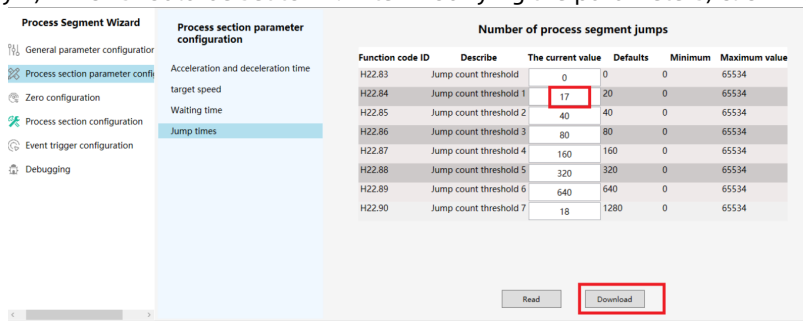




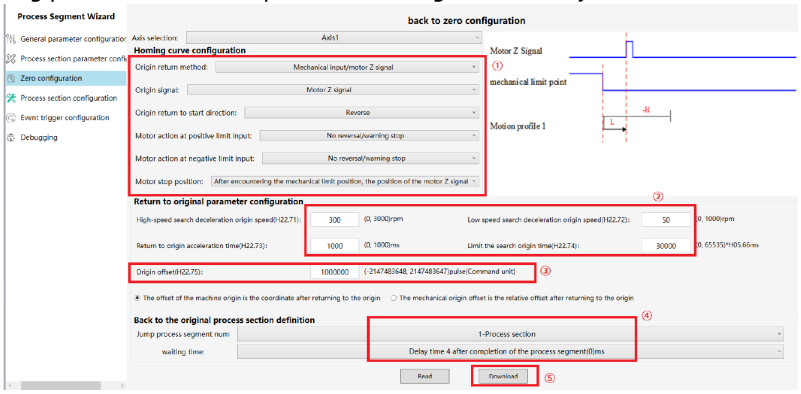
b. The waiting time can be changed. In case 1, the waiting time is set to 10s.



c. The number of segments is 18, including the last jump. Therefore, the jump count needs to be subtracted by 1, which should be set to 17. After modifying the parameters, click "Download".

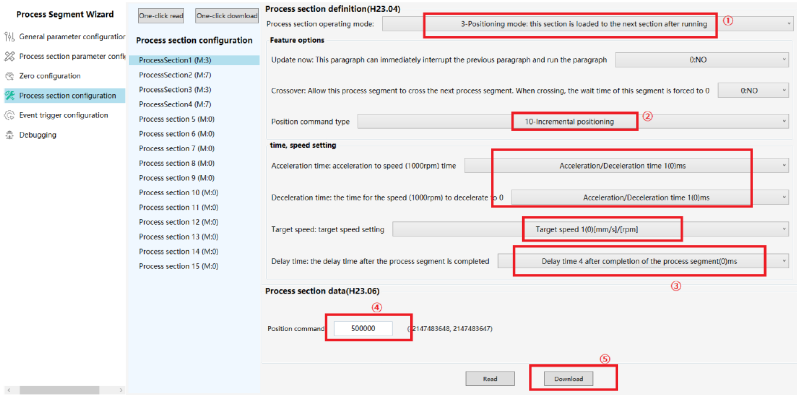


4. Configure homing parameters. Because the left limit switch is the home, you need to locate the limit switch in the reverse direction, and configure the homing speed. In case 1, the homing offset is set to 1000000 (home offset calculated above), the jump process segment is set to process segment 1, and the delay time is set to 10s. After you complete the settings, click "Download". Note: The waiting position is the first point for table generation by the laser interferometer.

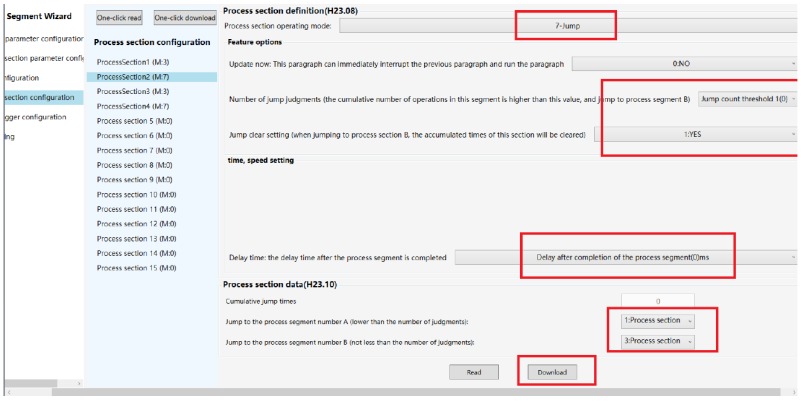


5. Configure process segment parameters.

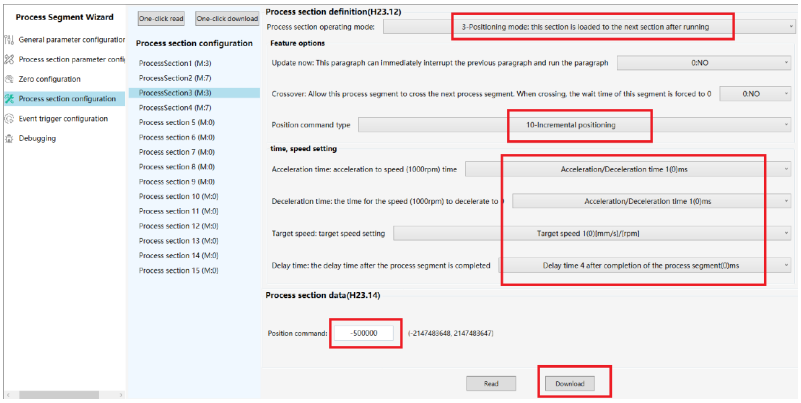
a. Select mode 3 for process segment 1 and incremental mode for position reference. Set the target speed and the delay time to 10s. Set the position reference to 50000 pulses, and click "Download" finally.



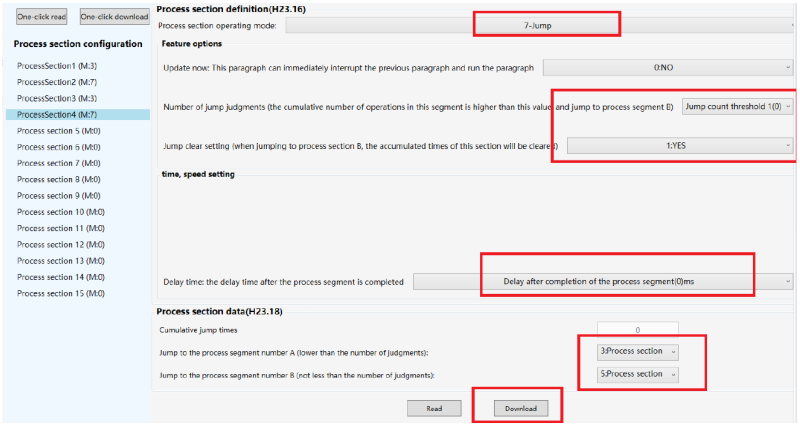
b. The process segment 2 is configured to jump at mode 7. Set the Jump judgment count to 17 as set previously. And set "Jump clear setting" to "Yes". Set the jump delay time to 0 ms (as single-segment operation has been delayed 10s), set "Jump to process segment A" to process segment 1 and execute cyclically. Set "Jump to process segment B" to process 3. After you complete the settings, click "Download".



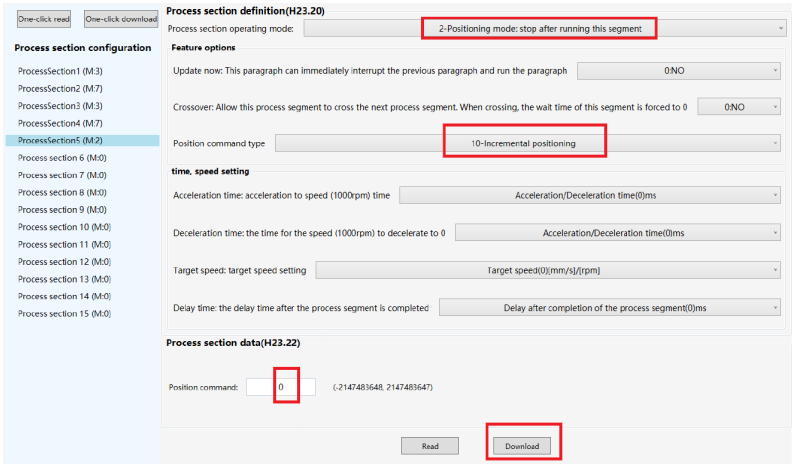
c. Refer to segment 1 for how to set process segment 3, except that the position reference is set to -500000.



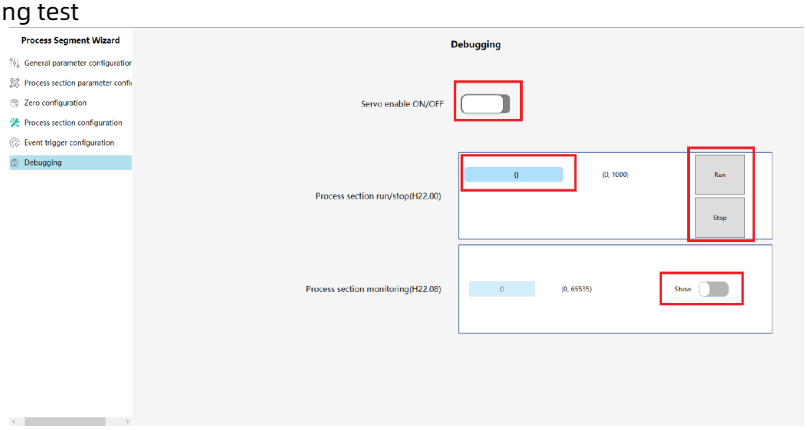
d. The procedure for setting process segment 4 is as follows. Note that the jump condition for process segment 4 differs from that for process segment 2.



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. After you complete the settings, click "Download".



6. Commissioning test

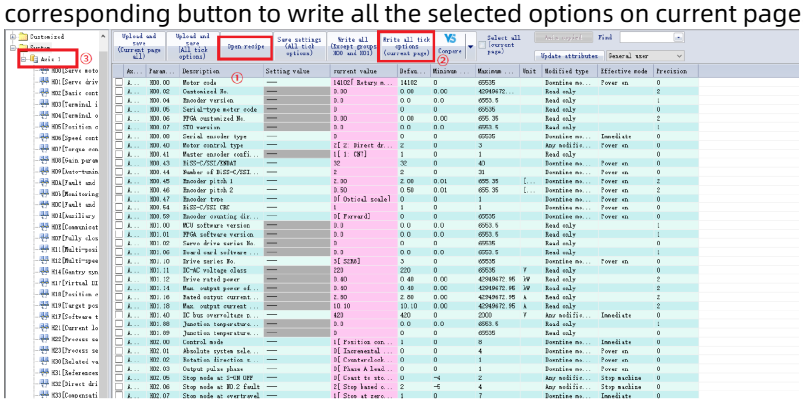


Simple setting procedure for accuracy compensation table generation

1. Click "Parameter list".

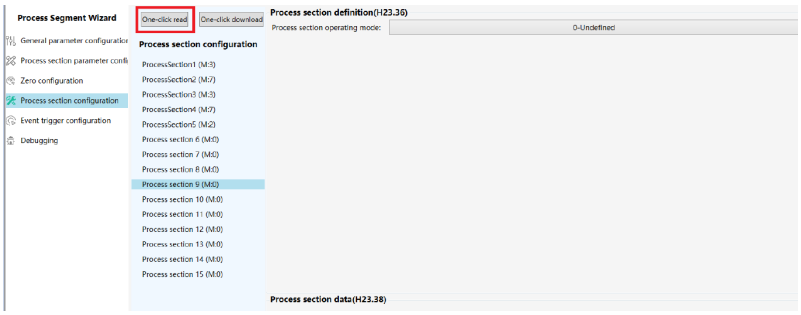


2. Click "Open parameter file", select the parameter file below, click "Left axis 1", and click the corresponding button to write all the selected options on current page.



The parameters are provided below. You can download all parameters to the drive and perform commissioning directly.

3. Go to the process segment page and click "Read all".

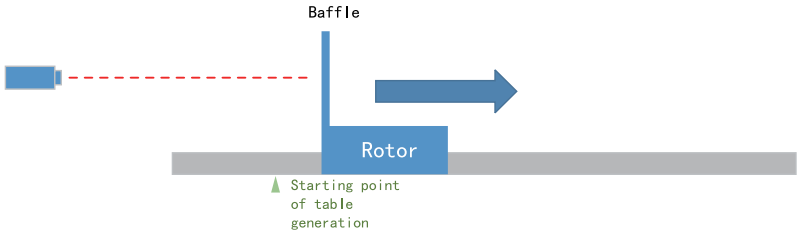


4. Perform commissioning.

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, then the following formula apply when table generation is required every 5 cm from the starting position.

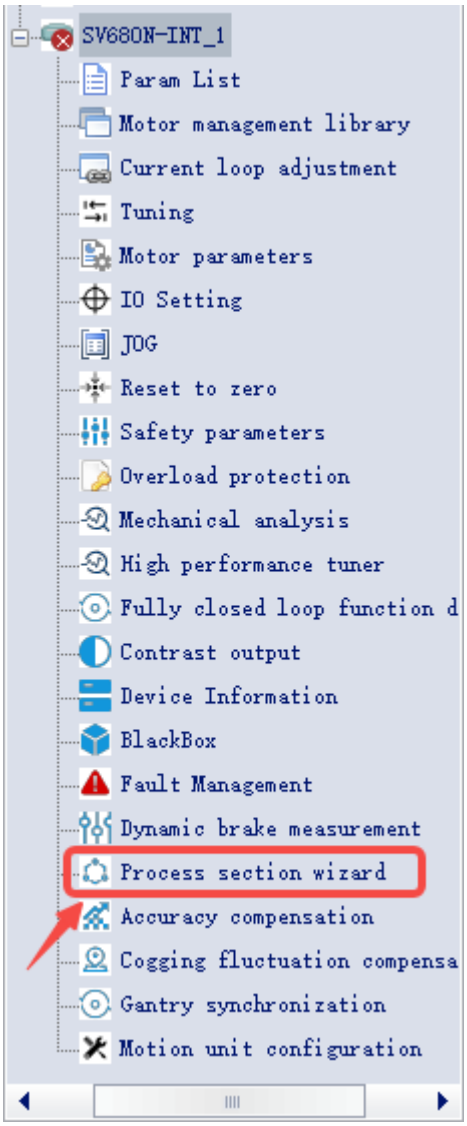


Segments of table generation: 0.9 m ÷ 0.05 m =18 segments

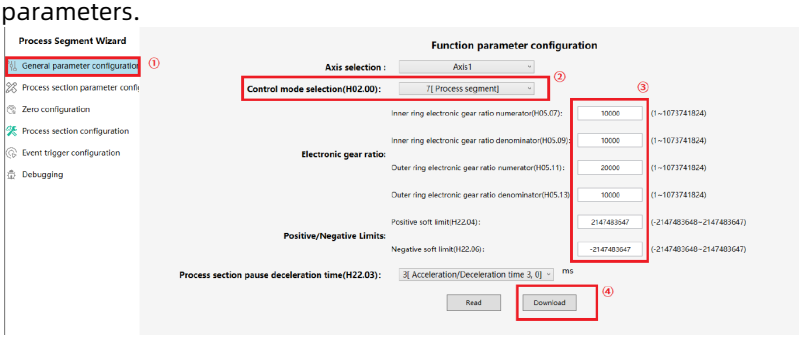
Calculating the increment of single-segment operation: 5 cm = 50000 μm = 50000 μm ÷ (0.1 μm ÷ pulses) = 500000 pulses

Procedure for setting accuracy compensation table generation

1. Complete the operation in process segment mode.

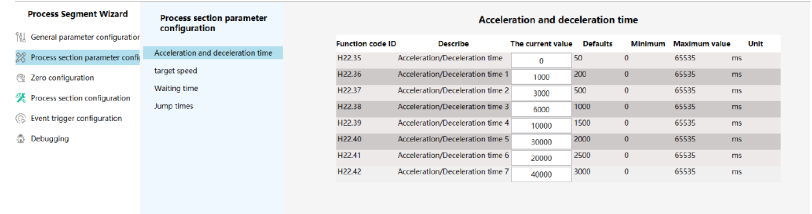


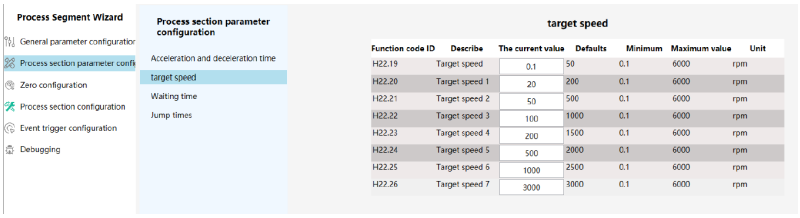
2. Set the basic parameters.



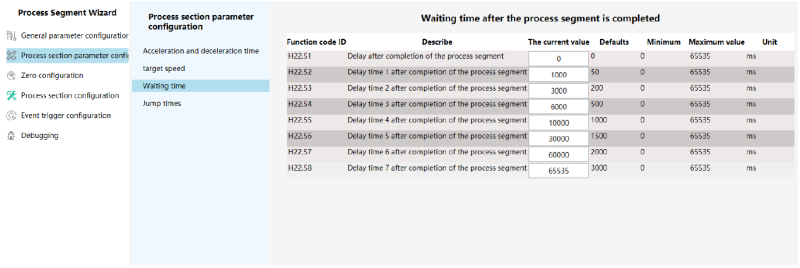
3. Set process segment parameters according to actual conditions.

   a. Use the default values of acceleration and target speed, and click "Jump count".

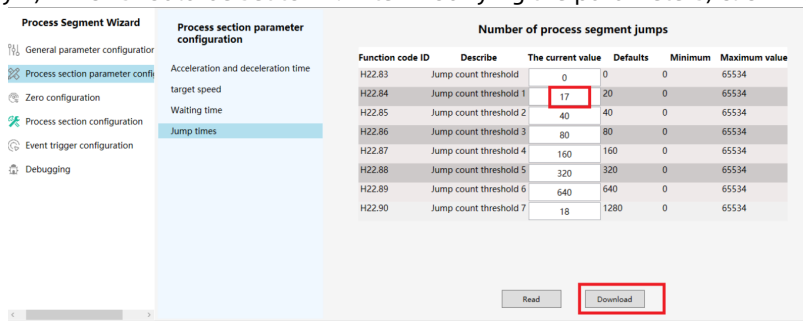




b. The waiting time can be changed. In case 1, the waiting time is set to 10s.



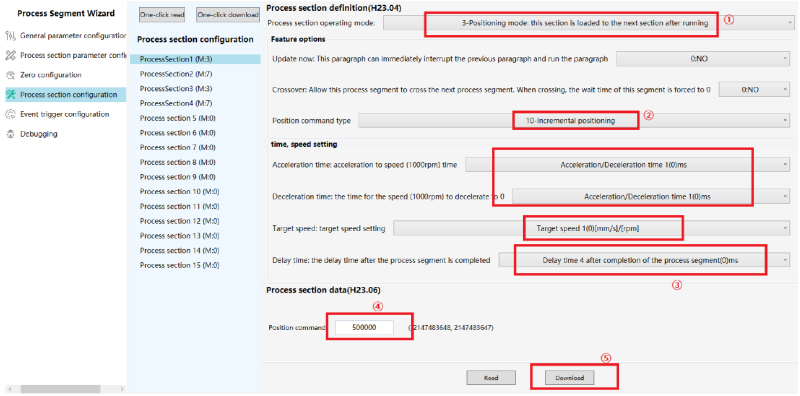
c. The number of segments is 18, including the last jump. Therefore, the jump count needs to be subtracted by 1, which should be set to 17. After modifying the parameters, click "Download".



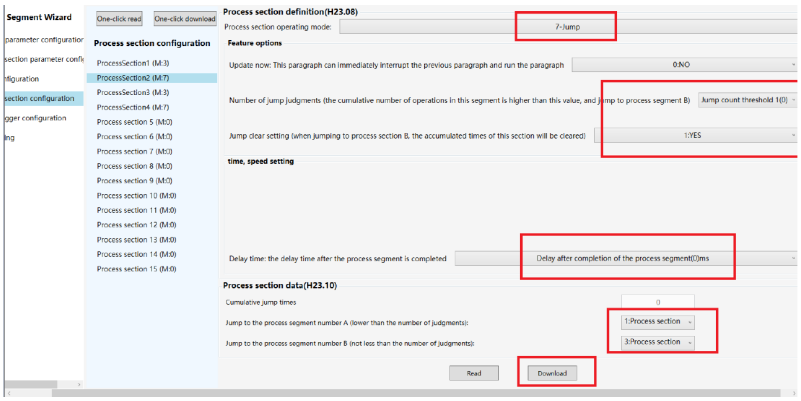
4. Configure process segment parameters.

Use the above parameters to configure process segments 1 to 5.

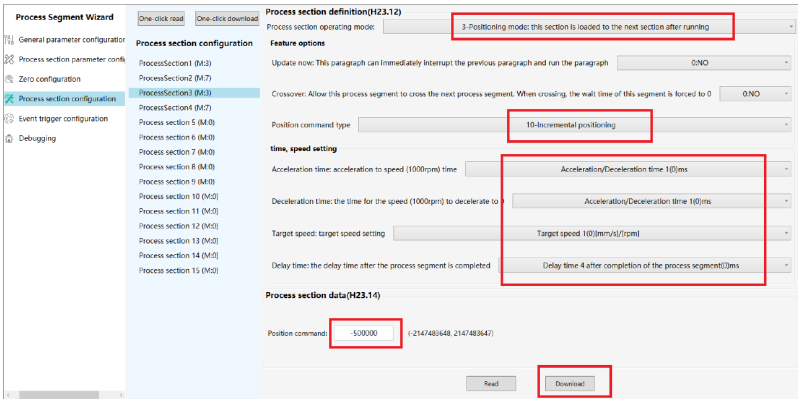
a. Select mode 3 for process segment 1 and incremental mode for position reference. Set the target speed and the delay time to 10s. Set the position reference to 50000 pulses, and click "Download" finally.



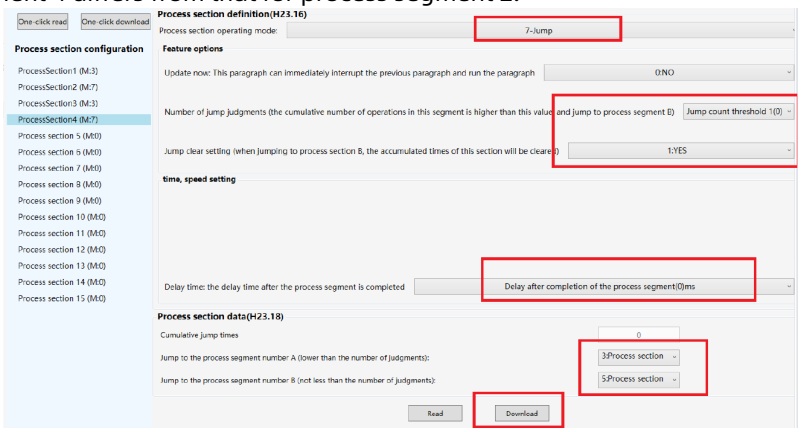
b. The process segment 2 is configured to jump at mode 7. Set the Jump judgment count to 17 as set previously. And set "Jump clear setting" to "Yes". Set the jump delay time to 0 ms (as single-segment operation has been delayed 10s), set "Jump to process segment A" to process segment 1 and execute cyclically. Set "Jump to process segment B" to process 3. After you complete the settings, click "Download".



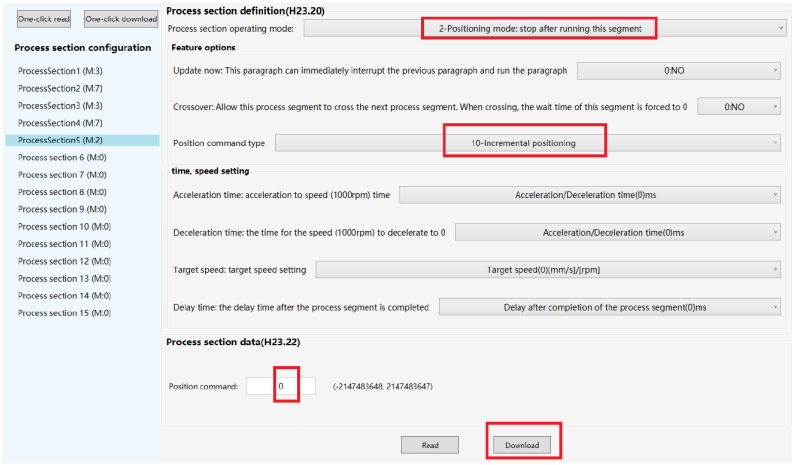
c. Refer to segment 1 for how to set process segment 3, except that the position reference is set to -500000.



d. The procedure for setting 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. After you complete the settings, click "Download".



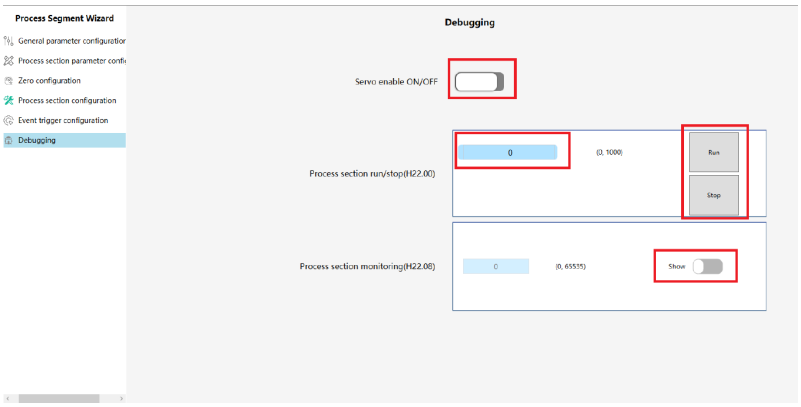
f. Configure process segment 6.



g. Configure process segment 7 and jump once.



5. Perform commissioning.

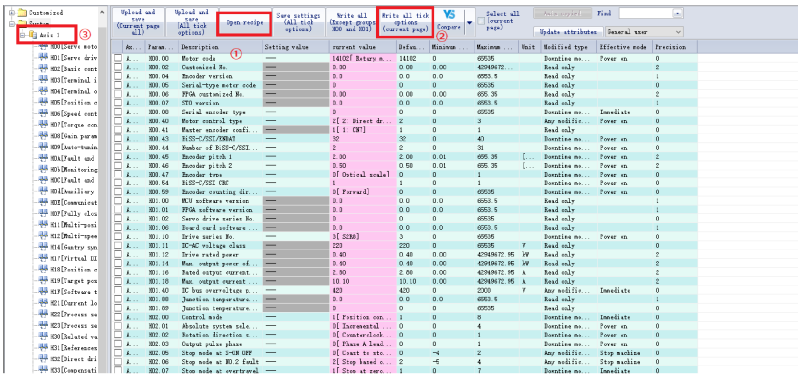


Simple setting procedure for accuracy compensation table generation

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.



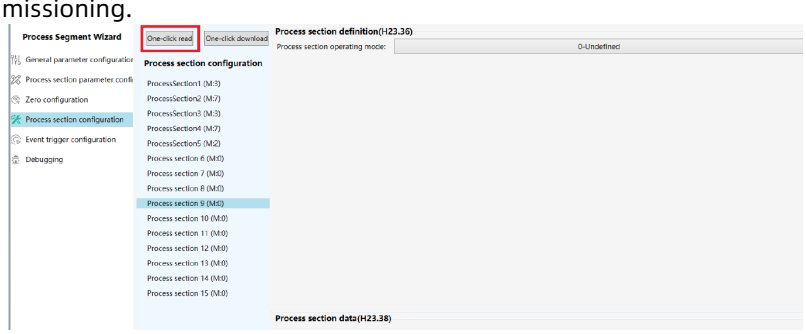
The parameters are provided below. You can download all parameters to the drive and perform commissioning directly.

3. Go to the process segment page and click "Read all".



SV680-INT accuracy compensation table - Process segment case 1.inoparam

4. Perform commissioning.



12.13 Quadrant Friction Compensation

Function overview

The quadrant friction compensation function is designed to compensate the large delay in motor speed feedback due to large static friction of the mechanical system when the motor changes its direction. In actual machining (such as circular machining), the system friction during motor direction change will cause quadrant protrusion, resulting in quadrant marks on the workpiece surface.

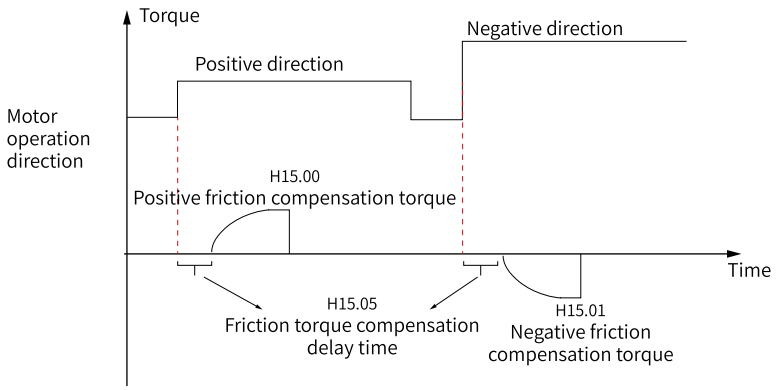
Note

Quadrant friction compensation is effective only in position mode.

Related parameters

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H15.00	2015-01h	Forward friction compensation torque	0.0 to 50.0	0.0	%	Real time	"H15_en.00" on page 968
H15.01	2015-02h	Negative friction compensation torque	0.0 to 50.0	0.0	%	Real time	"H15_en.01" on page 968
H15.02	2015-03h	Forward friction torque filter time constant	0.10 to 100.00	0.10	ms	Real time	"H15_en.02" on page 969
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 969
H15.04	2015-05h	Friction torque compensation speed reference source	0: Speed reference 1: Model speed 2: Speed feedback 3: Observation speed 4: Speed reference	0x2	-	Real time	"H15_en.04" on page 969
H15.05	2015-06h	Friction torque compensation delay time	0.00 to 300.00	0.00	ms	Real time	"H15_en.05" on page 969
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 970

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.

12.14 Backlash compensation instruction

Function overview

The backlash compensation function is used to compensate poor positioning performance after the motor direction is reversed when the mechanic is loose or experiences backlash.

Note

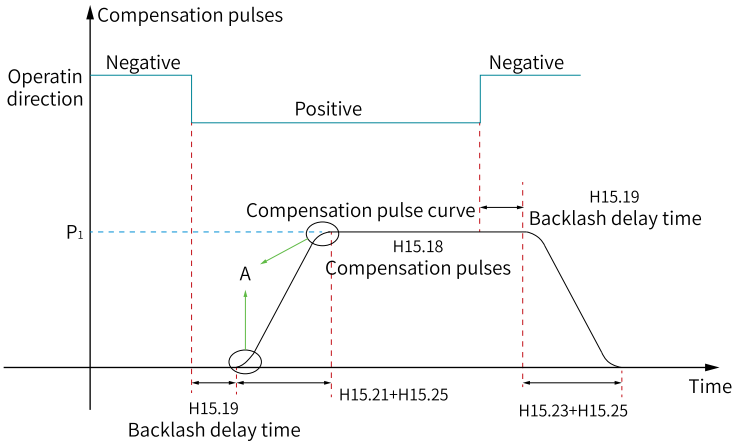
Backlash compensation is effective only in position mode.

Related parameters

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H15.15	2015-10h	Backlash compensation enable	0: Disable 1: Ramp	0	-	Real time	"H15_en.15" on page 970
H15.16	2015-11h	Backlash compensation speed reference source	0: Speed reference 1: Model speed 2: Speed feedback 3: Observation speed 4: Speed reference	0x4	-	Real time	"H15_en.16" on page 970
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 970
H15.18	2015-13h	Number of pulses of backlash compensation	0 to 65535	0	p	Real time	"H15_en.18" on page 971
H15.19	2015-14h	Backlash delay	0.0 to 300.0	0.0	ms	Real time	"H15_en.19" on page 971
H15.21	2015-16h	Forward backlash compensation time	0.1 to 300.0	0.1	ms	Real time	"H15_en.21" on page 971

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H15.23	2015-18h	Reverse backlash compensation time	0.1 to 300.0	0.1	ms	Real time	"H15_en.23" on page 971
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 972

How it works



Parameter settings:

1. Set H15.15 to 1 to enable backlash compensation.
2. Set H15.16 and H15.17 to select the position or speed signal used to detect motor direction reverse and the minimum speed threshold for detecting direction reverse.
   Note: If H15.16 is set to 0x00 (Position reference), H15.17 can be skipped. Otherwise, H15.17 must be set.
3. Settings of H15.18, H15.19, H15.21, H15.23, and H15.25 are shown in the preceding figure. Where:

   H15.18 is used to set the number of backlash compensation pulses. Set the parameter according to the actual backlash.

   H15.19 is used to set the delay time between the time when direction reverse is detected by the servo and the start time of backlash compensation.

   H15.21 and H15.23 are used to set the time between the start time of backlash compensation in the positive and negative directions and the time when backlash compensation reaches the set number of pulses. The smaller the parameter value, the faster the backlash compensation speed.

   H15.25 is used to smooth the backlash compensation curve. For details, see the section marked by A in the preceding figure.

13 Gantry Synchronization

In industrial manufacturing, gantry synchronization is widely used in premium manufacturing equipment. To meet the requirements for high precision and high coordination in motion, the gantry architecture supports higher stability based on gantry synchronization, which enables highly responsive coordinated control.

13.1 Wiring

The wiring of gantry synchronization is shown in *"Figure 13-1" on page 556* . 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.

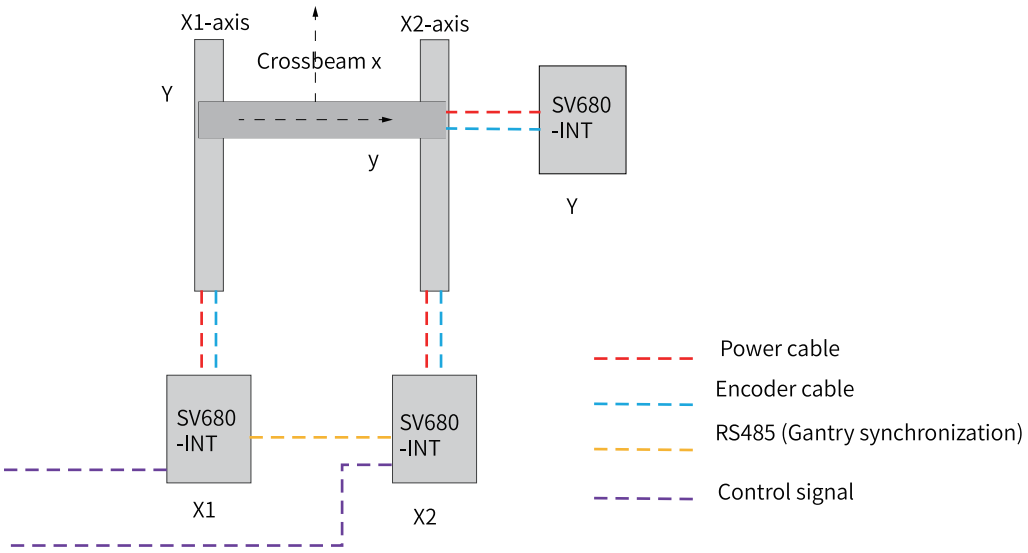
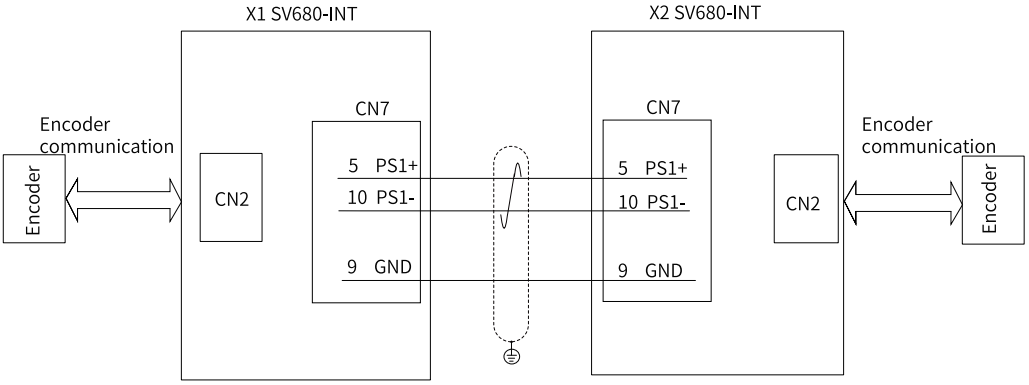


Figure 13-1 Wiring of gantry synchronization

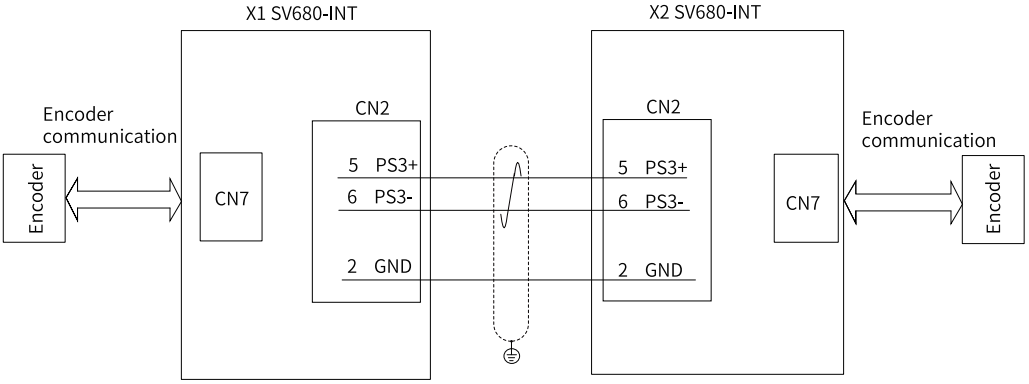
When SV680-INT works with a direct drive or third-party motor, the motor is connected to terminal CN7 of the primary encoder by default. When SV680P-SINT works with an Inovance motor, the motor is connected to terminal CN2 of the primary encoder. You can set H32.01 = 1 to switch between encoder terminals. 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.

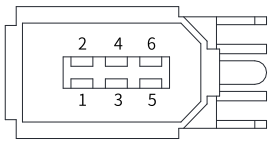
- If the primary encoder is connected to Cn2, gantry communication must be connected to the following pins:



- 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 13-2 Layout of CN2 terminal pins

Table 13–1 Pins of the CN2 terminal

Pin No.	Pin assignment	Pin description
1	5 V	5 V power supply
2	GND	5 V power supply ground
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

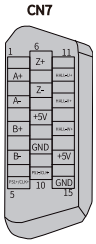


Figure 13-3 Layout of CN7 terminal pins

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 secondary 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.

13.2 Gantry Commissioning Solutions

Gantry structures and synchronization control schemes

Table 13–2 Gantry structures

Gantry structure	Description
Rigid gantry	The two axes are connected over a rigid crossbeam, allowing only a small deviation to prevent stuck axes.
Flexible gantry	The two axes are connected over a flexible crossbeam, allowing a certain synchronization deviation between the axes.
Virtual gantry	The axes are independent of each other, with no crossbeam installed. Deviation is allowed between the axes. Yaw axis control is supported.

SV680-INT supports *"Table 13-3 Gantry synchronization control schemes" on page 559*two gantry synchronization control schemes, applicable to different gantry structures. For details, see .

Table 13–3 Gantry synchronization control schemes

Gantry synchronization control schemes	Scheme	Scope of application
Scheme 1	When the master axis receives an external position reference, both the master and slave axes follow the position reference. In addition, the slave axis starts eliminating synchronization deviation to align with the master axis.	Rigid gantry Flexible gantry Virtual gantry
Scheme 2[1]	When the master axis receives an external position reference, it follows the position reference. Meanwhile, the slave axis starts eliminating synchronization deviation to align with the master axis. The slave axis can receive position references to control the position deviation with the master axis by moving toward the master axis.	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 on applicable scenarios

The following limits apply to the applicable scenarios of gantry synchronization control for SV680-INT.

No.	Requirement	Limit
1	The motor models and specifications must be consistent.	The control modes of the two axes must be the same.
2	The encoder models and specifications must be consistent.	
3	A Hall sensor is required.	
4	The drive models and specifications must be consistent.	

Commissioning Precautions

1. Unlike single-axis servo commissioning, the commissioning of the gantry synchronization function requires consistent key parameter settings between the two axes. Otherwise, function anomalies may occur. The following table lists the parameters that must be consistent between the two axes. If you need to change the setting of a parameter for one of the axes, make sure that the new setting of the parameter is the same between the two axes. For details, see *"Table 13-4 Parameter configuration requirements" on page 560*

Table 13–4 Parameter configuration requirements

Precaution	Parameter type	Parameter
Consistent parameter settings between the master and slave axes	Motor and encoder parameters	Parameters in group H00
	Drive parameters	Parameters in group H01
	Basic functions	Control mode selection: H02.00 Absolute value system selection: H02.01 Stop mode: H02.05 to H02.08, and H02.17 to H02.18 Delay of dynamic braking: H02.20 Electronic gear ratio: H05.02, H05.07, H05.09, H05.11, H05.13, and 6091h Brake parameters: H02.09 to H02.12, and H02.16 Ramp to stop: 6084h and 6085h
	Reference limits	Speed limits: H07.17, H06.08, and H06.09 Torque limits: H07.07, and H07.09 to H07.12
	Gain parameters	Loop gain: H08.00, H08.01, H08.02, and H08.62 Loop feedforward: H08.18, H08.19, H08.20, and H08.21
	Filtering	Position reference filtering: H05.04, H05.06, and H05.70 Speed feedforward smoothing filtering: H06.13 Torque reference low-pass filtering: H07.05, H07.06, H07.37, H07.38, and H07.36 Speed measurement method and speed feedback filtering: H08.25, H08.22, and H08.23

2. Unlike single-axis servo commissioning, some functions will be unavailable after gantry synchronization is enabled. SV680-INT has internal limits, that is, user-defined settings do not take effect for the limited functions. The following table describes whether a function is supported after gantry synchronization is enabled. For details, see *"Table 13-5 Functions supported in scheme 1" on page 560 "Table 13-6 Functions supported in scheme 2" on page 561*

Table 13–5 Functions supported in scheme 1

No.	Function overview	Supported by master axis?	Configuration requirements for master and slave axes	Supported by slave axis?
1	Single Tune	STune1-8 supported	Slave axis automatically synchronizes with master axis	STune1-8 supported
2	Speed feedforward	Supported	Slave axis must synchronize with master axis	Supported
3	Torque feedforward	Supported	Slave axis must synchronize with master axis	Supported

No.	Function overview	Supported by master axis?	Configuration requirements for master and slave axes	Supported by slave axis?
4	External feedforward	Supported	Slave axis must synchronize with master axis	Supported
5	Model control	Supported	Slave axis must synchronize with master axis	Supported
6	QFC control	Supported	Slave axis must synchronize with master axis	Supported
7	Speed observer	Supported	Slave axis must synchronize with master axis	Supported
8	Disturbance compensator	Supported	Set parameters according to the actual condition	Supported
9	PDFF control	Supported	Slave axis must synchronize with master axis	Supported
10	Gain switchover	Supported	Slave axis must synchronize with master axis	Supported
11	Cogging compensation	Supported	Set parameters according to the actual condition	Supported
12	Encoder pitch fluctuation suppression	Supported	Set parameters according to the actual condition	Supported
13	Adaptive notch	Supported	Set parameters according to the actual condition	Supported
14	Online inertia auto-tuning	Supported	Slave axis must synchronize with master axis	Supported
15	Offline inertia auto-tuning	Not supported	After completing tuning for one of the axis, calculate (a – 2) ÷ 2 for both axes.	Not supported
16	Gravity compensation	Supported	Set parameters according to the actual condition	Supported
17	Friction compensation	Supported	Set parameters according to the actual condition	Supported
18	Low-frequency jitter suppression 1 at the mechanical end	Supported	Slave axis must synchronize with master axis	Supported
19	Low-frequency jitter suppression 2/3 at the mechanical end	Supported	Slave axis must synchronize with master axis	Supported
20	Field weakening	Supported	Slave axis must synchronize with master axis	Supported

Table 13–6 Functions supported in scheme 2

No.	Function overview	Supported by master axis?	Supported by slave axis?
1	Single Tune	STune1-6 supported	STune1 supported only (stiffness table)
2	Speed feedforward	Supported	Not supported
3	Torque feedforward	Supported	Not supported
4	External feedforward	Supported	Not supported

No.	Function overview	Supported by master axis?	Supported by slave axis?
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	Cogging compensation	Supported	Supported
12	Encoder pitch fluctuation suppression	Supported	Supported (only speed feedback available)
13	Adaptive notch	Supported	Supported
14	Online inertia auto-tuning	Supported	Not supported
15	Offline inertia auto-tuning	Not supported (manually divide the tuned value by 2 and rewrite the result)	Not supported (manually divide the tuned value by 2 and rewrite the result)
16	Gravity compensation	Supported	Supported
17	Friction compensation	Supported	Supported (only speed feedback available)
18	Low-frequency jitter suppression 1 at the mechanical end	Supported	Not supported
19	Low-frequency jitter suppression 2/3 at the mechanical end	Supported	Not supported
20	Field weakening	Supported	Supported

13.3 Gantry Commissioning Process

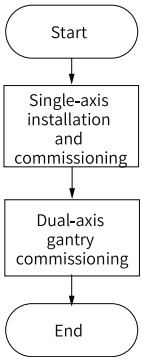


Figure 13-4 Overall process

13.4 Single-axis Commissioning

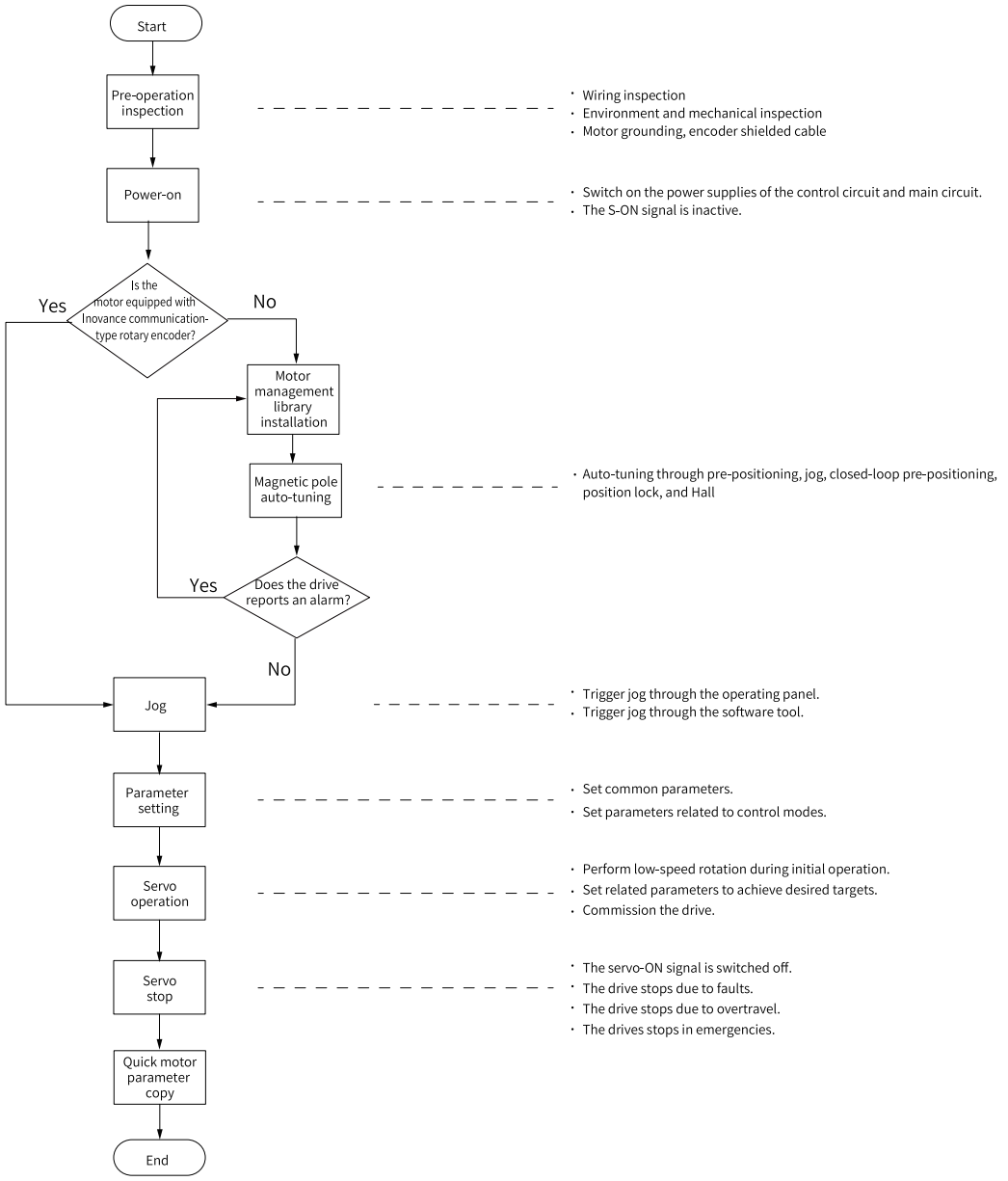


Figure 13-5 Commissioning flowchart of the drive

Refer to the flowchart to install and commission the master and slave axes, ensuring that both axes can operate smoothly.

13.5 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.

13.5.1 Commissioning procedure for gantry synchronization control scheme 1

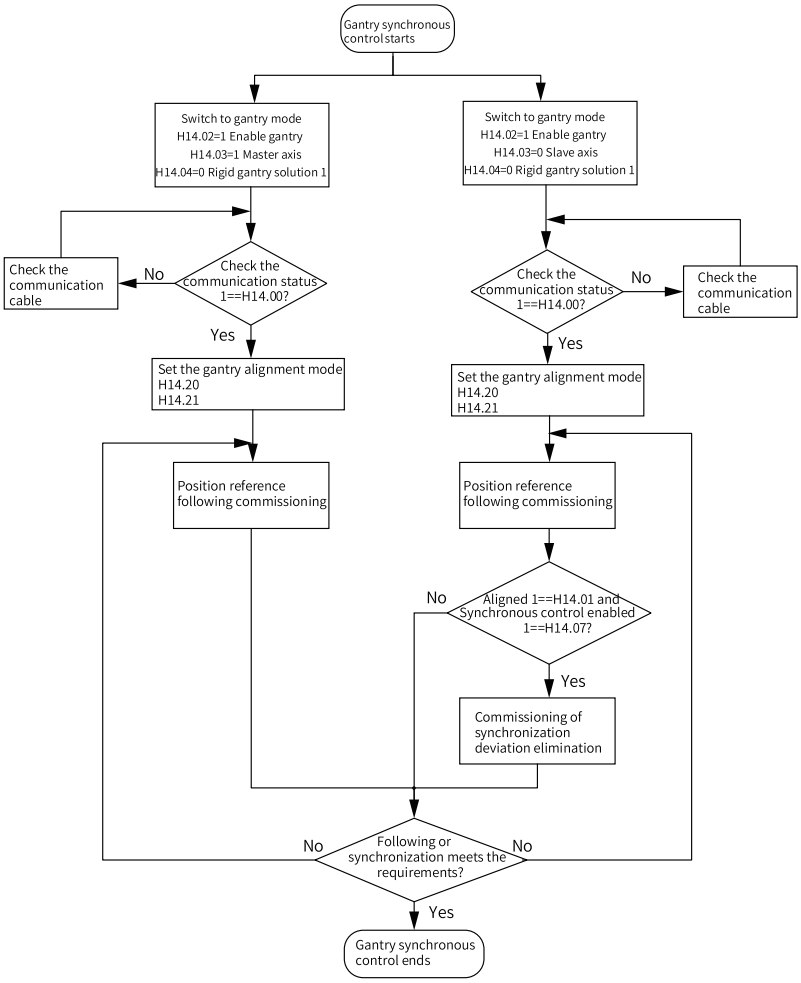


Figure 13-6 Commissioning procedure for gantry synchronization control scheme 1

Setting the gantry synchronization direction

The single-axial operation direction has been configured through single-axis installation and commissioning. For details, see *"13.4 Single-axis Commissioning" on page 563*. In this example, configure the operation direction for the communication data between the two axes of the gantry

system to ensure that the control data directions for both axes are consistent, enabling smooth operation.

Setting gantry alignment

The gantry synchronization function and the position deviation alarm function take effect only after gantry alignment is completed. Gantry alignment is configured based on H14.21. After both axes are aligned and in the run state, the slave axis can start eliminating synchronization deviation to move to the aligned position relative to the master axis. At this point, alarm monitoring for excessive synchronization deviation becomes active.

If H14.20 is set to 1, the two axes will be aligned with their positions after both axes are powered on as the zero position, before the gantry meets the alignment condition.

- For scenarios where only one axis uses a photoelectric sensor, the alignment method is as follows:
  - **Align the axes based on the positions at the moment when both axes are powered on.** Set H14.20 for both axes to 1. In this mode, synchronization is based on the positions of both axes at the time they are powered on. If there is a deviation after both axes are powered on, the slave axis will start eliminating the deviation upon the first power-on. No gantry alignment DO is output at this time, and gantry alignment can work with other alignment modes. H14.01 and its corresponding DO will not be set to 1 if only this condition is met.
  - **Alignment is performed with both axes enabled as the reference**: Set H14.21 for both axes to 3. In this mode, synchronization is based on the positions of both axes when they are in the Run state, and the axes exit the gantry alignment state each time the axes are disabled.
  - **Torque slope alignment**: Set H14.21 to 2 for both axes. Set the enable mode in H14.26, which enables gantry alignment when the DI is active or when both axes are in the Run state. Related parameters for slope alignment are H14.26 to H14.33.
- For scenarios where both axes use a photoelectric sensor, the alignment procedure is as follows:
  - **When using a non-absolute encoder**, set H14.21 to 0 for both axes and align them based on their home positions. Alternatively, you can set H14.71 to 1 for both axes and configure an offset in parameter H14.72. The offset can be tuned via H14.25. For details, see "Alignment by homing (H14.21=0)".
  - **When using absolute encoders**: After ensuring that both axes are equipped with absolute encoders, set H02.01 to enable the absolute mode for both axes. Then, set H14.21 to 0 and H14.51 to 1 to align the axes based on their absolute positions.

The following section describes the gantry alignment modes (H14.21).

1. **Alignment by homing (H14.21=0)**

   Gantry alignment by homing

   During the gantry alignment by homing process, the limit switches (photoelectric limit and hardware limit) of both the master axis and the slave axis are activated.

   - Rigid gantry: Supports all homing methods. The homing path is the same as that of the planned homing path. For details about the homing path of a rigid gantry, see *"11.14 Homing" on page 471* and *"11.8.6 Homing Operation" on page 365*

- . Flexible gantry: Only the following homing methods are supported. For details about the homing path of a flexible gantry, see *"13.7 Flexible gantry homing trajectory" on page 572*
  . Local homing modes: 0, 1, 8, 9, 12, and 13.

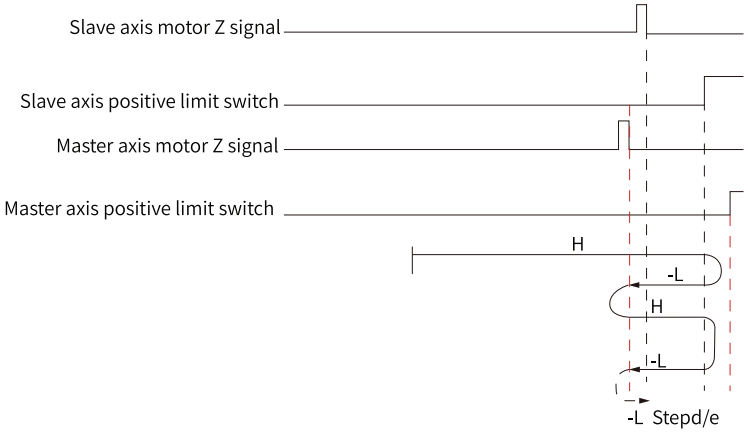
Note

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
  : The flexible gantry limit or home switch must be installed on both axes. The procedure is as follows.

  a. When the flexible gantry initiates the homing sequence, if both axes have not previously been aligned, the automatic torque alignment function (H14.18) is activated. When alignment is complete, the homing path is executed. Otherwise, the homing operation proceeds directly.
  b. Both axes move simultaneously. The master axis first searches for its home position, following the originally planned path. When the home is located, the master axis reverses its direction at a high speed. When it reaches the deceleration point or limit, both axes reverse their direction to search for the slave axis home.
  c. After locating the slave axis home, both axes simultaneously move to the master axis home. If the homing function is not enabled for the slave axis (H14.71 of the slave axis is 0), the homing process is considered complete. In Gantry Scheme 1 mode, when H14.71 of the slave axis is set to 1, if the gantry deviation compensation value (H14.72) of the slave axis is 0, step d is performed. Otherwise, step e is performed. In Gantry Scheme 2 mode, when H14.71 of the slave axis is set to 2, Step f is performed.
  d. The slave axis individually moves to its home position.
  e. The slave axis moves independently to the corresponding position based on the set deviation (H14.72 = Slave axis home – Master axis home).
  f. The two axes first move to the center of their respective homes, and then each returns to its own home.

  Taking homing path 1 in homing mode -2 as an example, the path is as follows:



- Gantry homing torque alignment and deviation tuning
  - Torque alignment

Flexible gantries: Torque pre-alignment is performed before homing (H14.18 = 1). After triggering the homing sequence, the slave axis automatically executes torque pre-alignment. When pre-alignment is complete, H14.18 is reset, and the standard homing process begins.

- Deviation tuning
  - Flexible gantries: Activate the homing deviation torque alignment tuning function for the master and master axes (H14.25 = 1 and H14.71 = 0 for both axes). After the flexible gantry completes its homing sequence, the slave axis automatically performs torque alignment. When alignment is complete, the gantry automatically learns the home deviation value between the master and slave axes and writes this value to the gantry deviation compensation register (H14.72), then resets parameter H14.25.
  - Flexible gantries: Activate the homing deviation position tuning function for the master and master axis (H14.25 = 2 and H14.71 = 0 for both axes). After the flexible gantry completes its homing sequence, it automatically learns the home deviation value between the master and slave axes and writes this value to the gantry deviation compensation register (H14.72), then resets parameter H14.25.

2. **Torque alignment (H14.21=2)**

Gantry torque alignment method:

The gantry master axis remains stationary, while the slave axis is limited in torque and moves forward and backward. According to the limit position of forward and backward movement, the binary search method is used to determine the alignment base between the slave and the main axis.

Procedure:

a. Set parameter H14.21 to 2. In this mode, the gantry master axis remains stationary, and the slave axis moves forward and backward with its torque limited.

b. Gantry torque alignment enable must be set according to parameter H14.26 of the master axis. In this case, if H14.26 is set to direct enable, you must first enable the servo drive, then set H14.26 to 1 for the torque alignment function to take effect.

c. The alignment torque, number of alignment operations, alignment speed, and other parameters for gantry torque alignment can be configured via 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 this parameter to a relatively high value. During measurement, when the system is moving at a constant speed, the torque reference equals the resultant force of friction and the elastic force from mechanical coupling.
- H14.28 sets the number of forward and reverse operations. 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 to ensure that the motor remains in the constant-speed phase when the zero-speed condition is being checked.
- H14.32 is the zero-speed threshold for the motor, used to determine whether the mechanical limit has been reached at the current torque command during the alignment process. This

threshold must be greater than the rotational speed fluctuation value when the motor is enabled and stationary.

3. **Alignment at enabling (H14.21=3):**
   When the enable signal is set as the alignment reference and parameter H14.21 is set to 3, each time both axes re-enter the enabled state, the gantry references the positions of both axes at the time they enter this state for alignment.

4. **DI-based alignment (H14.21=4)**
   The gantry establishes or clears the alignment reference via the DI signal from the master axis. When parameter H14.21 is set to DI-based alignment, the gantry references the positions of the two axes at the time the master axis receives the DI signal for alignment. Both axes of the gantry can clear the alignment reference via another DI signal.

5. **Initial alignment at power-on (H14.20=1)**
   Both axes start alignment based on the position at power-on. After parameter H14.20 is set to 1, alignment is performed based on the position at the time both axes are powered on. If there is a deviation after both axes are powered on, the slave axis starts eliminating the deviation between the two axes. The gantry exits the alignment reference when the alignment conditions specified in H14.21 are met.

6. **Alignment by absolute position (H14.21=0, H14.51=1)**
   The axes align based on the absolute position of the master axis.

   a. Encoder mode configuration: Set H02.01 of both axes to the absolute mode.
   b. Alignment reference configuration: Set H14.21 to 0 and H14.51 to 1. Upon each power-up, the system will align the axes based on the absolute position of the master axis and enter the alignment state. H14.35 (Gantry position deviation) is displayed as the present master-slave axis position deviation. After alignment is enabled, the slave axis will first move to the absolute position of the master axis. Make sure that the absolute zero points of both axes are at the same position.

Alarm for excessive gantry synchronization deviation

To prevent mechanical failures caused by unsynchronized axis positions or torque in gantry systems, the gantry supports two alarm modes: excessive gantry position deviation alarm and excessive gantry torque deviation alarm. These alarm modes can be flexibly configured based on actual operating conditions.

- Enable the gantry position deviation alarm function by setting (H14.47 = 1), and set the deviation threshold and the allowable duration exceeding the threshold in H14.45 and H14.44. When the positional deviation between the master and slave axes exceeds the threshold and persists for the specified duration, the excessive gantry deviation alarm is triggered.
- Enable the gantry torque deviation alarm function by setting (H14.50 = 1), and set the deviation threshold and the allowable duration exceeding the threshold in H14.48 and H14.49. When the torque deviation between the master and slave axes exceeds the threshold and persists for the specified duration, the excessive gantry torque alarm is triggered.

Commissioning elimination of gantry synchronization deviation

The gantry synchronization function operates in a master-slave mode. The master axis compensation for eliminating synchronization deviation is not active. You can set this function only in parameter H14.07 of the slave axis. You can set this parameter to enable by default or DI-enabled (DI 59), enabling the slave axis to follow the master axis. The synchronization procedure is as follows.

- When the gantry alignment flag is 1, after the two axes transition from the disabled to the enabled state, the slave axis moves to the alignment position relative to the master axis. When both axes are enabled, the slave axis moves to the alignment position relative to the master axis whenever the gantry alignment flag changes from 0 to 1. The alignment speed and acceleration are set in H14.13 and H14.14, respectively.
- Tune the synchronization deviation elimination gain (H14.08 to H14.11) to eliminate synchronization deviation and ensure synchronization between the two axes.

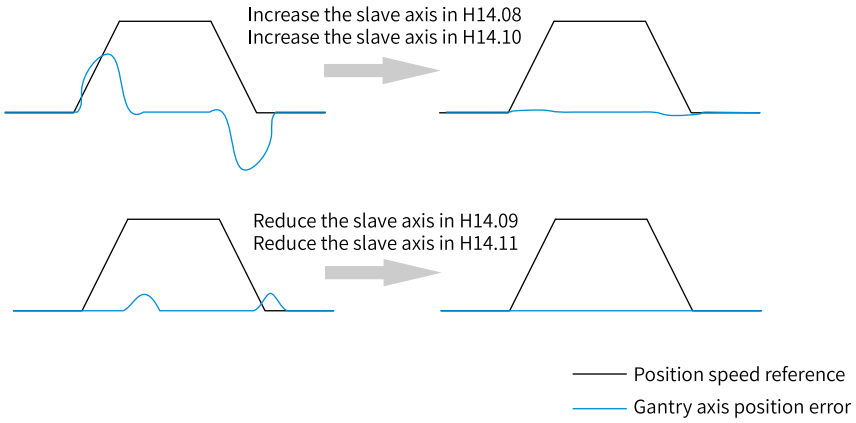


Figure 13-7 Curves before and after commissioning

13.5.2 Commissioning procedure for gantry synchronization control scheme 2

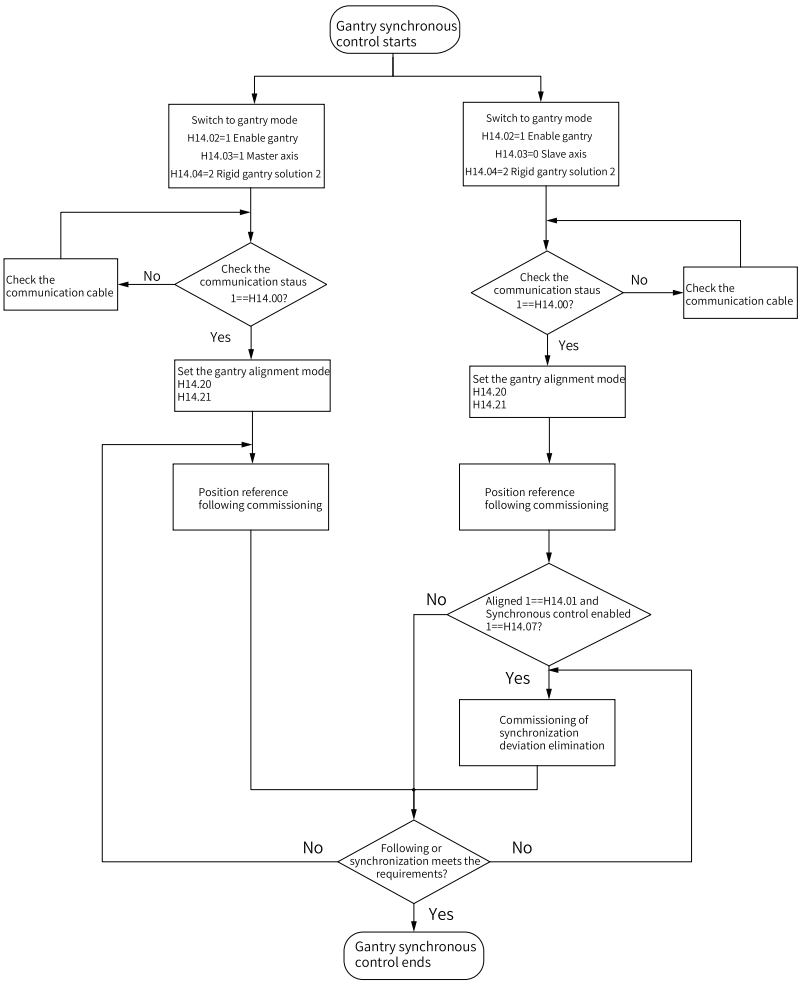


Figure 13-8 Commissioning procedure for gantry synchronization control scheme 2

Setting the gantry synchronization direction

For details, see *" Setting the gantry synchronization direction" on page 564*.

Setting gantry alignment

For details, see *" Setting gantry alignment" on page 565*.

Note

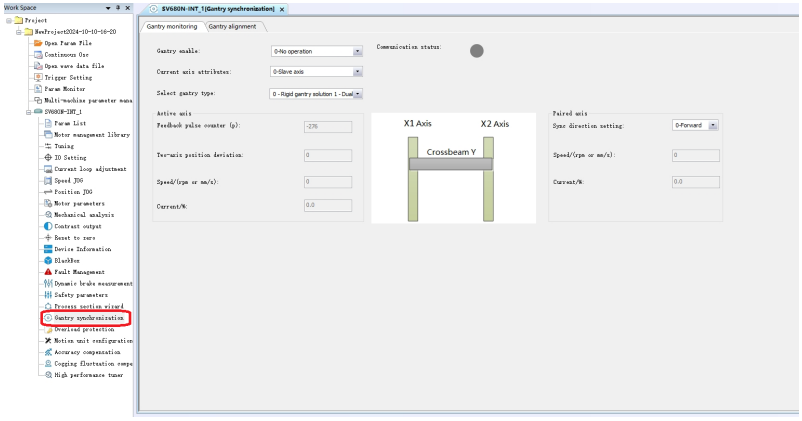
The torque alignment mode (including the torque skew alignment mode) and the absolute position alignment mode are not supported.

Commissioning elimination of gantry synchronization deviation

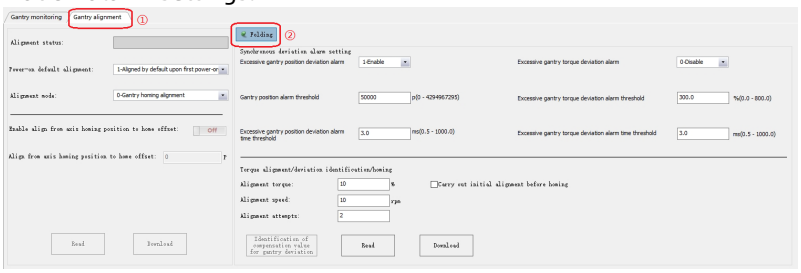
Gantry synchronous control scheme 2 is activated by the slave axis, aiming to eliminate synchronization deviation when the slave axis follows the master axis. To control the synchronization deviation, set H14.07 for the slave axis. Unlike scheme 1, parameters H08.00 to H08.02 must be set before synchronization deviation control can be activated. When H08.00 = H08.02 = 0 and H08.01 = 512, synchronous deviation control is disabled.

Gantry commissioning on the host controller

1. Click "Gantry synchronization" in the workspace. Enable the gantry function, configure the gantry axis attributes, and select a gantry control type. Observe the communication status, verify that the gantry communication is established, and monitor the status of the current axis and its paired axis.



2. On the "Gantry alignment" tab, select an alignment mode (Gantry homing alignment, Gantry torque alignment, Gantry enable alignment, or Gantry DI alignment), and set the parameters for torque alignment, deviation tuning, and homing pre-alignment (Alignment torque, Alignment speed, and Alignment attempts). You can also configure the synchronization position deviation and torque deviation alarm settings.



13.6 Gantry Applications in Fully-closed Mode

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.

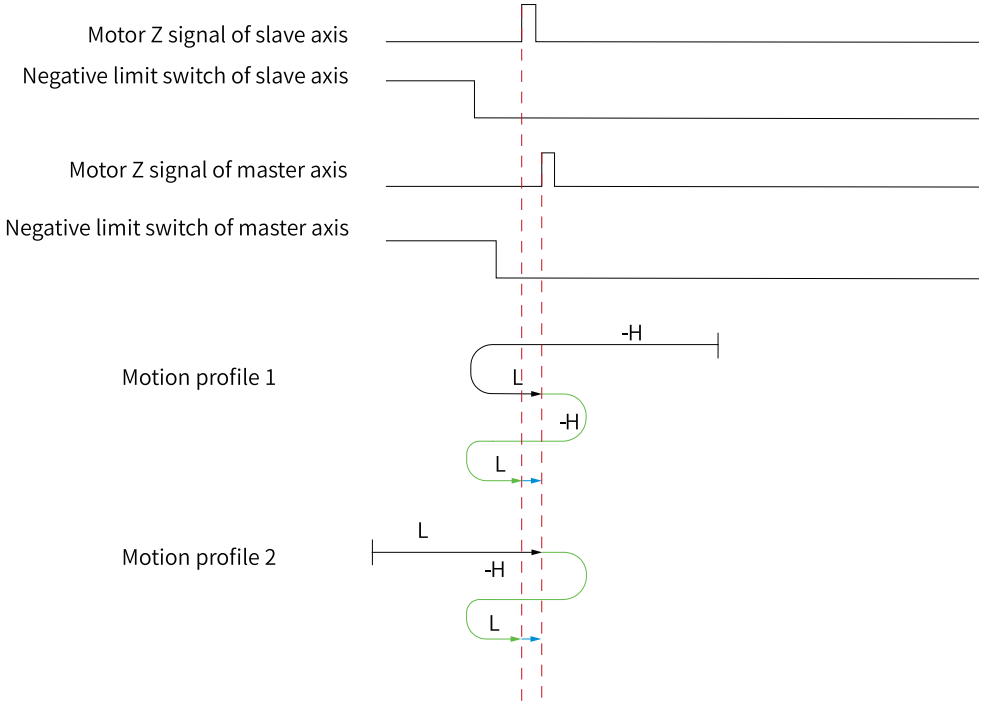
13.7 Flexible gantry homing trajectory

- The black trajectory indicates the search for the home signal of the master axis, the green trajectory indicates the search for the home signal of the slave axis, and the blue trajectory indicates the return to the home position of the master axis.
- When the master axis finds the home signal, the system reverses at high speed to search for the slave axis home signal.
- When the slave axis origin signal is found, the system continues moving to the master axis home position.

6098=1

Home: motor Z signal

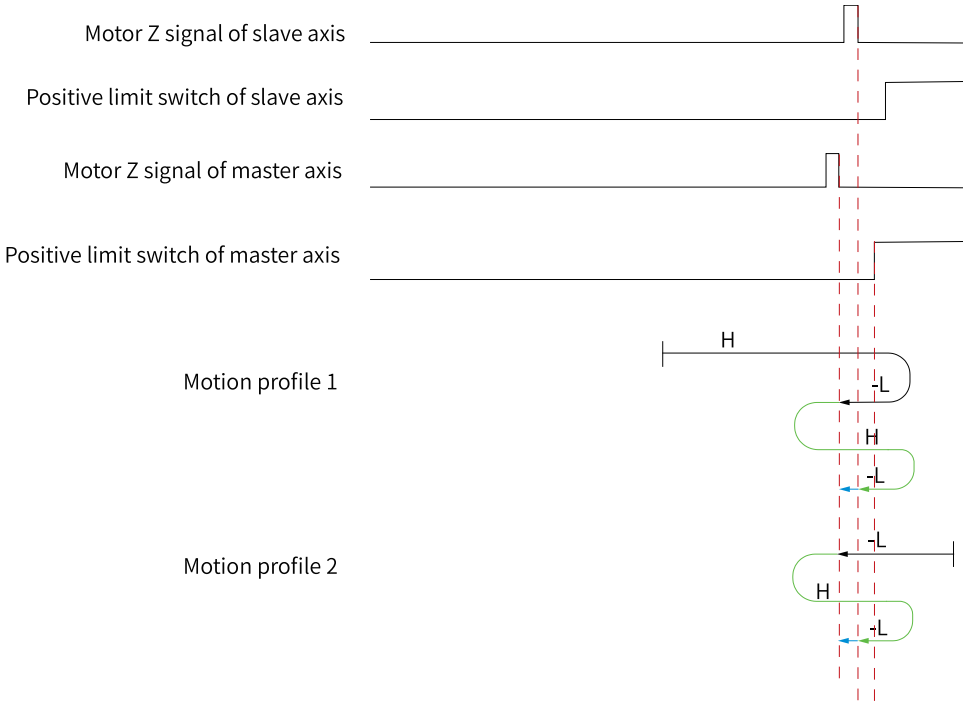
Deceleration point: negative limit switch



6098=2

Home: motor Z signal

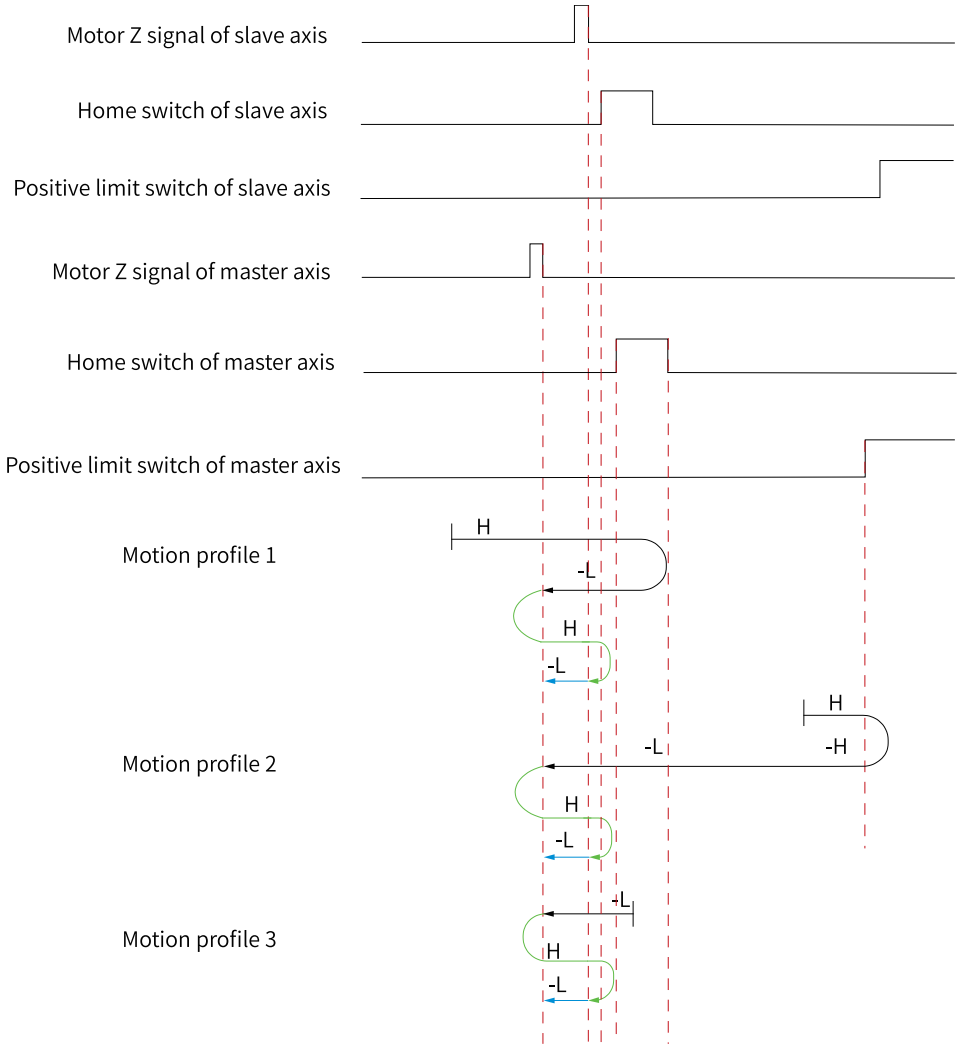
Deceleration point: positive limit switch



6098=7

Home: motor Z signal

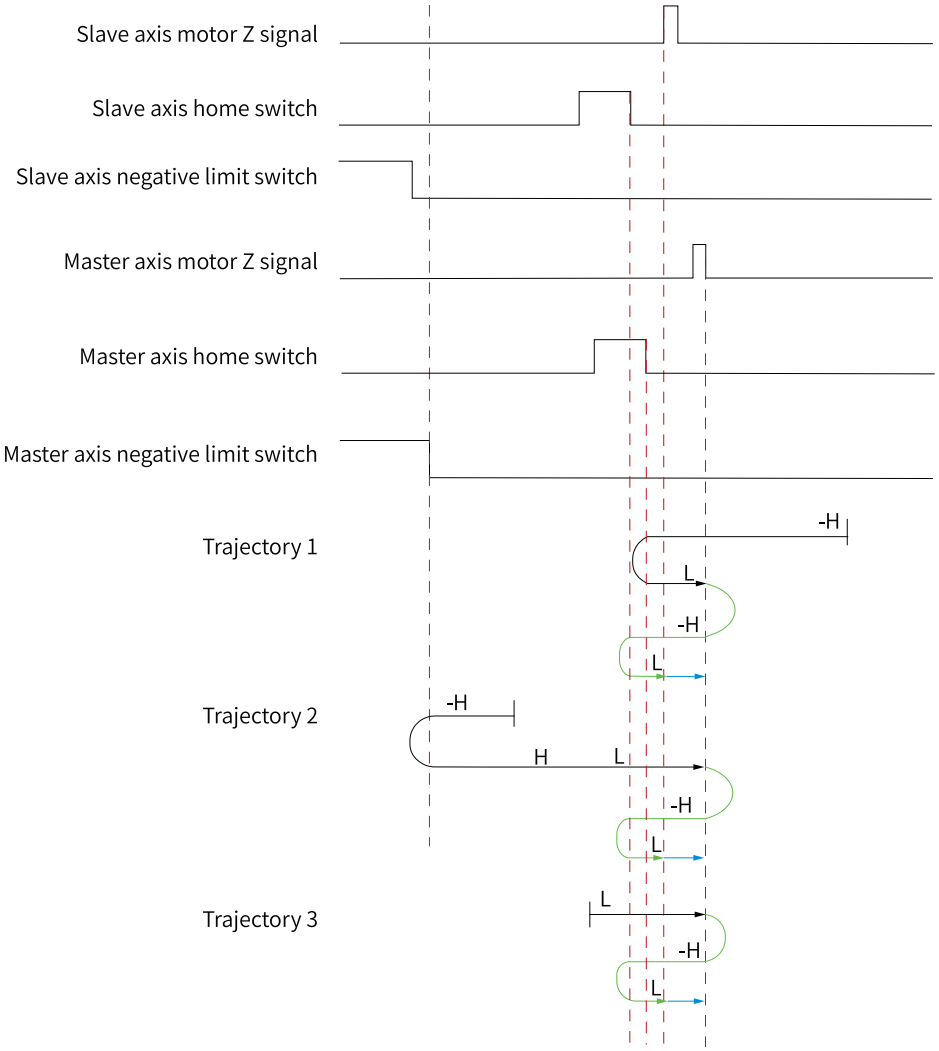
Deceleration point: home switch (HW)



6098=11

Home: motor Z signal

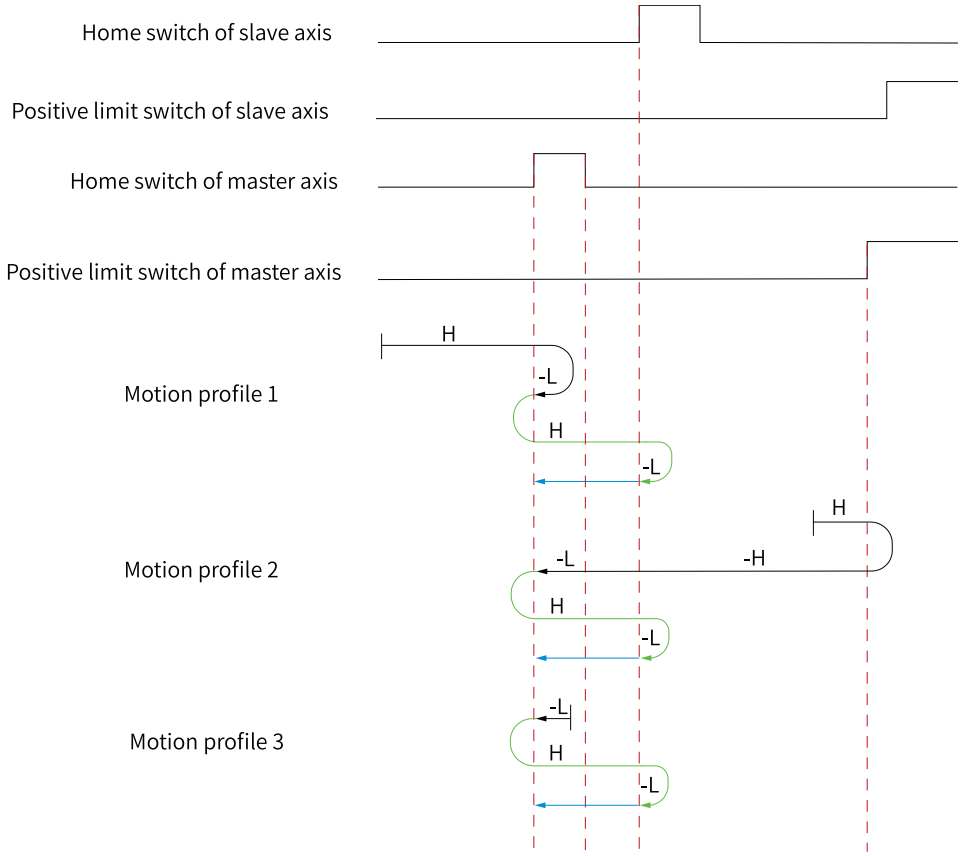
Deceleration point: home switch (HW)



6098=23

Home: home switch (HW)

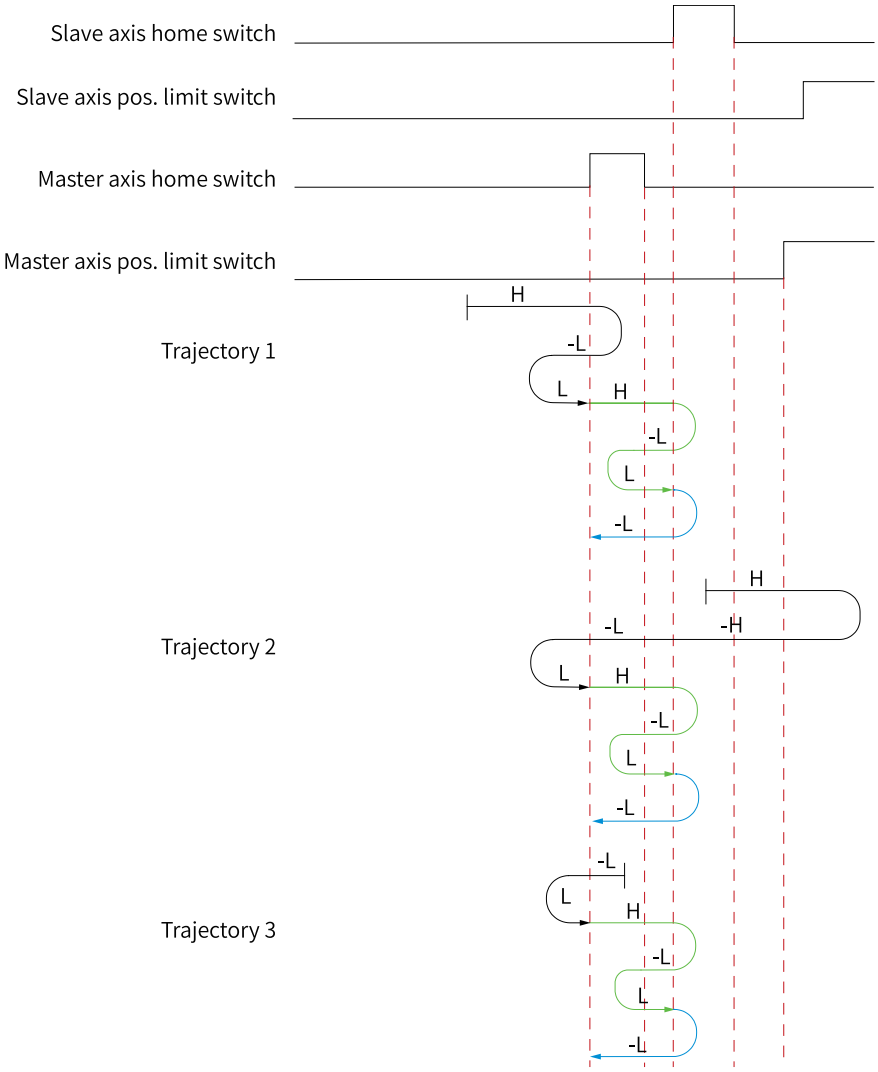
Deceleration point: home switch (HW)



6098=24

Home: home switch (HW)

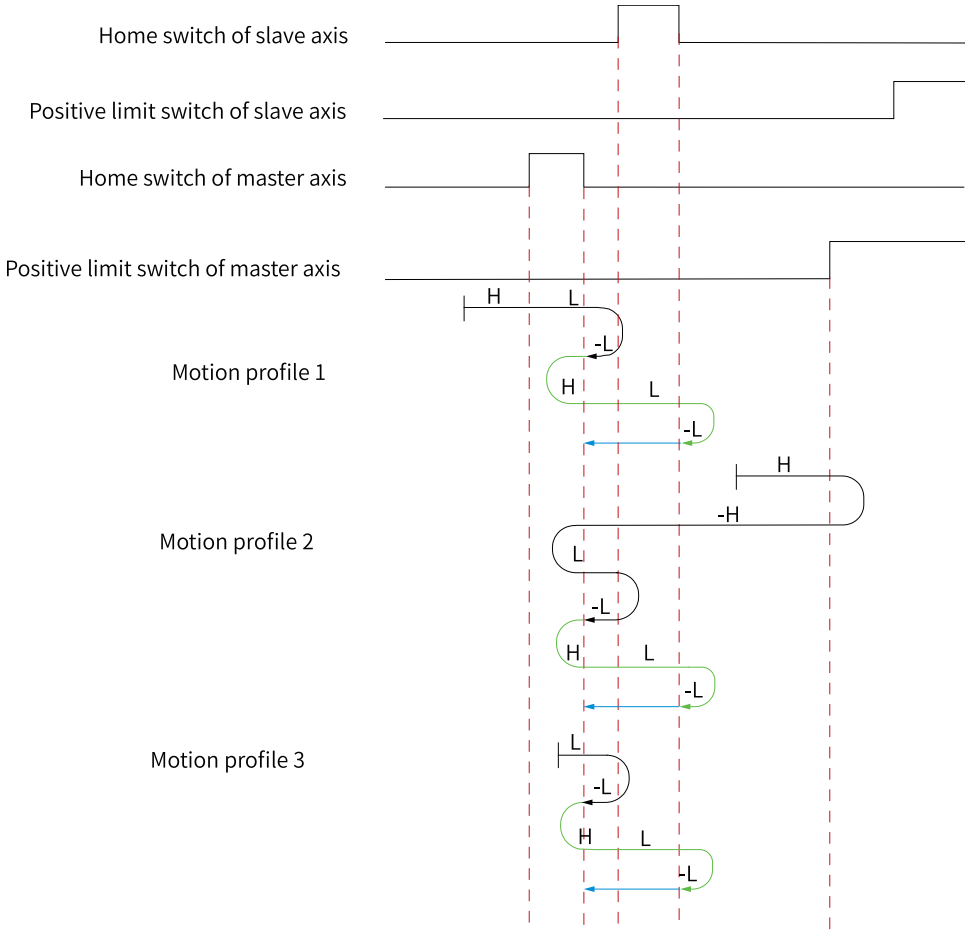
Deceleration point: home switch (HW)



6098=25

Home: home switch (HW)

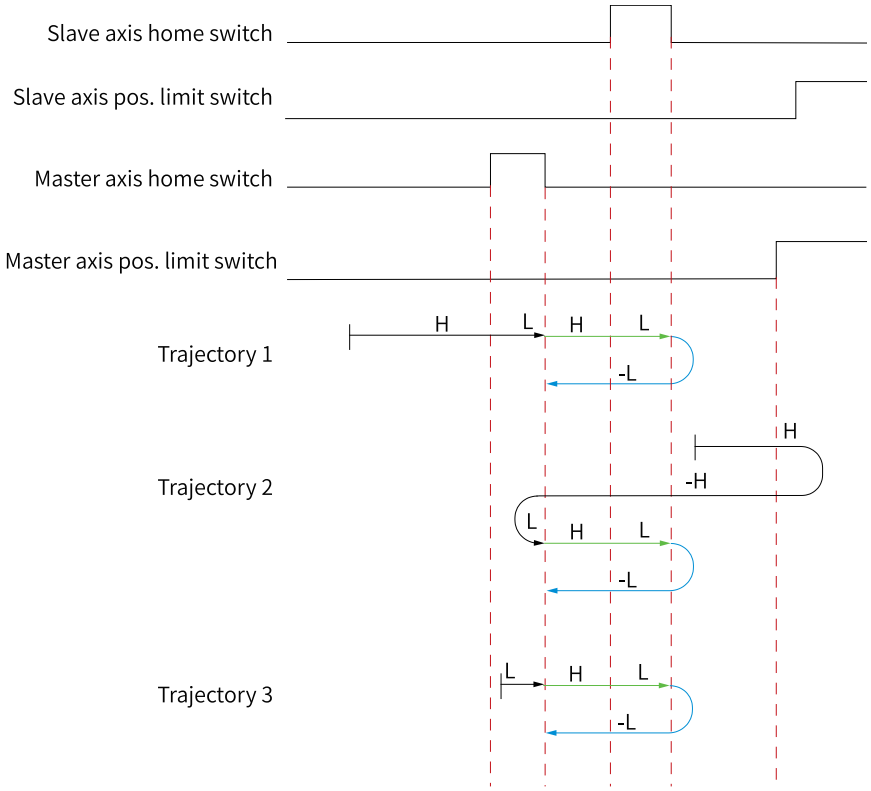
Deceleration point: home switch (HW)



6098=26

Home: home switch (HW)

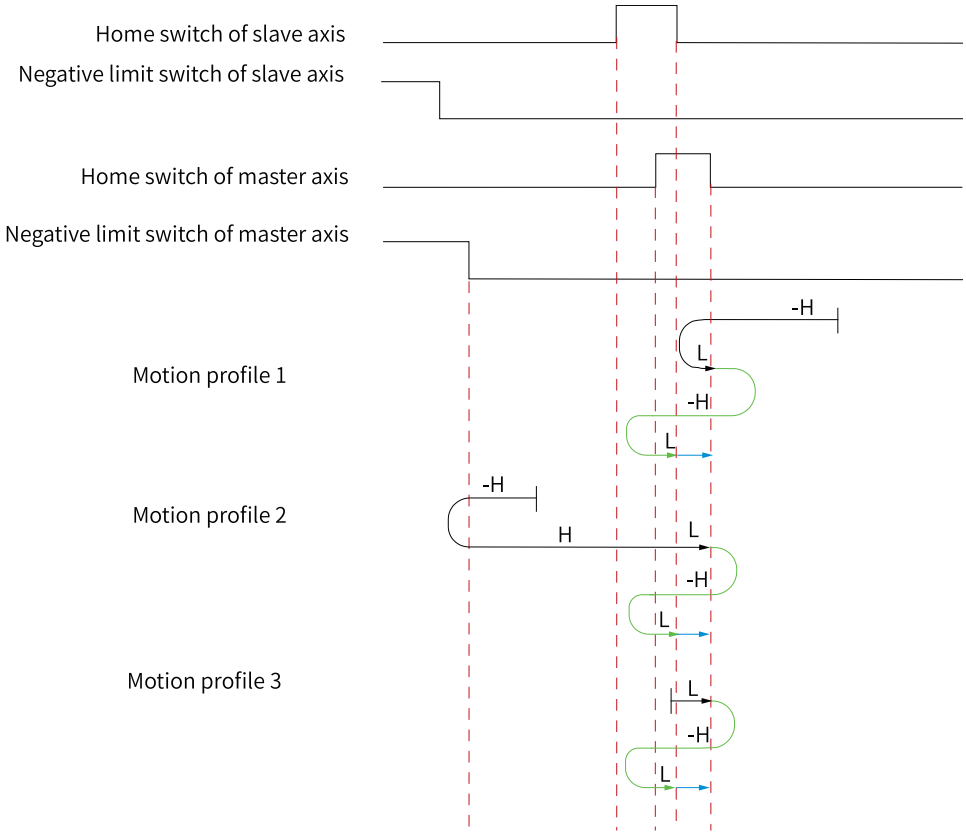
Deceleration point: home switch (HW)



6098=27

Home: home switch (HW)

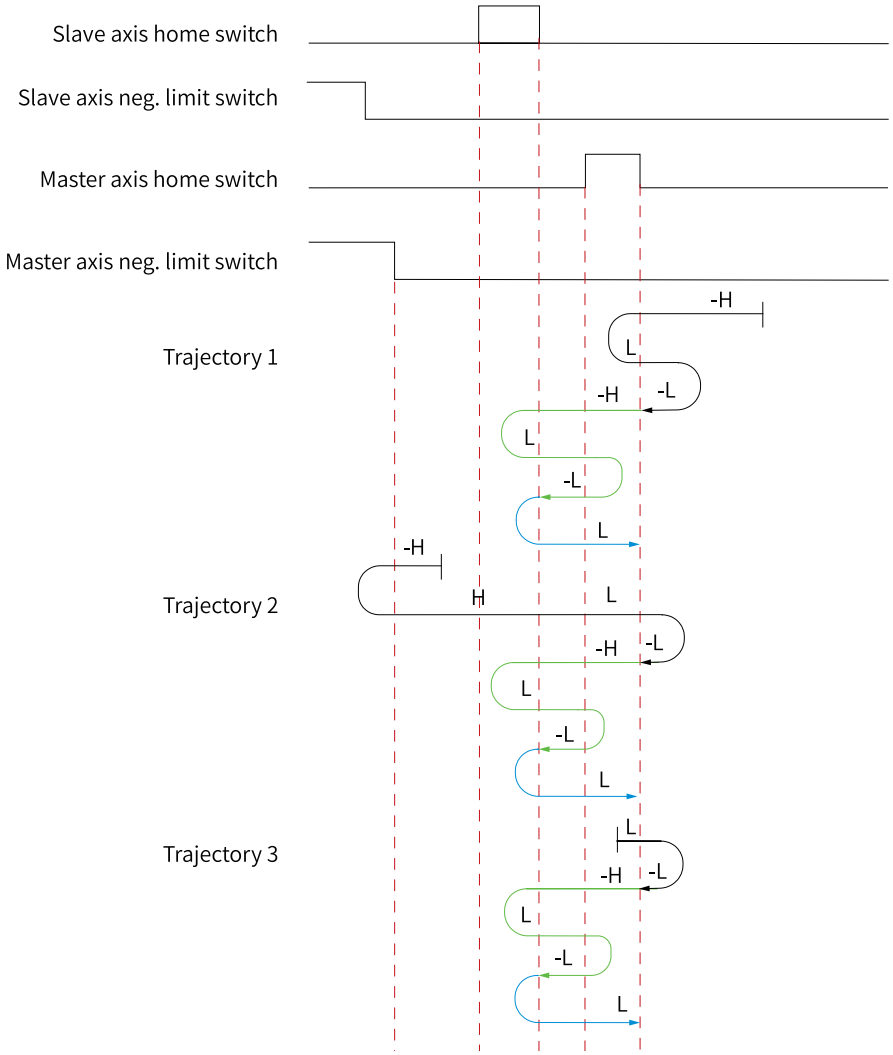
Deceleration point: home switch (HW)



6098=28

Home: home switch (HW)

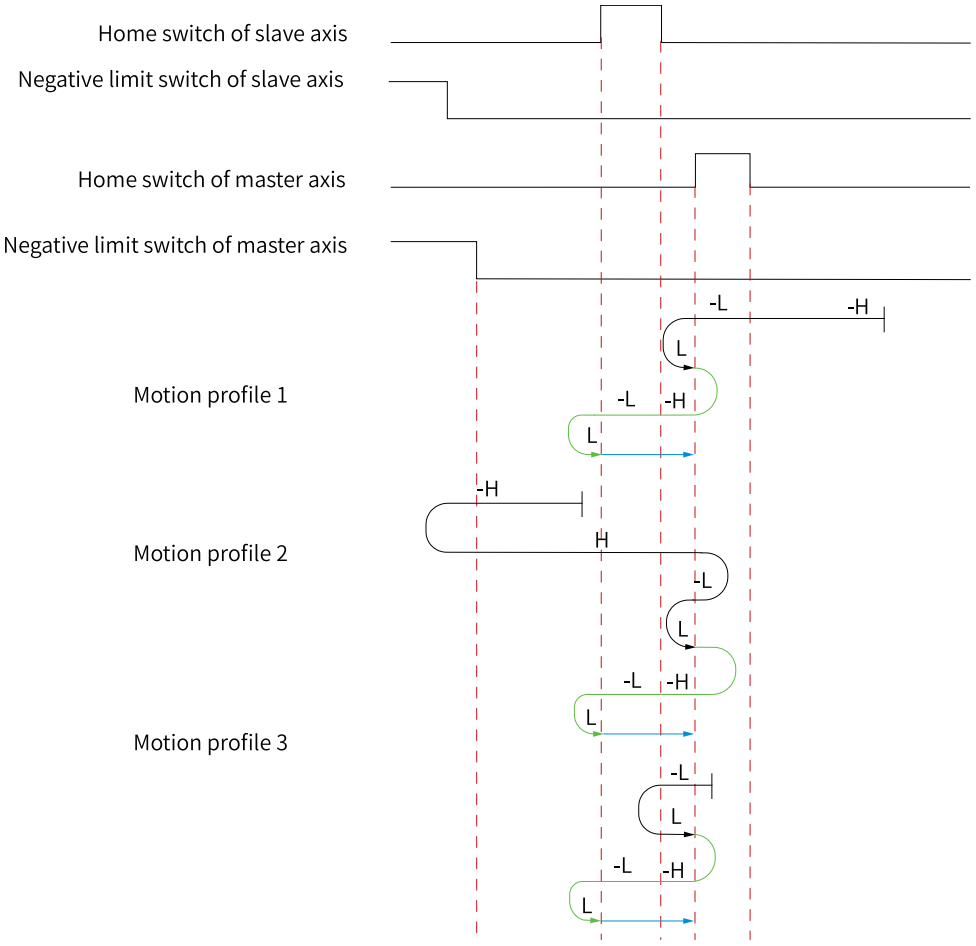
Deceleration point: home switch (HW)



6098=29

Home: home switch (HW)

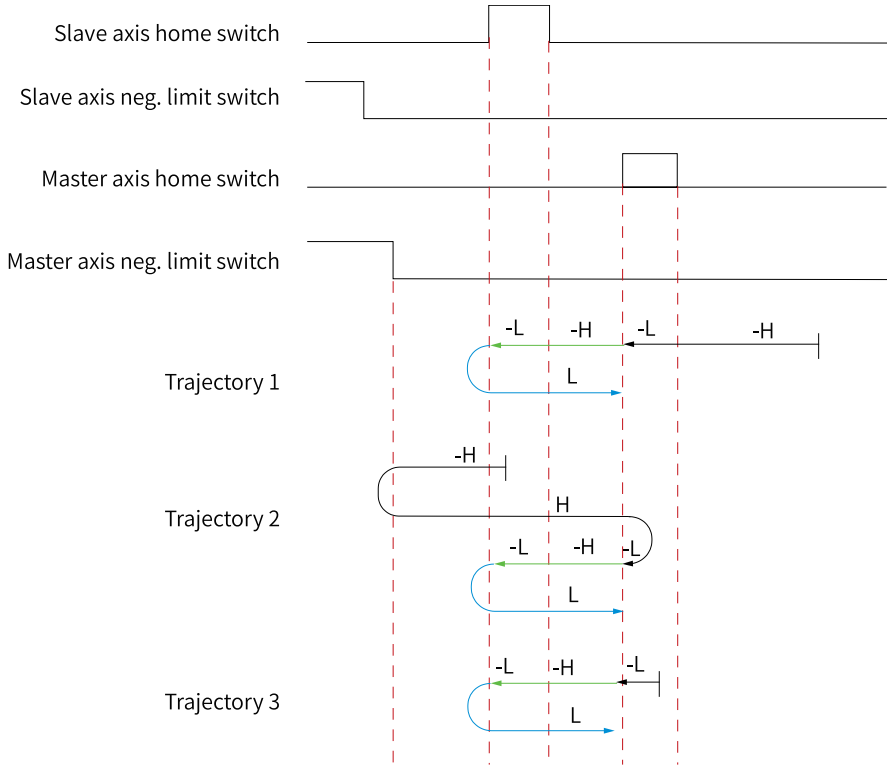
Deceleration point: home switch (HW)



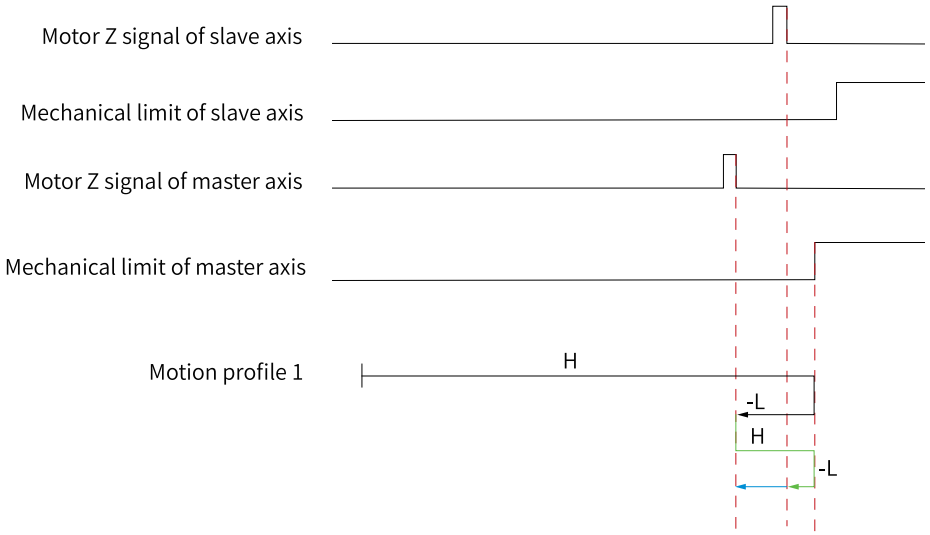
6098=30

Home: home switch (HW)

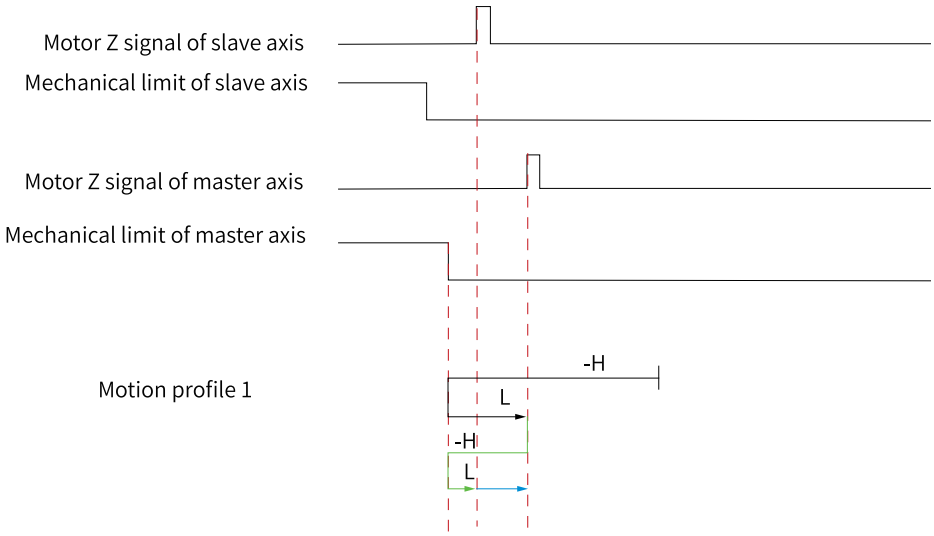
Deceleration point: home switch (HW)


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

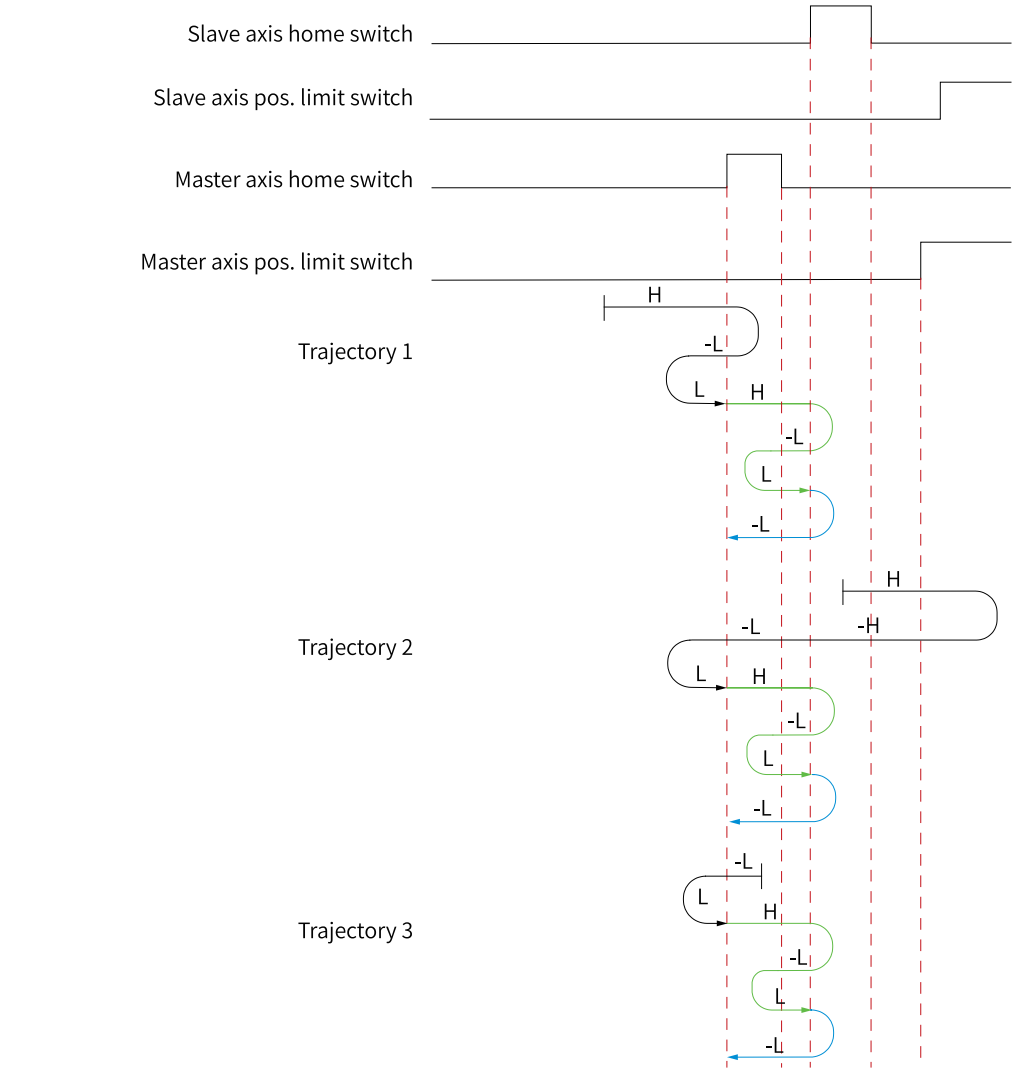

Motor Z signal of slave axis
Mechanical limit of slave axis
Motor Z signal of master axis
Mechanical limit of master axis
Motion profile 1
H
-L
H
-L

6098 = -1



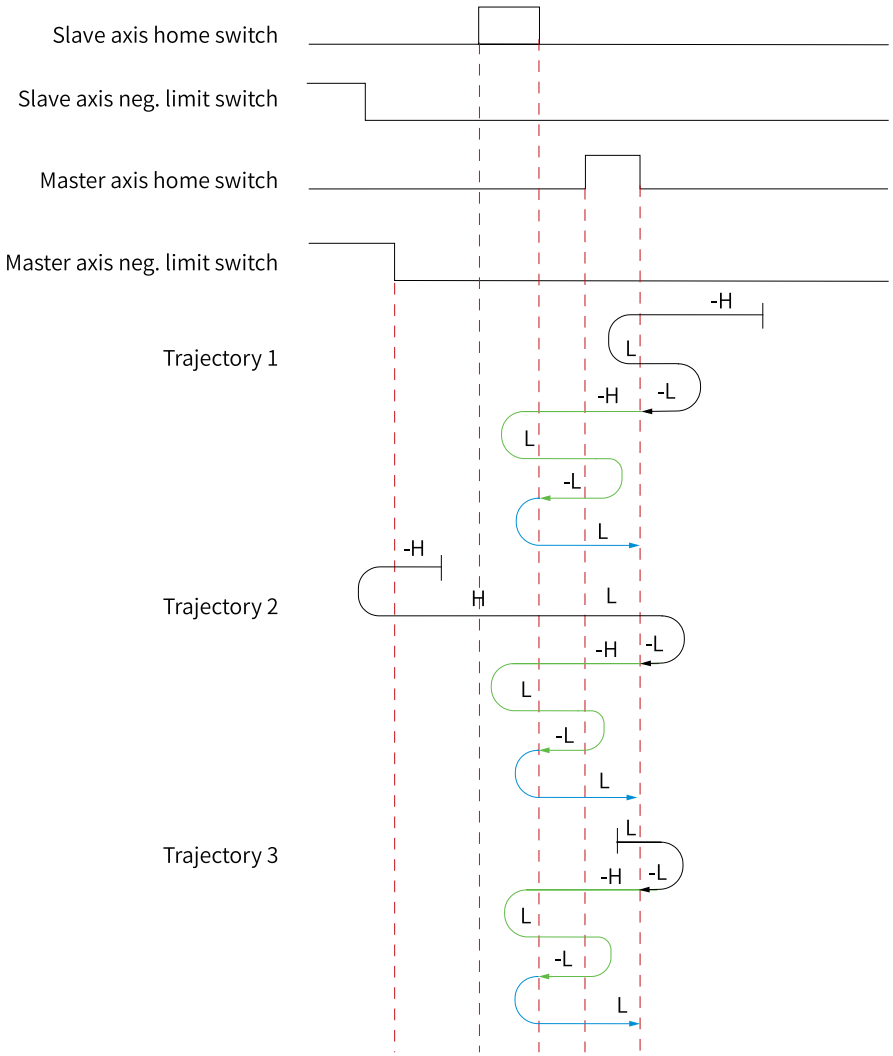
H05.31=0

Forward homing, home switch as deceleration point and home



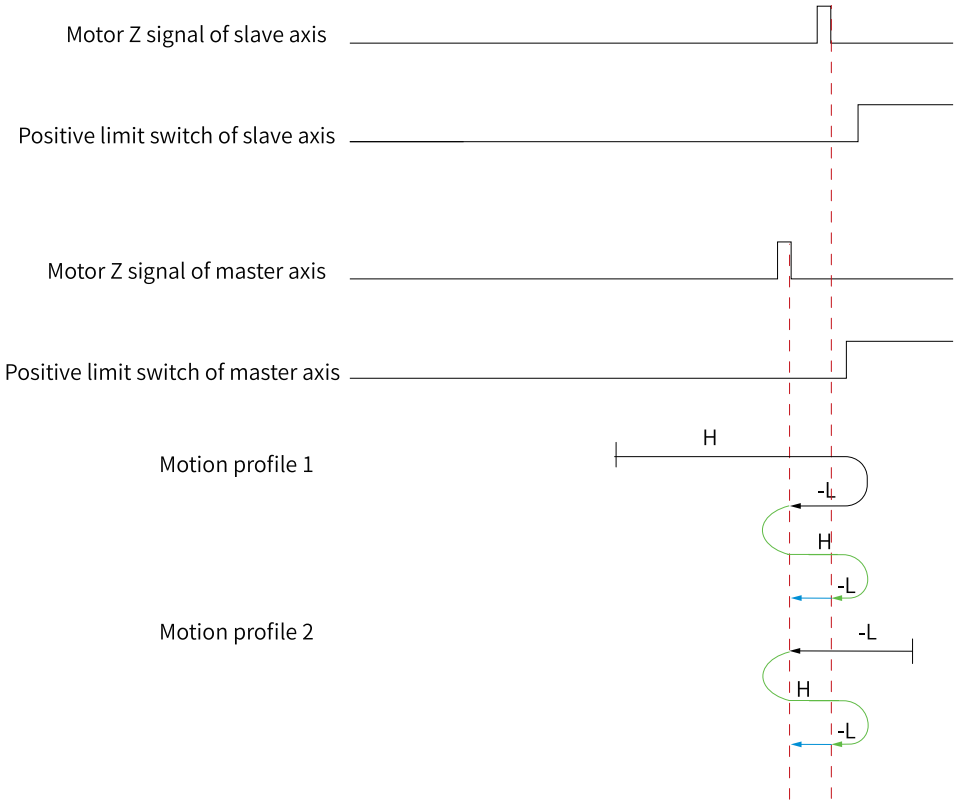
H05.31=1

Reverse homing, home switch as deceleration point and home



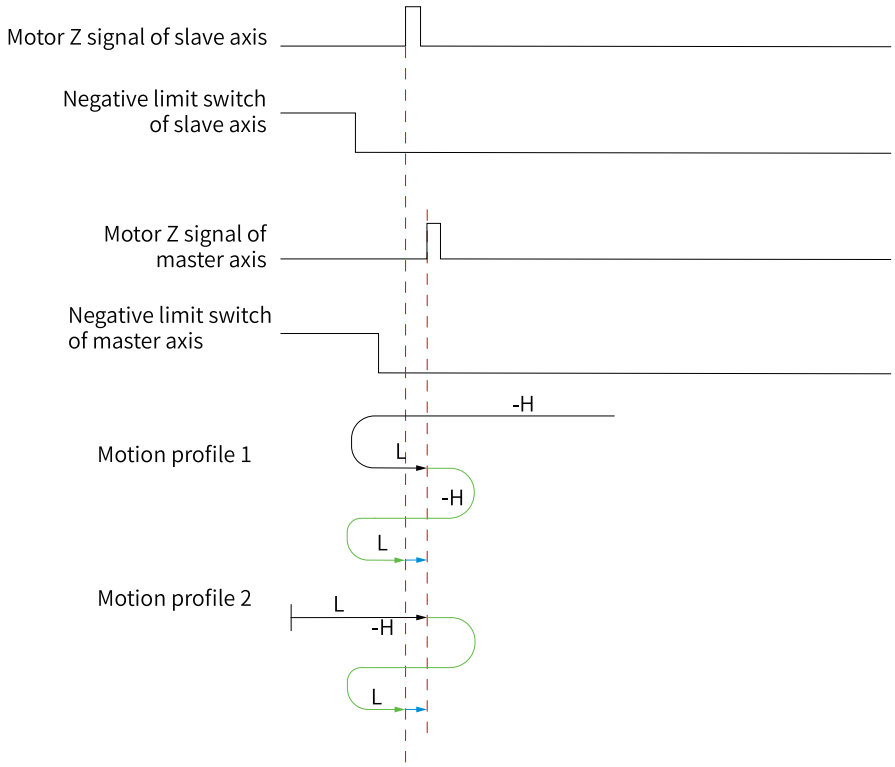
H05.31=8

Forward homing, positive limit switch as deceleration point and Z signal as home



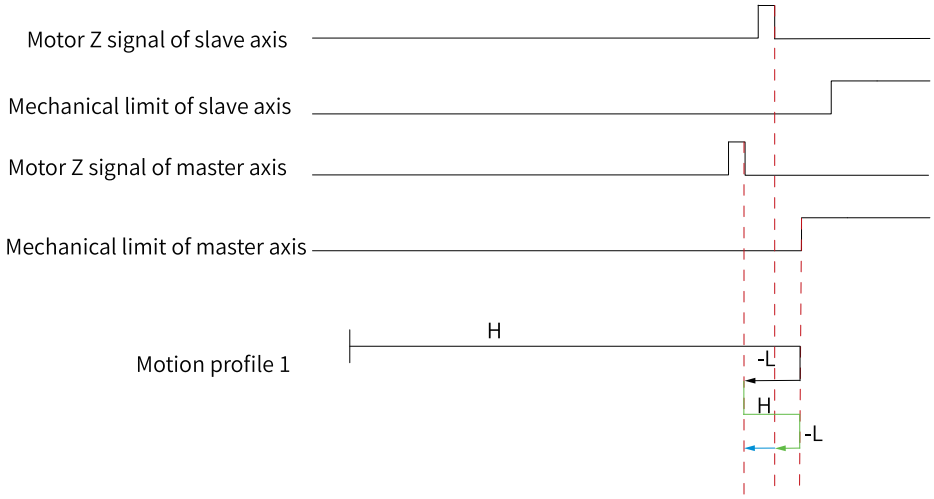
H05.31=9

Reverse homing, negative limit switch as deceleration point signal and Z signal as home



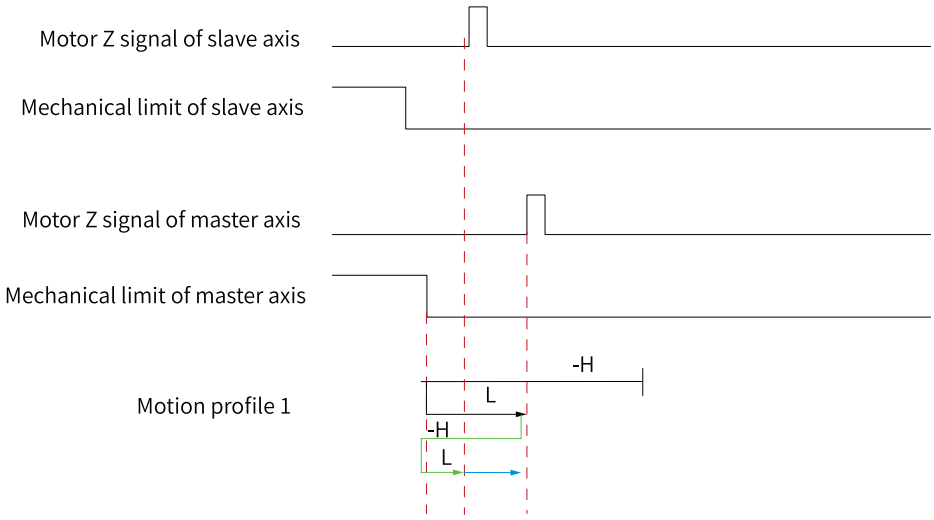
H05.31=12

Forward homing, mechanical limit as the deceleration point, and motor Z signal as the home



H05.31=13

Reverse homing, mechanical limit as the deceleration point, and motor Z signal as the home



14 Safety Functions [Functional Safety Models]

14.1 Overview

14.1.1 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 the local DI.
  The combination of safety module, SV680P-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.
- When using a pulse type servo drive, you can only control the safety functions through the local mode.



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).

14.1.2 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 14–1 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.

14.1.3 General

The combination of the safety module, SV680P-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 must set H20.01 to the local mode.

You can only choose the local mode when a pulse-type servo drive is used.

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 1149

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.

Note

When the safety functions are configured to be locally triggered, the TPDO does not update.

Priority of safety functions

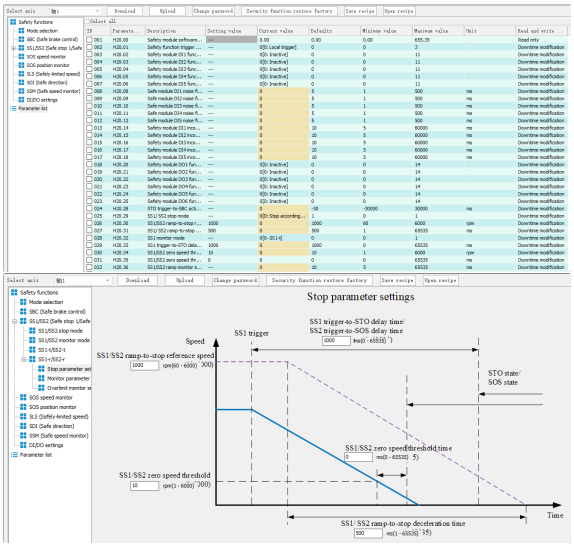
When several safety functions are activated simultaneously, the following priority applies:

- STO has priority over SS1 and SS2.
- SLS/SDI/SSM are independent of each other.

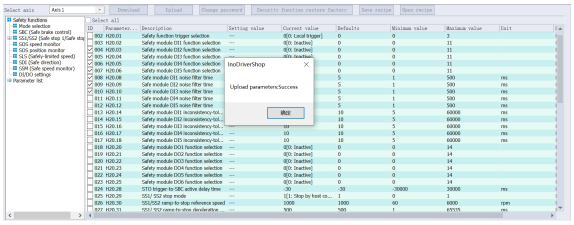
When a safety function overrides another, this does not cancel the request for the overridden safety function. Therefore, the overridden safety function is restarted after other safety functions are completed.

14.2 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.

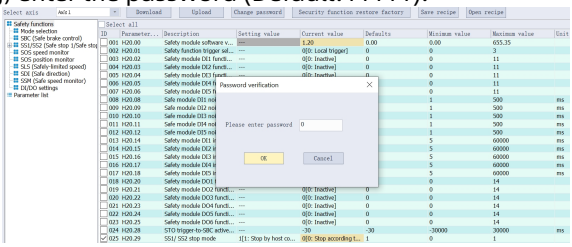


1. On the parameter list, select a parameter you want to configure and then click Upload to read the value of the selected parameter.

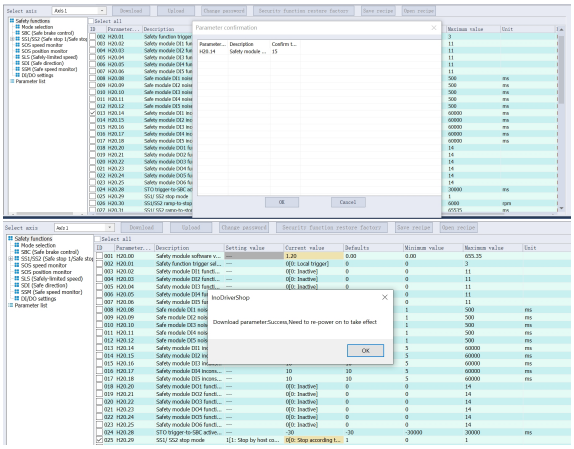


Any changes to any safety parameters take effect only at next power-on.

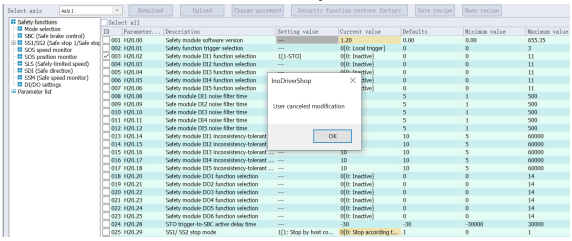
2. Enter a value for the safety parameter and click Download. A password verification dialog pops up. In the pop-up dialog, enter the password (Default:11111).



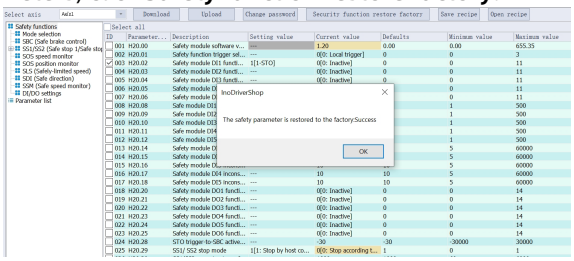
3. A confirmation dialog pops up. Make sure the value entered is correct and click OK. The value is written into the safety module.



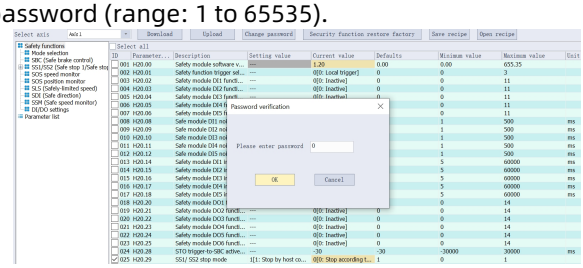
4. If you click Cancel, or fail to click OK within 10 seconds, you are prompted that the modification is canceled. The value will not be written into the safety module.



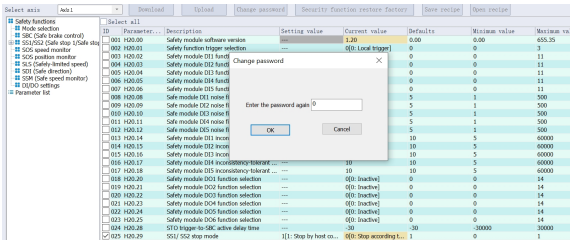
5. To reset the safety parameters, click **Safety function restore factory**.



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.



14.3 Safety DI/DO Function

14.3.1 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 14–2 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 14–3 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.

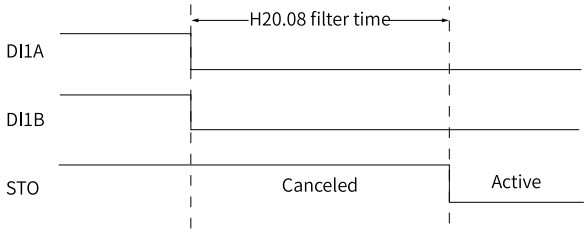


Figure 14-1 Diagram of DI1 noise rejection filter time H20.08

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 14–4 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
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

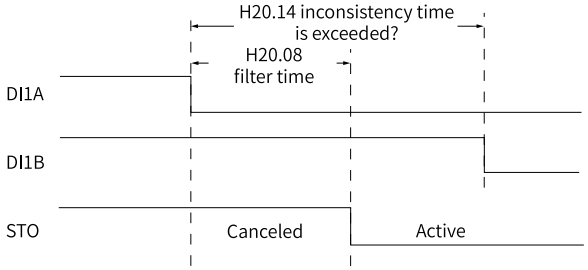


Figure 14-2 Checking for discrepancy at input signals of DI1

Note

The safety DI is mainly used together with the safety DO. For wiring of the safety DI function, see *"6.11 Expansion Safety Function Terminals CN9 and CN10" on page 144*.

14.3.2 Safety DO Function

DO Function Selection

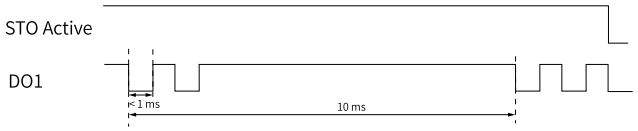
The safety module has six DO terminals, which are all set to 0-Disabled by default. DO3 and DO6 are non-safe DO circuits and cannot be used to configure SSM. You can assign each DI with a logic function using the software tool.

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 651*.
- The safety DO is mainly used together with the safety DI. For wiring of the safety DO function, see *"6.11 Expansion Safety Function Terminals CN9 and CN10" on page 144*.

14.4 STO

14.4.1 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.

14.4.2 STO Triggered by Local Mode

In order to use the input signal function of the safety module properly, the DI cable must be connected correctly.

Set H20.01 to 0 to trigger the safety function by a local DI.

Table 14–5 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 off.
- ON (1): The 24V voltage of the corresponding DI is off.

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 1150*
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 1150*

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 1151
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 1151
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: SDIp10: SDIn 11: Ack	0	-	At stop	"H20_en.06" on page 1152
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 1155

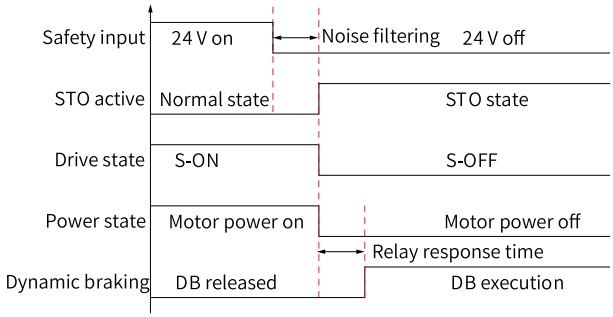
Parameter	Name	Value	Default	Unit	Change Mode	Page
H20.21	Safety module DO2 function selection	0: Inactive 1: STO Active 2: SBC Active 3: SS1 Active 4: SS2 Active 5: SLS1 Active 6: SLS2 Active 7: SLS3 Active 8: SLS4 Active 9: SDIp Active 10: SDIn Active 11: SOS Active 12: SSM Active 13: SS1-r Active 14: SS2-r Active	0	-	At stop	"H20_en.21" on page 1155
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 1156
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 1156

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 1157
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 1157

14.4.3 Sequence Diagram

Operation sequence to enter safe state

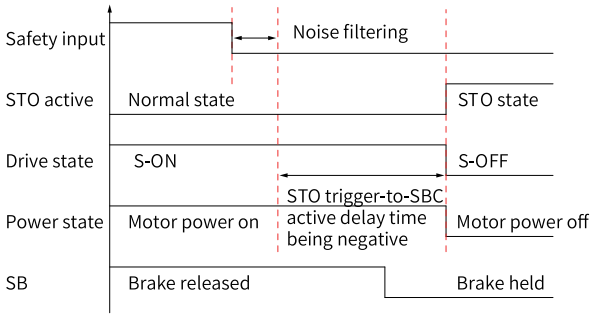
- SBC is not enabled



The safety module starts to shift to STO status when any of the STO inputs 1 and 2 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.

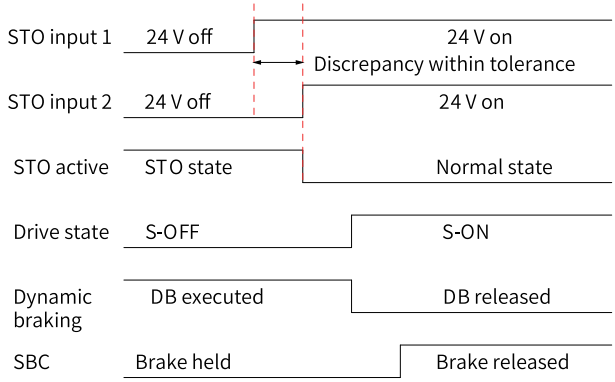
- SBC is enabled
  When you set H20.28 to a negative value, the sequence of STO operations is shown in the following figure.



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.

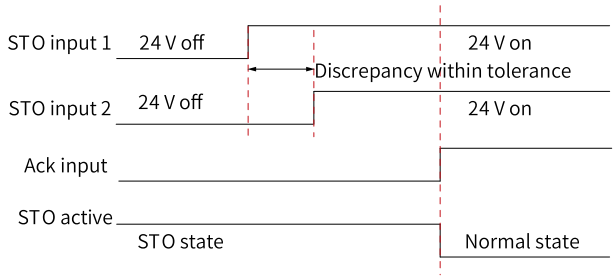
Reset sequence to exit STO safe state

- 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.

14.5 Safe Brake Control (SBC)

14.5.1 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.

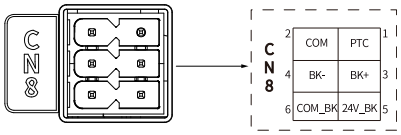


Figure 14-3 Description of CN8 pins

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 issues an alarm E631.0.

14.5.2 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 14–6 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 1150
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 1150

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 1151
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 1151
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 1152

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 1155
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 1155
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 1156

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 1156
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 1157
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 1157

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 1148
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 1148

14.5.3 Sequence Diagram

The response sequence of the SBC function execution is shown below.

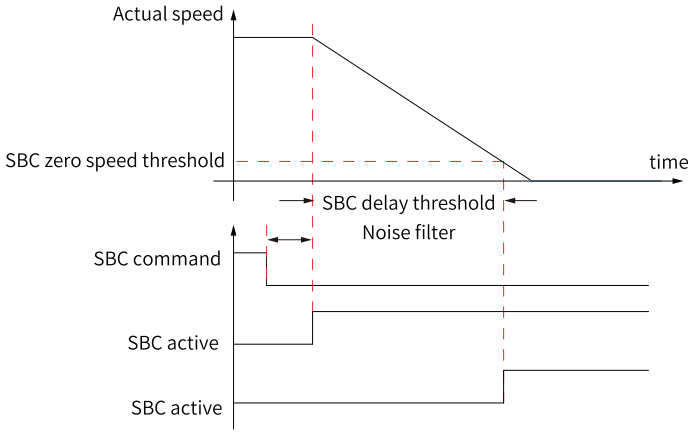


Figure 14-4 Response sequence of SBC function execution

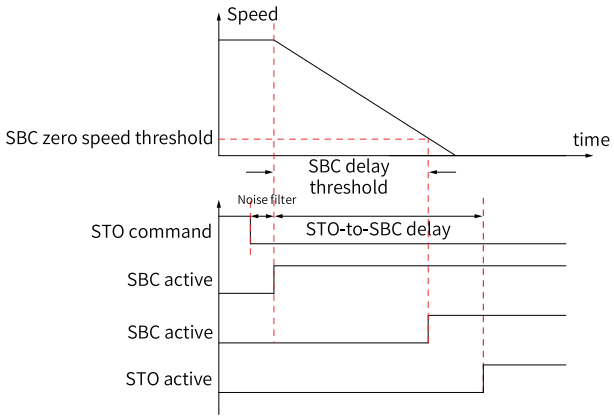
When the SBC command is determined as a valid signal after noise filtering, the S-ON OFF stop is executed. When the SBC zero speed threshold set by H02.11 is reached or the SBC delay threshold set by H02.12 expires, the safety module triggers the motor to brake. The motor rotor is held and the safety 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.

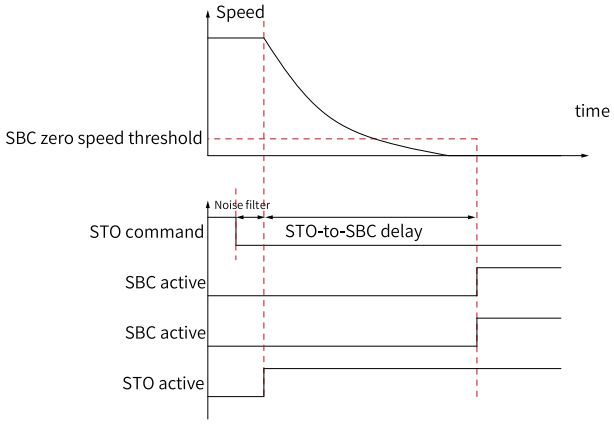
When the delay time or the SBC zero speed threshold is reached, the SBC brake takes effect and the motor rotor is held.

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.

14.6 Safe Stop 1 (SS1)

14.6.1 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.
- 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.

If you choose to trigger safety function locally, you can set parameters H20.02 to H20.06 and set DI function to 3-SS1 to trigger SS1 through DI.

SS1 stop monitoring includes two modes: SS1-t and SS1-r, which can be selected through parameter H20.32. When SS1-r is selected, the safety motor must be used.

When SS1-t is selected, the drive is switched to STO status regardless of the motor speed after the delay time between SS1 is triggered and the drive enters STO state elapsed. A safety motor is not required. When the safety motor is used, the drive is switched to STO status 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 switching condition is met.

14.6.2 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 14–7 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 1158*

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.

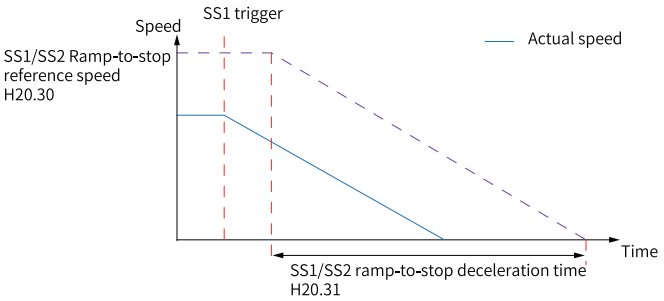


Figure 14-5 Motor speed during ramp stop

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 1158
H20.31	SS1/ SS2 ramp-to-stop deceleration time	1 ms–65535 ms	500	ms	At stop	"H20_en.31" on page 1159

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.

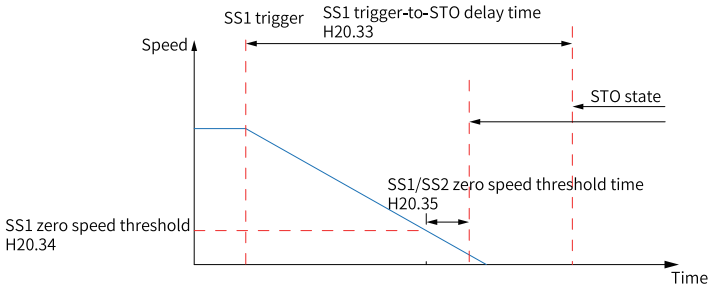


Figure 14-6 Safety function triggered locally, motor speed change

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 1159
H20.34	SS1/ SS1 zero speed threshold	1 rpm to 6000 rpm	10	rpm	At stop	"H20_en.34" on page 1159
H20.35	SS1/SS2 zero speed threshold time	0 ms-65535 ms	0	ms	At stop	"H20_en.35" on page 1160

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 1159

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.

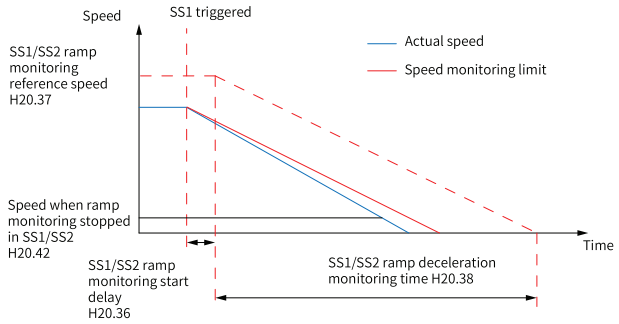


Figure 14-7 Motor speed when safety function is triggered

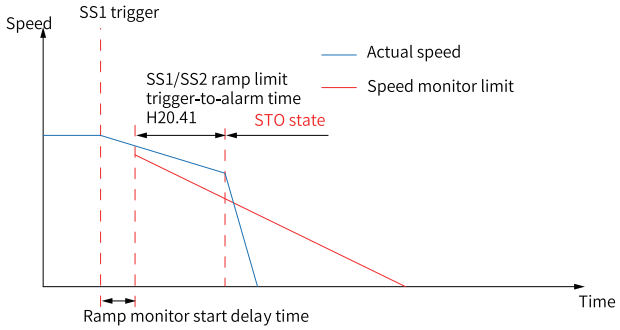


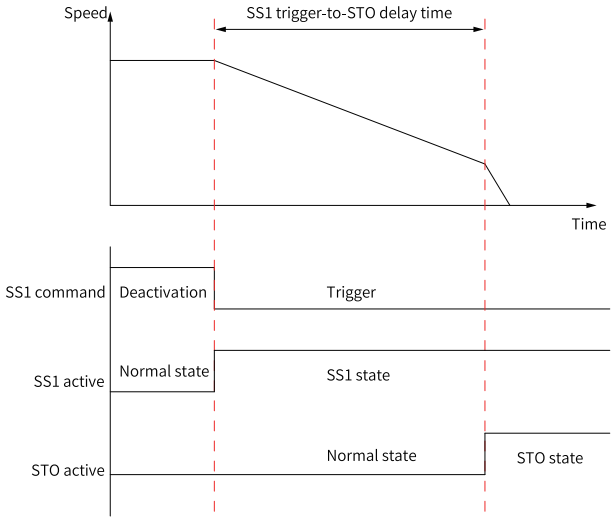
Figure 14-8 Motor speed when ramp limit is triggered

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 1160
H20.37	SS1/SS2 ramp monitor reference speed	60 rpm to 6000 rpm	1000	rpm	At stop	"H20_en.37" on page 1160
H20.38	SS1/SS2 ramp deceleration monitor time	1 ms-65535 ms	65535	ms	At stop	"H20_en.38" on page 1160
H20.41	SS1/SS2 ramp limit trigger-to-alarm time	0 ms-65535 ms	5	ms	At stop	"H20_en.41" on page 1161
H20.42	SS1/SS2 ramp monitor stop speed	0 rpm to 6000 rpm	1	rpm	At stop	"H20_en.42" on page 1161

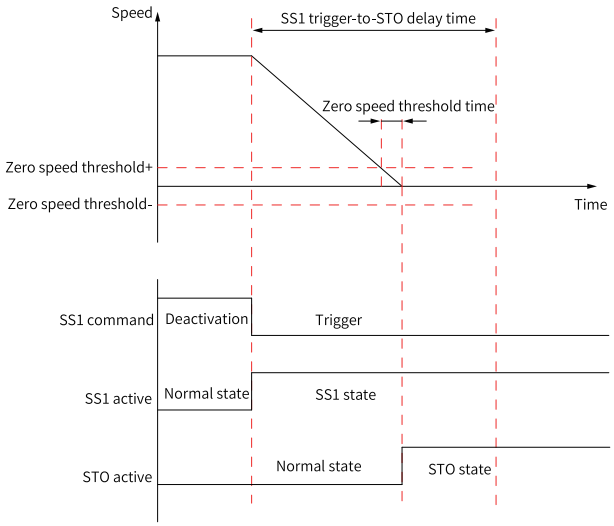
14.6.3 Sequence Diagram

SS1 is triggered and the drive enters STO state after a delay time has elapsed



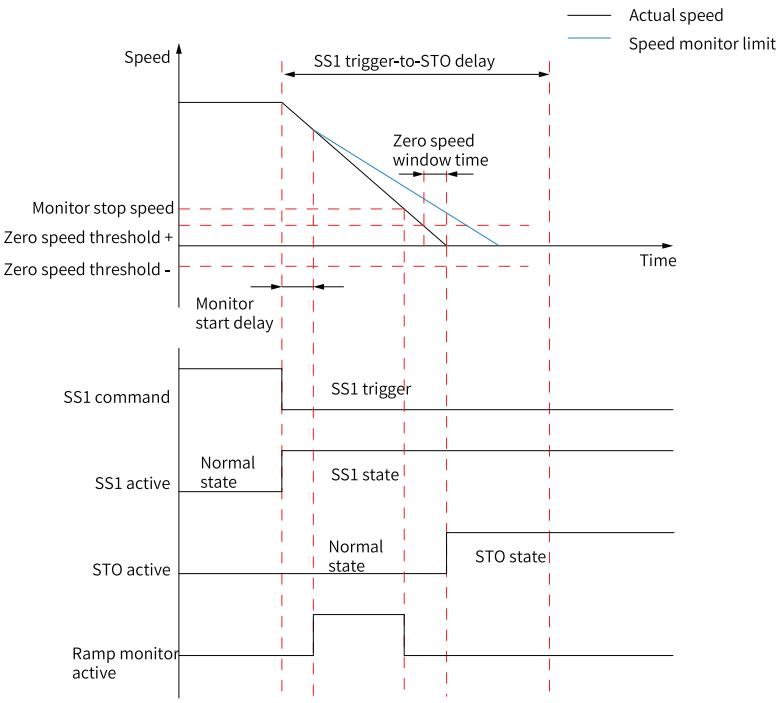
After SS1 is triggered, if you cancel an SS1 command during SS1 stop, the drive will continue to finish the stop process.

SS1 is triggered and the drive enters STO state when the speed meets zero speed conditions

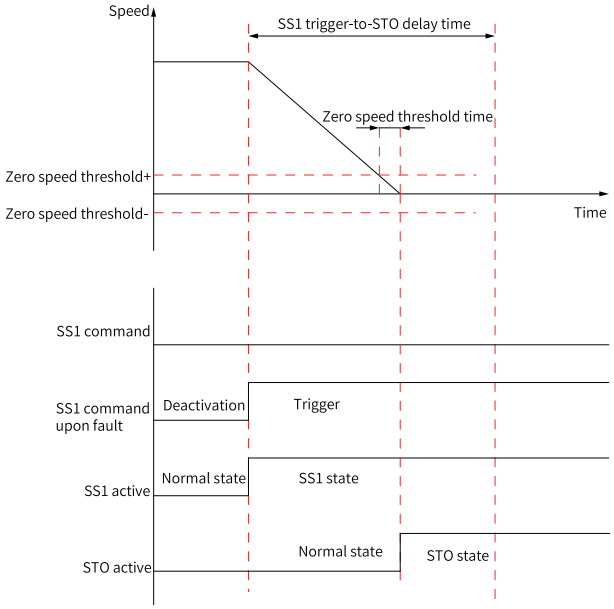


If the SS1 command is canceled after SS1 has been triggered, the drive will retain the SS1 state until the delay time has elapsed or the zero speed conditions are met.

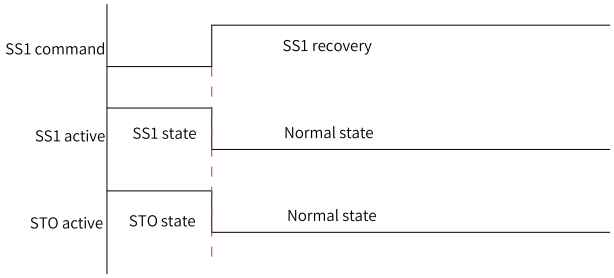
Starting SS1 speed ramp monitoring



SS1-t is triggered by fault and the drive enters STO state when the speed meets zero speed conditions



SS1 reset



14.7 Safe Stop 2 (SS2)

14.7.1 Overview

SS2 is used to activate motor deceleration 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 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. 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. The SS2 function requires a safety encoder.

If you choose to trigger safety function locally, you can set parameters H20.02 to H20.06 and set DI function to 4-SS2 to trigger SS2 through DI.

SS2 stop monitoring includes two modes: SS2-t and SS2-r, which can be selected through parameter 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.

14.7.2 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 14–8 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 off.
- ON (1): The 24V voltage of the corresponding DI is off.

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 1158*

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.

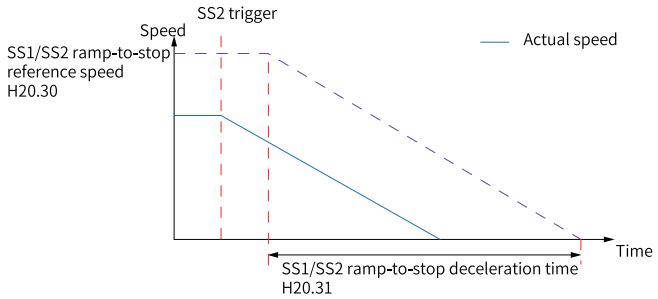


Figure 14-9 Motor speed during ramp stop

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 1158
H20.31	SS1/ SS2 ramp-to-stop deceleration time	1 ms-65535 ms	500	ms	At stop	"H20_en.31" on page 1159

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.

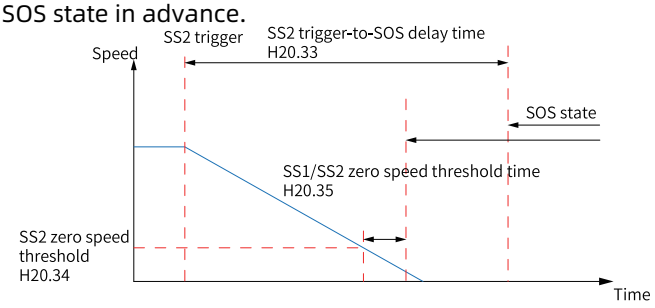


Figure 14-10 Safety function triggered locally, motor speed change

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 1159
H20.34	SS1/ SS1 zero speed threshold	1 rpm to 6000 rpm	10	rpm	At stop	"H20_en.34" on page 1159
H20.35	SS1/SS2 zero speed threshold time	0 ms-65535 ms	0	ms	At stop	"H20_en.35" on page 1160

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 1161

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.

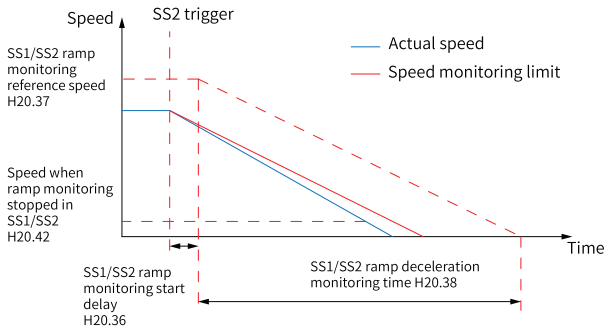


Figure 14-11 Motor speed when safety function is triggered

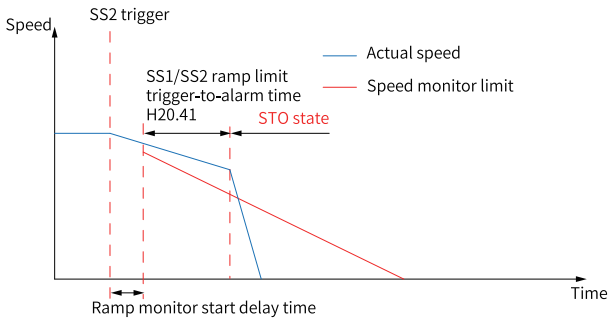


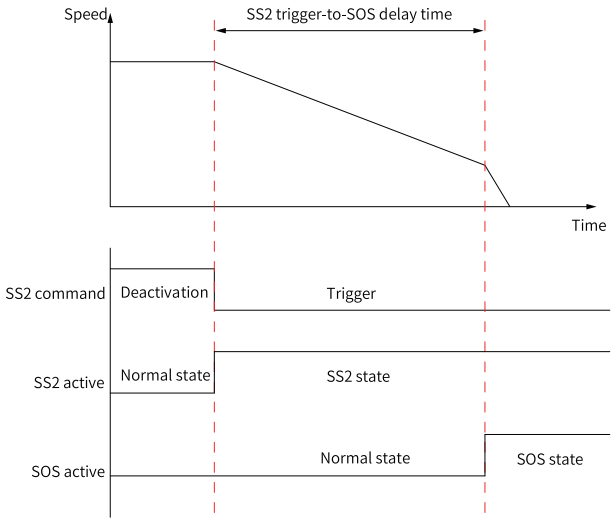
Figure 14-12 Motor speed when ramp limit is triggered

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 1160
H20.37	SS1/SS2 ramp monitor reference speed	60 rpm to 6000 rpm	1000	rpm	At stop	"H20_en.37" on page 1160
H20.38	SS1/SS2 ramp deceleration monitor time	1 ms–65535 ms	65535	ms	At stop	"H20_en.38" on page 1160
H20.41	SS1/SS2 ramp limit trigger-to-alarm time	0 ms–65535 ms	5	ms	At stop	"H20_en.41" on page 1161
H20.42	SS1/SS2 ramp monitor stop speed	0 rpm to 6000 rpm	1	rpm	At stop	"H20_en.42" on page 1161

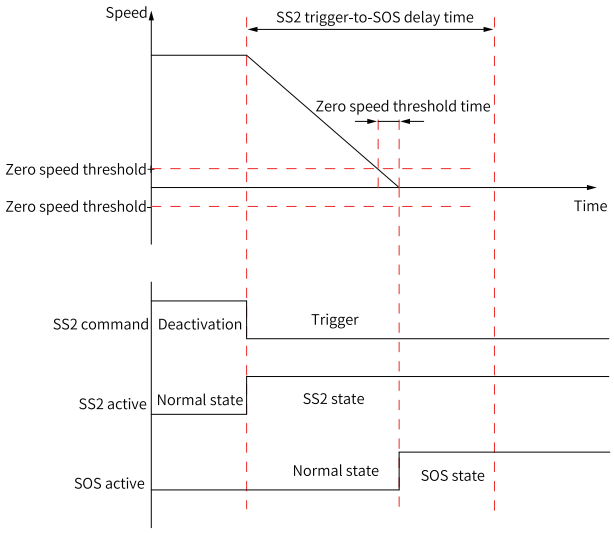
14.7.3 Sequence Diagram

SS2 is triggered and the drive enters SOS state after a delay time has elapsed



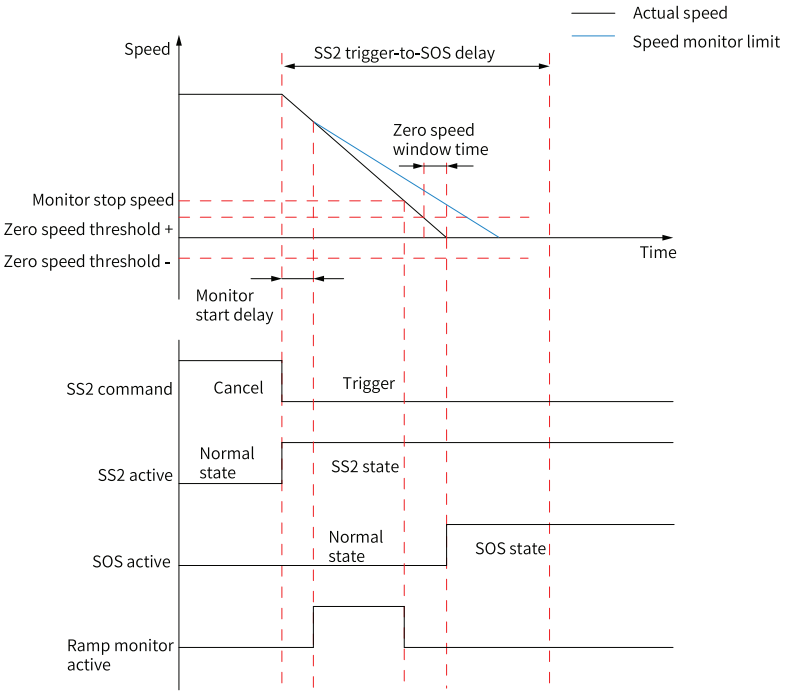
If the SS2 command is canceled after SS2 has been triggered, the drive will retain the SS2 state until the delay time has elapsed.

SS2 is triggered and the drive enters SOS state when the speed meets zero speed conditions

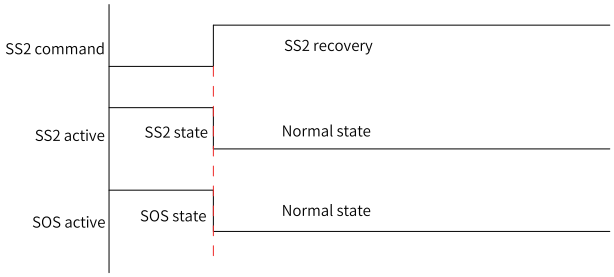


If the SS2 command is canceled after SS2 has been triggered, the drive will retain the SS2 state until the delay time has elapsed or the zero speed conditions are met.

Starting SS2 speed ramp monitoring



SS2 reset



14.8 Safe Operating Stop (SOS)

14.8.1 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.

Do not send any command to the servo drive when SOS monitoring is effective. Otherwise, the drive has to respond to the accumulated commands after the SOS monitoring state exits.

14.8.2 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 14–9 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.

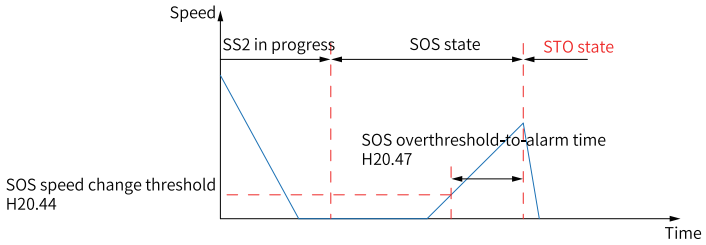


Figure 14-13 SOS speed change threshold

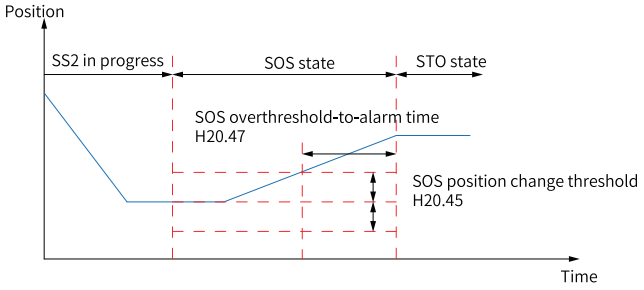


Figure 14-14 SOS position change threshold

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 1161
H20.45	SOS position change threshold	1 to 536870912	932067	encoder unit	At stop	"H20_en.45" on page 1162
H20.47	SOS overthreshold-to-alarm time	0 ms-65535 ms	5	ms	At stop	"H20_en.47" on page 1162

14.8.3 Sequence Diagram

SOS speed monitoring overrun

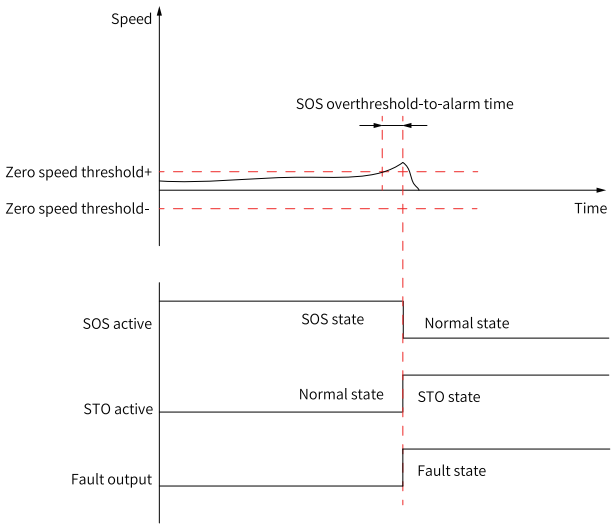


Figure 14-15 SOS speed monitoring timing diagram

SOS position monitoring overrun

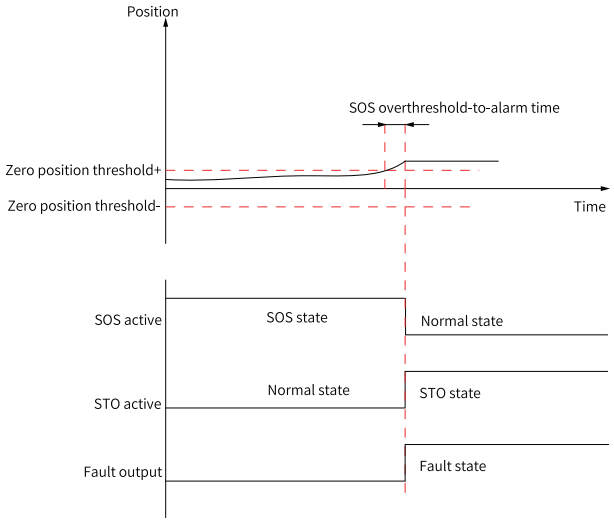


Figure 14-16 SOS position monitoring timing diagram

14.9 Safety-limited Speed (SLS)

14.9.1 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.

14.9.2 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 14–10 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
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 1150
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 1150
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 1151
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 1151

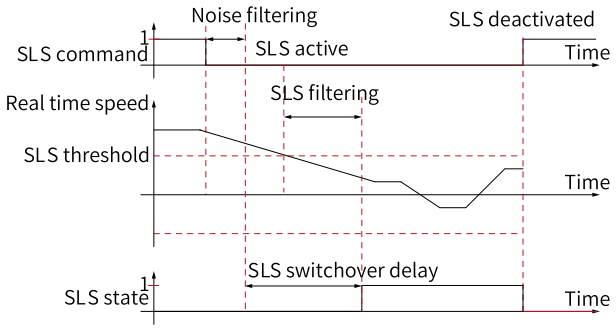
Parameter	Name	Value	Default	Unit	Change Mode	Page
H20.06	Safety module DI5 function selection	0: Inactive 1: STO 2: SBC 3: SS1 4: SS2 5: SLS1 6: SLS2 7: SLS3 8: SLS4 9: SDIp 10: SDIn 11: Ack	0	-	At stop	"H20_en.06" on page 1152
H20.20	Safety module DO1 function selection	0: Inactive 1: STO Active 2: 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 1155
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 1155

Parameter	Name	Value	Default	Unit	Change Mode	Page
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 1156
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 1156
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 1157

Parameter	Name	Value	Default	Unit	Change Mode	Page
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 1157
H20.48	SLS1 switchover delay	0 ms-65535 ms	100	ms	At stop	"H20_en.48" on page 1162
H20.49	SLS2 switchover delay	0 ms-65535 ms	100	ms	At stop	"H20_en.49" on page 1162
H20.50	SLS3 switchover delay	0 ms-65535 ms	100	ms	At stop	"H20_en.50" on page 1163
H20.51	SLS4 switchover delay	0 ms-65535 ms	100	ms	At stop	"H20_en.51" on page 1163
H20.52	SLS1 threshold	0 rpm to 6000 rpm	1000	rpm	At stop	"H20_en.52" on page 1163
H20.53	SLS2 threshold	0 rpm to 6000 rpm	1000	rpm	At stop	"H20_en.53" on page 1163
H20.54	SLS3 threshold	0 rpm to 6000 rpm	1000	rpm	At stop	"H20_en.54" on page 1163
H20.55	SLS4 threshold	0 rpm to 6000 rpm	1000	rpm	At stop	"H20_en.55" on page 1164
H20.56	SLS1 filter time	0 ms-65535 ms	100	ms	At stop	"H20_en.56" on page 1164
H20.57	SLS2 filter time	0 ms-65535 ms	100	ms	At stop	"H20_en.57" on page 1164
H20.58	SLS3 filter time	0 ms-65535 ms	100	ms	At stop	"H20_en.58" on page 1164
H20.59	SLS4 filter time	0 ms-65535 ms	100	ms	At stop	"H20_en.59" on page 1164

14.9.3 Sequence Diagram

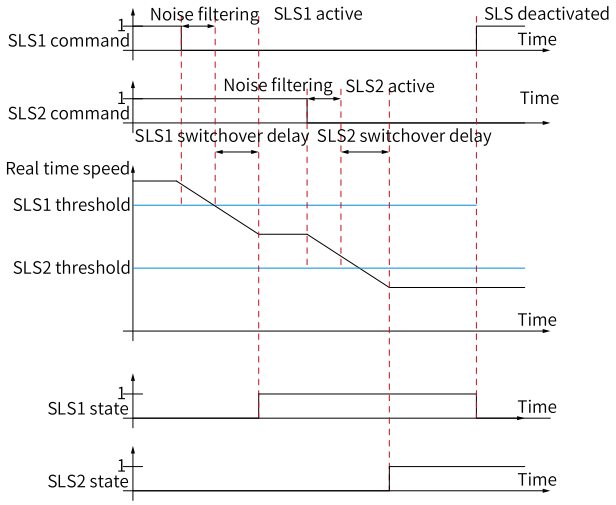
Sequence of SLS triggering



- 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.

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.

14.10 Safe Direction (SDI)

14.10.1 Overview

The Safe Direction (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 for SDI faults through H20.78.

The SDI function must be used with a safety motor.

14.10.2 SDI Triggered in Local Mode

The SDI controlled by the safety DI involves the following parameter configurations.

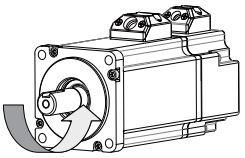
Table 14–11 Description of function numbers

No.	Name	Function name	Function
FunIN.9	SDIp command	SDIp command	0: SDIp active, forward rotation prohibited 1: SDIp canceled, forward rotation allowed
FunIN.10	SDIn command	SDIn 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 state	0: SDIn inactive, motor not rotating reversely 1: SDIn active, motor rotating reversely

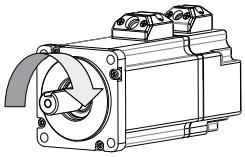
Note

- OFF (0): The 24 V voltage of the corresponding DI is disconnected.
- ON (1): The 24 V voltage of the corresponding DI is connected.

Viewing from the motor load side, clockwise rotation of the motor is abbreviated as CW, and counterclockwise rotation is abbreviated as CCW, as shown below.



CCW



CW

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 only rotate 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:

Parameter	Comm. address	Parameter name	Setpoint	Default value	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 1150
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 1150

Parameter	Comm. address	Parameter name	Setpoint	Default value	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 1151
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 1151
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 1152

Parameter	Comm. address	Parameter name	Setpoint	Default value	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 1155
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 1155
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 1156

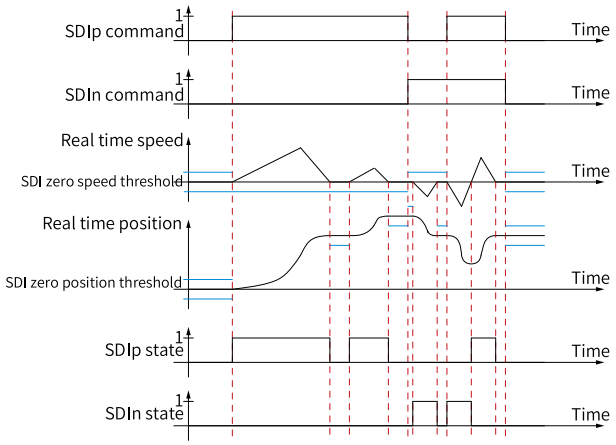
Parameter	Comm. address	Parameter name	Setpoint	Default value	Unit	Change mode	Page
H20.23	-	Safety module DO4 function selection	0: Inactive 1: STO Active 2: SBC Active 3: SS1 Active 4: SS2 Active 5: SLS1 Active 6: SLS2 Active 7: SLS3 Active 8: SLS4 Active 9: SDIp Active 10: SDIn Active 11: SOS Active 12: SSM Active 13: SS1-r Active 14: SS2-r Active	0	-	At stop	"H20_en.23" on page 1156
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 1157
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 1157
H20.74	-	SDI zero position threshold	1 to 536870912	932067	Encoder unit	At stop	"H20_en.74" on page 1166
H20.76	-	SDI zero speed threshold	0 to 3000	10	rpm	At stop	"H20_en.76" on page 1166

Parameter	Comm. address	Parameter name	Setpoint	Default value	Unit	Change mode	Page
H20.77	-	SDI delay time	0 to 65535	0	ms	At stop	"H20_en.77" on page 1166
H20.78	-	SDI fault response mode	0:STO 1:SS1-t	0	-	At stop	"H20_en.78" on page 1166
H20.00	-	Functional safety module software version	0.00 to 655.35	0.00	-	Read-only	"H20_en.00" on page 1149
H02.02	2002-03h	Direction of rotation	0: CCW direction as the forward direction 1: CW direction as the forward direction	0	-	At stop	"H02_en.02" on page 1148

14.10.3 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.



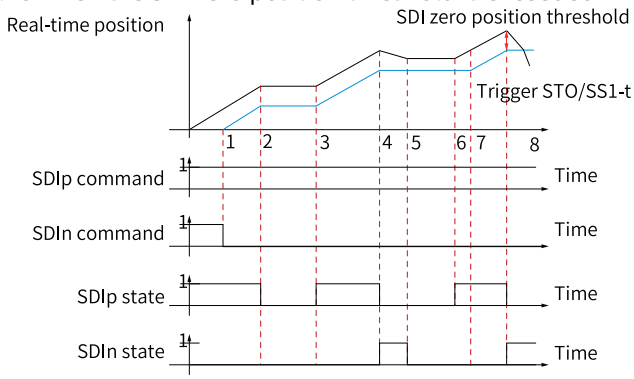
- The SDIp and SDIn states displayed by the safety module indicate the current rotational state of the servo motor, independent of whether the input SDI command is active or not. When both SDIp and SDIn states are 0, it means the servo motor is stopped.
- When the SDIp command is deactivated, the motor 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.

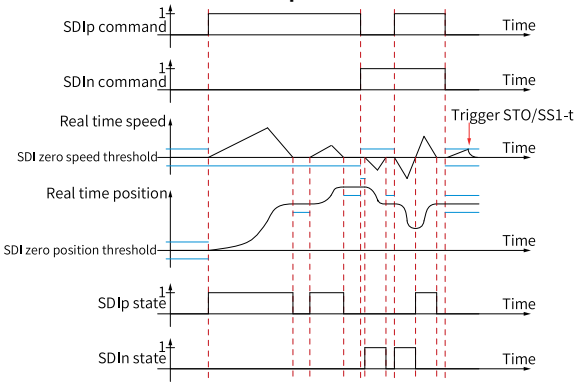
5. The motor stops before the maximum reverse position threshold is reached.

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.

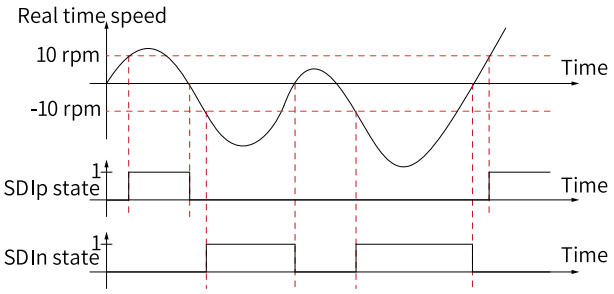
8. The zero position threshold is exceeded and the safety stop set by H20.78 is triggered.

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.



14.11 Safe Speed Monitor (SSM)

14.11.1 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 only in local mode.

14.11.2 SSM Triggered Locally

The parameter DO: FunOUT.12 (SSM Active) enables the DO to output that SSM function is active.

Table 14–12 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:

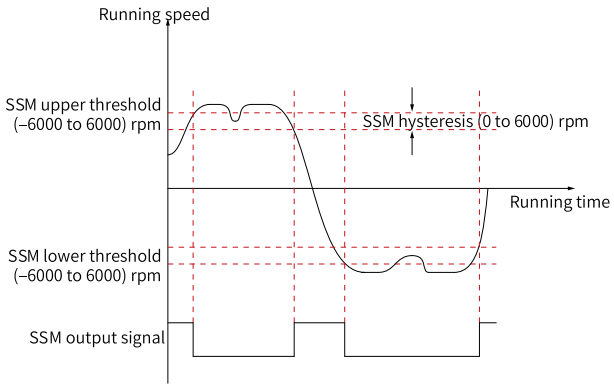
Parameter	Name	Value	Default	Unit	Change Mode	Page
H20.20	Safety module DO1 function selection	0: Inactive 1: STO Active 2: SBC Active 3: SS1 Active 4: SS2 Active 5: SLS1 Active 6: SLS2 Active 7: SLS3 Active 8: SLS4 Active 9: SDIp Active 10: SDIn Active 11: SOS Active 12: SSM Active 13: SS1-r Active 14: SS2-r Active	0	-	At stop	"H20_en.20" on page 1155
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 1155
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 1156

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 1157
H20.70	SSM upper limit	-6000 rpm to 6000 rpm	200	rpm	At stop	"H20_en.70" on page 1165
H20.71	SSM lower limit	-6000 rpm to 6000 rpm	-200	rpm	At stop	"H20_en.71" on page 1165
H20.72	SSM hysteresis threshold	0 rpm to 6000 rpm	10	rpm	At stop	"H20_en.72" on page 1165

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.

14.11.3 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.

14.12 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.

14.12.1 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 14–13 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).

14.13 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/warning, set H0d.01 (Fault reset) to 1 or activate the DI terminal assigned with DI function 2 (FunIN.2: ALM- RST, fault and warning reset).

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.

14.14 Commissioning and Operation

14.14.1 Pre-operation Inspection

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

Table 14–14 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.	□

14.14.2 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.

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.

14.14.3 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 14–15 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.	□
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 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 #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".	□

No.	Item	Yes
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.

Caution

- 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.

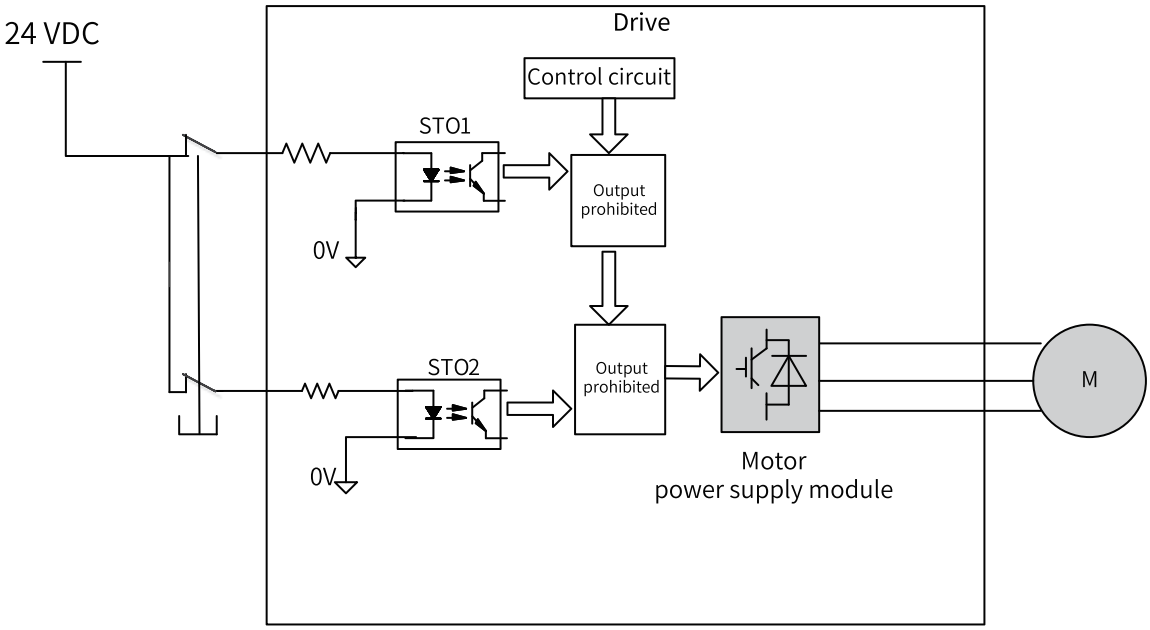
Validation of safety functions

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.

15 STO Integration

15.1 Overview



By cutting off the output of the motor supply module, the power supply current and torque of the motor is off.

Figure 15-1 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 SV680PS-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.

15.2 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.

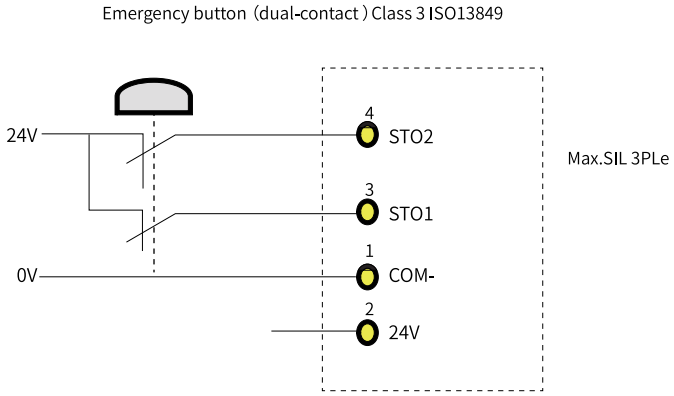
Signal name	Symbol	Optocoupler logic			
Safety input	STO1	ON	ON	OFF	OFF
	STO2	ON	OFF	ON	OFF
EDM output	EDM	OFF	OFF	OFF	ON

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



15.3 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.

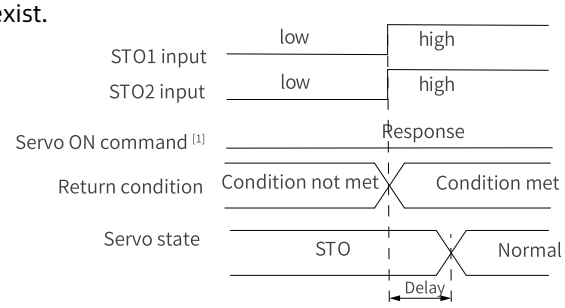


Figure 15-2 Return condition of external STO request state

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.

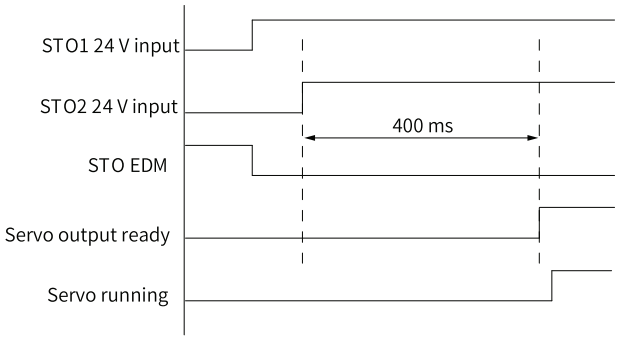
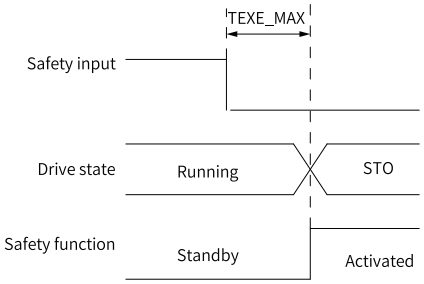


Figure 15-3 Servo drive reset sequence diagram

15.4 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.

15.5 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.

16 Communication

16.1 Modbus RTU

16.1.1 Communication Overview

16.1.1.1 Modbus communication specifications

Item		Specification
Modbus RTU Basic performance of slave	Link layer protocol	RS485
	Application layer protocol	Modbus RTU, GBT 19582.2-2008, using custom command area
	Baud rate	2400 kbps, 4800 kbps, 9600 kbps, 19200 kbps, 38400 kbps, 57600 kbps, and 115200 kbps
	Duplex mode	Half-duplex
	Data format	8-N-1 (8 data bits, no parity check, 1 stop bit)

16.1.1.2 Modbus Protocol

Modbus RTU protocol is a common language applied to electronic controllers. This protocol allows communication between the drives and between the drive and other devices such as the HMI and PLC. It has become a general industry standard. Based on the Modbus RTU protocol, control devices produced by different manufacturers can be connected to form an industrial network for centralized monitoring.

16.1.2 Hardware Configuration

16.1.2.1 Terminal Layout

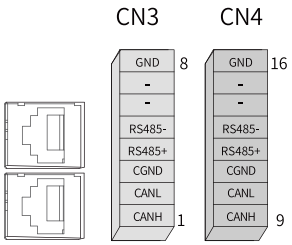


Figure 16-1 Communication terminal pin layout of the servo drive

Table 16–1 Description of communication terminal pins

Pin No.	Assignment	Description
1 and 9	CANH	CAN communication port
2 and 10	CANL	
3 and 11	CGND	CAN communication ground
4 and 12	RS485+	Modbus RTU communication port
5 and 13	RS485–	
6 and 14	-	-
7 and 15	-	-

Pin No.	Assignment	Description
8 and 16	GND	Signal reference ground
Enclosure	PE	Shield

16.1.2.2 Wiring example of RS485 communication

RS485 communication connection with PLC

The following figure shows the cable connection between the servo drive and the PLC during RS485 communication networking.



Figure 16-2 Diagram of the drive-to-PLC communication cable

Use a three-conductor shielded cable to connect the RS485 bus, with three conductors connected to 485+, 485-, and GND, respectively. GND represents non-isolated RS485 signal reference ground. Connect the twisted pairs to the RS485+ and RS485– terminals. Connect the third cable to the RS485 reference ground (GND). Connect the shield to the device ground (PE). Connect 120 Ω termination resistors only at the head and tail ends of the bus to prevent RS485 signal reflection.

Table 16–2 Pin connections of the cable used for CAN communication between the servo drive and PLC

RJ45 on the drive (A)			PLC side (B)		
Communication type	Pin No.	Definition	Communication type	Pin No.	Definition
RS485	4	485+	RS485	4	485+
	5	485-		5	485-
	8	GND		8	GND
-	Housing	PE (shield)	-	Housing	PE (shield)

RS485 communication for multiple drives installed in parallel

The following figure shows the cable connection between multiple servo drives during RS485 communication networking.

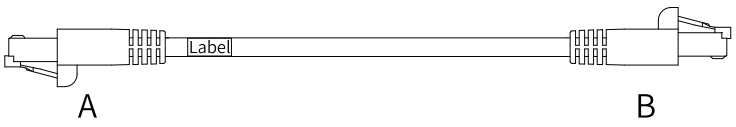


Figure 16-3 Diagram of the multi-drive communication cable

Table 16–3 Pin connections of the cable used for multi-drive RS485 communication (pins in 485 group used only)

RJ45 on the drive (A)			RJ45 on drive side (B)		
Communication type	Pin No.	Definition	Communication type	Pin No.	Definition
RS485	4	485+	RS485	4	485+
	5	485-		5	485-
	8	GND		8	GND
-	Housing	PE (shield)	-	Housing	PE (shield)

In case of a large number of nodes, connect the RS485 communication using the daisy chain mode. Connect the RS485 signal reference grounds of all the nodes (up to 128 nodes) together.

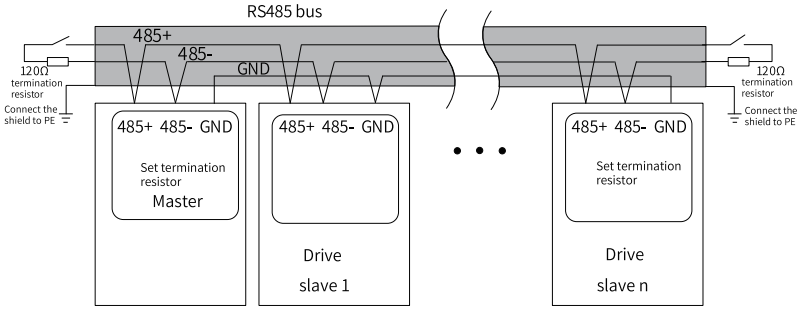


Figure 16-4 RS485 bus topology

Caution

- Set the termination resistor: Insert S6-L-T03-0.0 into the RJ45 connector.
- Do not connect the CGND terminal of the host controller to the GND terminal of the servo drive. Failure to comply will damage the machine.

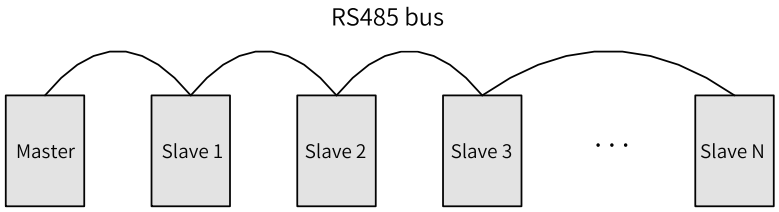


Figure 16-5 Daisy chain mode

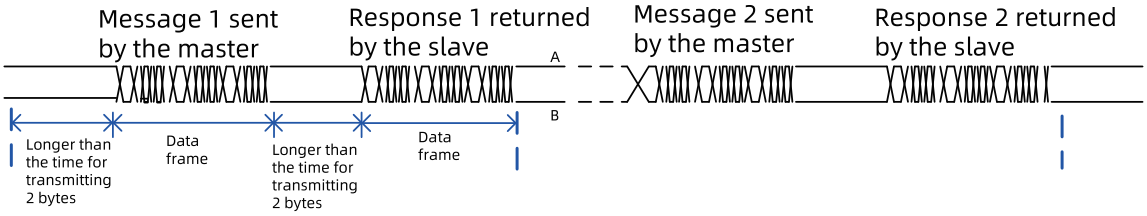
The following table lists the maximum number of nodes and transmission distance supported by the Inovance standard RS485 circuit at different transmission rates.

Table 16–4 Transmission distance and number of nodes

No.	Transmission rate (kbps)	Transmission distance (m)	Number of nodes	Cable size (AWG)
1	115.2	100	128	26
2	19.2	1000	128	26

16.1.3 Communication Transmission Mode

In an RS485 communication network, data is transmitted in asynchronous serial and half-duplex transmission mode. Data is sent frame by frame in the message format specified by the Modbus-RTU protocol. The idle time longer than 2-byte transmission time marks the start of a new communication frame.



The built-in communication protocol of the drive is the Modbus RTU slave communication protocol, which allows the AC drive to respond to the query command from the master or execute the action according to query command from the master and respond with communication data.

The master can be a personal computer (PC), an industrial control device, or a programmable logic controller (PLC). It can communicate with a slave separately, or send broadcast messages to all slaves. When the master sends a query command to a single slave, the slave is required to return a response frame. For a broadcast message sent by the master, no response from the slaves is required.

16.1.4 Communication data frame structure

Parameters of the SV680P-INT series servo drive are classified into 16-bit and 32-bit parameters based on the data length. Data read/write for the parameters is implemented based on the Modbus RTU protocol.

The command codes for reading/writing parameters vary with the data length.

Operation	Command code
Reading 16-bit/32-bit parameters	0x03
Writing 16-bit parameters	0x06
Write 32-bit parameters	0x10

Command code for reading parameter: 0x03

Based on the Modbus RTU protocol, command code 0x03 is used to read both 16-bit and 32-bit parameters.

Request frame format:

Value	Description
START	Equal to or larger than 2-character idle time, indicating the start of a frame.
ADDR	Servo axis address: 1 to 127 **Note: 1 to 127 are decimal values that need to be converted to hexadecimal equivalents.**
CMD	Command code: 0x03

Value	Description
DATA[0]	Register start address (high 8 bits): parameter group number of the start register. For example, for parameter H06.11, where 06 is the group number, DATA[0] is 0x06. **Note: 06 is a hexadecimal value that does not need to be converted.**
DATA [1]	Register start address (low 8 bits): offset within the parameter group of the start register For example, for parameter H06.11, where 11 is the offset within the parameter group, DATA[1] is 0x0B. **Note: 11 is a decimal value that needs to be converted to its hexadecimal equivalent 0x0B.**
DATA [2]	Read the eight high bits N (H) of the number of parameters (hexadecimal).
DATA [3]	Read the eight low bits N (L) of the number of parameters (hexadecimal).
CRCL	CRC valid byte (low 8 bits).
CRCH	CRC valid byte (high 8 bits).
END	Equal to or larger than 2-character idle time, indicating the end of a frame.

Response frame format:

Value	Description
START	Equal to or larger than 2-character idle time, indicating the start of a frame.
ADDR	Servo axis address, hexadecimal
CMD	Command code: 0x03
DATALENGTH	Number of parameter bytes, equal to twice the number of parameters to be read, that is, N × 2.
DATA[0]	Data of the first register parameter (high 8 bits)
DATA [1]	Data of the first register parameter (low 8 bits)
DATA[...]	...
DATA[N × 2 – 2]	Data of the Nth register parameter (high 8 bits)
DATA[N × 2 – 1]	Data of the Nth register parameter (low 8 bits)
CRCL	CRC valid byte (low 8 bits).
CRCH	CRC valid byte (high 8 bits).
END	Equal to or larger than 2-character idle time, indicating the end of a frame.

Based on the Modbus RTU protocol, command code 0x06 is used to write 16-bit parameters. Command code 0x10 is used to write 32-bit parameters.

Communication example

- To read two-word data with H02.02 as the start register from the drive whose servo axis address is 01:

  The master sends the following request frame:

01	03	02	02	00	02	CRCL	CRCH

  Slave response frame

01	03	04	00	01	00	00	CRCL	CRCH

  The response frame means that the slave returns data of 2 word length (4 bytes), and the data content is 0x0001, 0x0000.

  If the slave response frame is:

01	83	02	CRCL	CRCH

The response frame indicates that a communication error occurs and the error code is 0x02. (0x83 indicates an error).

- To read parameter H05.07 (32-bit) from the drive whose servo axis address is 01:
  The master sends the following request frame:

01	03	05	07	00	02	CRCL	CRCH

Slave response frame

01	03	04	00	01	00	00	CRCL	CRCH

The response frame indicates that the value of parameter H05.07 is 0x00000001.

Command code for writing 16-bit parameters: 0x06

Caution

Do not write 32-bit parameters with 0x06. Failure to comply can result in unexpected error.

Request frame format:

Value	Description
START	Equal to or larger than 2-character idle time, indicating the start of a frame.
ADDR	Servo axis address 1 to 127 **Note: 1 to 127 are decimal values that need to be converted to hexadecimal equivalents.**
CMD	Command code: 0x06
DATA[0]	Register start address (high 8 bits): parameter group number of the start register. For example, to write data to parameter H06.11, where 06 is the group number, DATA[0] is 0x06. **Note: 06 is a hexadecimal value that does not need to be converted.**
DATA [1]	Register start address (low 8 bits): offset within the parameter group of the start register For example, to write data to parameter H06.11, where 11 is the offset within the parameter group, DATA[1] is 0x0B. **Note: 11 is a decimal value that needs to be converted to its hexadecimal equivalent 0x0B.**
DATA [2]	Write the 8 high bits of register data (hexadecimal).
DATA [3]	Write the 8 low bits of register data (hexadecimal).
CRCL	CRC valid byte (low 8 bits).
CRCH	CRC valid byte (high 8 bits).
END	Equal to or larger than 2-character idle time, indicating the end of a frame.

Response frame format:

Value	Description
START	Equal to or larger than 2-character idle time, indicating the start of a frame.
ADDR	Servo axis address, hexadecimal
CMD	Command code: 0x06

Value	Description
DATA[0]	Register start address (high 8 bits): parameter group number of the start register. For example, to write data to parameter H06.11, where 06 is the group number, DATA[0] is 0x06. **Note: 06 is a hexadecimal value that does not need to be converted.**
DATA [1]	Register start address (low 8 bits): offset within the parameter group of the start register For example, to write data to parameter H06.11, where 11 is the offset within the parameter group, DATA[1] is 0x0B. **Note: 11 is a decimal value that needs to be converted to its hexadecimal equivalent 0x0B.**
DATA [2]	Write the 8 high bits of register data (hexadecimal).
DATA [3]	Write the 8 low bits of register data (hexadecimal).
CRCL	CRC valid byte (low 8 bits).
CRCH	CRC valid byte (high 8 bits).
END	Equal to or larger than 2-character idle time, indicating the end of a frame.

Communication example

To write data 0x0001 to parameter H02.02 in the drive whose servo axis address is 01:

The master sends the following request frame:

01	06	02	02	00	01	CRCL	CRCH

Slave response frame

01	06	02	02	00	01	CRCL	CRCH

The response frame indicates that data 0x0001 has been written to parameter H02.02 in the drive whose servo axis address is 01.

If the slave response frame is:

01	86	02	CRCL	CRCH

The response frame indicates that a communication error occurs, and the error code is 0x02. In this example, 0x86 indicates an error.

Command code for writing 32-bit parameters: 0x10



Do not write 16-bit parameters with 0x10. Failure to comply can result in unexpected error.

Request frame format:

Value	Description
START	Equal to or larger than 2-character idle time, indicating the start of a frame.
ADDR	Servo axis address 1 to 127 **Note: 1 to 127 are decimal values that need to be converted to hexadecimal equivalents.**

Value	Description
CMD	Command code: 0x10
DATA[0]	Register start address (high 8 bits): parameter group number of the start register. For example, to write data to parameter H11.12, where 11 is the group number, DATA[0] is 0x11. **Note: 11 is a hexadecimal value that does not need to be converted.**
DATA [1]	Register start address (low 8 bits): offset within the parameter group of the start register Take H11.12 as an example, **"12" is the offset within the parameter group**, which means DATA[1] = 0x0C. **Note: 12 is a decimal value that needs to be converted to its hexadecimal equivalent 0x0C.**
DATA [2]	High 8 bits of the number of parameters to which data will be written (hexadecimal), M(H) For example, to write data to parameter H05.07 alone, DATA[2] is 00, DATA[3] is 02, and M is H0002. **One 32-bit parameter is counted as two words.**
DATA [3]	Write the eight low bits M (L) of the number of parameters (hexadecimal).
DATA [4]	Number of bytes corresponding to data to be written to the register, that is, M × 2. For example, to write data to parameter H05.07 alone, DATA[4] is H04.
DATA [5]	Write the eight high bits of the start register data (hexadecimal).
DATA [6]	Write the eight low bits of the start register data (hexadecimal).
DATA [7]	Write the eight high bits of the start register address +1 (hexadecimal).
DATA [8]	Write the eight low bits of the start register address +1 (hexadecimal).
CRCL	CRC valid byte (low 8 bits).
CRCH	CRC valid byte (high 8 bits).
END	Equal to or larger than 2-character idle time, indicating the end of a frame.

Response frame format:

Value	Description
START	Equal to or larger than 2-character idle time, indicating the start of a frame.
ADDR	Servo axis address, hexadecimal.
CMD	Command code: 0x10
DATA[0]	Register start address (high 8 bits): offset within the parameter group of the start register For example, to write data to parameter H11.12, DATA[0] is 0x11.
DATA [1]	Register start address (low 8 bits): offset within the parameter group of the start register For example, to write data to parameter H11.12, DATA[1] is 0x0C.
DATA [2]	High 8 bits of the number of parameters to which data will be written (hexadecimal), M(H)
DATA [3]	Write the eight low bits M (L) of the number of parameters (hexadecimal).
CRCL	CRC valid byte (low 8 bits).
CRCH	CRC valid byte (high 8 bits).
END	Equal to or larger than 2-character idle time, indicating the end of a frame.

Incorrect response frame

Error frame response format:

Value	
START	Equal to or larger than 2-character idle time, indicating the start of a frame.
ADDR	Servo axis address, hexadecimal
CMD	Command code: 0x80
DATA[0] to DATA[3]	DATA error code
CRCL	CRC valid byte (low 8 bits).
CRCH	CRC valid byte (high 8 bits).
END	Equal to or larger than 2-character idle time, indicating the end of a frame.

Error codes:

Error code	Description
0x0001	Invalid command code
0x0002	Invalid data address
0x0003	Invalid data
0x0004	Slave device fault

32-bit parameter addressing

When Modbus RTU commands are used to read/write 32-bit parameters, the communication address is determined by the address of the parameter with the smaller offset number. Two parameters are operated per operation. See the following examples.

Note

In the following examples, the servo axis address is 01 by default.

- The Modbus RTU command for reading parameter H11.12 (1st displacement) is as follows.

01	03	11	0C	00	02	CRCL	CRCH

If the "1st displacement" is 0x40000000 (decimal equivalent: 1073741824), then the following response frames apply:

- When H0E.84 is set to 1 (Low 16 bits before high 16 bits), the response frame is as follows.

01	03	04	00	00	40	00	CRCL	CRCH

- H0E.84 = 0 (High 16 bits before low 16 bits), then the response frame is:

01	03	04	40	00	00	00	CRCL	CRCH

- The Modbus RTU command for writing 0x12345678 to parameter H11.12 (1st displacement) is as follows.

- If H0E.84 = 1 (Low 16 bits before high 16 bits):

01	10	11	0C	00	02	04	56	78	12	34	CRCL	CRCH

- If H0E.84 = 0 (High 16 bits before low 16 bits):

01	10	11	0C	00	02	04	12	34	56	78	CRCL	CRCH

CRC check

The host controller and the servo drive must use the same CRC algorithm during communication. Otherwise, a CRC error will occur. The SV680P series servo drive adopts 16-bit CRC with low bytes before high bytes. The polynomial used for CRC is $X^{16} + X^{15} + X^2 + 1$ (0xA001).

```
Uint16 COMM_CrcValueCalc(const Uint8 *data, Uint16 length)
{
  Uint16 crcValue = 0xffff;
  int16 i;
  while (length--)
  {
    crcValue ^= *data++;
    for (i = 0; i < 8; i++)
    {
      if (crcValue & 0x0001)
      {
        crcValue = (crcValue >> 1) ^ 0xA001;
      }
      else
      {
        crcValue = crcValue >> 1;
      }
    }
  }
  return (crcValue);
}
```

16.1.5 Communication parameters

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H0E.00	200E-01h	Node address	1 to 127	1	-	At stop	"H0E_en.00" on page 895
H0E.80	200E-51h	Modbus baud rate	0: 300 bps 1: 600 bps 2: 1200 bps 3: 2400 bps 4: 4800 bps 5: 9600 bps 6: 19200 bps 7: 38400 bps 8: 57600 bps 9: 115200 bps	9	-	Real time	"H0E_en.80" on page 900
H0E.81	200E-52h	Modbus data format	0: No parity, 2 stop bits (N-2) 1: Even parity, 1 stop bit (E-1) 2: Odd parity, 1 stop bit (O-1) 3: No parity, 1 stop bit (N-1)	3	-	Real time	"H0E_en.81" on page 901
H0E.84	200E-55h	Modbus communication data sequence	0: High-order bits are followed by low-order bits. 1: Low-order bits are followed by high-order bits.	1	-	Real time	"H0E_en.84" on page 901

16.2 CANopen Communication

16.2.1 Communication Overview

16.2.1.1 Communication Technical Data

Item	Name	Description
Parameter setting	Node address switching	The node address can only be set manually. The maximum value is 127.
	Baud rate switching	The baud rate can only be set manually.
Description of state machine	State description/display of communication layer	Initializing, Pre-Operational, Operational, Stopped
	Description/display of emergency error codes	Time-Out, State-Switch-Err, PDO-Length-Err
Error frame recording	Reception error frames can be recorded.	Count of NMT frames with incorrect length
		Count of NMT frames with incorrect command
		Count of heartbeat/node protection frames with incorrect length

Item	Name	Description
Sync deviation detection	Multi-quantile sync deviation detection	1/4-period deviation
		1/2-period deviation
		3/4-period deviation
		1-period deviation
		2-period deviation
Baud rate	20 k-1 M	20kbps, 50kbps, 100kbps, 125kbps, 250kbps, 500kbps, 1Mbps
SYNC	SYNC Producer	Synchronous frame production
	SYNC Consumer	Synchronous signal consumption with deviation detection (in IP mode)
SDO	Start domain upload/ download	Transmit data ≤ 4 bytes
	SDO abort error	Report an SDO error code contextually
PDO	Synchronous TPDO	The sync number is 1-240. The default number of TPDOs/RPDOs is 4, which can be configured.
	Asynchronous TPDO	Time-triggered by time. The default number of TPDOs/ RPDOs is 4, which can be configured.
EMCY	**Emergency message**	Heartbeat timeout, PDO length error, node state switching error, application layer error
NMT	Bootup Service	Support for node online message transmit
NMTErrCtl	Life Guard	Optional node protection (cannot be used with heartbeat production)
	Heartbeat Consumer	Node heartbeat consumption
	Heartbeat Producer	Node heartbeat production
Expert mode	PDO communication parameters and their mapping are set through parameters.	PDO communication parameters and their mapping are set manually.

16.2.1.2 Protocol Description

CANopen is a protocol for the application layer of the network transmission system based on CAN serial bus. It complies with the ISO/OSI standard model. Devices in the network exchange data through the object dictionaries or objects. The master node obtains or modifies data in the object dictionaries of other nodes through PDOs or SDOs. The following figure shows a CANopen equipment model.

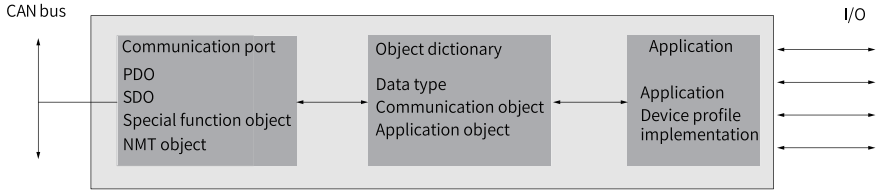


Figure 16-6 CANopen device model

16.2.2 Hardware Configuration

16.2.2.1 Terminal Layout

For details, see *"16.1.2.1 Terminal Layout" on page 656*.

16.2.2.2 CAN Communication Connection Examples

CAN communication with PLC

The following figure shows the cable used for the communication between the servo drive and PLC in CAN communication networking.

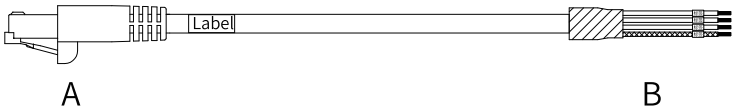


Figure 16-7 Diagram of the drive-to-PLC communication cable

Use a three-conductor shielded cable to connect the CAN bus, with the three conductors connected to CANH, CANL, and CGND (CGND represents isolated RS485 circuit signal reference ground) respectively. Connect the twisted pairs to the CANH and CANL terminals. Connect the CGND terminal to the CAN reference ground. Connect the shield to the device ground. Connect 120 Ω termination resistors only at the head and tail ends of the bus to prevent CAN signal reflection.

Table 16–5 Pin connections of the cable used for CAN communication between the servo drive and PLC

RJ45 on the drive (A)			PLC side (B)		
Communication type	Pin No.	Definition	Communication type	Pin No.	Definition
CAN	1	CANH	CAN	1	CANH
	2	CANL		2	CANL
	3	CGND		3	CGND
-	Housing	PE (shield)	-	Housing	PE (shield)

CAN communication for multiple drives installed in parallel

The following figure shows the cable used for multi-drive CAN communication.

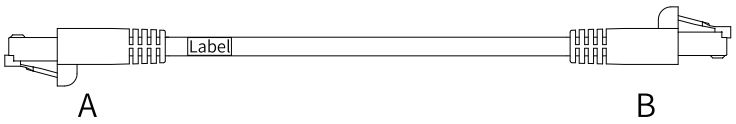


Figure 16-8 Diagram of the multi-drive communication cable

Table 16–6 Connection of pins of the multi-drive communication cable (only CAN pins used)

RJ45 on the drive (A)			RJ45 on drive side (B)		
Communication type	Pin No.	Definition	Communication type	Pin No.	Definition
CAN	1	CANH	CAN	1	CANH
	2	CANL		2	CANL
	3	CGND		3	CGND
-	Housing	PE (shield)	-	Housing	PE (shield)

Use the daisy chain mode for CAN bus, as shown in the following figure.

- Shielded twisted pair cables are recommended for connecting the CAN bus. Twisted pairs are recommended for connecting CANH and CANL.
- Connect 120 Ω termination resistors only at both ends of the bus to prevent signal reflection.
- Connect the CAN signal reference grounds of all the nodes together.
- Up to 127 nodes can be connected.

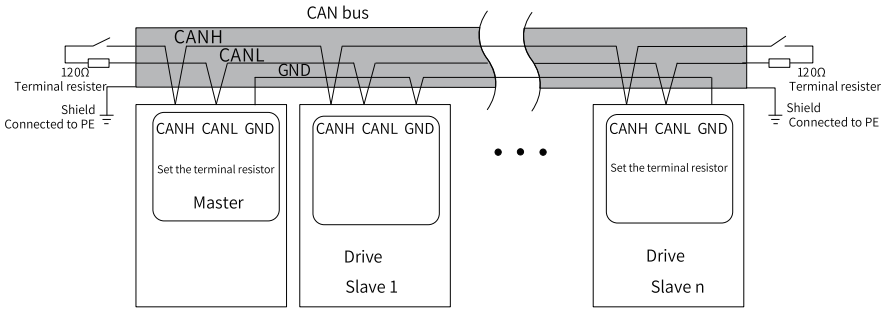


Figure 16-9 CAN bus topology

Caution

Do not connect the CGND terminal of the host controller to the GND terminal of the servo drive. Otherwise, the servo drive may be damaged.

16.2.3 Communication Transmission Mode

CANopen provides multiple communication objects, each of which has different characteristics and applies to different applications. The predefined COB-ID is used. Specific rules are as follows:

- Network management (NMT) object: 0x000
- Synchronization (SYNC) object: 0x080
- SDO object:
  - Transmit SDO: 0x600+Node-Id
  - Receive SDO: 0x580+Node-Id
- PDO object:
  - RPDO1: 0x200+Node-Id
  - RPDO2: 0x300+Node-Id
  - RPDO3: 0x400+Node-Id
  - RPDO4: 0x500+Node-Id

  - TPDO1: 0x180+Node-Id
  - TPDO2: 0x280+Node-Id
  - TPDO3: 0x380+Node-Id
  - TPDO4: 0x480+Node-Id
- EMCY object: 0x80+Node-Id

Communication objects are defined as follows:

- Network management (NMT) object
  The NMT object includes Boot-up messages, Heartbeat protocol, and NMT messages. Based on the master-slave mode, an NMT is used to manage and monitor nodes in the network and implements three functions: node status control, error control, and node activation.
- Service data object (SDO)
  By using index and subindex, SDO enables the client to access entries in the device object dictionary. SDO is implemented via CMS objects of the multi-element domain in CAL, allowing data of any length to be transmitted (split into multiple messages if exceeding 4 bytes). The protocol is an acknowledged service type and generates a response for each message. SDO request and response messages always contain 8 bytes.
- Process data object (PDO)
  PDO is used to transmit real-time data from a single producer to one or more consumers. Data transmission is limited to one to eight bytes. Each CANopen device has eight default PDO channels, that is, four TPDOs and four RPDOs. PDO supports synchronous transmission and asynchronous transmission, determined by the PDO communication parameters. The content in a PDO message is predefined as determined by the PDO mapping parameters.
- Synchronous (SYNC) object
  A SYNC object is a message periodically broadcast by the CANopen master to the CAN bus. It is used to provide basic network clock signals. Each device determines whether to perform synchronous communication with other network devices using the event based on its configuration.

16.2.4 Communication Data Frame Structure

16.2.4.1 Network Management (NMT) System

The NMT system initializes, starts, and stops the network and devices in the network. It belongs to the master-slave system. A CANopen network includes only one NMT master. The CANopen network, including the master itself, can be configured.

NMT service

CANopen works according to the state machine specified by the protocol. Some states are converted automatically and some must be converted through NMT messages transmitted by the NMT master, as shown below.

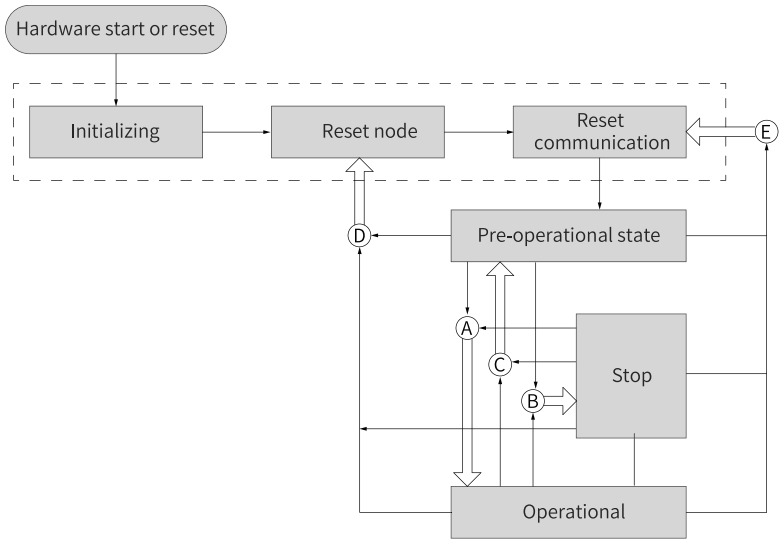


Figure 16-10 Execution process of the NMT state machine

In the figure above, conversion marked with a letter is implemented through NMT messages. Only the NMT master can transmit NMT control messages. The message format is shown in *"Table 16-7" on page 671*.

Table 16–7 NMT message format

COB-ID	RTR	Data/Byte	
		0	1
0x000	0	Command word	Node_ID

The COB-ID of an NMT message is always "0x000".

The data segment contains two bytes. The first byte is a command word indicating that this frame is for control purpose. See *"Table 16-8" on page 671* for details.

The second byte (Node_ID) is the CANopen node address. The byte value 0 indicates that it is a broadcast message to all the slaves in the network.

Table 16–8 NMT message command

Command word	Conversion code	Description
0x01	A	Instruction for starting a remote node
0x02	B	Instruction for stopping a remote node
0x80	C	Instruction for entering the pre-operational status
0x81	D	Instruction for resetting a node
0x82	E	Instruction for resetting communication

1. After power-on, the device automatically enters the initialization state, including initializing, node reset, and communication reset. During initializing, parameters of each mode are loaded. During node reset, the manufacturer-defined area and profile area of the object dictionary are restored to values saved last time. During communication reset, communication parameters in the object dictionary are restored to values saved last time.
2. Next, the device sends Boot-up and enters the pre-operational state, which is the main configuration node state.

3. After configuration is done, the node device can enter the operational state only after the NMT master sends the NMT message. The operational state means that the CANopen is working properly, with every module working properly.
4. When the NMT master sends a node stop message, the device enters the stop state and only the NMT module is working in CANopen communication.

The following table lists CANopen services available in different NMT states.

Table 16–9 Services supported in different NMT states

Service	Pre-operational	Operation	Stop
Process data object (PDO)	No	Yes	No
Service data object (SDO)	Yes	Yes	No
Synchronization (SYNC) object	Yes	Yes	No
Emergency (EMCY) message	Yes	Yes	No
Network Management System (NMT)	Yes	Yes	Yes
Error control	Yes	Yes	Yes

NMT error control

NMT error control is used to detect whether devices in the network are online and device status, including node guarding, life guarding, and heartbeat.

Note

- Life guard and heartbeat cannot be used at the same time.
- Do not set the node guarding, life guarding, and heartbeat time to small values to prevent excessive network load.

- **Node/life guarding**

  In node guarding, the NMT master periodically checks the status of an NMT slave through remote frames. In life guarding, a slave indirectly monitors the status of the master based on the interval of remote frames the slave receives for slave monitoring. Node guarding complies with the master/slave model. Every remote frame must be responded.

  Objects related to node/life guarding include the protection time 100Ch and life factor 100Dh. The value of 100Ch is the remote frame interval (ms) of node guarding under normal conditions. The product of 100Ch multiplied by 100Dh determines the latest time of master query. Node guarding is available normally. When 100Ch and 100Dh of a node are non-zero values and a node guarding request frame is received, life guarding will be activated.

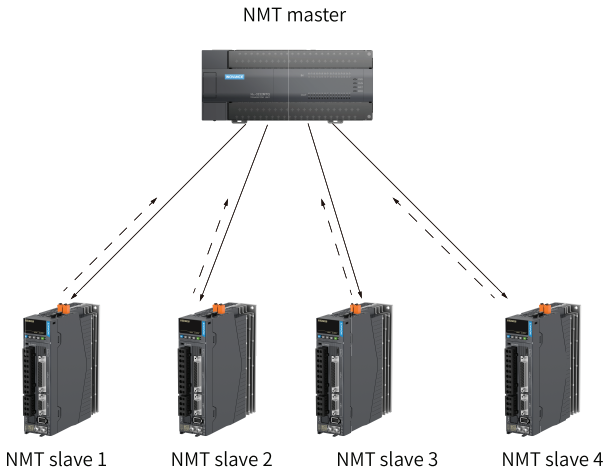


Figure 16-11 Description of node guarding

As shown in the figure above, the master sends a node guarding remote frame at the interval defined by 100Ch, and the slave must respond to the remote frame. Otherwise, the slave is considered to be offline.

If the slave does not receive any node guarding remote frame within the time defined by 100Ch × 100Dh, the master is considered to be offline.

The following table describes the remote frame sent by the NMT master.

Table 16–10 Node guarding remote frame message

COB-ID	RTR
0x700+Node_ID	1

The following table describes the response message returned by the NMT slave. The data segment is a status word consisting of one byte.

Table 16–11 Node guarding response message

COB-ID	RTR	Data
0x700 + Node-ID	0	Status word

Table 16–12 Description of response message state

Data bit	Description
bit7	Set to 0 or 1 alternatively
bit6 to bit0	4: Stopped 5: Operational 127: Pre-operation

Caution

It is recommended that the protection time 100Ch be longer than 10 ms, and the life factor be greater than or equal to 2.

- **Heartbeat**

The heartbeat mode adopts the producer-consumer model. CANopen devices can send heartbeat messages based on the cycle (ms) defined by the producer heartbeat interval object (1017h). The network bus includes a node configured with the consumer heartbeat function. Such a node monitors the producer based on the consumer time defined by object 1016h. If the node does not receive any producer heartbeat within the consumer heartbeat time, the corresponding producer is considered to be faulty.

After the producer heartbeat interval (1017h) is configured, the node heartbeat function is activated and a heartbeat message is generated. After a valid sub-index is configured for consumer heartbeat (1016h) and a heartbeat frame is received from the corresponding node, monitoring starts.

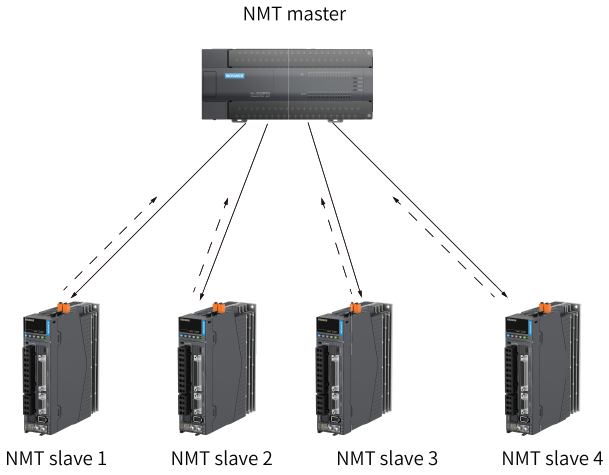


Figure 16-12 Heartbeat diagram

The master sends heartbeat messages based on the producer time. If the slave that monitors the master does not receive any heartbeat message within the time defined by the sub-index of 1016h, the master is considered to be offline. The time of the sub-index of 1016h must be longer than or equal to the master producer time multiplied by 1.5. Otherwise, a false report indicating the master is offline may occur.

The slave sends a heartbeat message at the interval defined by 1017h. If the master (or another slave) that monitors the slave does not receive the heartbeat message within the consumer time, the slave is considered to be offline. If 1017h multiplied by 1.5 is smaller than or equal to the consumer time of the master (or another slave) that monitors the slave, a false report indicating the slave is disconnected may be reported.

The following table describes the format of a heartbeat message. The data segment contains only one byte. The most significant bit is permanently set to 0 and other bits are consistent with the response message status of node guarding, as shown in the following table.

Table 16–13 Heartbeat message

COB-ID	RTR	Data
0x700 + Node-ID	0	Status word

The SV680P-INT servo drive is both a heartbeat producer and a heartbeat consumer. It can serve as the heartbeat consumer of up to five different nodes. It is recommended that the heartbeat

producer time be set to a value not lower than 20 ms and the consumer heartbeat time be set to a value not lower than 40 ms (Consumer heartbeat time > 1.5 x Producer heartbeat time).

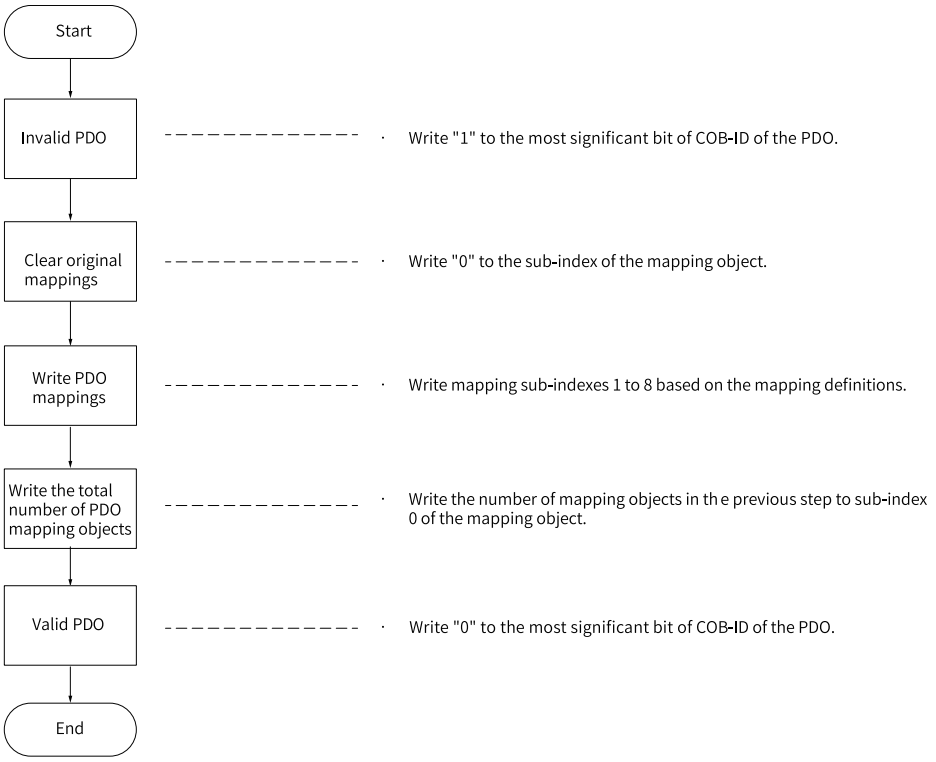
16.2.4.2 Service data object (SDO)

The SDO is associated with the object dictionary through object index and sub-index. Based on the SDO can read the object content in the object dictionary or modify the object data if allowed.

16.2.4.3 Process Data Object (PDO)

The PDO is used to transmit real-time data, which is the major data transmission mode in CANopen. PDO transmission features high speed as no response is required and the PDO may consist of fewer than eight bytes.

The following figure shows the PDO mapping configuration process.



PDO transmission framework

PDO transmission complies with the producer- consumer model. In the CAN bus network, the TPDO generated by a producer may be received by one or multiple consumer RPDOs in the network based on the COB-ID. The transmission model is shown in the following figure.

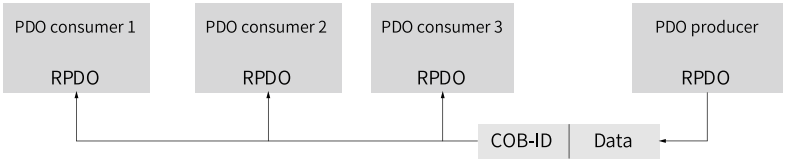


Figure 16-13 PDO transmission model

CANopen communication in SV680P-INT series servo drives only supports point-to-point PDO transmission.

PDOs

PDOs can be divided into RPDOs and TPDOs. The final PDO transmission mode and content are determined by communication parameters and mapping parameters. The SV680P-INT series servo drive uses four RPDOs and four TPDOs to transmit the PDO. The following table lists the related objects.

Table 16–14 PDOs of SV680P-INT servo drives

Name		COB-ID	Communication object	Mapping object
RPDO	1	200h+Node_ID	1400h	1600h
	2	300h+Node_ID	1401h	1601h
	3	400h+Node_ID	1402h	1602h
	4	500h+Node_ID	1403h	1603h
TPDO	1	180h+Node_ID	1800h	1A00h
	2	280h+Node_ID	1801h	1A01h
	3	380h+Node_ID	1802h	1A02h
	4	480h+Node_ID	1803h	1A03h

PDO communication parameters

- **CAN identifiers of PDOs**

  The CAN identifier of a PDO, namely COB-ID of a PDO, includes a control bit and identifier data. It determines the bus priority of the PDO.

  The COB-ID is indicated in sub-index 01 of communication parameters (RPDO: 1400h to 1403h; TPDO: 1800h to 1803h). Its most significant bit decides whether the PDO is valid.

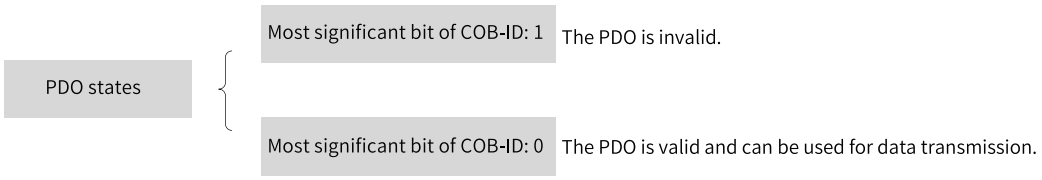


Figure 16-14 Description of PDO states

The SV680P-INT servo drive only supports point-to-point PDO transmission. Therefore, the less significant seven bits of the COB-ID must be the station address of the node.

Example:

For the node whose station No. is 4, when TPDO3 is invalid, its COB-ID is 80000384h. When 384h is written to the COB-ID, it indicates that the PDO is activated.

- **PDO transmission types**

  The PDO transmission type is indicated in sub-index 02h of communication parameters (RPDO: 1400h to 1403h, TPDO: 1800h to 1803h). It determines the mode in which the PDO is transmitted.

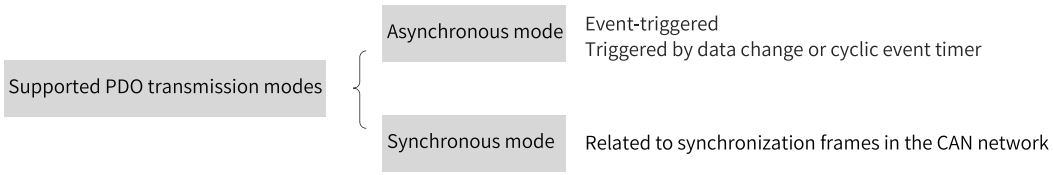


Figure 16-15 Supported PDO transmission modes

Different values of sub-index 02 of communication parameters (RPDO: 1400h to 1403h, TPDO: 1800h to 1803h) stand for different transmission types. This sub-index defines the method of triggering TPDO transmission or processing received RPDOs. The following table lists the specific relationships.

Table 16–15 Methods of triggering TPDOs and RPDOs

Value of Communication Type	Synchronous		Asynchronous
	Cycle	Acyclic	
0	-	√	-
1 to 240	√	-	-
241 to 253	-		
254, 255	-	-	√

- In TPDO transmission type 0, the TPDO is transmitted when the mapping data changes and a synchronization frame is received.
- In TPDO transmission types 1 to 240, the TPDO is transmitted when a specified number of synchronization frames are received.
- In TPDO transmission type 254 or 255, the TPDO is transmitted when the mapping data changes or when the event timer expires.
- In RPDO transmission types 0 to 240, the latest data of the RPDO is updated to the application once a synchronization frame is received. In RPDO transmission type 254 or 255, the received data is directly updated to the application.

- **Inhibit time**

  The inhibit time is set for TPDOs and is saved to sub-index 03h of communication parameters (1800h to 1803h) to prevent the CAN network from being continuously occupied by PDOs with lower priorities. After the parameter (unit: 100 us) is set, the transmission interval of one TPDO must be longer than or equal to the time corresponding to this parameter.

  Example: If the inhibit time of TPDO2 is 300 × 100 μs, the transmission interval of TPDOs must not be shorter than 30 ms.

- **Event timer**

  For TPDO transmitted in asynchronous mode (transmission types 254 or 255), the event timer is defined in sub-index 05 of communication parameters (1800h–1803h). The event timer can be considered as a trigger event. It also triggers corresponding TPDO transmission. If another event, for example, data change, occurs in the operation cycle of the event timer, the TPDO is triggered, and the event timer is reset immediately.

PDO mapping parameters

PDO mapping parameters include the indicators of process data for PDOs, including indexes, sub-indexes, and the mapping object length. The length of each PDO data can be up to eight bytes and

one or multiple objects can be mapped. Sub-index 00 records the number of objects mapped by the PDO and sub-indexes 01 to 08 are the mapping content.

The following description takes 1600h as an example.

Table 16–16 Description of PDO mapping relation

Index	Sub-index	Description
1600h	00	Number of mapping objects
	01	Content of mapping parameter
	...	
	08	

Table 16–17 Definition of PDO mapping parameters

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.

Table 16–18 Relation between object length and object bit length

Object length	Bit length
08h	8-bit
10h	16-bit
20h	32-bit

Example: The mapping parameter of the 16-bit command word 6040.00h is 60400010h.

The following example describes the PDO mapping relation.

Example:

RPDO1 maps the following three parameters.

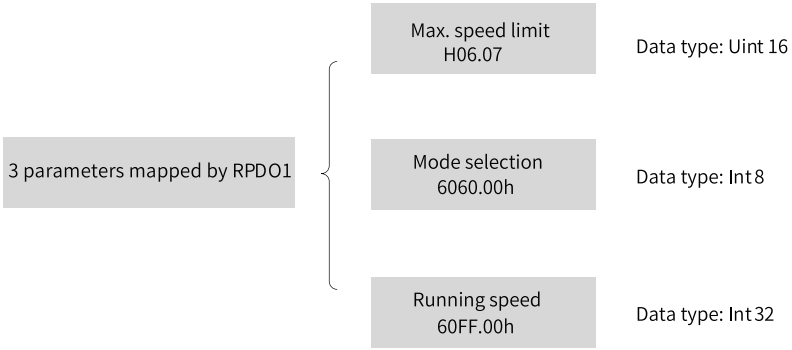


Figure 16-16 Example of PDO1 mapping relation

Then, the mapping length is seven bytes (2+1+4), namely there are seven bytes in the data segment of RPDO1 during transmission. The mapping relation is shown in the following figure.

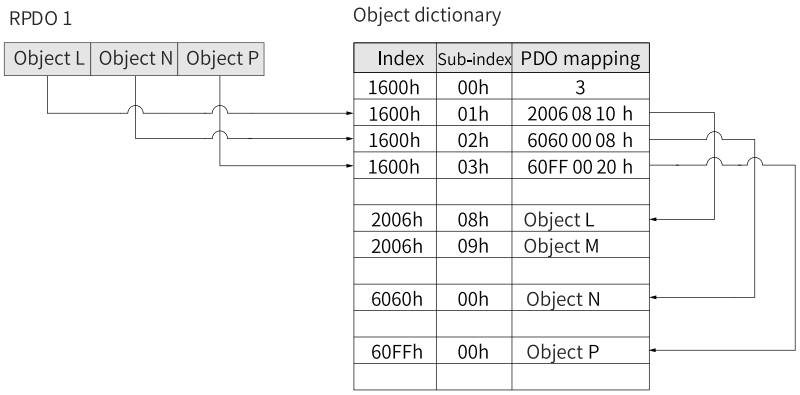


Figure 16-17 Example of RPDO mapping relation

The mapping mode of TPDO is the same as that of RPDO, but in the opposite direction. The RPDO decodes the input based on the mappings. The TPDO encodes the output based on the mappings.

Example:

TPDO2 maps the following two parameters.

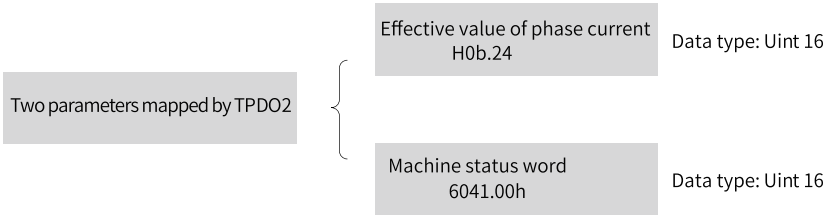


Figure 16-18 Example of TPDO2 mappings

Then, the mapping length is four bytes (2+2), namely there are four bytes in the data segment of TPDO2 during transmission. The mapping relation is shown in the following figure.

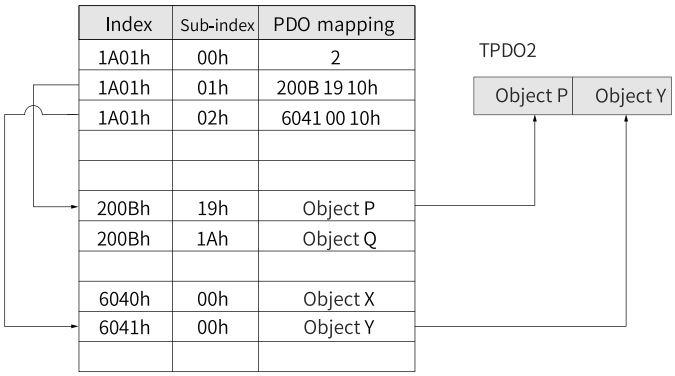


Figure 16-19 Example of TPDO mapping relation

16.2.4.4 Synchronization (SYNC) Object

The SYNC object is a special mechanism that controls harmony and synchronization between transmission and reception of multiple nodes. It is used for synchronous transmission of the PDO.

The following figure shows the process of configuring the SYNC generator.

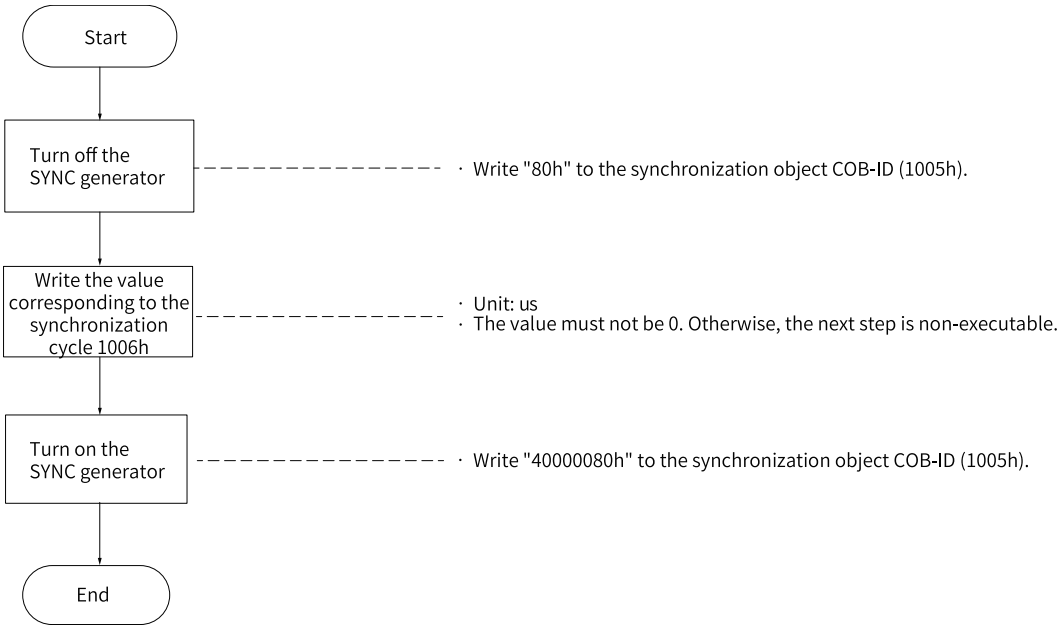


Figure 16-20 SYNC generator configuration process

Note

The SV680P-INT servo drive does not support the synchronization generator whose cycle is shorter than 500 μs. It is recommended that the cycle 1 ms is not used.

SYNC generator

The SV680P-INT servo drive is both a synchronization consumer and a synchronization producer. The objects related to synchronization are synchronization object COB-ID (1005h) and synchronization cycle (1006h).

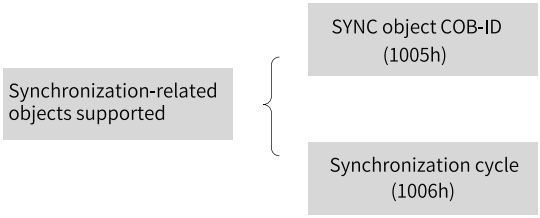


Figure 16-21 Description of synchronization-related objects supported

The second most significant bit of the synchronization object COB-ID determines whether to activate the SYNC generator.

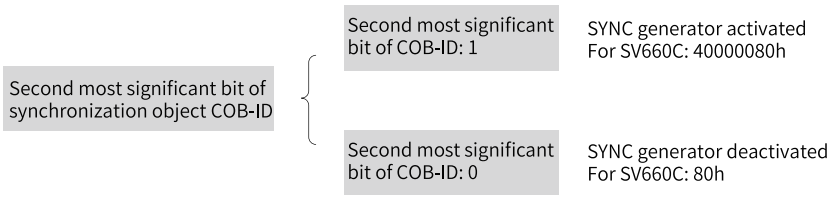


Figure 16-22 Activating the SYNC generator

The SYNC cycle (unit: μs) is used for the SYNC generator only. It indicates the interval at which a node generates synchronization objects.

SYNC object transmission framework

Similar to PDO transmission, SYNC objects are transmitted based on the producer-consumer model. The SYNC producer sends a SYNC frame, and other nodes in the CAN network receive the frame as consumers, without providing any feedback. Only one SYNC generator can be activated in one CAN network. The following figure shows the framework of SYNC object transmission.

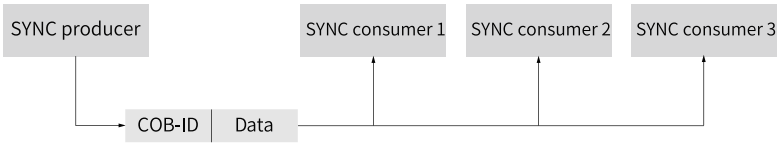


Figure 16-23 Synchronization transmission framework

Transmission of synchronization PDOs is closely related to synchronization frames.

- For a synchronization RPDO, the received PDO, once received, will be updated to the application in the next synchronization.
- A synchronization TPDO can be transmitted in the cyclic/acyclic synchronization mode.

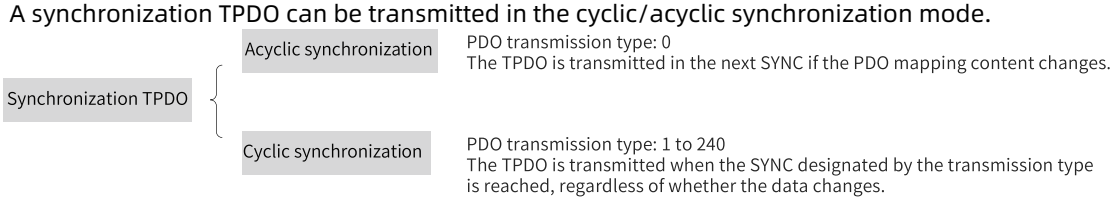


Figure 16-24 Description of synchronization TPDO

The following figure shows the synchronous transmission model.

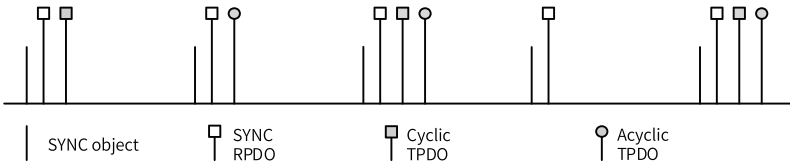


Figure 16-25 Synchronous transmission model

Example:

The transmission type of RPDO1 is 0; the transmission type of RPDO2 is 5; the transmission type of TPDO1 is 0; the transmission type of TPDO2 is 20. Once RPDO1 and RPDO2 receive a PDO, the latest PDO data will be updated to the corresponding application in the next synchronization. In contrast, TPDO1 will be sent in the next synchronization only if the mapping data of TPDO1 changes. PDOs will be sent after TPDO2 experiences 20 SYNCs, regardless of whether the data changes.

16.2.4.5 Emergency (EMCY) Object Service

When an error occurs on a CANopen node, the node sends an EMCY message according to the standard mechanism. The EMCY message complies with the producer-consumer model. After the node fault is sent, other nodes in the CAN network may handle the fault. The SV680P-INT series servo drive only serves as the emergency message producer, which means it does not process emergency messages of other nodes.

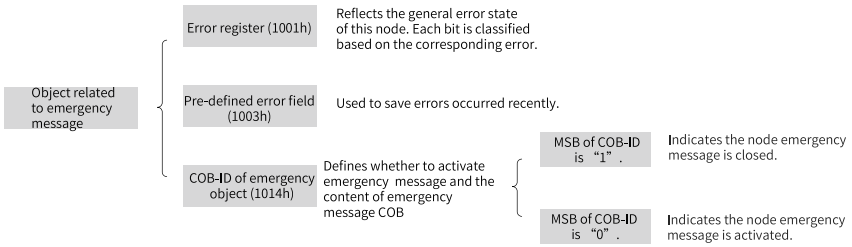


Figure 16-26 Description of objects related to EMCY messages

When a fault occurs on the node, the error register and the pre-defined error field must be updated regardless of whether the EMCY object is activated. The content of the EMCY message follows the following specifications.

Table 16–19 Specifications of the content of an EMCY message

COB-ID	0	1	2	3	4	5	6	7
80h+Node_ID	Error code		Error register	Reserve	Auxiliary byte			

- The error register is always consistent with 1001h.
- When a communication error occurs, the error code is consistent with DS301 requirements and the auxiliary byte is 0.
- When an error specified by the user occurs on the servo drive, the error code is 0xFF00 and the auxiliary byte shows the error code specified by the user.

16.2.4.6 SDO Transmission Message

The SDO can be transmitted using data with no more than four bytes or data with more than four bytes. For the former, the expedited SDO transmission mode is adopted. For the latter, the segmented or block transmission mode is adopted.

The SV680P-INT servo drive supports only accelerated SDO transmission and segmented transmission.

An SDO transmission message consists of a COB-ID and a data segment. As shown in the following table, the COB-ID of T_SDO is different from that of R_SDO.

The data segment adopts the little endian mode (low bits before high bits). Every data segment of an SDO message must consist of eight bytes. The following table describes the format of SDO transmission messages.

Table 16–20 Format of an SDO transmission message

COB-ID	Data (Data segment)							
580h+Node_ID	0	1	2	3	4	5	6	7
600h+Node_ID	Command code	Index		Sub-index	Data			

The command code specifies the transmission type and transmission data length of the SDO. The index and sub-index indicate the position of the object in the list. The data indicates the value of the object.

Write message in expedited SDO mode

Expedited SDO transmission is used for reading/writing object data with no more than four bytes. The transmission message varies the read/write mode and data length. The following table describes the write message in the expedited SDO mode.

Table 16–21 Write message in expedited SDO mode

<table>
<tr><th colspan="2"></th><th>COB-ID</th><th>0</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th></tr>
<tr><td colspan="2" rowspan="4">Client→</td><td rowspan="4">600h+Node_ID</td><td>23h</td><td colspan="2" rowspan="4">Index</td><td rowspan="4">Sub-index</td><td colspan="4">Data</td></tr>
<tr><td>27h</td><td colspan="3">Data</td><td>-</td></tr>
<tr><td>2bh</td><td colspan="2">Data</td><td>-</td><td>-</td></tr>
<tr><td>2fh</td><td>Data</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td rowspan="2">←Server</td><td>Normal</td><td rowspan="2">580h+Node_ID</td><td>60h</td><td colspan="2" rowspan="2">Index</td><td rowspan="2">Sub-index</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Exception</td><td>80h</td><td colspan="4">Abort code</td></tr>
</table>

Note

"-" indicates data exists but is not considered. It is recommended that 0 is written.

Example:

Assume that the slave station No. is 4. To use the SDO mode to write a value 1000 (namely 0x3E8) to parameter 60FF.00h (target velocity in the speed control mode), the master sends a message as shown in the following table.

Table 16–22 Example of a message sent by the master

COB-ID	0	1	2	3	4	5	6	7
604	23	FF	60	00	E8	03	00	00

If the write operation succeeds, the servo drive returns the following message.

Table 16–23 Example of a message returned by the servo drive upon successful write operation

COB-ID	0	1	2	3	4	5	6	7
584	60	FF	60	00	00	00	00	00

If the type of the data written does not match, the fault code 0x06070010 is returned. The message is as follows.

Table 16–24 Example of a message returned upon mismatch of the written data type

COB-ID	0	1	2	3	4	5	6	7
584	80	FF	60	00	10	00	07	06

Read message in expedited SDO mode

The expedited mode is used for reading object data with no more than four bytes. The following table describes the read message in expedited SDO mode.

Table 16–25 Structure of the start message in SDO transmission

		COB-ID	0	1	2	3	4	5	6	7
Client→		600h+Node_ID	40h	Index		Sub-index	-	-	-	-
←Server	Normal	580h+Node_ID	41h	Index		Sub-index	Data length			
	Exception		80h				Abort code			

During transmission, the trigger bit (bit6) of the command code sends 0 or 1 alternatively. This rule must be maintained so that the slave can respond to the message. The message structure during transmission is shown in the following table.

Table 16–26 Structure of a message during SDO transmission

		COB-ID	0	1	2	3	4	5	6	7
Client→		600h+Node_ID	60h	-	-	-	-	-	-	-
←Server	Normal	580h+Node_ID	00h	Data length						
	Exception		80h	Index		Sub-index	Abort code			
Client→		600h+Node_ID	70h	-	-	-	-	-	-	-
←Server	Normal	580h+Node_ID	10h	Data length						
	Exception		80h	Index		Sub-index	Abort code			

The response packet for the end frame transmitted in the segmented mode includes the identifier and valid data length of the end frame. The transmission message structure is shown in the following table.

Table 16–27 Structure of the end frame in SDO segmented transmission

		COB-ID	0	1	2	3	4	5	6	7
Client→		600h+Node_ID	60h/70h	Index		Sub-index	-	-	-	-
←Server	Normal	580h+Node_ID	01h/11h	Data						
			03h/13h	Data						-
			05h/15h	Data					-	-
			07h/17h	Data				-	-	-
			09h/19h	Data			-	-	-	-
			0Bh/1Bh	Data		-	-	-	-	-
			0Dh/1Dh	Data	-	-	-	-	-	-
	Exception		80h	Index		Sub-index	Abort code			

16.2.4.7 SDO Transmission Framework

SDO transmission complies with the client-server mode, that is, one initiates a request and the other responds to the request. The SDO client in the CAN bus network initiates a request and the SDO server responds to the request. Therefore, data exchange between SDOs requires at least two CAN messages with different CAN identifiers. The SDO transmission model is shown in the following figure.

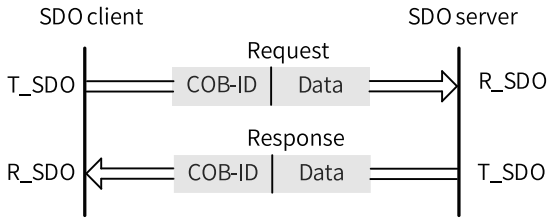


Figure 16-27 Object word in the SDO server read/written by the SDO client

16.2.5 Communication Parameters

To connect the SV680P-INT series servo drive to the CANopen fieldbus network, set related parameters of the servo drive properly.

CANopen parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode	Page
H02.00	2002-01h	Control mode selection	0: Speed control mode 1: Position control mode 2: Torque control mode 3: Torque/Speed control mode 4: Speed/Position control mode 5: Torque/Position control mode 6: Torque/Speed/Position compound mode 7: Process segment 8: CANopen mode	1	-	At stop	"H02_en.00" on page 739
H0E.00	200E-01h	Node address	1 to 127	1	-	At stop	"H0E_en.00" on page 895
H0E.01	200E-02h	Save data 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	1	-	Real time	"H0E_en.01" on page 896
H0E.10	200E-0Bh	CAN selection	0: Pulse/Axis control command 1: Enhanced axis control command 2: CANopen	0	-	At stop	"H0E_en.10" on page 897
H0E.11	200E-0Ch	CAN baud rate	0: 20 kbps 1: 50 kbps 2: 100 kbps 3: 125 kbps 4: 250 kbps 5: 500 kbps 6: 1 Mbps 7: 1 Mbps - non-standard	5	-	At stop	"H0E_en.11" on page 898

16.3 Communication Configuration Examples

16.3.1 CANopen Communication Configuration Examples

16.3.1.1 Connecting SV680P-INT to Schneider 3S Master

The following takes the position mode as an example. For details about the position mode, see “ *Position control mode” on page 382*.

In position control mode, objects used as PDOs are allocated as follows.

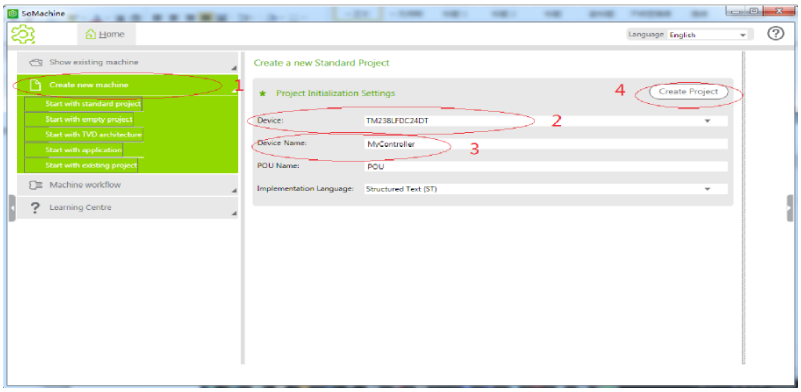
Table 16–28 PDO mapping allocation

PDO	Object	Definition	Bit length
RPDO1	6040.00h	Control word	Uint16
	6060.00h	Mode selection	Int8
RPDO2	6081.00h	Profile velocity	Uint32
	607A.00h	Target position	Int32
TPDO1	6041.00h	Status word	Uint16
	6061.00h	Operation mode display	Int8
TPDO2	606C.00h	Speed feedback	Int32
	6064.00h	Position feedback	Int32
TPDO3	H0b.26	Phase current feedback	Uint16

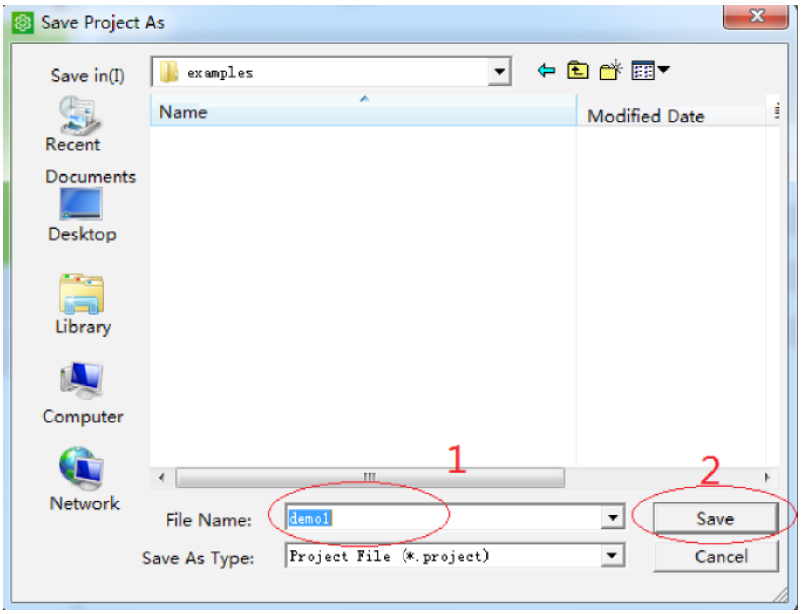
SDOs are used to write 6083h (acceleration), 6084h (deceleration), and 605Ah (emergency stop).

SoMachine is Schneider 3S series master node background software. This section describes how to connect the SV680P-INT servo drive to the Schneider M238 master node.

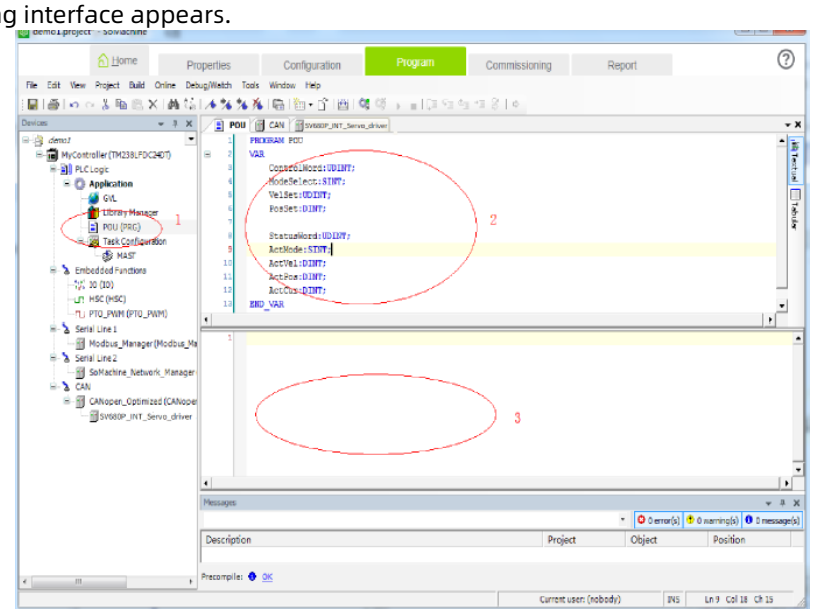
1. Start SoMachine and click "Create new machine" based on a standard project. Select a master device, for example, TM238LFDC24DT, modify the device name, and click "Create Project", as shown below.



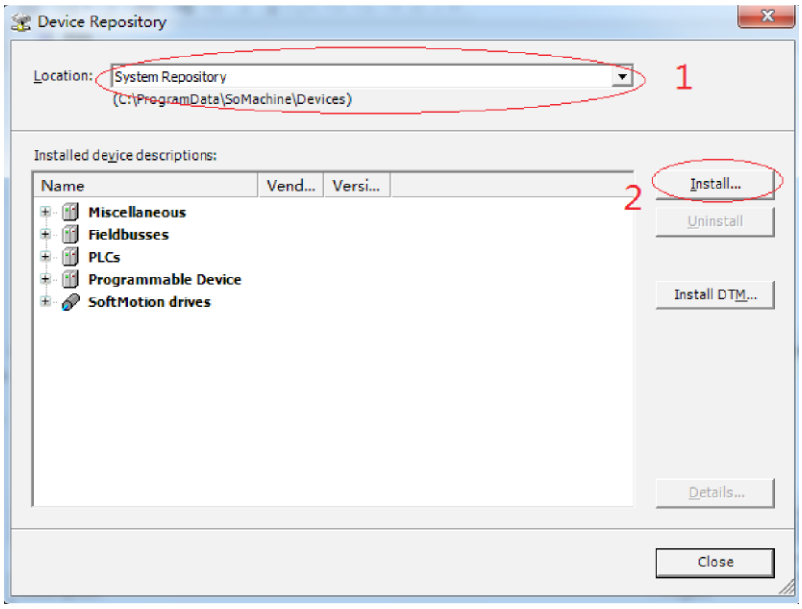
2. In the "Save Project As" dialog box, enter a file name and click "Save".



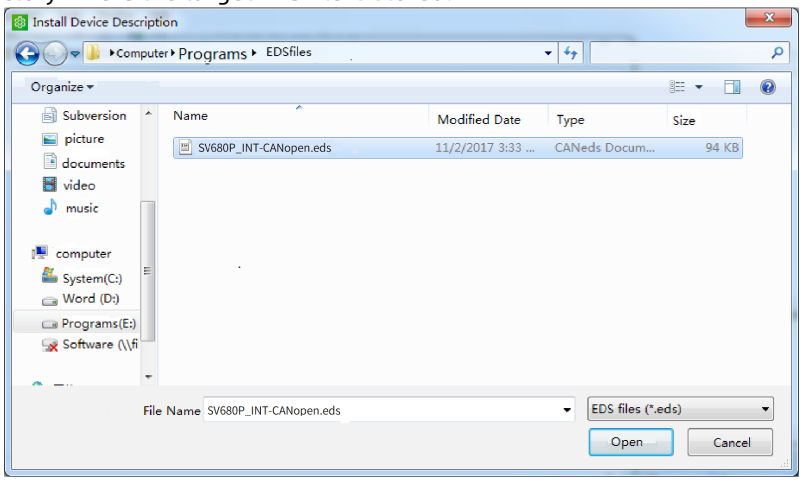
3. The following interface appears.



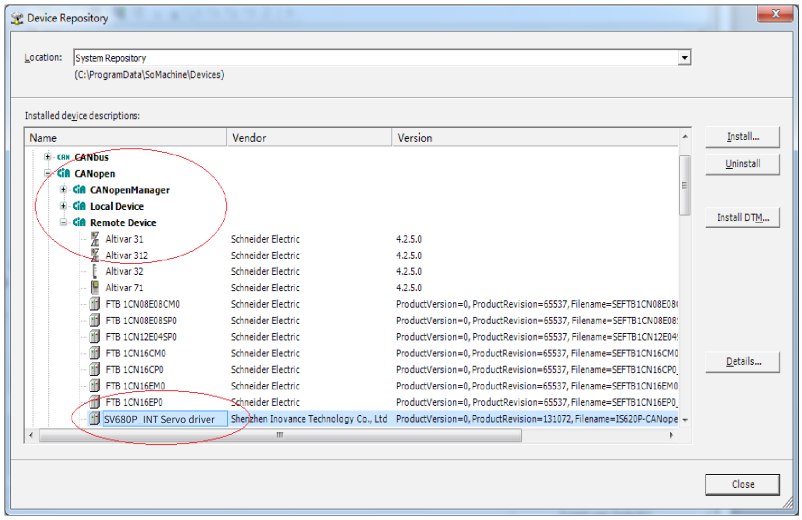
4. In the toolbar, choose "Tools" > "Device Repository" to open the "Device Repository" dialog box. If the target EDS file has been imported, skip steps 4 to 6.



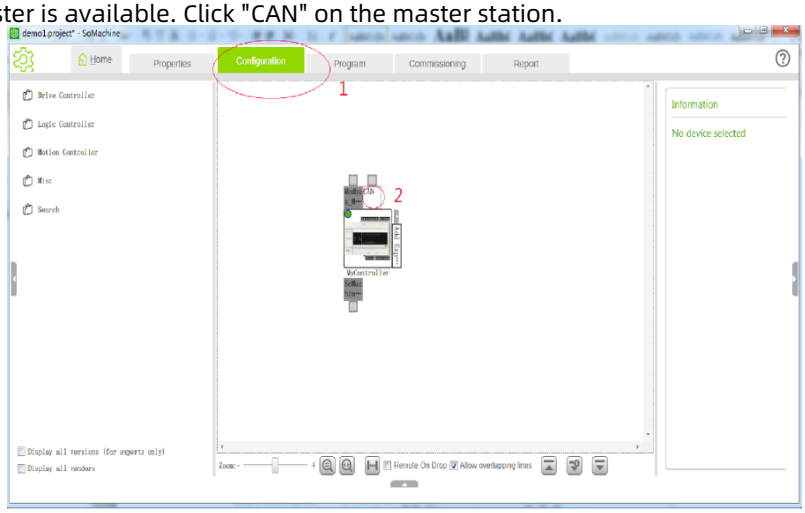
5. In the "Location" field, select "System Repository" and click "Install". In the window displayed, select the directory where the target EDS file is stored.



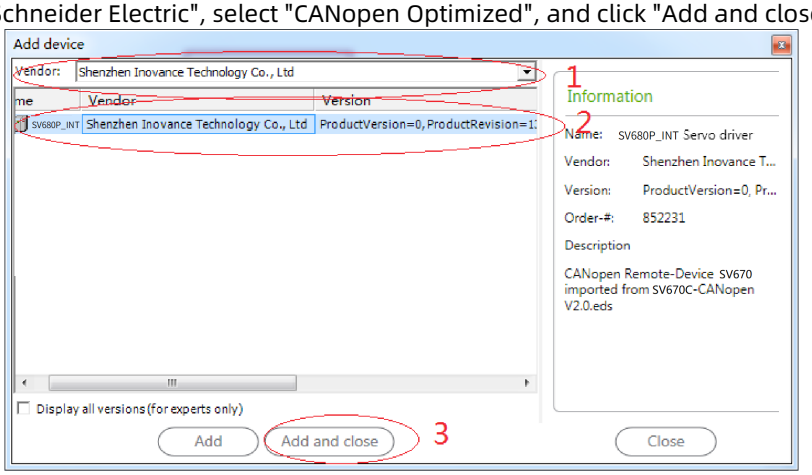
6. Click "Open" and the EDS file of the SV680P-INT servo drive is imported to SoMachine. In the "Device Repository" dialog box, you can choose "Fieldbusses" > "CANopen" > "Remote Device" to view devices.



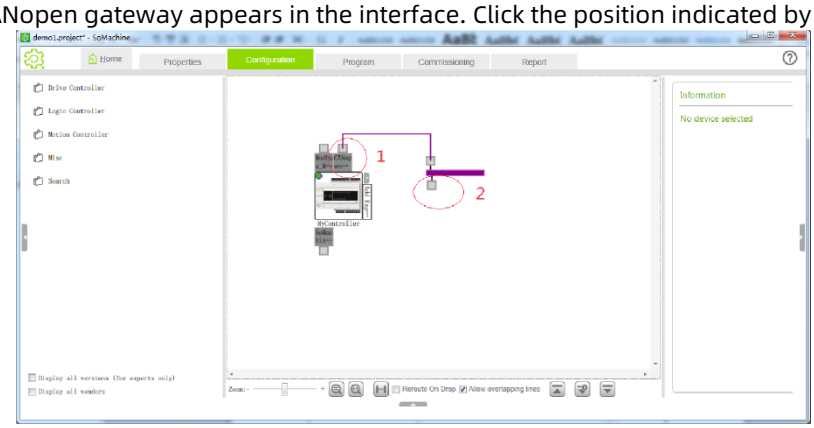
7. Close the "Device Repository" dialog box. Click "Configuration". In the interface displayed, only the M238 master is available. Click "CAN" on the master station.



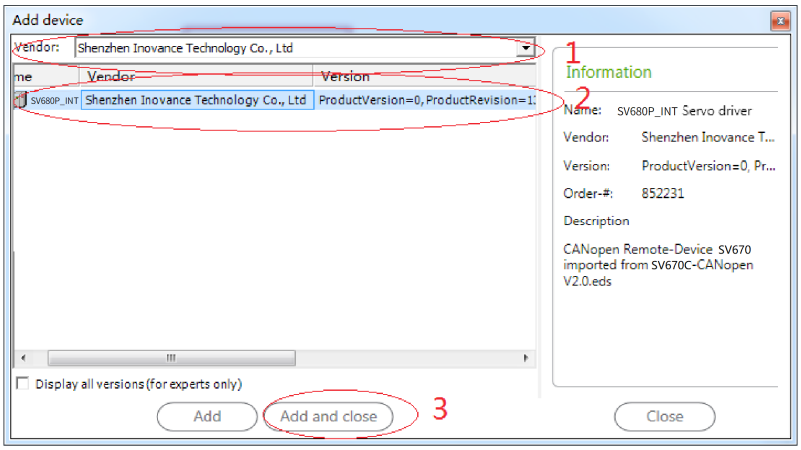
8. The "Add device" dialog box is displayed. Add a CANopen gateway. For this purpose, set "Vendor" to "Schneider Electric", select "CANopen Optimized", and click "Add and close".



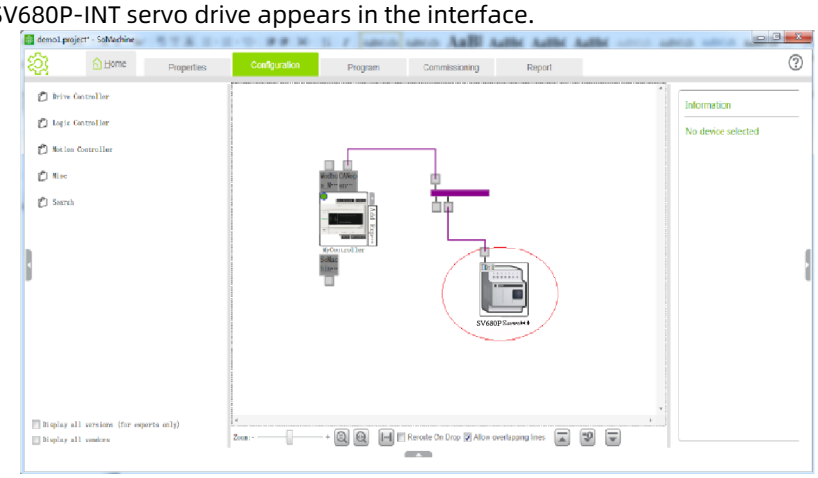
9. Now, the CANopen gateway appears in the interface. Click the position indicated by mark 2.



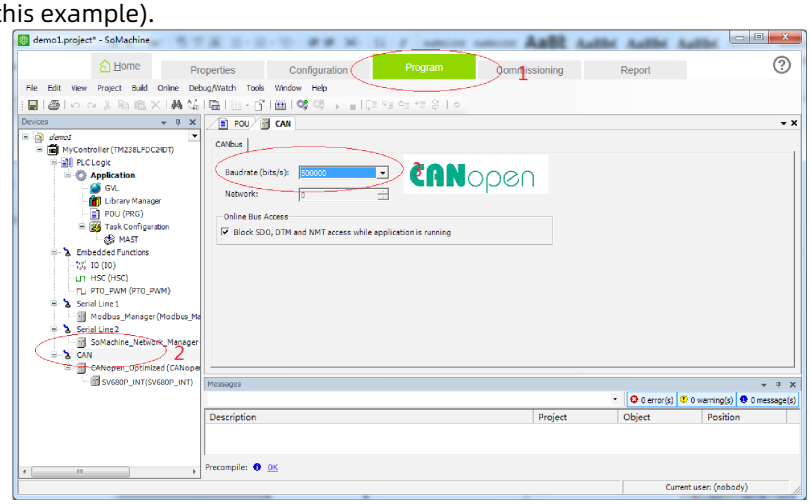
10. The "Add device" dialog box appears again. Select Inovance as the vendor and SV680 as the device, and then click "Add and close".



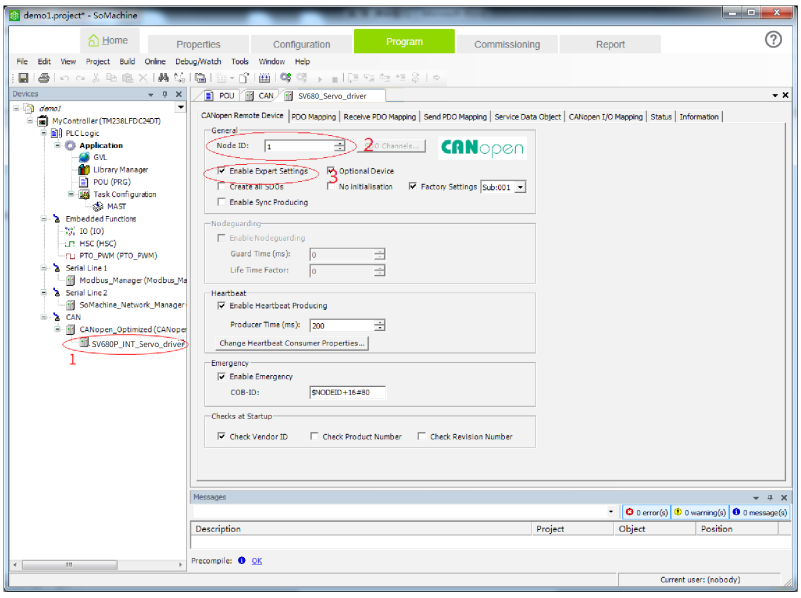
11. Now, the SV680P-INT servo drive appears in the interface.



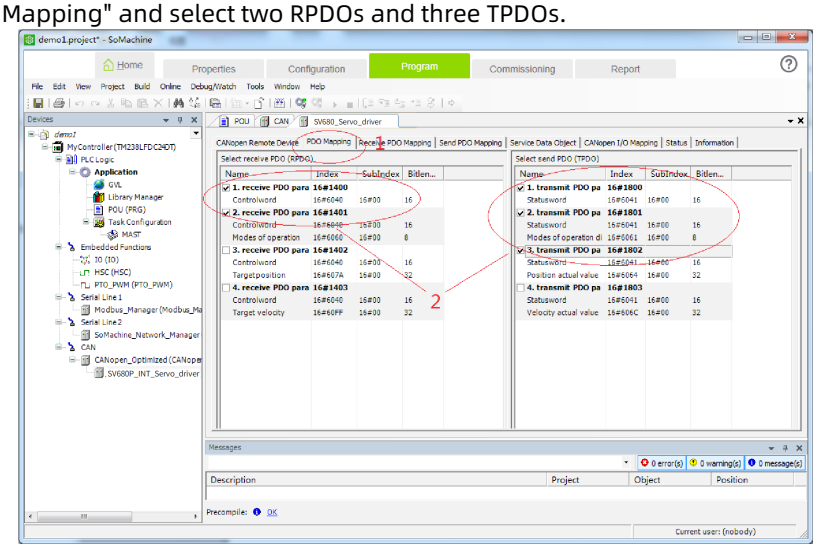
12. Click "Program". Double-click "CAN" on the left, and set the baud rate to an appropriate value (500 kbps in this example).



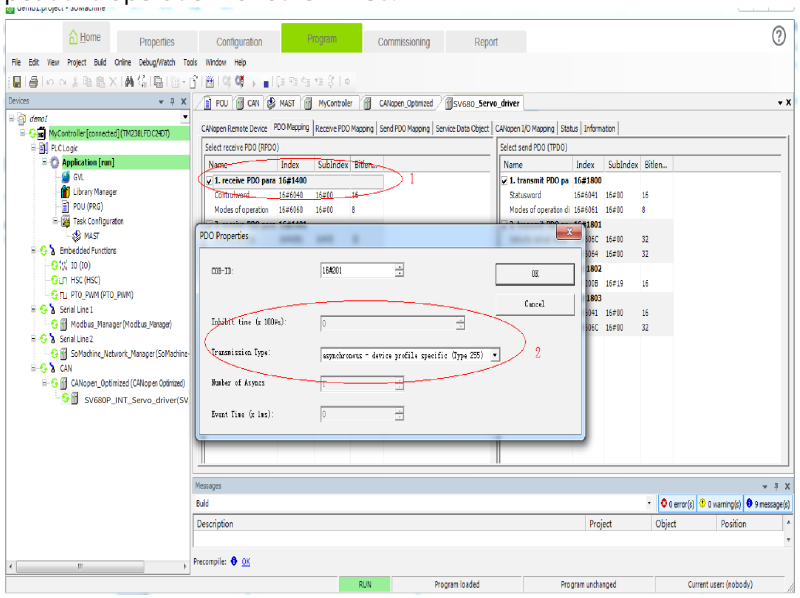
13. Double-click "SV680P_INT_Servo_Driver" on the left. The node ID can be modified. Select "Enable Expert Settings".



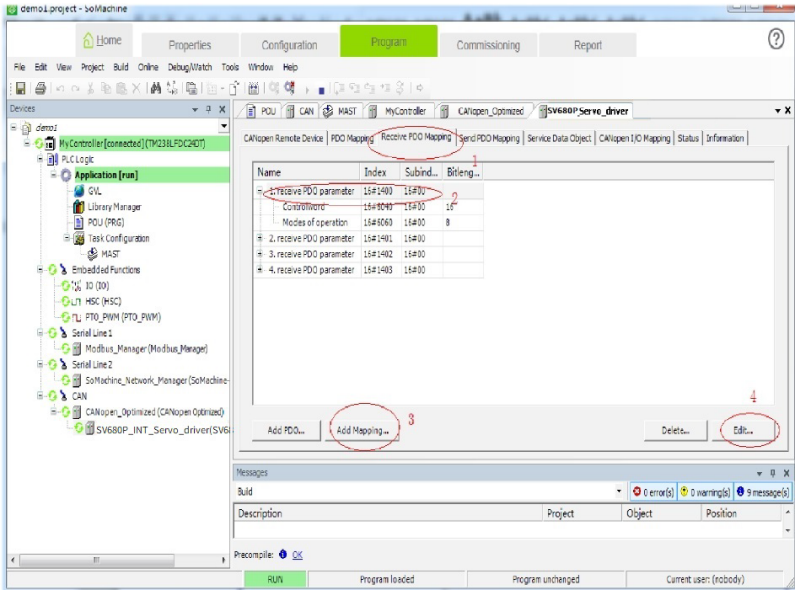
14. Click "PDO Mapping" and select two RPDOs and three TPDOs.



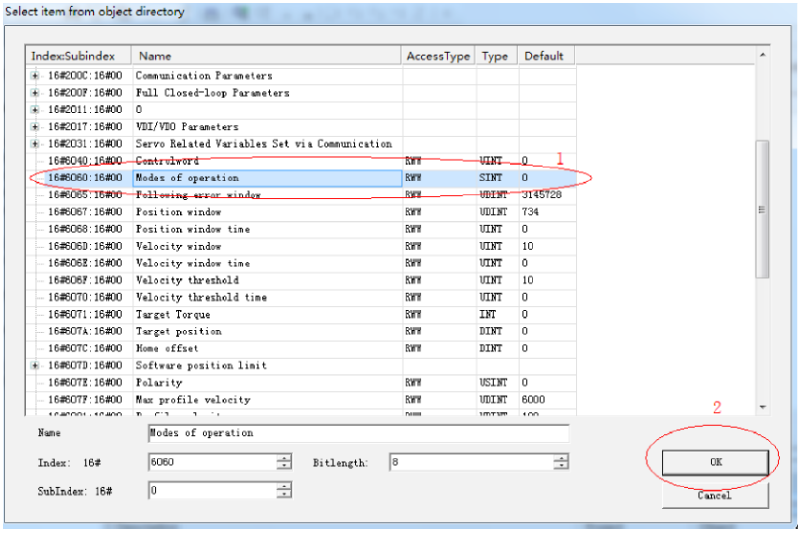
15. Double-click "RPDO1" to open the "PDO Properties" dialog box and set "Transmission Type" to "Type 255". Repeat this operation for other PDOs.



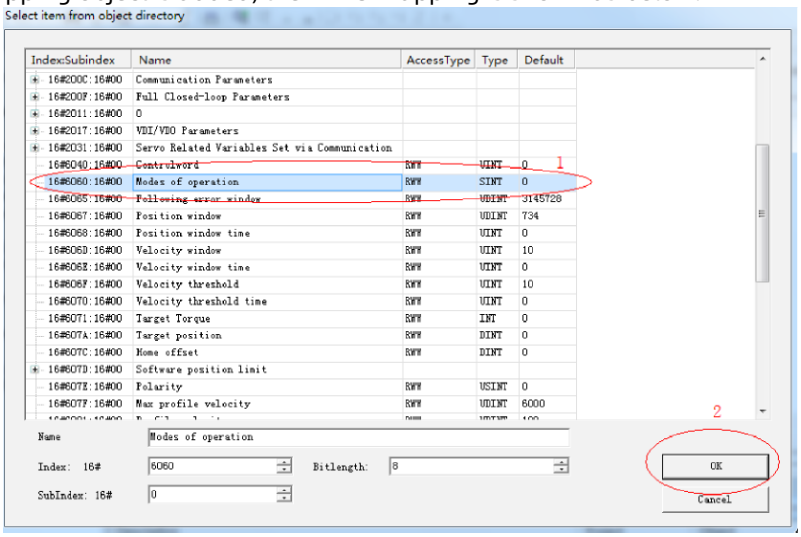
16. Select "Receive PDO Mapping", click "receive PDO parameter", and click "Add Mapping" or select a mapping and click "Edit".



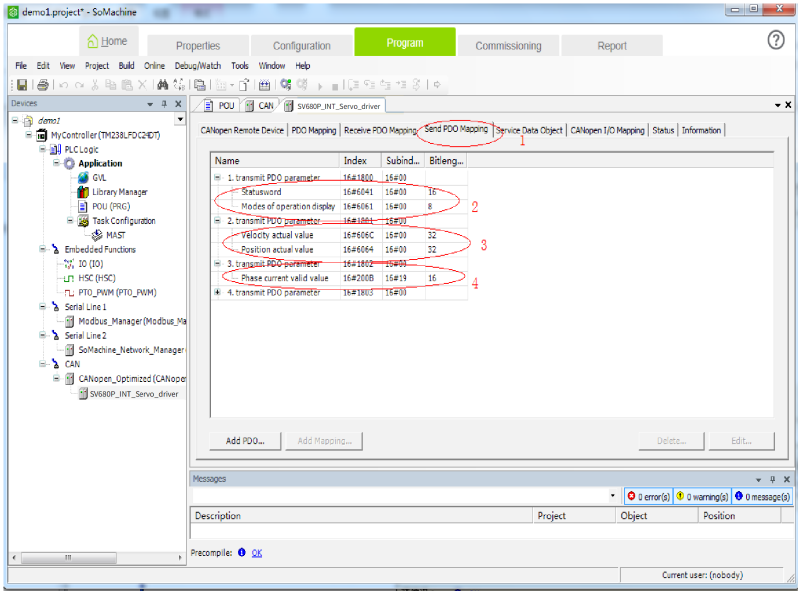
17. In the dialog box displayed, select a proper mapping object according to *"Table 16-28" on page 686*.



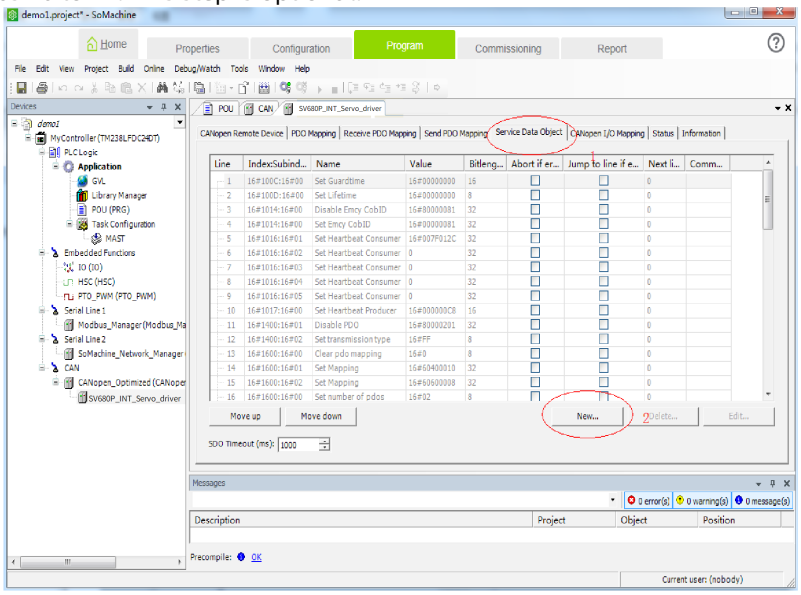
18. After the mapping object is added, the RPDO mapping is shown as below.



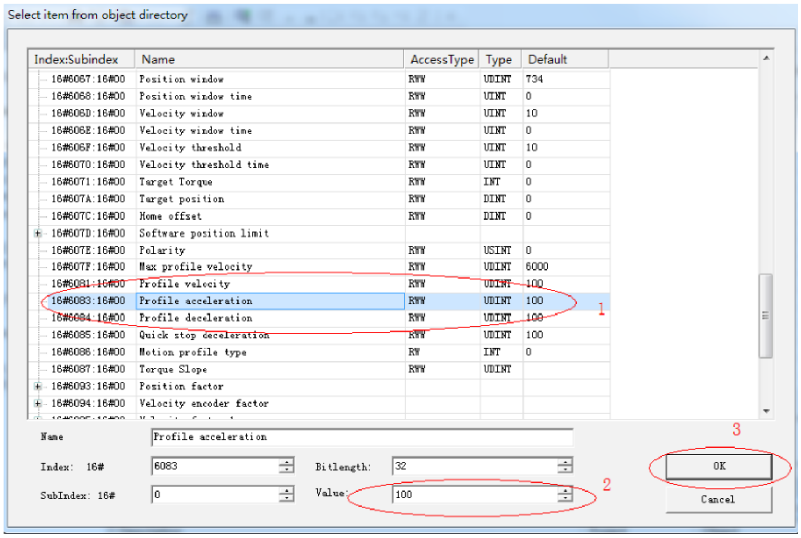
19. Similarly, select "Send PDO Mapping" and configure PDOs according to *"Table 16-28" on page 686*, as shown below.



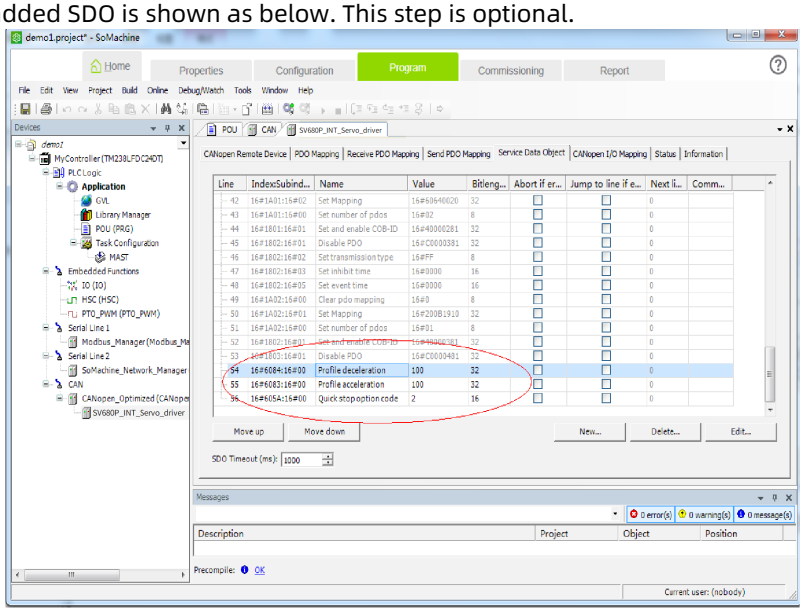
20. Click "Service Data Object", and then click "New" to add the SDO needed. If default values are used, skip steps 20 to 22. This step is optional.



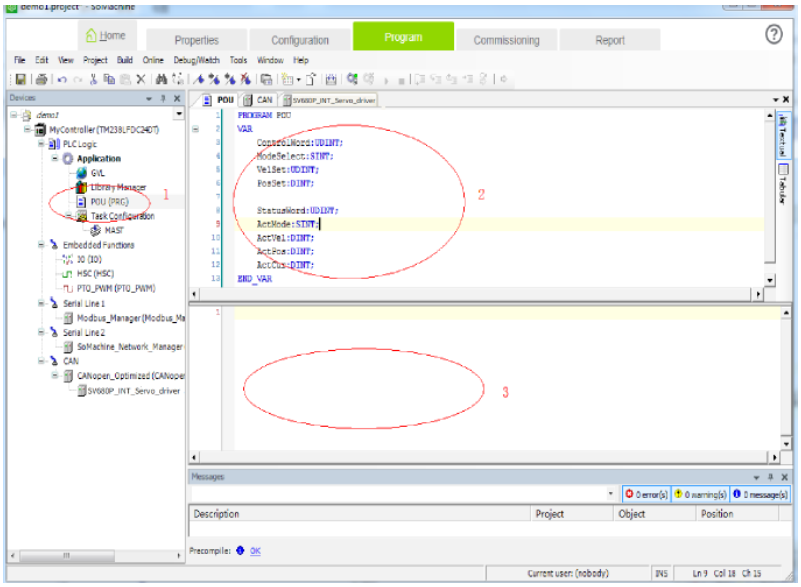
21. In the list displayed, select the target SDO, modify the value as needed, and click "OK". This step is optional.



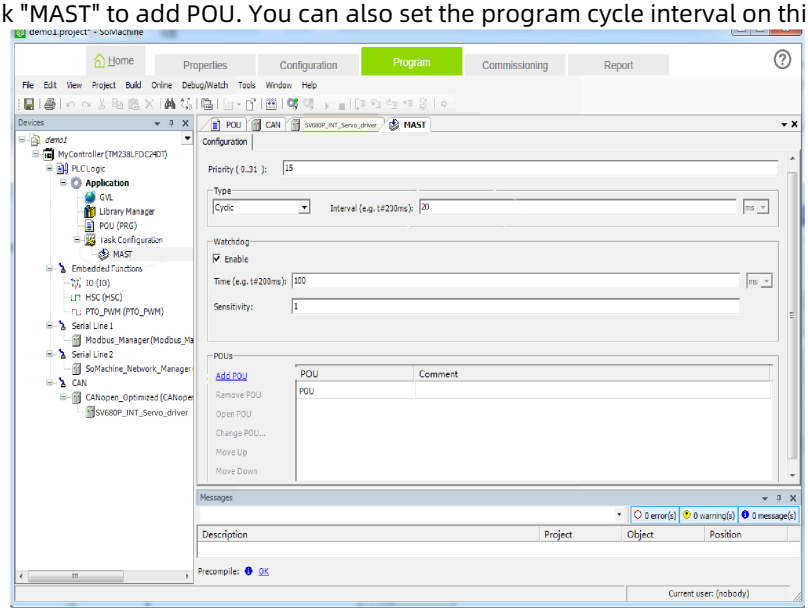
22. The newly added SDO is shown as below. This step is optional.



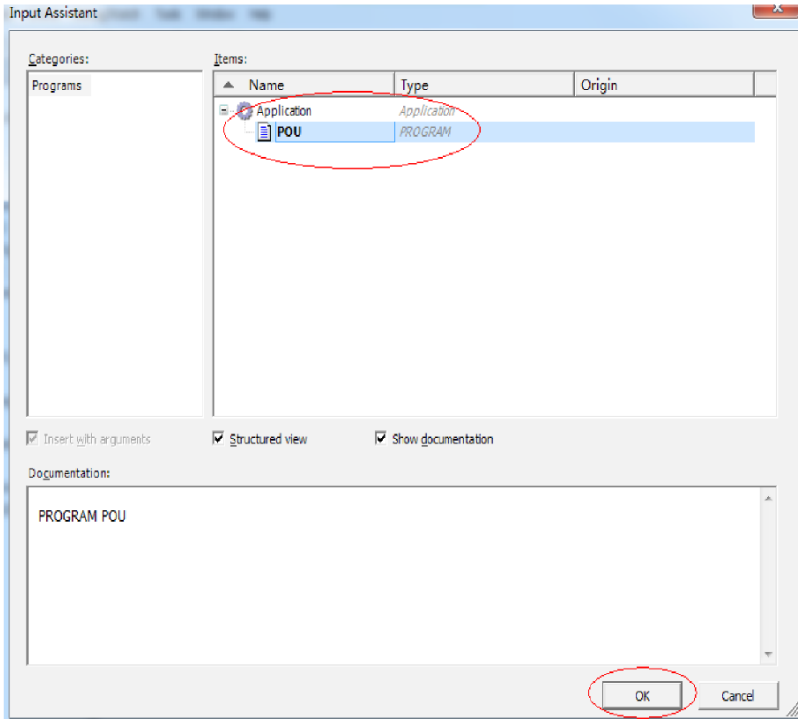
23. Double-click "POU" on the left. You can add variable definitions in the section indicated by mark 2 and add PLC program logic in the section indicated by mark 3. Then, click "Edit" or press F11. If no error occurs, proceed with the next step.



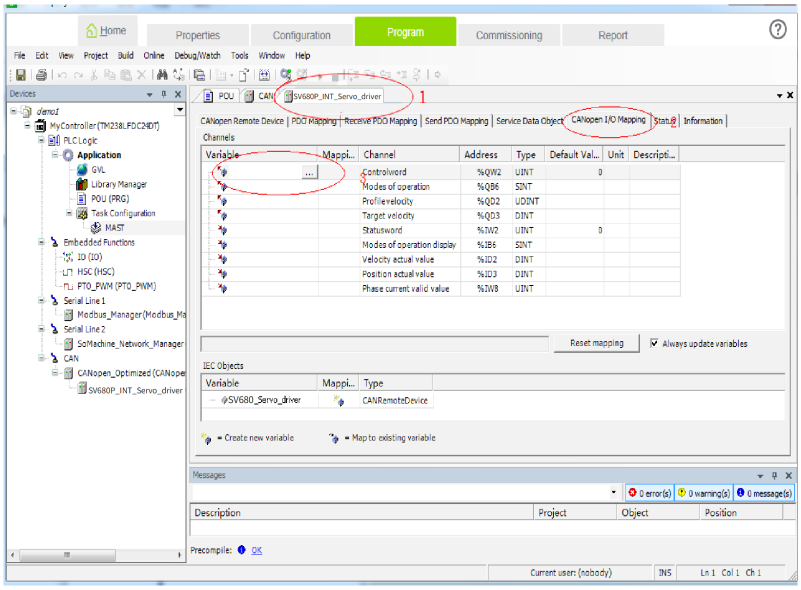
24. Double-click "MAST" to add POU. You can also set the program cycle interval on this page.



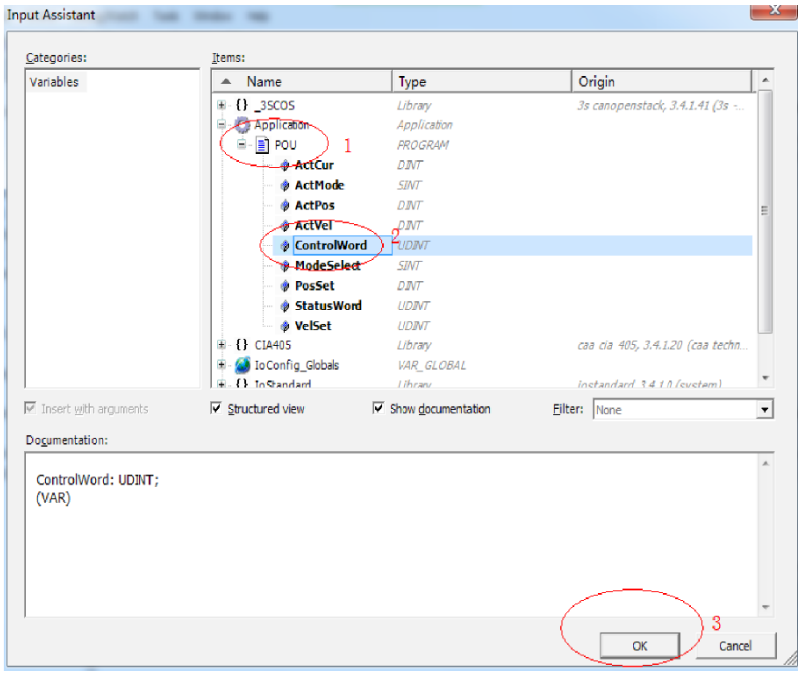
25. Select the POU to be added and click "OK".



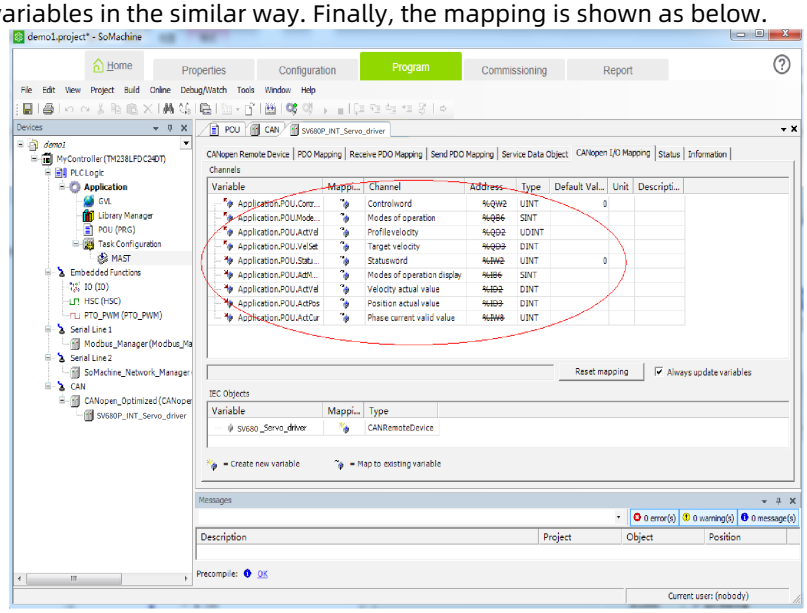
26. Choose "SV680P_IN..." > "CANopen I/O Mapping". Double-click the target variable to show the "..." button, and then click the "..." button.



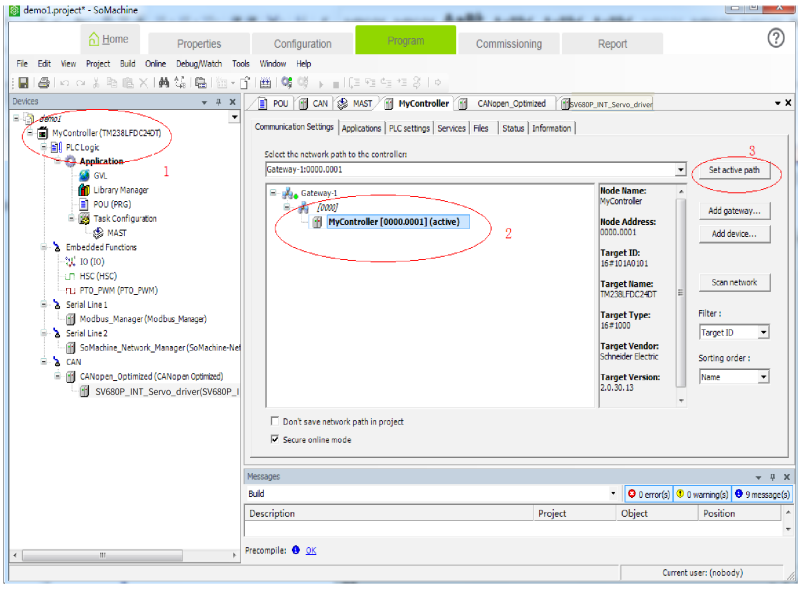
27. Select the PLC-defined variable according to the following steps.



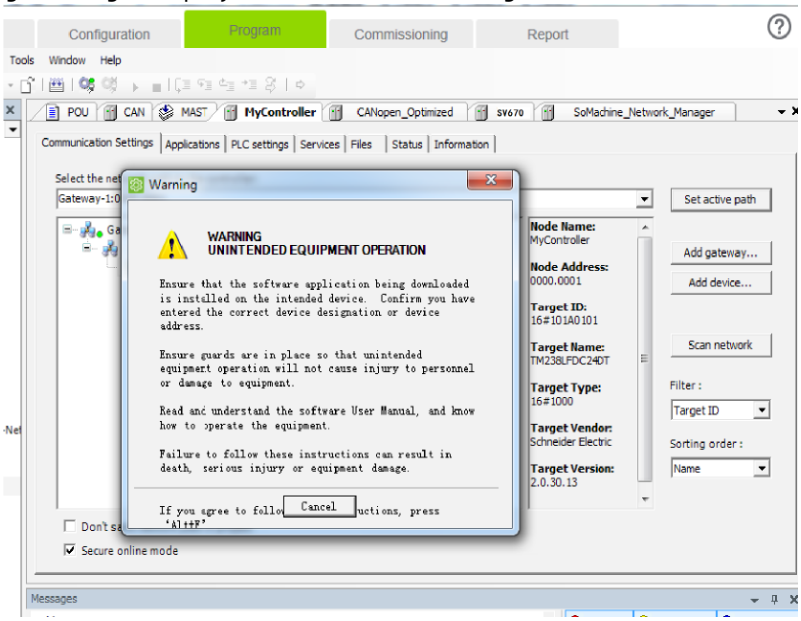
28. Add other variables in the similar way. Finally, the mapping is shown as below.



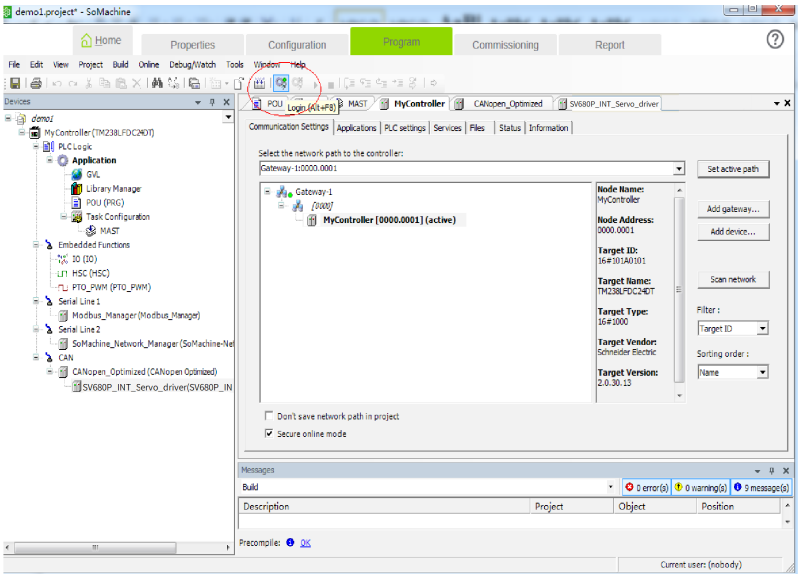
29. Double-click the master name on the left. Select "MyController" and click "Set active path" on the right.



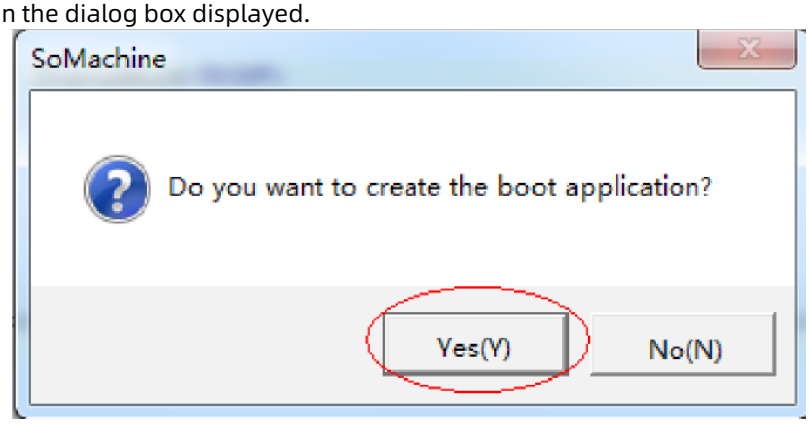
30. The following warning is displayed. Press Alt+F according to the instructions.



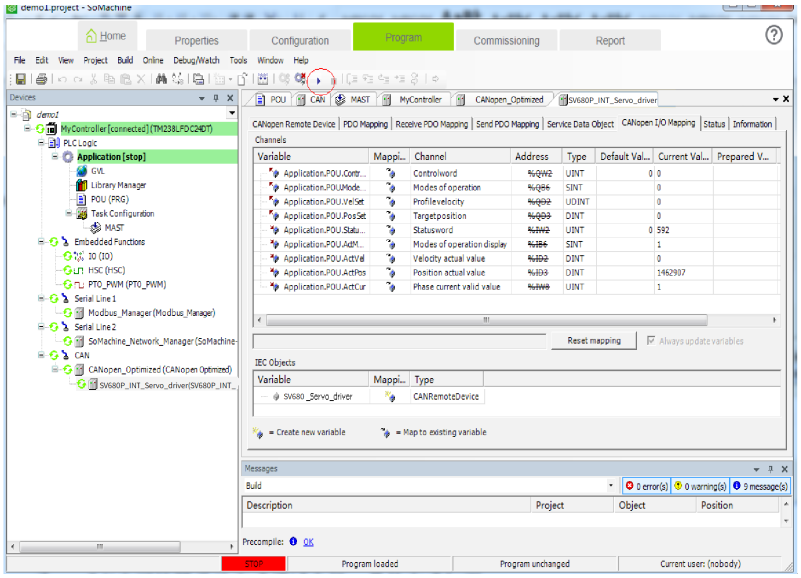
31. Click the icon circled in the following figure, and choose "Online" > "Login" or press Alt+F8.



32. Click "Yes" in the dialog box displayed.



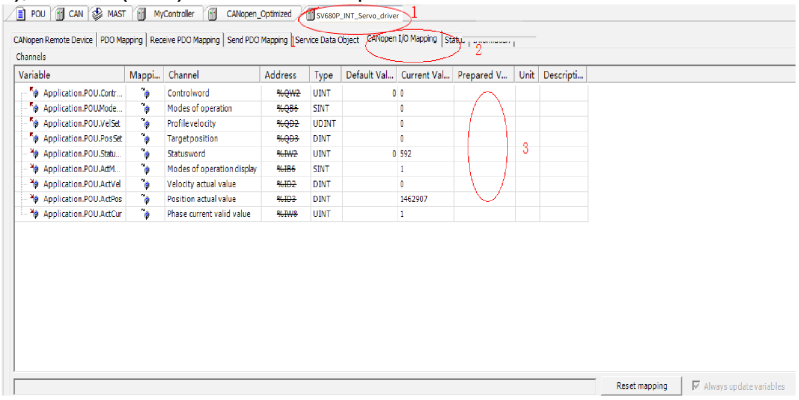
33. After the application is downloaded, click the ▶ icon and choose "Online" > "Start" or press F5 to start the PLC program written by the user. In this case, the motor operates in the mode defined by the user.



34. You can also perform motor commissioning manually according to the following steps.

Select "CANopen I/O Mapping" under "SV680_Servo_driver" and enter the value needed in the "Prepared V..." column. Next, choose "Debug/Watch" > "Forced Value" or press F7 to modify the variable manually.

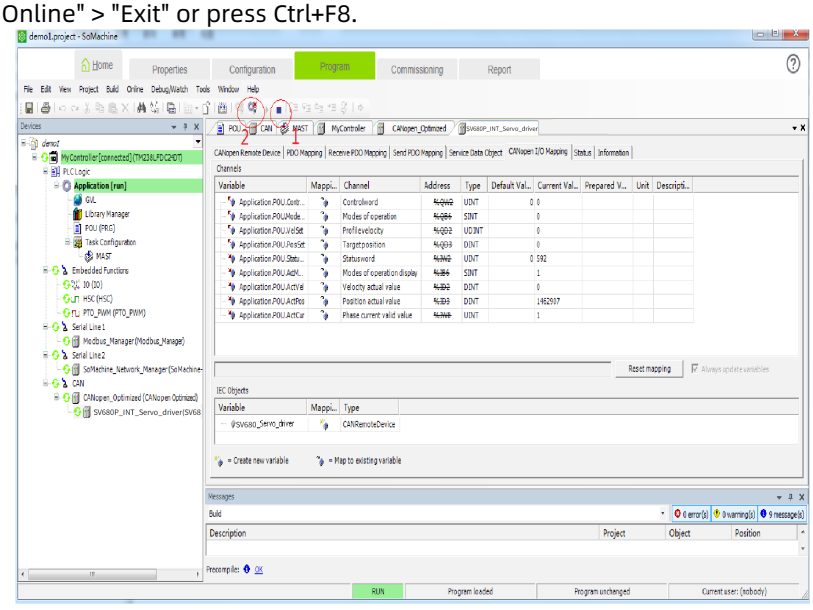
35. Write 1 to 6060h, 100 to 6081h, and 671088640 (10 revolutions) to 607Ah. Write 6 (0x06), 7 (0x07), 47 (0x2f), and 63 (0x3f) to 6040h in sequence to make the motor run.



Note

- When writing multiple values for one variable, execute the "Forced value" command every time a value is written. When writing values for multiple variables, you can execute the "Forced value" command once for all after all values are written.
- When a new position or speed reference is required, write the new reference and set 6040h to 47(0x2f) and 63 (0x3f) in turn. The motor runs to the position according to the new reference regardless of whether the previous reference is executed.
- To stop the motor, set 6040h to 0.
- To terminate manual writing of values, go to the toolbar and choose "Debug/Watch" > "Release Values" or press Alt + F7. Then, variables will be executed according to the PLC program logic instead of manually written values.

36. To stop the PLC program, click the button indicated by mark 1 and choose "Online" > "Stop" in the toolbar or press Shift+F8. To exit from the online function, click the button indicated by mark 2 and choose "Online" > "Exit" or press Ctrl+F8.



16.3.1.2 Connecting SV680P-INT to Beckhoff CANopen Master

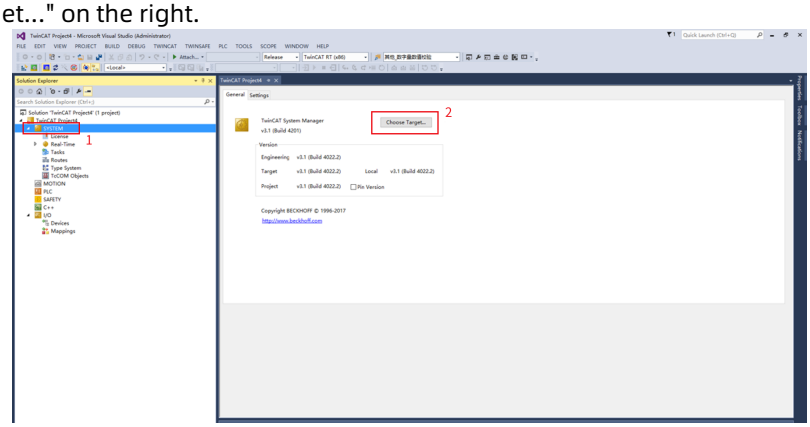
This section also takes the position control mode as example. Allocate PDOs according to *"Table 16-29" on page 701*.

1. Manually configure the PDO mappings before connecting to the network. You can change the mappings by modifying parameters based on the following table. The parameters to be modified are as follows.

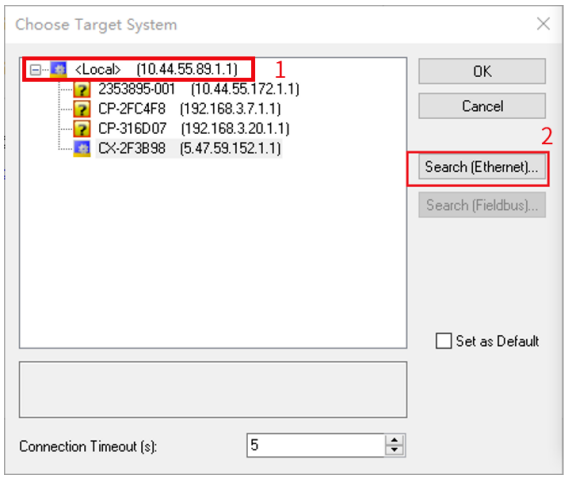
Table 16–29 Example of PDO mapping of Beckhoff master

Parameter	Object	Mapping object	Input
H2d.32	1600.00h	Number of RPDO1 mapping objects	2
H2d.33	1600.01h	6040.00h	60400010h
H2d.35	1600.02h	6060.00h	60600008h
H2d.49	1601.00h	Number of RPDO2 mapping objects	2
H2d.50	1601.01h	6081.00h	60810020h
H2d.52	1601.02h	607A.00h	607A0020h
H2E.20	1A00.00h	Number of TPDO1 mapping objects	2
H2E.21	1A00.01h	6041.00h	60410010h
H2E.23	1A00.02h	6061.00h	60610008h
H2E.37	1A01.00h	Number of TPDO2 mapping objects	2
H2E.38	1A01.01h	606C.00h	606C0020h
H2E.40	1A01.02h	6064.00h	60640020h
H2E.54	1A02.00h	Number of TPDO3 mapping objects	1
H2E.55	1A02.01h	200B.19h	200B1910h
H2E.57	1A02.02h	-	0

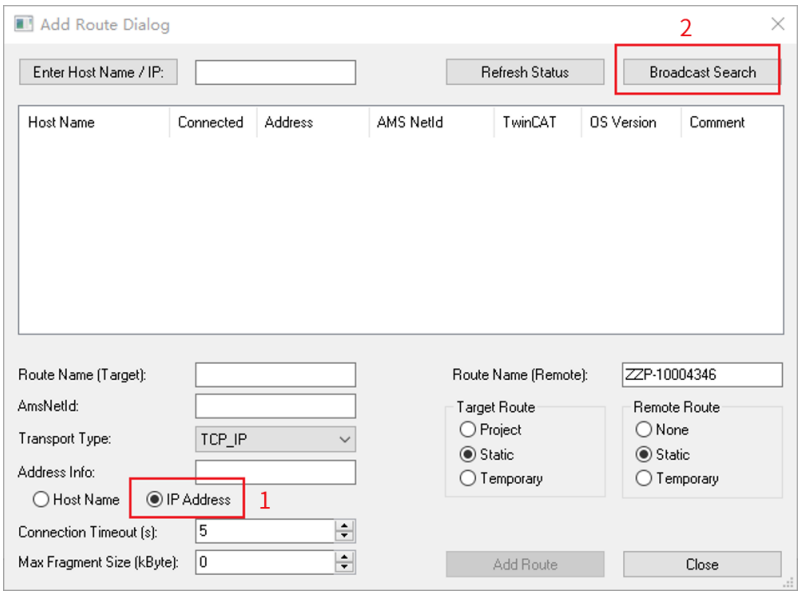
2. Connect Beckhoff CX9020, as a master node, to the CANopen module of EL6751 and perform the test. Ensure that the IP address of CX9020 is in the same network segment as the IP address of the PC and the first four bytes of AMS Net (Properties > AMS Router > AMS Net) of Beckhoff TwinCAT software are the same as the IP address of the PC.
3. Open TwinCAT System Manager and create an empty project. Click "SYSTEM" on the left and click "Choose Target..." on the right.



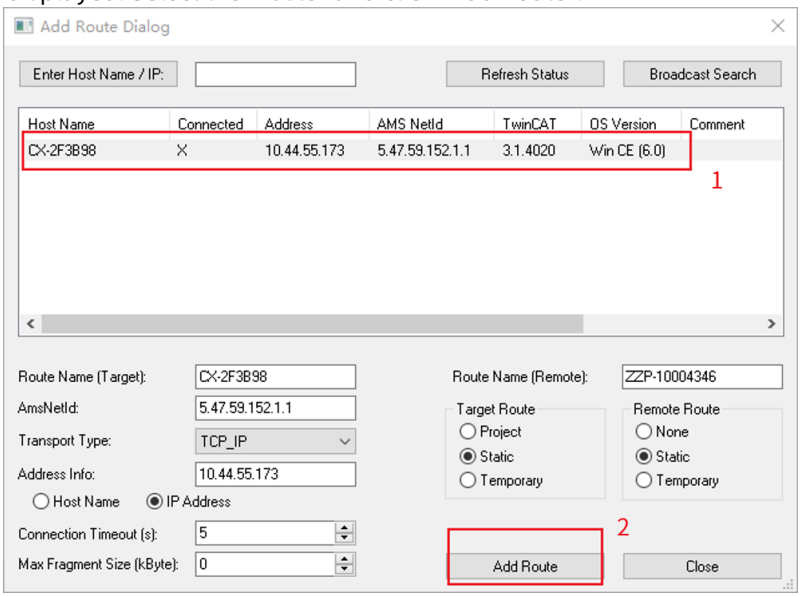
4. In the dialog box displayed, select "...Local..." and click "Search (Ethernet)".



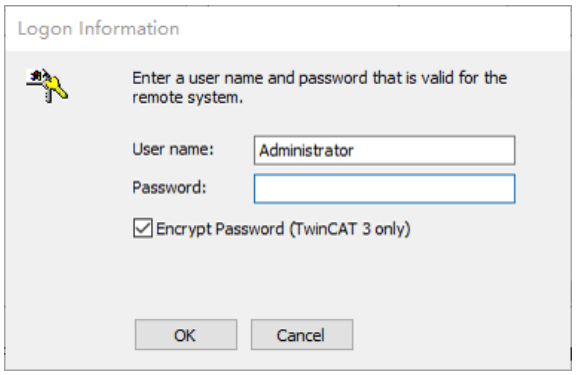
5. In the dialog box displayed, select "IP Address" as indicated by mark 1 and click "Broadcast Search".



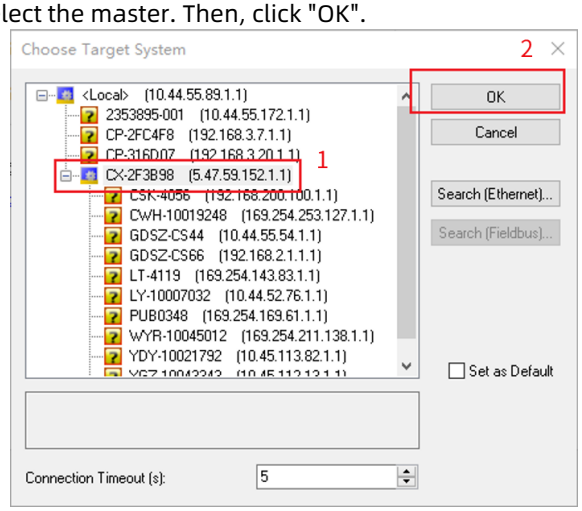
6. The master is displayed. Select the master and click "Add Route".



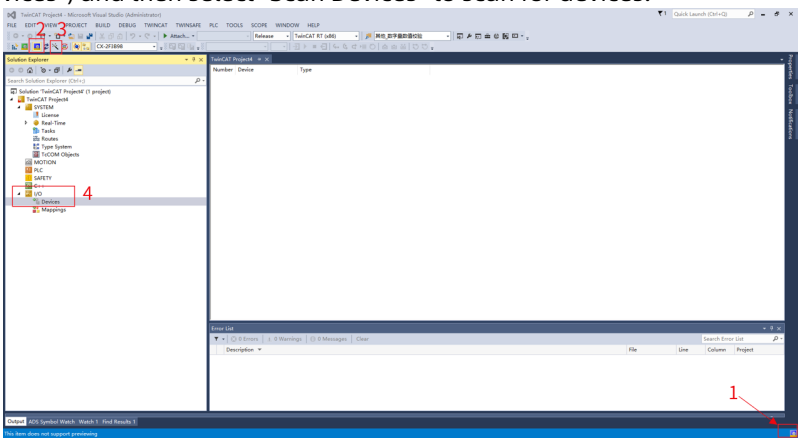
7. In the dialog box displayed, enter the username, which is the host name of the master, leave the "Password" field blank, and click "OK".



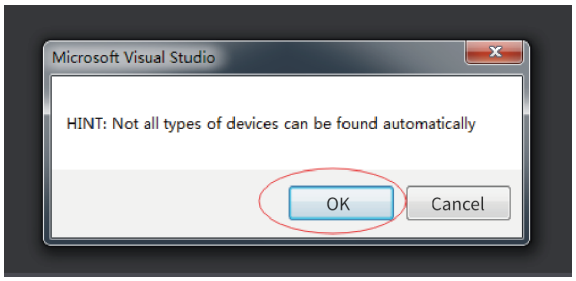
8. Click "Close" on the interface shown in Step 6. In the "Choose Target System" dialog box, click "+" to unfold the list and select the master. Then, click "OK".



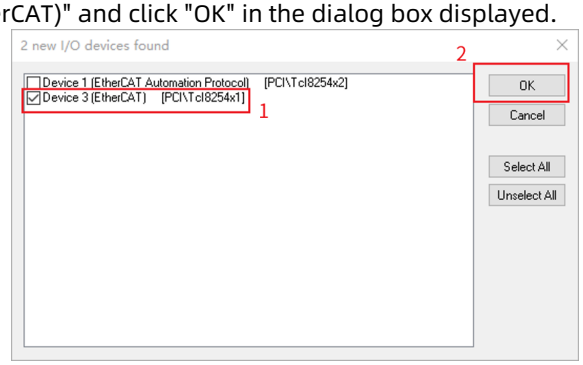
9. Check the master configuration status marked by "1". If the master is in the Run mode, click the icon marked by "2" to switch to the configuration mode. Click the icon marked by "3" or "I/O", right-click "Devices", and then select "Scan Devices" to scan for devices.



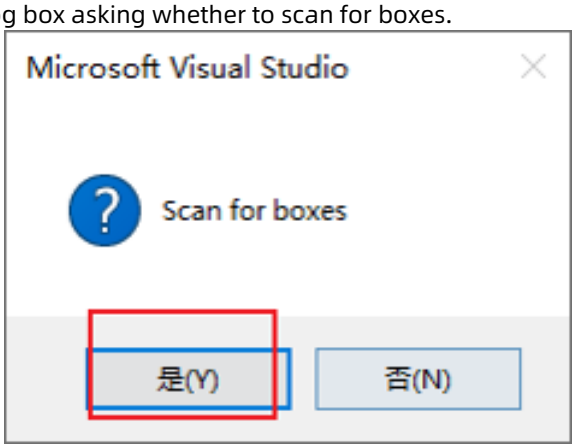
10. Click "OK" in the alarm dialog box displayed.



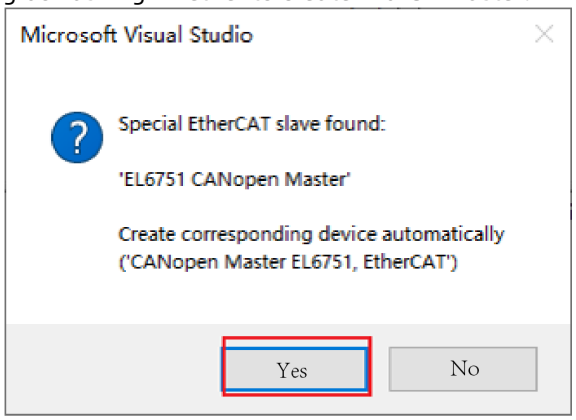
11. Select "Device 1 (EtherCAT)" and click "OK" in the dialog box displayed.



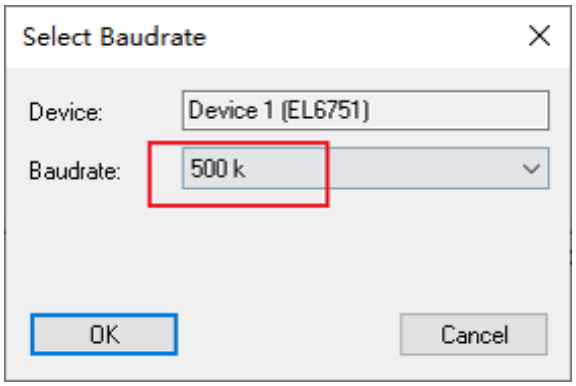
12. Click "Yes" in the dialog box asking whether to scan for boxes.



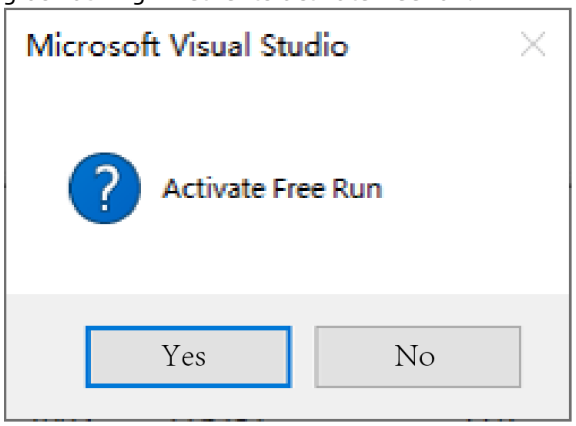
13. Click "Yes" in the dialog box asking whether to create EL6751 master.



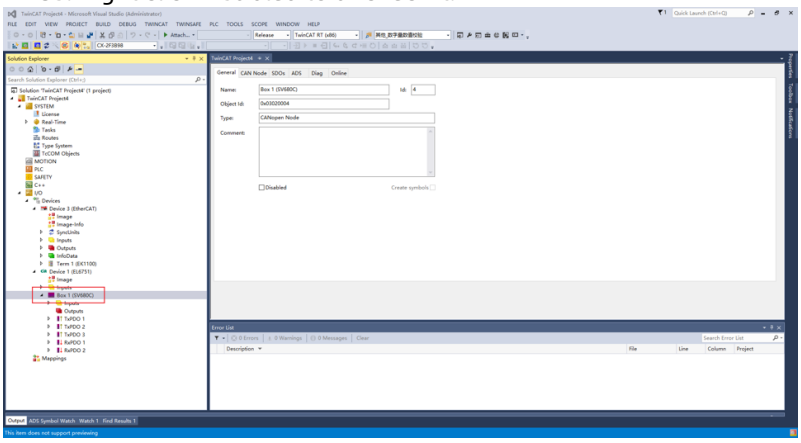
14. Select the baud rate (defaulted to 500 kbps) and click "OK". The master starts device searching, which may take a while.



15. Click "Yes" in the dialog box asking whether to activate free run.



16. The Box of SV680P-INT series servo drive is now displayed on the left. Right-click to insert three TPDOs and 2 RPDOs. Right click Disabled to uncheck it.

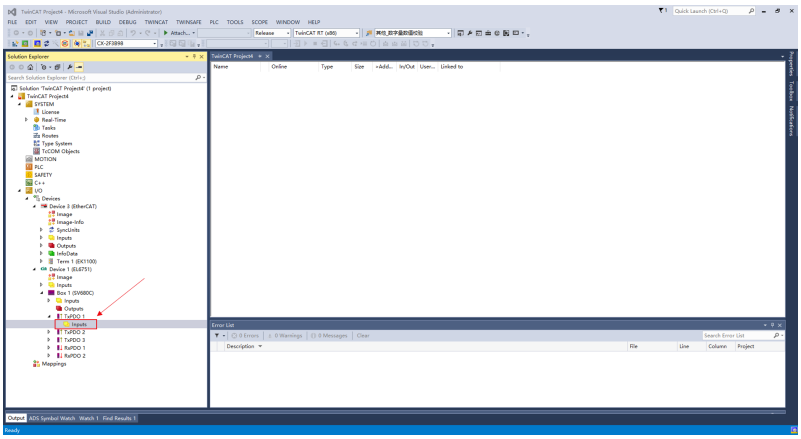


Note

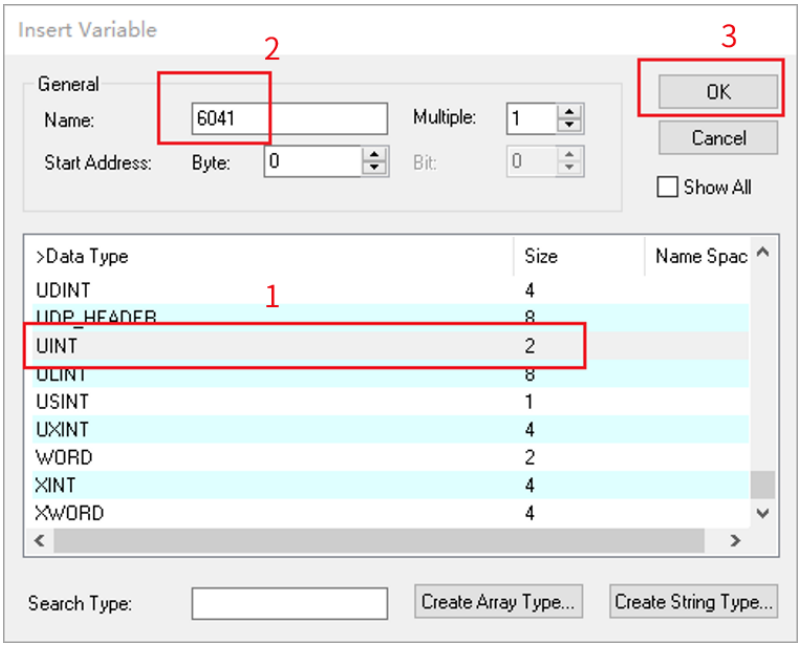
Only servo drives equipped with termination resistors can be scanned by the master.

This product supports CANopen communication, and the device name in the description file is SV680C. For specific models of SV680-INT, see section "Model description".

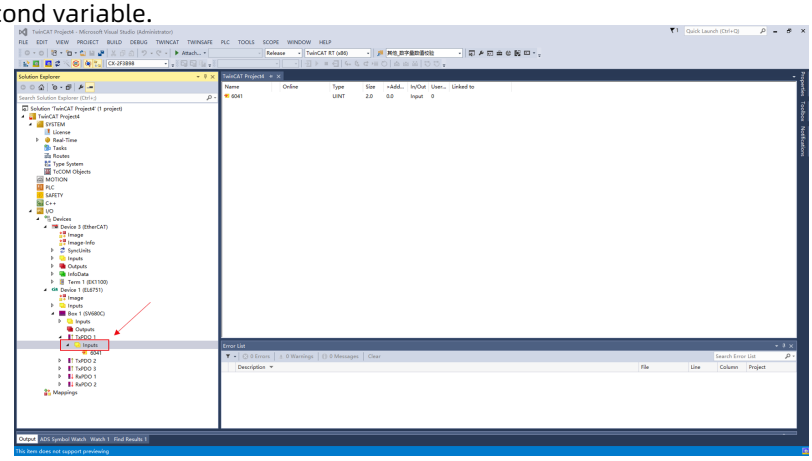
17. The following figure shows the result after the previous operation is complete. Choose "TPDO1" > "Inputs", right-click, and choose "Insert Variable".



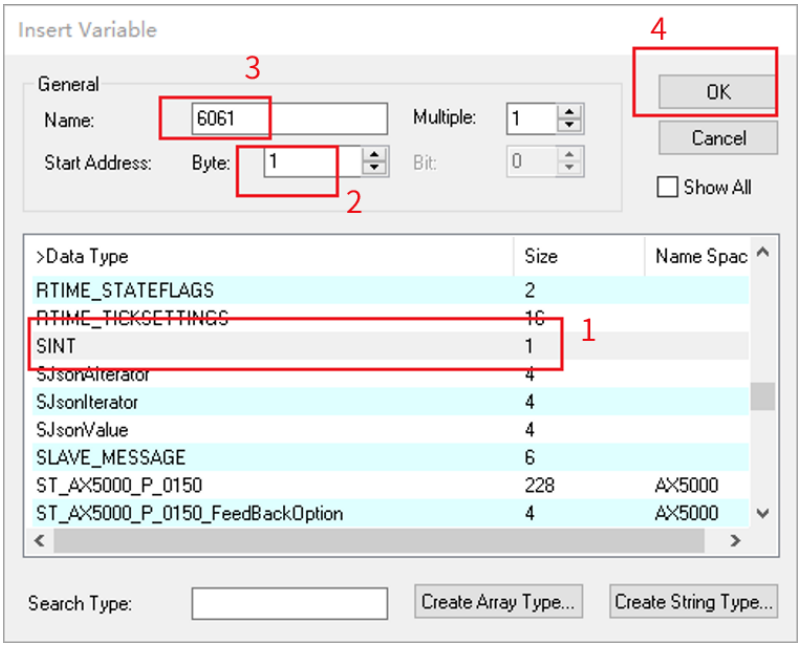
18. Map each PDO to different variables according to *"Table 16-29 Example of PDO mapping of Beckhoff master" on page 701*. Map TPDO1 to 6041.00h and 6061.00h. To insert the first variable 6041h, select "UINT" in the "Variable Type" section, enter a proper name in the "Name" field, and click "OK".



19. Now, 6041h is added to TPDO1. Similarly, right-click "Inputs", and choose "Insert Variable" to insert the second variable.

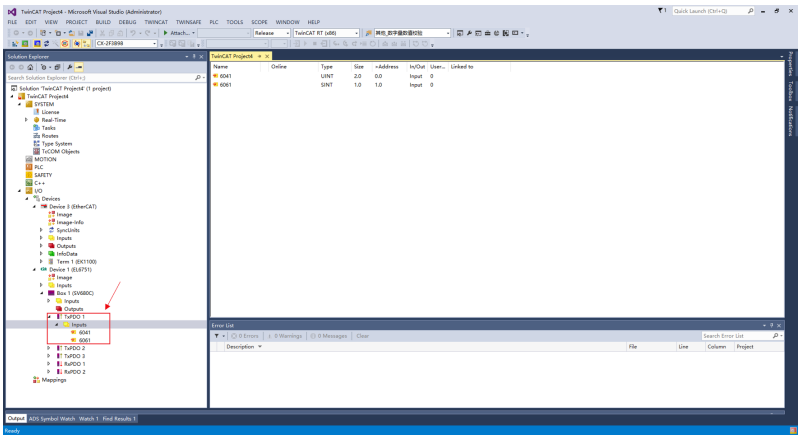


20. For the inserted variable 6061h, select INT8 (the object dictionary can be queried) for Variable Type, enter a large value for Byte of Start Address to prevent 6061h from being inserted in front of 6041h, enter a proper name, Click OK.

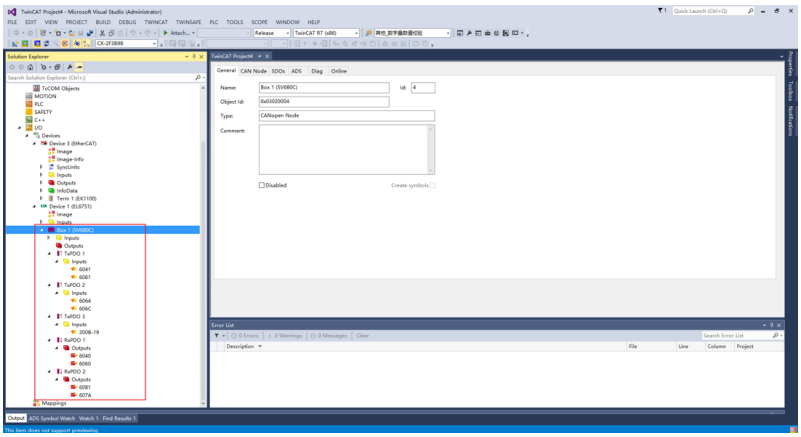


21. Now, two objects are added to TPDO1. Note that the sequence of the two variables must be consistent with *"Table 16-29 Example of PDO mapping of Beckhoff master" on page 701*. Otherwise, delete the second variable, re-insert the variable, and enter a large value in the field indicated by mark 2 in the figure in Step 20.

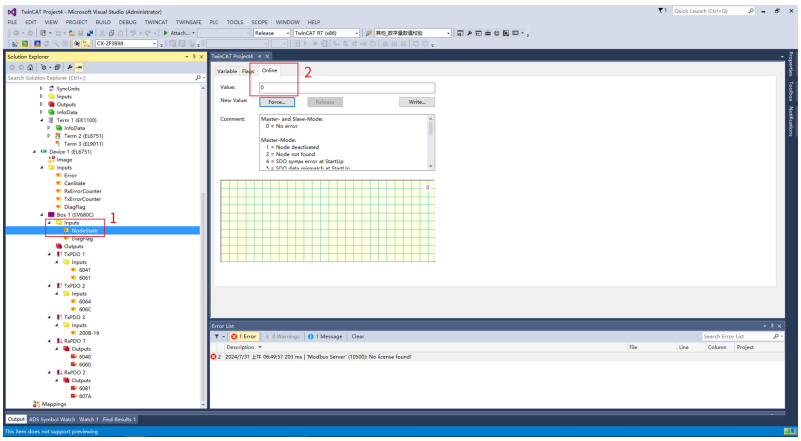
After making sure that the variable sequence is correct, choose "TxPDO1" > "Inputs", right-click "Inputs", and choose "Recalc Address" to allocate addresses. This step must be performed. Otherwise, address chaos may occur.



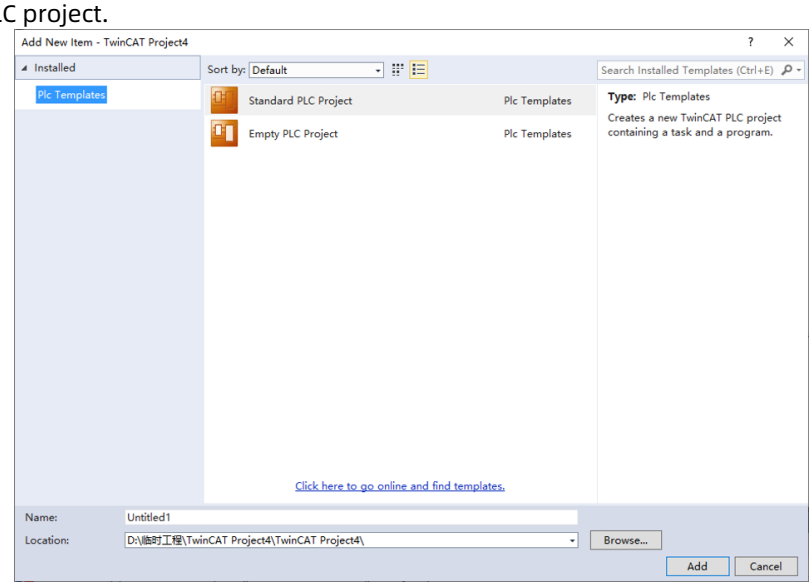
22. Repeat steps 17 to 21 for other PDOs. Add corresponding mapping variables according to *"Table 16-29 Example of PDO mapping of Beckhoff master" on page 701*. The interface after variables are added is shown below.



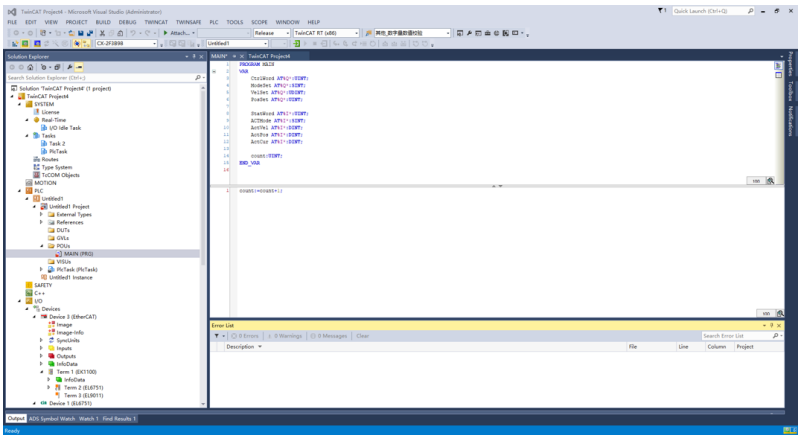
23. Click the Configuration Mode icon.
24. Select the Box of SV680P-INT and select "Inputs" > "NodeState". The node state in Online is 0, indicating the node is in a normal state.



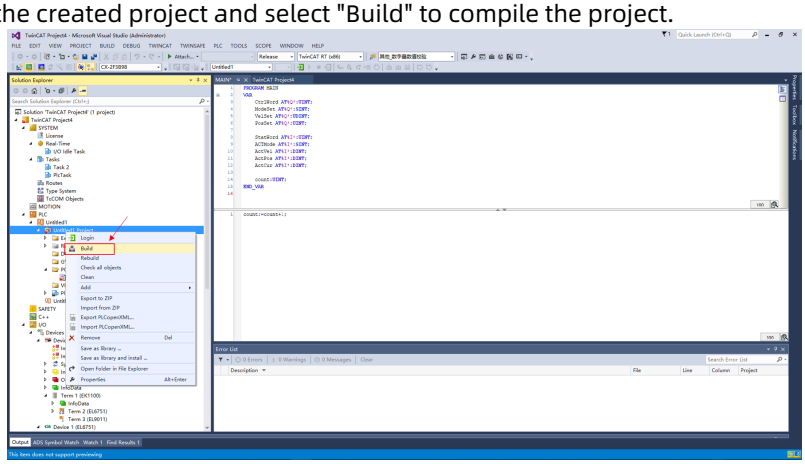
25. Create a PLC project.



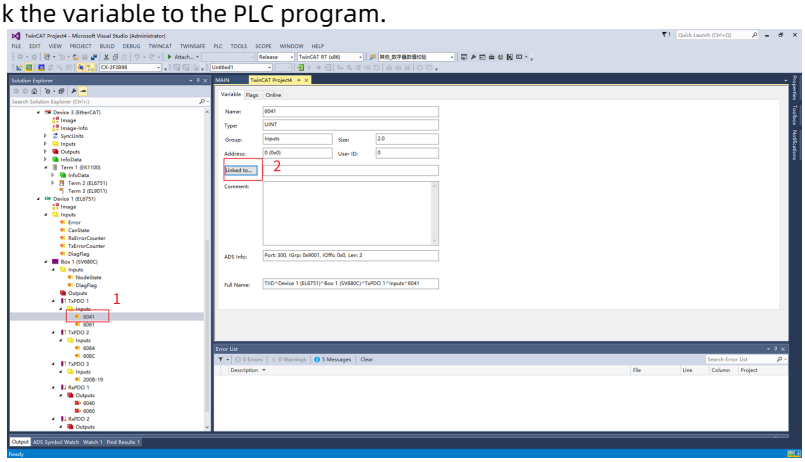
26. Enter corresponding variable definition and the PLC logic.



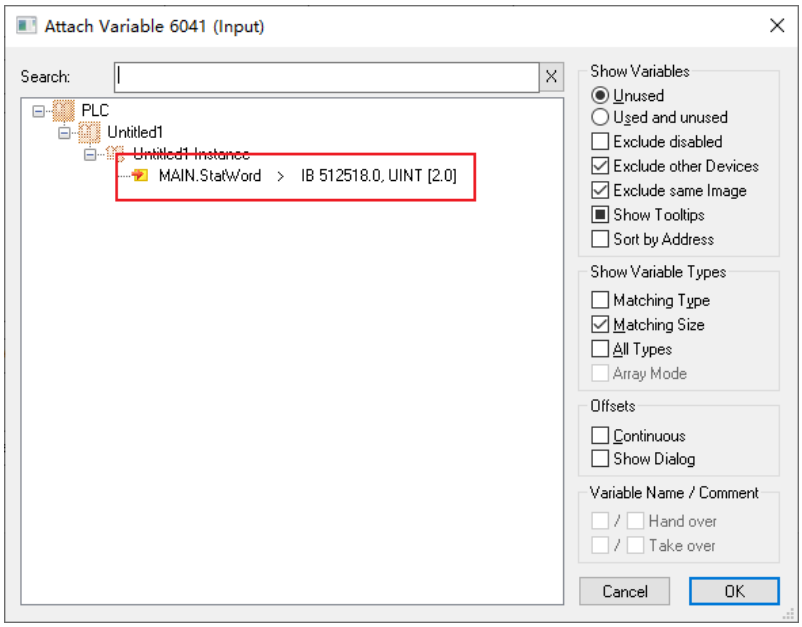
27. Right-click the created project and select "Build" to compile the project.



28. After the PLC program is added, select the PDO variable and click "Linked to" or double-click the variable to link the variable to the PLC program.



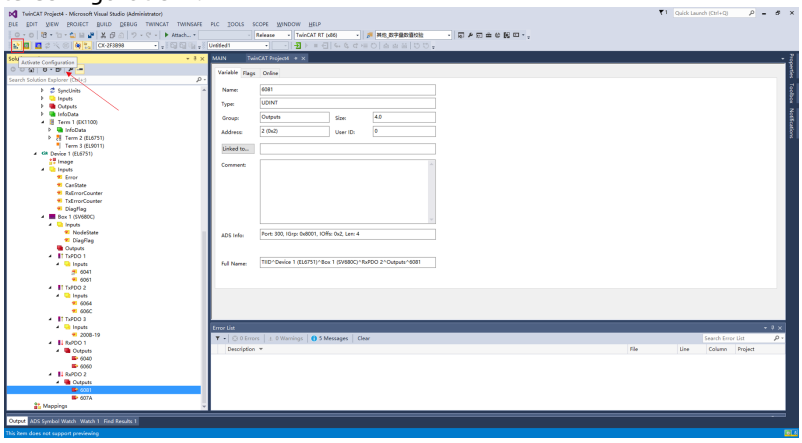
29. Select the corresponding PLC variable and click "OK".



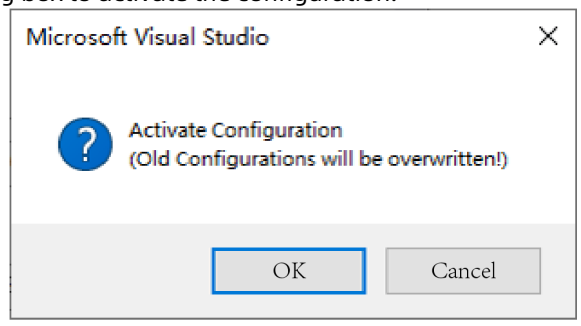
30. After the variable is linked, a small right arrow appears next to the variable name icon.



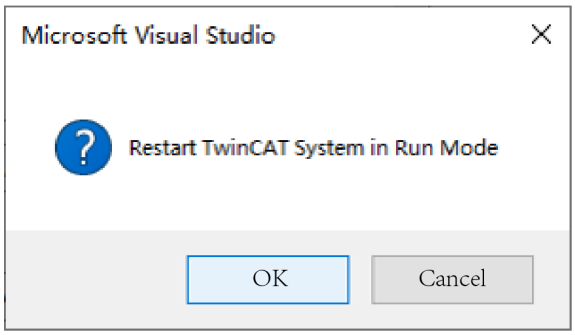
31. Click "Activate Configuration".



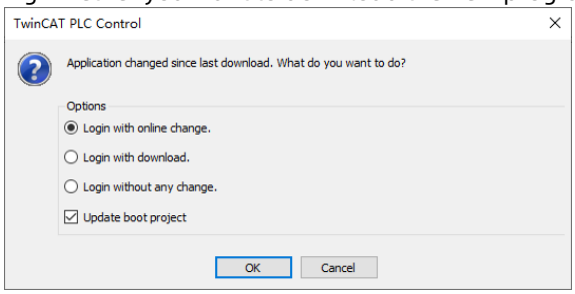
32. Click "OK" in the dialog box to activate the configuration.



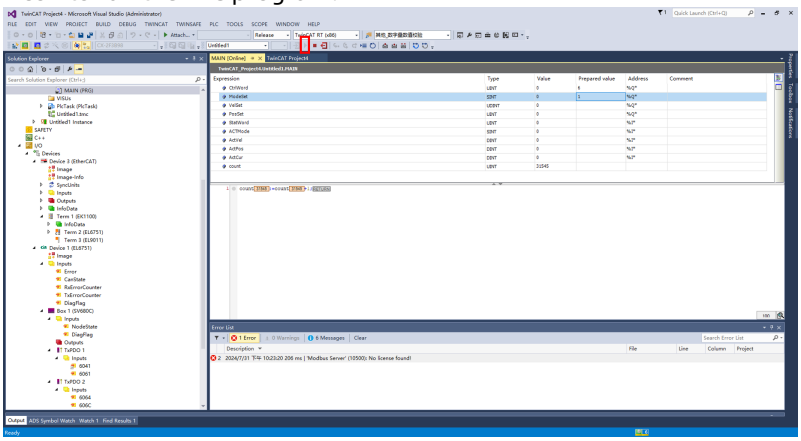
33. Click "OK" to restart the TwinCAT system in the Run mode.



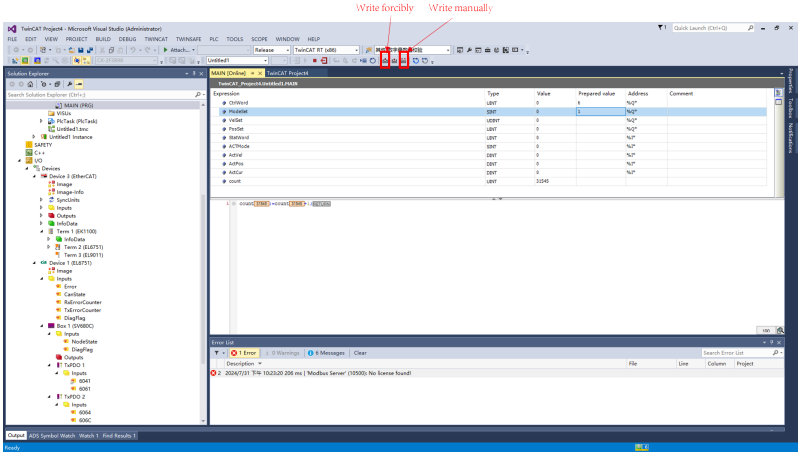
34. Open the project previously created in TwinCAT PLC Control, and choose "Online" > "Login". A dialog box appears, asking whether you want to download the new program.



35. Click the Run icon to run the PLC program.



36. You can perform write commissioning in forcible or manual mode. If the data written in manual mode does not take effect, switch to the forcible mode to write the data.



37. Enter a value and click "OK".

    The value entered is displayed in the square brackets behind the original variable. Click "Online" > "Forced Values" to write the value forcibly.

Write 1 to 6060h, 100 to 6081h, and 10485760 (10 revolutions) to 607Ah. Write 6 (0x06), 7 (0x07), 47 (0x2f), and 63 (0x3f) to 6040h in sequence to make the motor run.

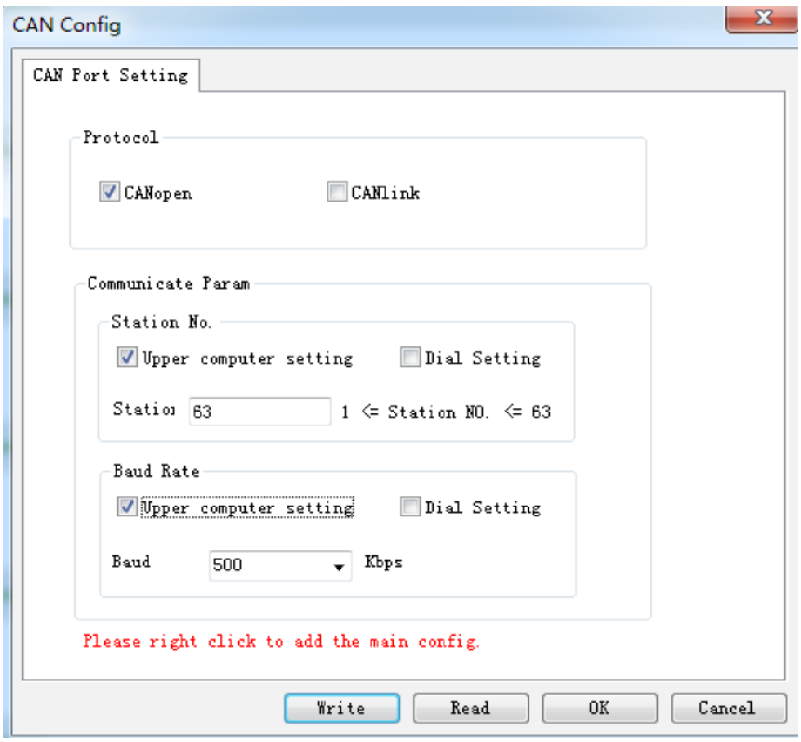
Note

- When writing multiple values for one variable, execute the "Forced value" command every time a value is written. When writing values for multiple variables, you can execute the "Forced value" command once for all after all values are written.
- When a new position or speed reference is required, write the new reference and set 6040h to 47(0x2f) and 63 (0x3f) in turn. The motor runs to the position according to the new reference regardless of whether the previous reference is executed.
- To stop the motor, set 6040h to 0.
- Do not enable manual value writing again. In the toolbar, choose "Online" > "Release Force" to terminate manual writing of values. The PLC program logic applies.

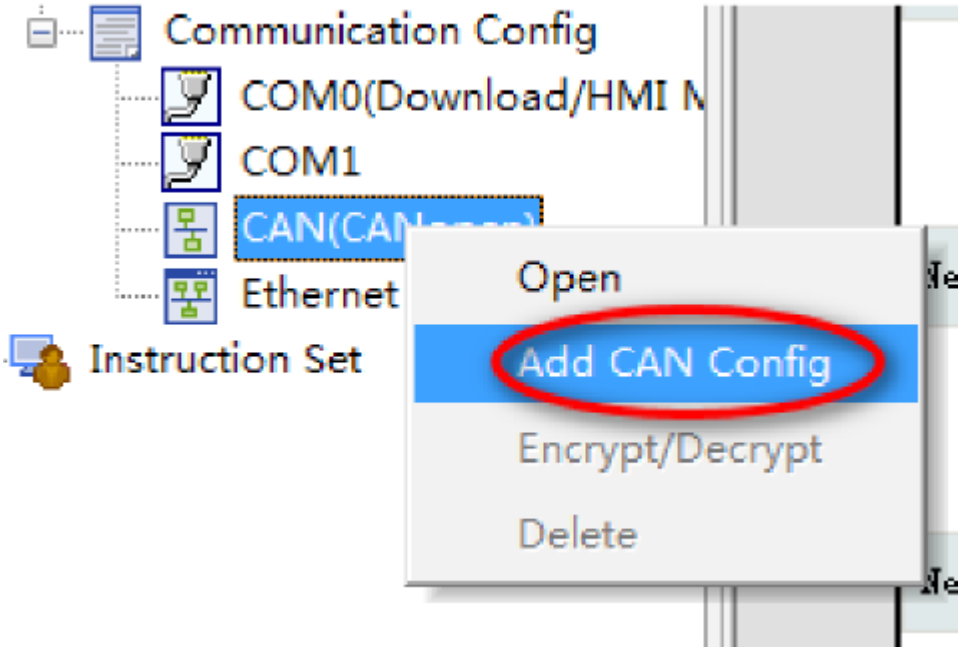
38. To stop executing the PLC program, choose "Online" > "Stop" in the toolbar. To continue editing the PLC program or exit, choose "Online" > "Logout".

16.3.1.3 Connecting SV680P-INT to Inovance H3U CANopen Master

1. Open AutoShop, go to "Communication Port" on the project management interface, and double-click "CAN" or right-click "CAN" and choose "Open". The "CAN Config" window is displayed. Set "Protocol" to "CANopen". Set "Station No." and "Baud Rate".



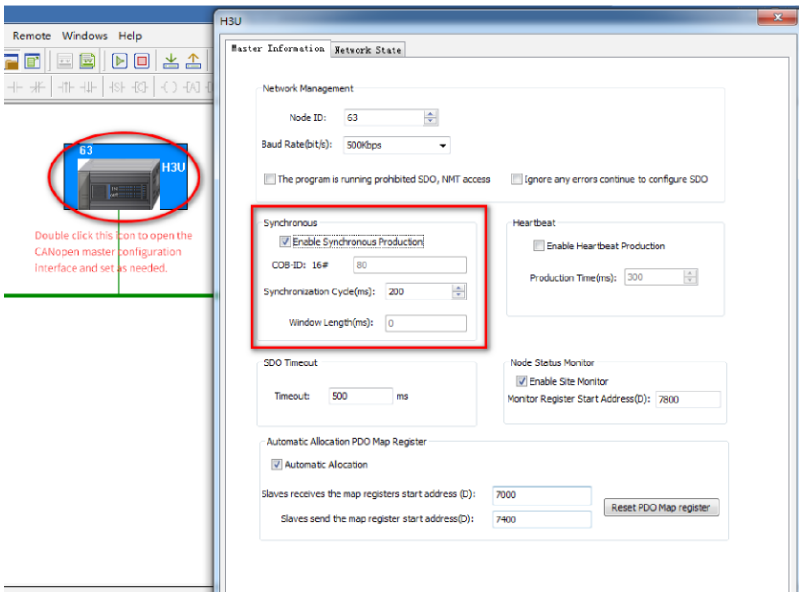
2. Right-click "CAN (CANopen)" and choose "Add CAN Config".



3. Double-click "CANopen configuration".

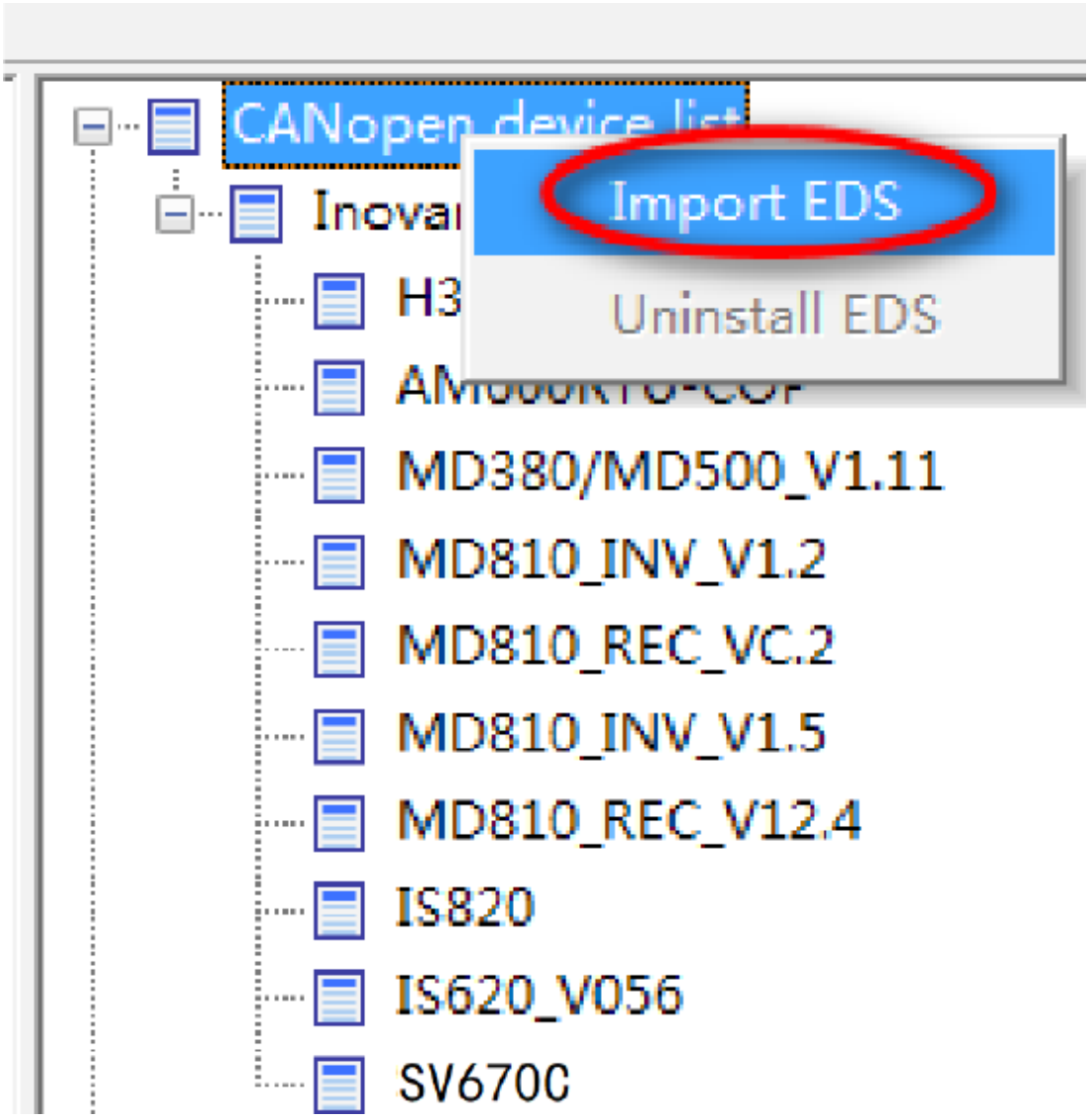
   The "CANopen configuration" window includes an H3U icon. Double-click the icon to open the master configuration interface and set parameters such as synchronization and heartbeat.

   H3U axis control commands control the servo drive through PDO communication. The PDO adopts the synchronous mode by default when the SV680P-INT series servo drive is working with an H3U master. Therefore, select "Enable Synchronous Production" on the master configuration interface and set the synchronization cycle as needed (typically 15 ms for 8-axis models). For other servo drive models, select this option if the PDO also adopts the synchronous mode.

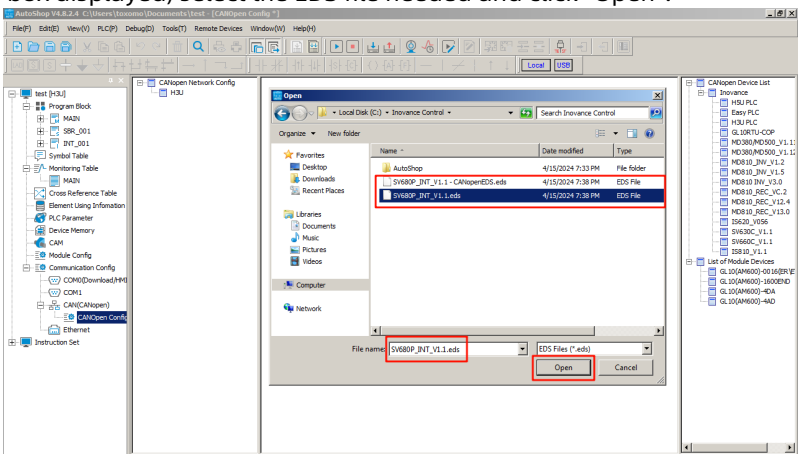


4. If the EDS file needed is not in the CANopen device list, add the device EDS file.

   a. Right-click "CANopen device list". On the short-cut menu displayed, choose "Import EDS".

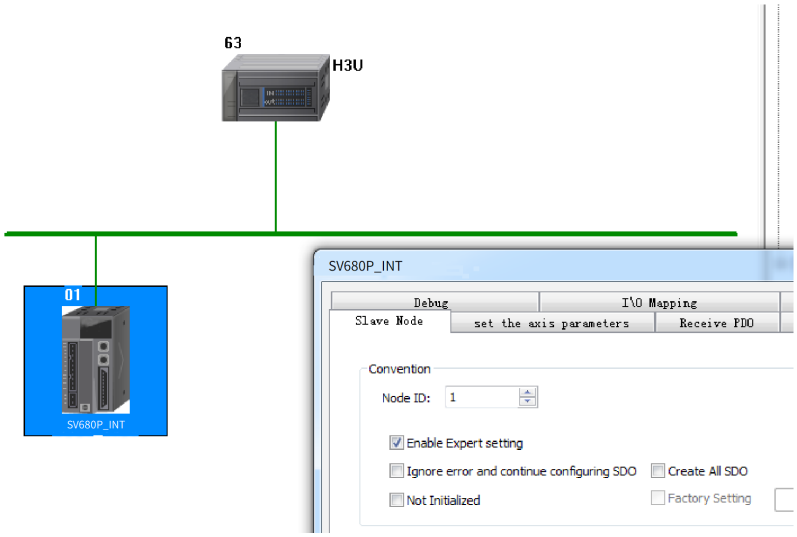


b. In the dialog box displayed, select the EDS file needed and click "Open".



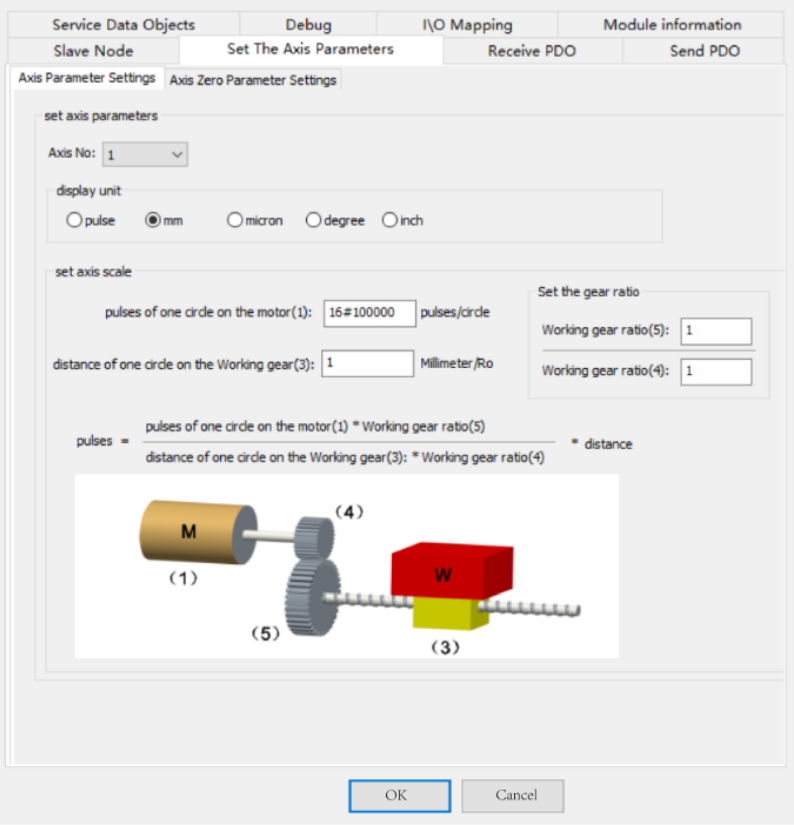
c. The device added is displayed in the CANopen device list on the right.

5. Double-click the SV680P in the CANopen device list to add CANopen slaves. Then, double-click the SV680P-INT icon in the configuration to open the slave configuration parameter list.



6. As shown in the following figure, the "Set The Axis Parameters" interface includes the "Axis Parameter Settings" and "Axis Zero Parameter Settings" tabs.

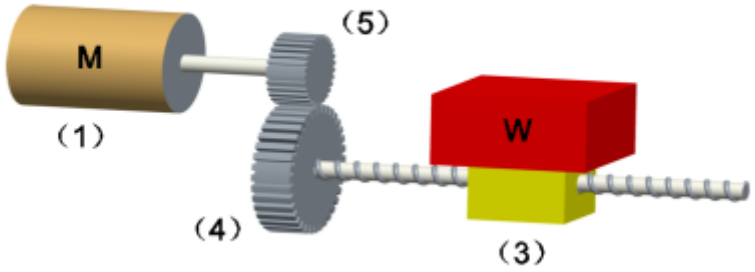
Configuring axis parameters



- For devices without reducers, set the gear ratio to 1:1. Set the pulses per motor revolution and distance per motor revolution correctly. The calculation formula is as follows.

$$\text{Number of pulses} = \frac{\text{Number of reference pulses per motor revolution}}{\text{Distance per motor revolution (3)}} \times \text{Travel distance (displayed unit)}$$

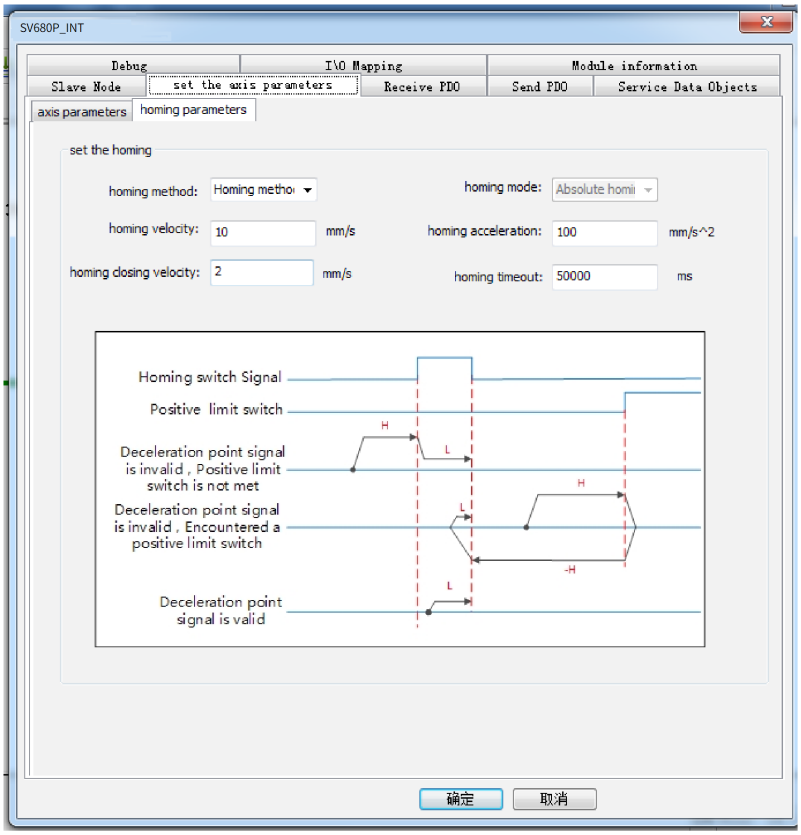
- Applications with reducers are shown as follows.



The calculation formula for devices with reducers is as follows.

$$\text{Number of pulses} = \frac{\text{Number of reference pulses per motor revolution (1) x Motor gear ratio (5)}}{\text{Travel distance per motor revolution (3) x Operating gear ratio (4)}} \text{ x Travel distance (displayed unit)}$$

Setting axis homing parameters



The range of the homing method is 1 to 35. The calculation formula for parameters and object dictionaries of the homing speed, homing acceleration, and homing proximity speed is shown as follows.

$$\text{Value of object dictionary} = \frac{\text{Number of reference pulses per motor revolution (1) x Motor gear ratio (5)}}{\text{Travel distance per motor revolution (3) x Operating gear ratio (4)}} \text{ x Setpoint in the software tool (displayed unit)}$$

The relationship between the preceding parameters and object dictionary items is summarized in the following table.

Index	Sub-index	Data type	Description	Unit
6098h	00	SINT	Homing method	-
6099h	01	UDINT	Speed during search for deceleration point signal	Reference unit/s

Index	Sub-index	Data type	Description	Unit
6099h	02	UDINT	Speed during search for zero	Reference unit/s
609Ah	00	UDINT	Homing acceleration	Reference unit/s^2
60E6h	00	USINT	Homing method	-

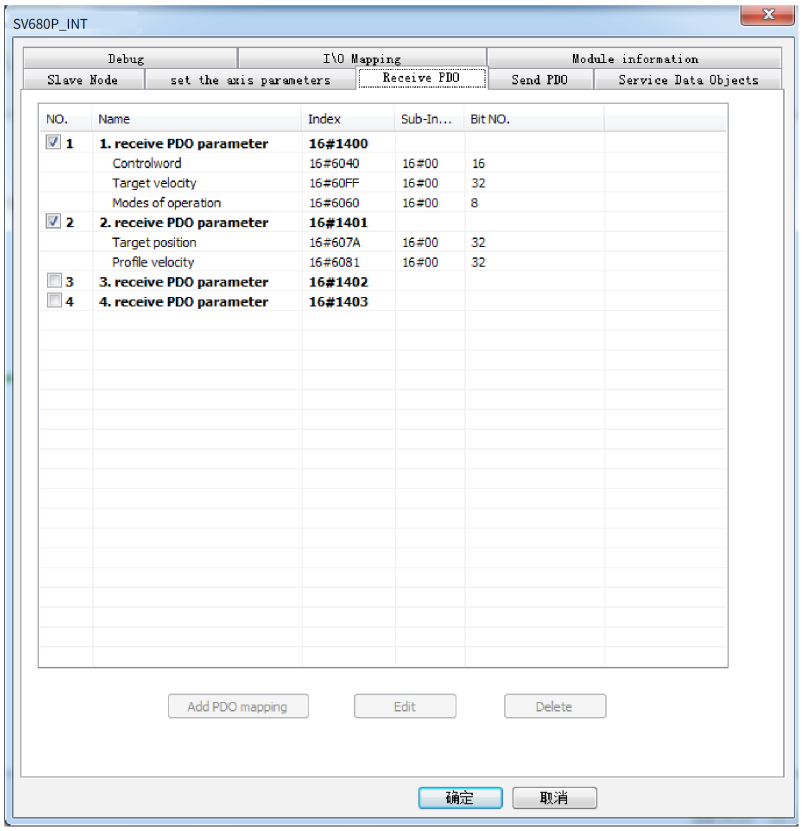
7. In CANopen CiA402 motion control, the object dictionary items that need to be operated in commands interact with the slave through PDO. These items include 6040h (control word), 6041h (status word), 6060h (operation mode selection), 6061h (current operation mode), 6081h (profile position mode target velocity), 607Ah (profile position mode target position), 60FFh (velocity mode target velocity), 6064h (current position), and 606Ch (current velocity). The preceding parameters must be configured as required below. Otherwise, axis configuration failure may occur during calling axis control commands.

Note

It is recommended to configure the PDO communication to synchronous mode to prevent frame loss caused by interference during communication. The synchronous mode requires synchronous production to be enabled in the master configuration. To ensure communication stability, the network load rate must be lower than 70%.

$$\text{Network load rate} = \frac{328 \times \text{Number of axes} + 79}{\text{Baud rate} \times \text{Sync cycle}} \times 100\%$$

RPDO configuration



Configure RPDOs in the following sequence.

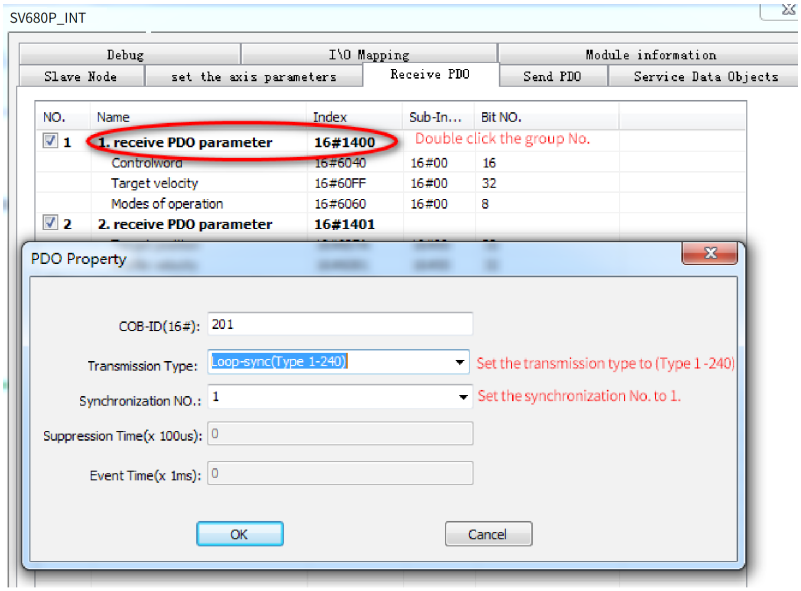
Index	Sub-index	Name
6040h	00	Control word
60FFh[1]	00	Target velocity

Index	Sub-index	Name
6060h	00	Modes of operation
607Ah	00	Target position
6081h	00	Profile velocity

Note

[1]: The object dictionary can be replaced by other object dictionaries with a length of 0x20.

It is recommended to use the synchronous mode for PDO communication. Follow the procedure below to set synchronous PDO communication for the slave.



Note

When MCMOVVEL and MCJOG are not in use, this object dictionary can be replaced by other object dictionaries with a length of 0x20.

Where:

- 1. Double-click the group No. and a dialog box appears.
- 2. Set "Transmission Type" to "Type1-240".
- 3. Set "Synchronization NO." to "1".

Configuring TPDOs:

Configure TPDOs in the following sequence.

Index	Sub-index	Name
6041h	00	Status word
60FDh[1]	00	Digital inputs
6061h	00	Modes of operation
6064h	00	Position actual value
606Ch	00	Velocity actual value

Note

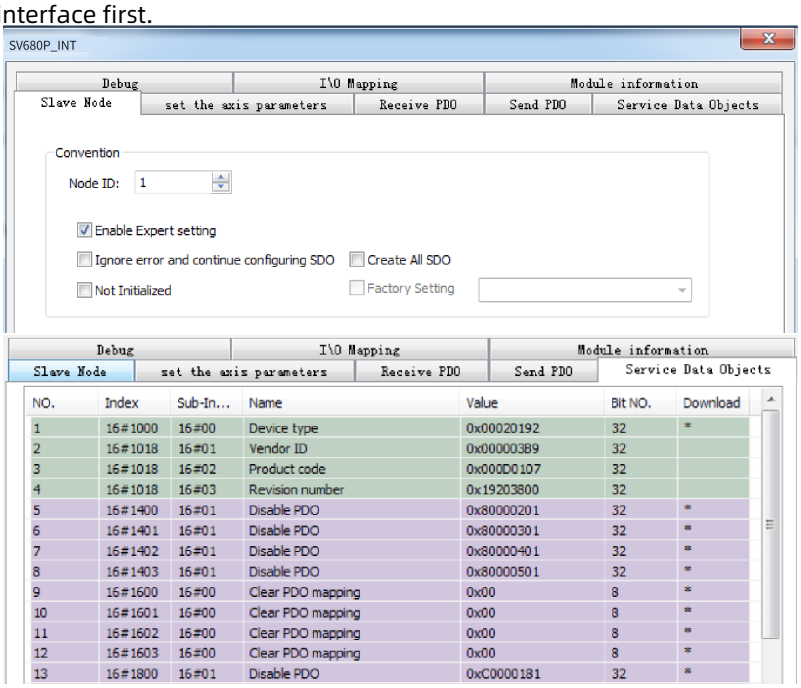
[1]: The object dictionary can be replaced by other object dictionaries with a length of 0x20.

The procedure for setting the synchronous mode of TPDO is similar to that for RPDO.

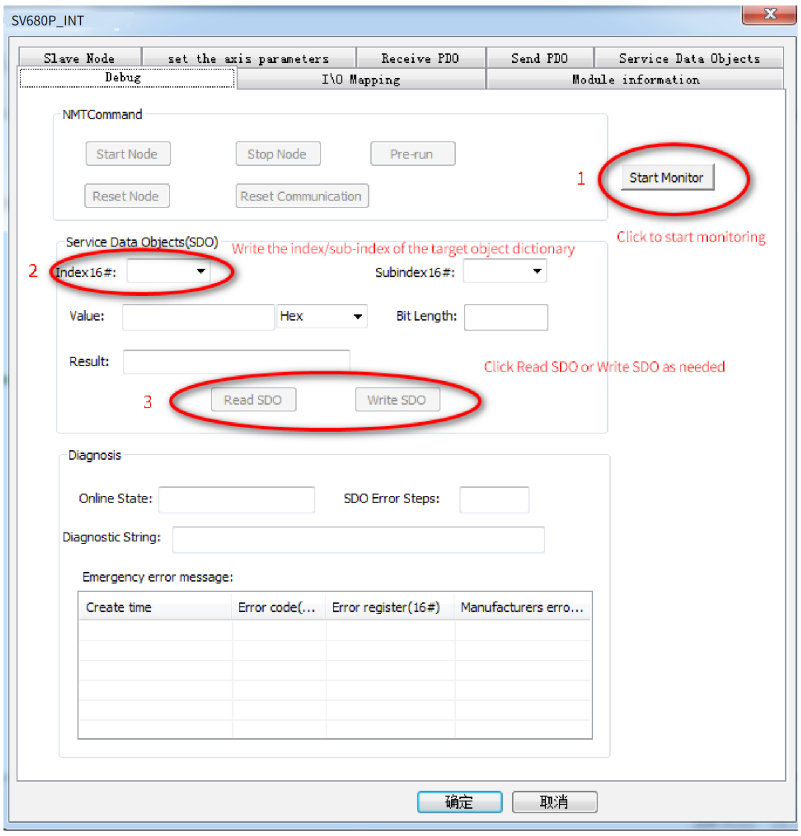
Caution

The EDS is configured based on the preceding sequence by default. Pay attention to the preceding configuration sequence when adding new objects. A wrong sequence will cause failure of H3U axis control commands. When using a PLC from any other manufacturer, you are not necessary to follow the sequence.

8. Download the CANopen configuration to H3U. The H3U starts to configure the slave based on the preceding configurations. The configuration is performed based on the object dictionary items listed on the "Servo Data Objects" interface. To view the list, select "Enable Expert Settings" on the "Slave Node" interface first.



During commissioning, you can monitor the device status online and read/write the object dictionary of the slave through H3U, as shown below.

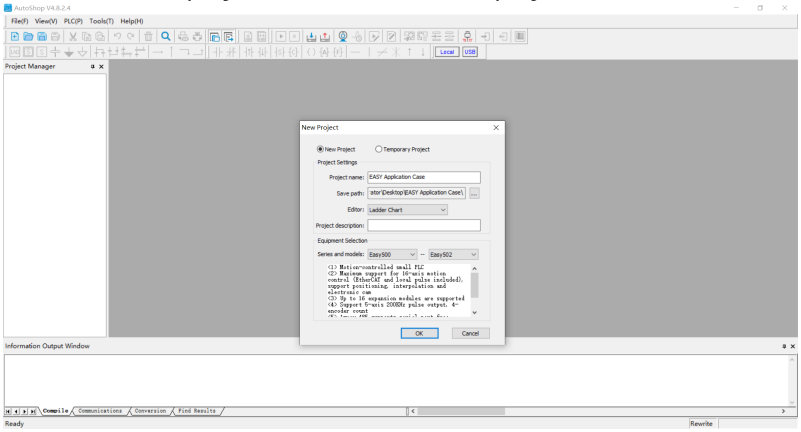


Where:

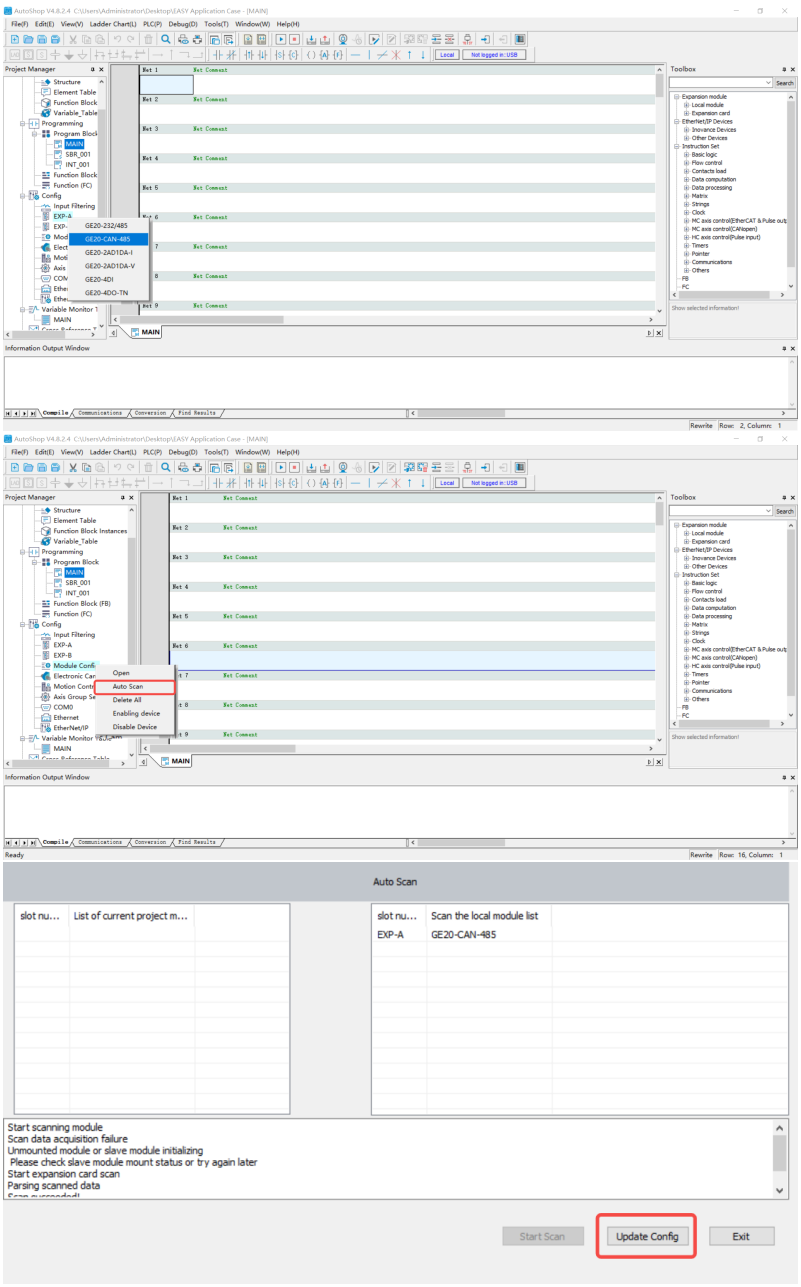
- 1. Click "Start Monitor".
- 2. Enter the index of the target object dictionary in "Index16#" and the sub-index in "Subindex16#".
- 3. Click "Read SDO" or "Write SDO" as needed.

16.3.1.4 Connecting SV680P-INT to Inovance EASY CANope Master

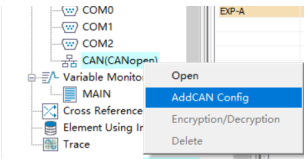
1. Open the Autoshop software, click "New project", select the editor type in the dialog box that opens, and then select Easy300 as the PLC type. Enter the project name and select the save path, and click "OK" to create a new project and enter the main project interface.

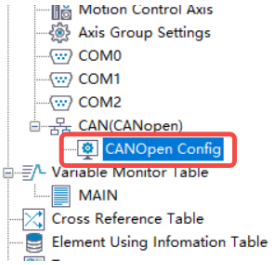


2. In the Project Manager, go to "Config", right-click "EXP-B" and select "GE20-CAN-485", or right-click "Module Config" and select "Auto Scan" to add the GE20-CAN-485 expansion card, as shown in the figure below. The GE20-CAN-485 expansion card only supports EXP-A.

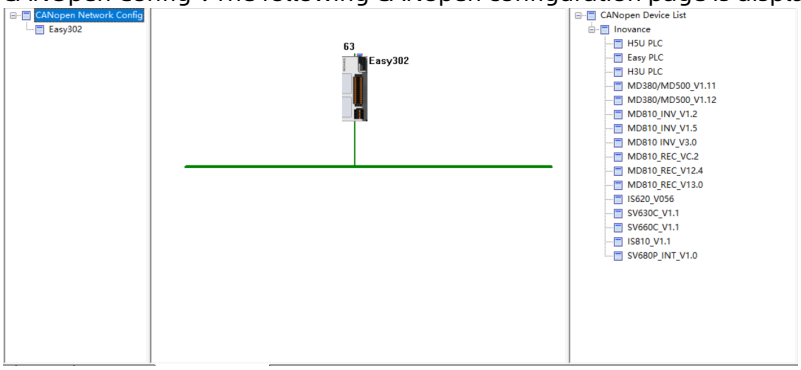


3. In the Project Manager, double-click "CAN". In the dialog box that appears, select "CANopen", configure the station number of baud rate, and then click "OK". In this example, CAN is configured as the CANopen slave station. Choose "Project Manager" > "Config". Right-click "CAN". In the window displayed, select "Add CAN Config" to configure it as the CANopen master station, as shown in the following figure.

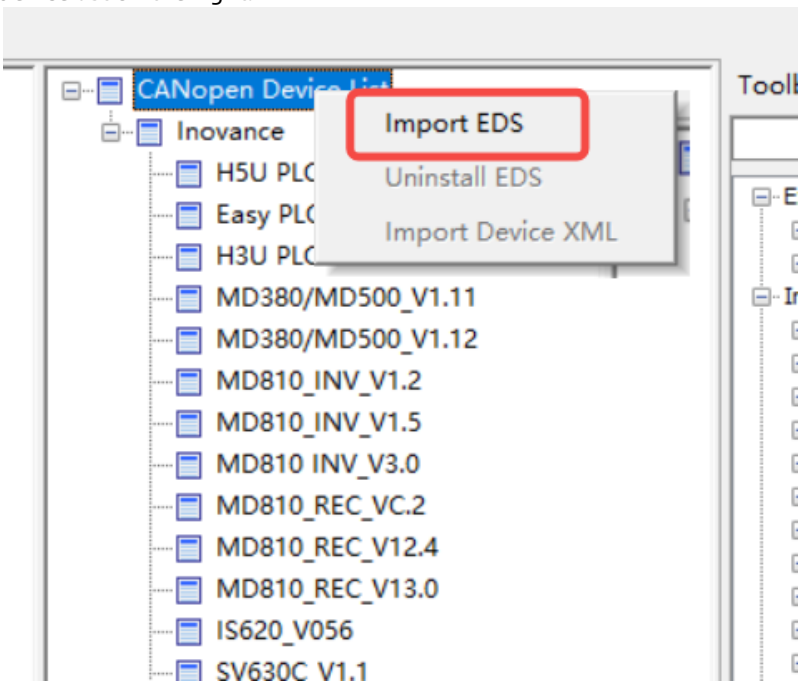




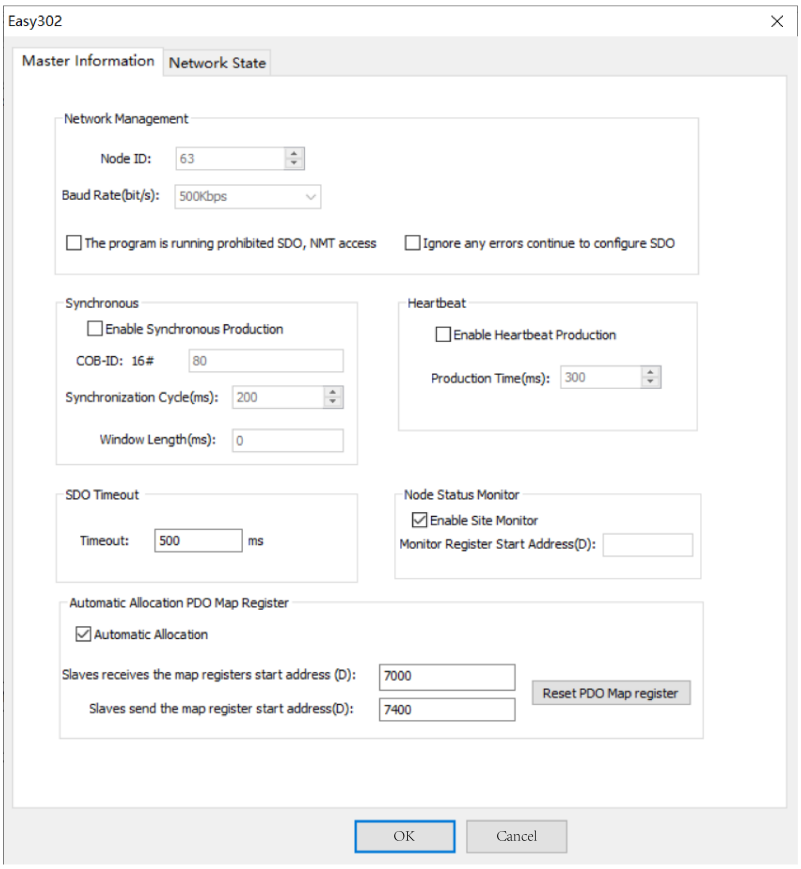
4. Double-click "CANOpen Config". The following CANopen configuration page is displayed:



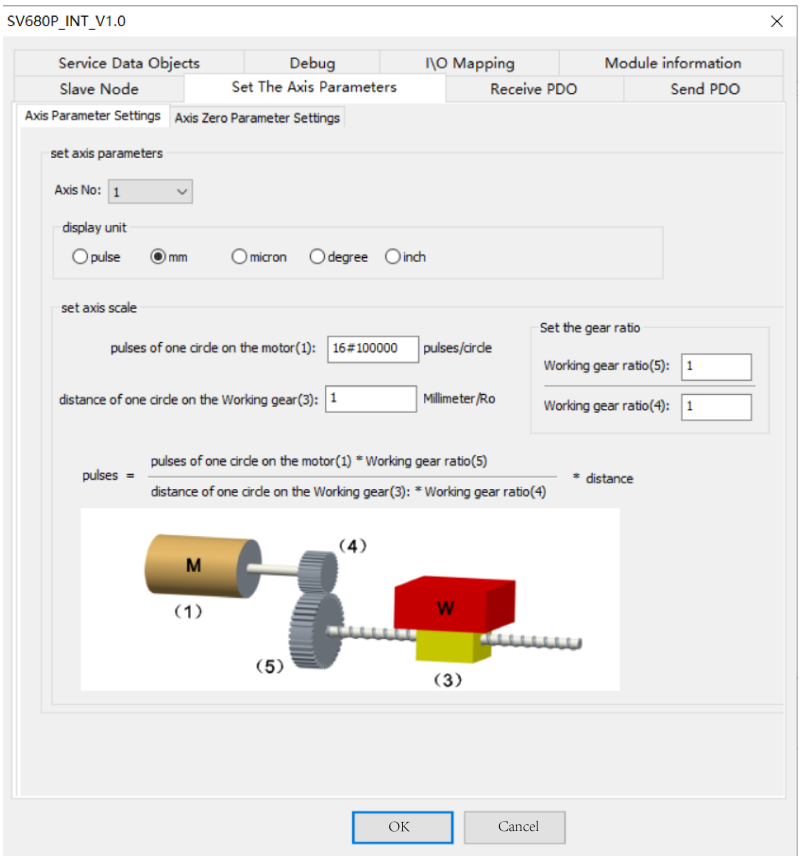
5. If the EDS file needed is not in the CANopen device list, add the device EDS file. Right-click "CANopen device list". On the short-cut menu displayed, choose "Import EDS". In the dialog box displayed, select the EDS device file needed and click Open. The device added will be displayed in the CANopen device list on the right.



6. Double-click the Easy master to open the master configuration interface, where you can configure synchronization and heartbeat parameters.



7. In the CANopen device list, double-click "SV680P_INT" to add CANopen slaves. In the configuration window displayed, double-click the SV680P_INT icon to open the slave configuration parameter list.
8. As shown in the following figure, the "Set The Axis Parameters" interface includes the "Axis Parameter Settings" and "Axis Zero Parameter Settings" tabs.

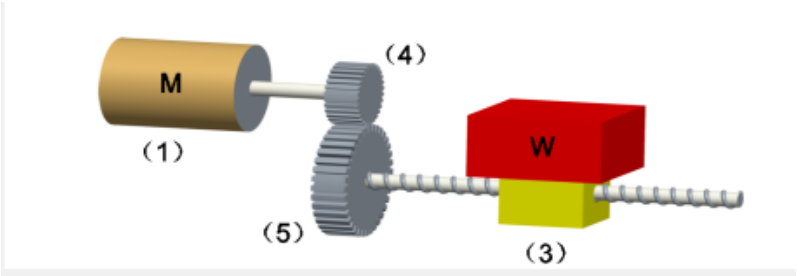


- **Configuring axis parameters**

  For devices without reducers, set the gear ratio to 1:1. Set the pulses per motor revolution and distance per motor revolution correctly. The calculation formula is as follows.

$$\text{Number of pulses} = \frac{\text{Number of reference pulses per motor revolution (1)}}{\text{Distance per motor revolution (3)}} \times \text{Displacement distance (displayed unit)}$$

  Applications with reducers are shown as follows.

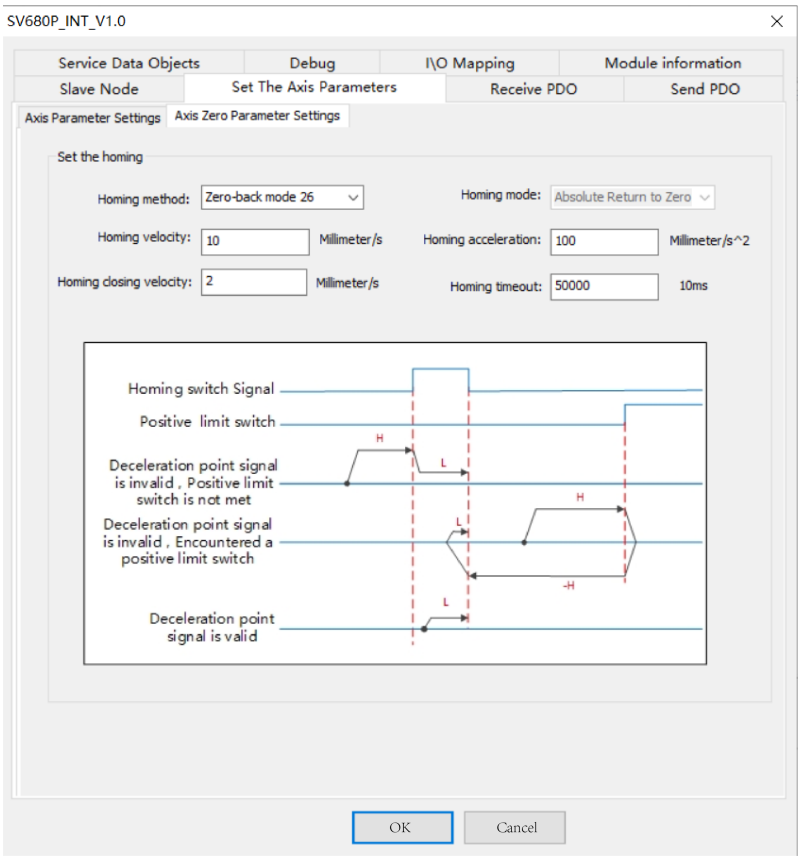


  The calculation formula for devices with reducers is as follows.

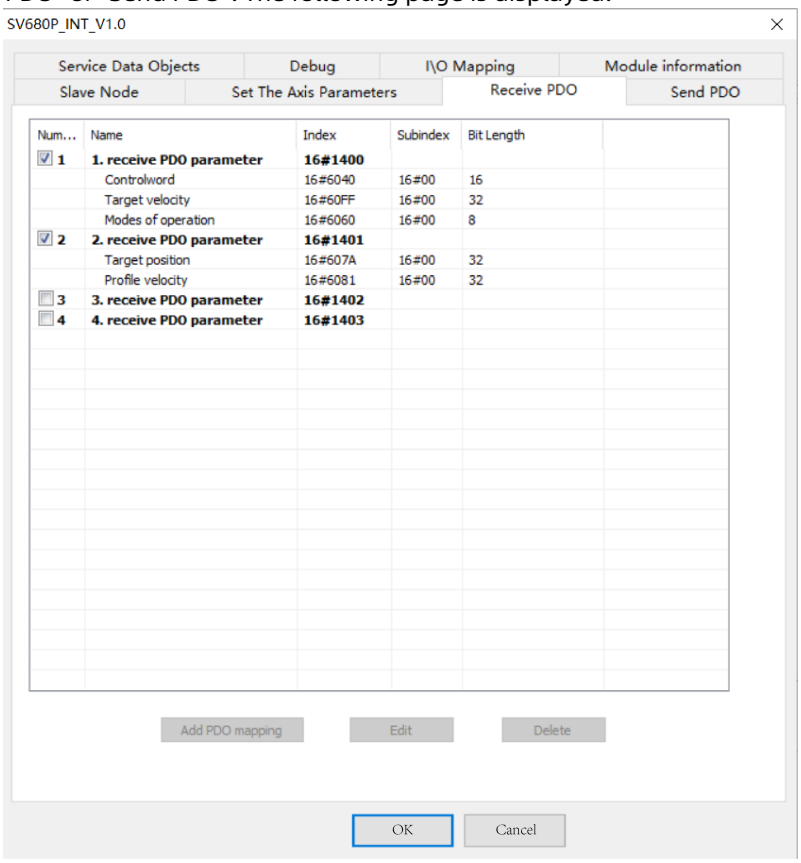
$$\text{Number of pulses} = \frac{\text{Number of reference pulses per motor revolution (1)} \times \text{Motor gear ratio (5)}}{\text{Distance per motor revolution (3)} \times \text{Operating gear ratio (4)}} \times \text{Displacement distance (displayed unit)}$$

- **Configuring homing**

  Available homing methods: 1 to 35. For details about each homing method, see *" Homing Mode (HM)" on page 359*.



9. Click "Receive PDO" or "Send PDO". The following page is displayed.

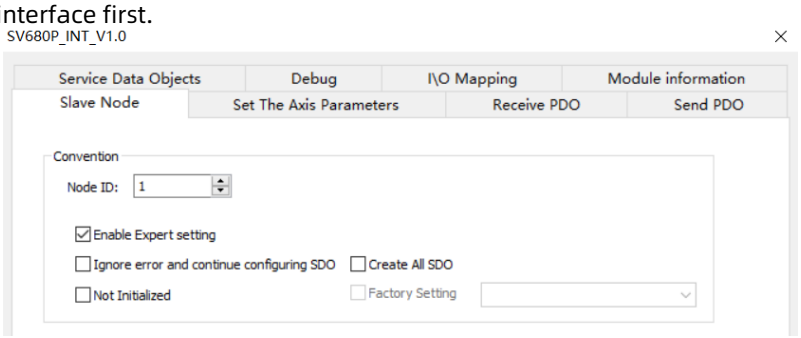


Receive PDO: The data sent by the master station to a slave station.

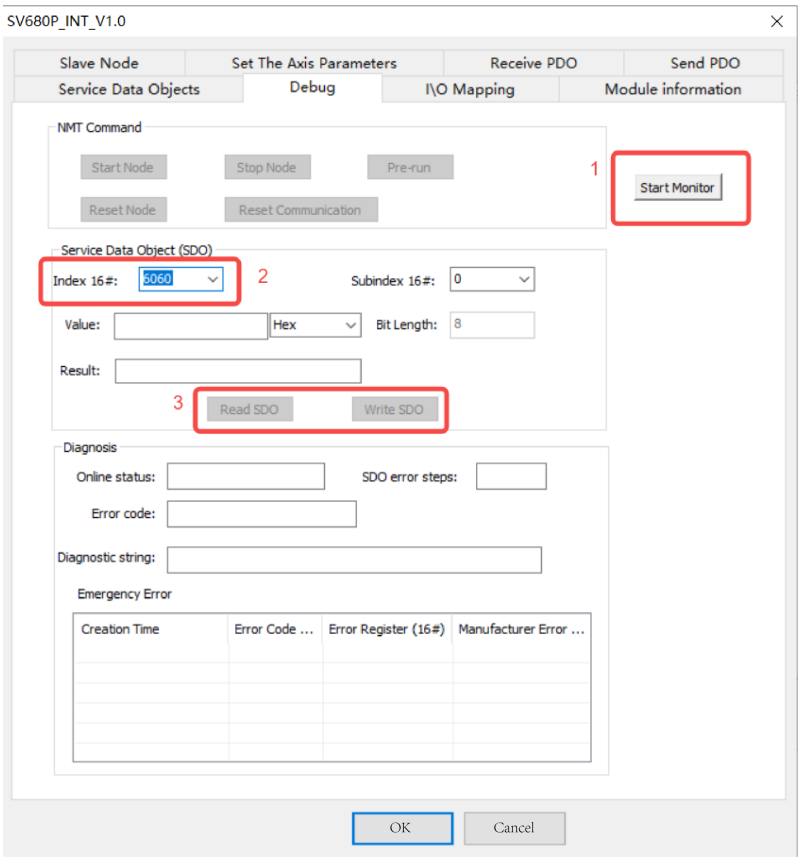
Send PDO: The data sent by a slave station to the master station.

You can check the box in front of the number to enable a PDO. The PDOs in the EDS file that take effect are checked by default. You can click "Add PDO mapping", "Edit", or "Delete" to edit PDO mapping.

10. Download the CANopen configuration to Easy. Easy starts to configure the slave based on the preceding configurations. The configuration is performed based on the object dictionary items listed on the "Servo Data Objects" interface. To view the list, select "Enable Expert Settings" on the "Slave Node" interface first.



During commissioning, you can monitor the device status online and read/write the object dictionary of the slave through Easy, as shown below.



17 Parameter Descriptions

17.1 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

Description

Indicates the corresponding number of each motor type.

H00.02 **Customized No.**

Comm. address:	2000-03h	Effective mode:	-
Min. value:	0.00	Unit:	-
Max. value:	42949672.95	Data type:	UInt32

Default value:	0.00	Change mode:	Read-only

Value range:
0.00 to 42949672.95
Description
Differentiates the customized MCU software version, which is not applicable to standard models.

H00.04 **Encoder version**

Comm. address:	2000-05h	Effective mode:	-
Min. value:	0.0	Unit:	-
Max. value:	6553.5	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Value range:
0.0 to 6553.5
Description
Saved in the encoder and used to differentiate the encoder software version.

H00.05 **Bus motor code**

Comm. address:	2000-06h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Description
Displays the code of the bus encoder motor, which is determined by the motor model and unchangeable.

H00.06 **Non-standard FPGA code**

Comm. address:	2000-07h	Effective mode:	-
Min. value:	0.00	Unit:	-
Max. value:	655.35	Data type:	UInt16
Default value:	0.00	Change mode:	Read-only

Value range:
0.00 to 655.35
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. value:	0.0	Unit:	-
Max. value:	6553.5	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Value range:
0.0 to 6553.5
Description
Displays the software version of STO function.

H00.08 **Bus encoder type**

Comm. address:	2000-09h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
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. value:	50	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	UInt16
Default value:	3000	Change mode:	At stop

Value range:
50 to 10000
Description
Defines the rated speed of the motor.

H00.15 **Maximum speed**

Comm. address:	2000-10h	Effective mode:	Next power-on
Min. value:	50	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	UInt16
Default value:	6000	Change mode:	At stop

Value range:
50 to 10000
Description
Defines the maximum speed of the motor.

H00.18 **Stator resistance**

Comm. address:	2000-13h	Effective mode:	Next power-on
Min. value:	0.001	Unit:	Ω
Max. value:	65.535	Data type:	UInt16
Default value:	0.500	Change mode:	At stop

Value range:
0.001 to 65.535

Description
Defines the motor stator resistance.

H00.19 **Stator inductance Lq**

Comm. address:	2000-14h	Effective mode:	Next power-on
Min. value:	0.01	Unit:	mH
Max. value:	655.35	Data type:	UInt16
Default value:	3.27	Change mode:	At stop

Value range:
0.01 to 655.35
Description
Defines motor stator inductance Lq.

H00.20 **Stator inductance Ld**

Comm. address:	2000-15h	Effective mode:	Next power-on
Min. value:	0.01	Unit:	mH
Max. value:	655.35	Data type:	UInt16
Default value:	3.87	Change mode:	At stop

Value range:
0.01 to 655.35
Description
Defines motor stator inductance Ld.

H00.22 **Torque coefficient Kt**

Comm. address:	2000-17h	Effective mode:	Next power-on
Min. value:	0.01	Unit:	[N/Arms]/[N·m/Arms]
Max. value:	655.35	Data type:	UInt16
Default value:	0.51	Change mode:	At stop

Value range:
0.01 to 655.35
Description
Defines the motor torque coefficient Kt.

H00.40 **Motor control type**

Comm. address:	2000-29h	Effective mode:	None
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	2	Change mode:	Read-only

Value range:
0: General-purpose rotary motor (ROT)
1: Direct drive rotary motor (DDR)
2: Direct drive linear motor (DDL)
3: Voice coil motor (VOL)
Description

Motor type supported:
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 **Master encoder configuration**

Comm. address:	2000-2Ah	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	1	Change mode:	Read-only

Value range:
0: CN2
1: CN7
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
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
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. value:	0.00	Unit:	[Mm]/[deg]
Max. value:	655.35	Data type:	UInt16
Default value:	2.00	Change mode:	At stop

Value range:
0.00 to 655.35
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. value:	0.00	Unit:	[Mm]/[deg]
Max. value:	655.35	Data type:	UInt16
Default value:	0.50	Change mode:	At stop

Value range:
0.00 to 655.35
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. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0: Optical scale
1: Magnetic scale
Description
Defines the 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. value:	0.01	Unit:	mm
Max. value:	655.35	Data type:	UInt16
Default value:	16.00	Change mode:	At stop

Value range:
0.01 to 655.35
Description
Defines the pole pitch between N-S of the linear motor.

H00.49 **Direct drive encoder resolution**

Comm. address:	2000-32h	Effective mode:	Next power-on
Min. value:	0.001	Unit:	um/p
Max. value:	65.535	Data type:	UInt16

Default value:	1.000	Change mode:	At stop

Value range:
0.001 to 65.535
Description
Defines the resolution of the linear motor readhead.

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
Description

BiSS-C:
0: CRC check value not inverted by bit
1: CRC check value inverted by bit

SSI:
0: Even check
1: Odd check

H00.55 **Rated torque (Uint32)**

Comm. address:	2000-38h	Effective mode:	Next power-on
Min. value:	0.00	Unit:	[N]/[N·m]
Max. value:	42949672.95	Data type:	UInt32
Default value:	2.00	Change mode:	At stop

Value range:
0.00 to 42949672.95
Description
Defines the rated torque of the motor.

H00.57 **Max. torque (Uint32)**

Comm. address:	2000-3Ah	Effective mode:	Next power-on
Min. value:	0.00	Unit:	[N]/[N·m]
Max. value:	42949672.95	Data type:	UInt32
Default value:	7.00	Change mode:	At stop

Value range:
0.00 to 42949672.95
Description
Defines the maximum motor torque.

H00.59 **Encoder counting direction**

Comm. address:	2000-3Ch	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: Forward
1: Reverse
Description
Defines the motor phase sequence.
0: Forward
1: Reverse

H00.63 **Maximum current (Uint32)**

Comm. address:	2000-40h	Effective mode:	Next power-on
Min. value:	0.00	Unit:	A
Max. value:	42949672.95	Data type:	UInt32
Default value:	3.00	Change mode:	At stop

Value range:
0.00 to 42949672.95
Description
Defines the maximum current.

H00.65 **Rated current (Uint32)**

Comm. address:	2000-42h	Effective mode:	Next power-on
Min. value:	0.00	Unit:	A
Max. value:	42949672.95	Data type:	UInt32
Default value:	1.00	Change mode:	At stop

Value range:
0.00 to 42949672.95
Description
Defines the rated current.

H00.67 **Moment of inertia (Uint32)**

Comm. address:	2000-44h	Effective mode:	Next power-on
Min. value:	0.00000	Unit:	[g]/[0.00001 kg·cm²]
Max. value:	42949.67295	Data type:	UInt32
Default value:	0.00001	Change mode:	At stop

Value range:
0.00000 to 42949.67295
Description
Defines the moment of inertia.

H00.69 **Linear back EMF coefficient (Uint32)**

Comm. address:	2000-46h	Effective mode:	Next power-on
Min. value:	0.00	Unit:	[V/(m/s)]/[100 mV/rpm]

Max. value:	42949672.95	Data type:	UInt32
Default value:	33.00	Change mode:	At stop

Value range:
0.00 to 42949672.95
Description
Defines the linear back EMF coefficient.

17.2 H01 Drive Parameters

H01.00 **MCU software version**

Comm. address:	2001-01h	Effective mode:	-
Min. value:	0.0	Unit:	-
Max. value:	6553.5	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Value range:
0.0 to 6553.5
Description
Displays the MCU software version.

H01.01 **FPGA software version**

Comm. address:	2001-02h	Effective mode:	-
Min. value:	0.0	Unit:	-
Max. value:	6553.5	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Value range:
0.0 to 6553.5
Description
Displays the FPGA software version.

H01.02 **Servo drive series No.**

Comm. address:	2001-03h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Description
Displays the servo drive series number.

H01.06 **Board card software version**

Comm. address:	2001-07h	Effective mode:	-
Min. value:	0.0	Unit:	-
Max. value:	6553.5	Data type:	UInt16

Default value:	0.0	Change mode:	Read-only

Value range:
0.0 to 6553.5
Description
Displays the board card software version.

H01.10 **Drive series No.**

Comm. address:	2001-0Bh	Effective mode:	Next power-on
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	3	Change mode:	At stop

Value 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
Description
Displays the drive series number.

H01.11 **DC-AC voltage level**

Comm. address:	2001-0Ch	Effective mode:	-
Min. value:	0	Unit:	V
Max. value:	65535	Data type:	UInt16
Default value:	220	Change mode:	Read-only

Value range:
0 to 65535
Description
Defines the DC-AC voltage level.

H01.12 **Rated power of the drive**

Comm. address:	2001-0Dh	Effective mode:	-

Min. value:	0.00	Unit:	kW
Max. value:	42949672.95	Data type:	UInt32
Default value:	0.40	Change mode:	Read-only

Value range:
0.00 to 42949672.95
Description
Displays the rated power of the drive.

H01.14 **Maximum output power of the drive**

Comm. address:	2001-0Fh	Effective mode:	-
Min. value:	0.00	Unit:	kW
Max. value:	42949672.95	Data type:	UInt32
Default value:	0.40	Change mode:	Read-only

Value range:
0.00 to 42949672.95
Description
Displays the maximum output power of the drive.

H01.16 **Rated output current of the drive**

Comm. address:	2001-11h	Effective mode:	-
Min. value:	0.00	Unit:	A
Max. value:	42949672.95	Data type:	UInt32
Default value:	2.80	Change mode:	Read-only

Value range:
0.00 to 42949672.95
Description
Displays the rated output current of the drive.

H01.18 **Maximum output current of the drive**

Comm. address:	2001-13h	Effective mode:	-
Min. value:	0.00	Unit:	A
Max. value:	42949672.95	Data type:	UInt32
Default value:	10.10	Change mode:	Read-only

Value range:
0.00 to 42949672.95
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. value:	0	Unit:	V
Max. value:	2000	Data type:	UInt16
Default value:	420	Change mode:	Real time

Value range:
0 to 2000
Description
Displays the DC bus overvoltage protection threshold.

H01.75 **Current loop amplification coefficient**

Comm. address:	2001-4Ch	Effective mode:	Real time
Min. value:	0.00	Unit:	-
Max. value:	655.35	Data type:	UInt16
Default value:	1.00	Change mode:	Real time

Value range:
0.00 to 655.35
Description
Displays the current loop amplification factor.

H01.88 **Junction temperature parameter version 1**

Comm. address:	2001-59h	Effective mode:	-
Min. value:	0.0	Unit:	-
Max. value:	6553.5	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Value range:
0.0 to 6553.5
Description
Display the version 1 of the junction temperature parameter.

H01.89 **Junction temperature parameter version 2**

Comm. address:	2001-5Ah	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
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
Description
The setpoint 1 indicates that the bit function of H00.60 is being masked.

17.3 H02 Basic Control Parameters

H02.00 **Control mode selection**

Comm. address:	2002-01h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	8	Data type:	UInt16
Default value:	1	Change mode:	At stop

Value range:

0: Speed control mode

1: Position control mode

2: Torque control mode

3: Torque/Speed control mode

4: Speed/Position control mode

5: Torque/Position control mode

6: Torque/Speed/Position compound mode

7: Process segment

8: CANopen mode

Description

Select the servo control mode

0: Speed control mode

1: Position control mode

2: Torque control mode

3: Torque/Speed control mode

4: Speed/Position control mode

5: Torque/Position control mode

6: Torque/Speed/Position compound mode

7: Process segment

8: CANopen mode

H02.01 **Absolute system selection**

Comm. address:	2002-02h	Effective mode:	Next power-on
Min. value:	0	Unit:	-
Max. value:	4	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value 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

Description

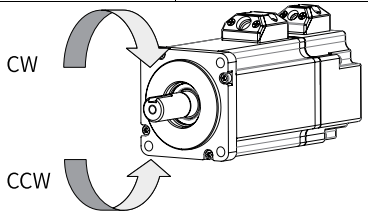
Defines the absolute encoder system mode.
0: Incremental mode
1: Absolute position linear mode
2: Absolute position rotation mode
3: Absolute position linear mode (without encoder overflow alarm)
4: Absolute position single-turn mode

H02.02 **Direction of rotation**

Comm. address:	2002-03h	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: CCW direction as the forward direction
1: CW direction as the forward direction
Description
Defines the forward direction of the motor when viewed from the motor shaft side.

Setpoint	Direction of rotation	Remarks
0	CCW direction as forward direction	When a forward command is input, the motor rotates in CCW direction viewed from the motor shaft side, that is, the motor rotates counterclockwise.
1	CW direction as forward direction	When a forward command is input, the motor rotates in CW direction viewed from the motor shaft side, that is, the motor rotates clockwise.

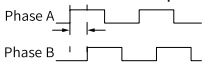
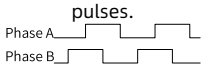


H02.03 **Output pulse phase**

Comm. address:	2002-04h	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: Phase A leads phase B
1: Phase A lags behind phase B
Description

Defines the relationship between phase A and phase B on the condition that the motor direction of rotation remains unchanged when pulse output is enabled.

Setpoint	Output pulse phase	Remarks
0	Phase A advancing phase B	Phase A leads phase B by 90° in encoder frequency-division output pulses. 
1	Phase A lagging phase B	Phase A lags behind phase B by 90° in encoder frequency-division output pulses. 

H02.05 **Stop mode at S-OFF**

Comm. address:	2002-06h	Effective mode:	At stop
Min. value:	-4	Unit:	-
Max. value:	2	Data type:	Int16
Default value:	0	Change mode:	Real time

Value range:

-4: Stop based on ramp 2, keeping dynamic braking state

-3: Stop at zero speed, keeping dynamic braking state

-2: Stop based on ramp 1, keeping dynamic braking state

-1: Dynamic braking stop, keeping dynamic braking state

0: Coast to stop, keeping de-energized state

1: Stop based on ramp 1, keeping de-energized state

2: Dynamic braking stop, keeping de-energized state

Description

Defines the deceleration mode of the motor for stopping rotating upon S-OFF and the motor state after stop.

-4: Ramp to stop based on ramp 2, keeping dynamic braking state

-3: Stop at zero speed, keeping dynamic braking state

-2: Ramp to stop based on ramp 1, keeping dynamic braking state

-1: Dynamic braking stop, keeping dynamic braking state

0: Coast to stop, keeping de-energized state

1: Dynamic braking stop, keeping de-energized state

2: Dynamic braking stop, keeping dynamic braking state

Note: After the brake is enabled, H02.08 will be forcibly set to 2 (Dynamic braking stop, keeping dynamic braking state).

H02.06 **Stop mode at No.2 fault**

Comm. address:	2002-07h	Effective mode:	At stop
Min. value:	-5	Unit:	-
Max. value:	4	Data type:	Int16
Default value:	2	Change mode:	Real time

Value range:

-5: Stop at zero speed, keeping dynamic braking state
-4: Stop at emergency stop torque, keeping dynamic braking state
-3: Stop based on ramp 2, keeping dynamic braking state
-2: Stop based on ramp 1, keeping dynamic braking state
-1: Dynamic braking stop, keeping dynamic braking state
0: Coast to stop, keeping de-energized state
1: Stop based on ramp 1, keeping de-energized state
2: Stop based on ramp 2, keeping de-energized state
3: Stop at emergency stop torque, keeping de-energized state
4: Dynamic braking stop, keeping de-energized state

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 based on ramp 2, keeping dynamic braking state
-2: Ramp to stop based on ramp 1, keeping dynamic braking state
-1: Dynamic braking stop, keeping dynamic braking state
0: Coast to stop, keeping de-energized state
1: Ramp to stop as defined by 6084h/609Ah (HM), keeping de-energized state
2: Ramp to stop as defined by 6085h, keeping de-energized state
3: Stop at emergency-stop torque, keeping de-energized state
4: Dynamic braking stop, keeping de-energized state

Note: After the brake is enabled, H02.06 will be forcibly set to -3 (Stop at emergency-stop torque as defined by 6085h, keeping de-energized state).

H02.07 **Stop mode at overtravel**

Comm. address:	2002-08h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	7	Data type:	UInt16
Default value:	1	Change mode:	At stop

Value 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: Stop based on ramp 2, keeping de-energized state
4: Stop based on ramp 2, 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

Description

Defines the deceleration mode of the 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 ramp 2, keeping de-energized state
4: Stop based on ramp 2, 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. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	2	Change mode:	At stop

Value 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
Description
Defines the deceleration mode of the motor for stopping rotating and the motor state when a No. 1 fault occurs.
0: Coast to stop, keeping de-energized state
1: Dynamic braking stop, keeping de-energized state
2: Dynamic braking stop, keeping dynamic braking state
Note: After the brake is enabled, H02.08 will be forcibly set to 2 (Dynamic braking stop, keeping dynamic braking state).

H02.09 Delay from brake output ON to command received

Comm. address:	2002-0Ah	Effective mode:	At stop
Min. value:	0	Unit:	ms
Max. value:	500	Data type:	UInt16
Default value:	250	Change mode:	Real time

Value range:
0 to 500
Description
Defines the delay from the moment the brake output signal is ON to the moment the 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. value:	50	Unit:	ms

Max. value:	1000	Data type:	UInt16
Default value:	150	Change mode:	Real time

Value range:
50 to 1000
Description
Defines the delay time from motor standstill (de-energized) to brake output OFF.

H02.11 Motor speed threshold at brake output OFF in rotation state

Comm. address:	2002-0Ch	Effective mode:	Real time
Min. value:	20	Unit:	[mm/s]/[rpm]
Max. value:	3000	Data type:	UInt16
Default value:	30	Change mode:	Real time

Value range:
20 to 3000
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 the rotary state

Comm. address:	2002-0Dh	Effective mode:	Real time
Min. value:	1	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	500	Change mode:	Real time

Value range:
1 to 65535
Description
Defines the delay time from BK OFF to S-ON OFF when the motor is in the rotation state.

H02.15 Alarm display on the LED

Comm. address:	2002-10h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0: Immediately output alarm message
1: Do not output alarm message
Description
Defines whether to switch the keypad to the fault display mode when a No. 3 alarm occurs.
0: Immediately output alarm message
1: Do not output alarm message

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
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. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	2	Change mode:	Real time

Value 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
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. value:	0	Unit:	-
Max. value:	7	Data type:	UInt16
Default value:	2	Change mode:	Real time

Value range:
0: Coast to stop, keeping de-energized state
1: Stop by ramp 1, keeping de-energized state
2: Stop by ramp 2, keeping de-energized state
3: Stop at emergency stop torque, keeping de-energized state
5: Stop by ramp 1, keeping position lock state
6: Stop by ramp 2, keeping position lock state
7: Stop at emergency stop torque, keeping position lock state
Description

Defines the deceleration mode of the motor for stopping rotating upon quick stop and the motor state after stop.
0: Coast to stop, keeping de-energized state
1: Ramp to stop based on ramp 1, keeping de-energized state
2: Ramp to stop based on ramp 2, keeping de-energized state
3: Stop at emergency stop torque, keeping de-energized state
5: Ramp to stop based on ramp 1, keeping position lock state
6: Ramp to stop based on ramp 2, keeping position lock state
7: Stop at emergency stop torque, keeping position lock state
Note: After the brake is enabled, if the setpoint of H02.18 is lower than 4, this parameter will be set to 2 forcibly.

H02.21 **Min. allowable resistance of braking resistor**

Comm. address:	2002-16h	Effective mode:	-
Min. value:	1	Unit:	Ω
Max. value:	1000	Data type:	UInt16
Default value:	40	Change mode:	Read-only

Value range:
1 to 1000
Description
The minimum allowable resistance of the braking resistor is only related to the drive model.

H02.22 **Power of built-in braking resistor**

Comm. address:	2002-17h	Effective mode:	-
Min. value:	0	Unit:	W
Max. value:	65535	Data type:	UInt16
Default value:	50	Change mode:	Read-only

Value range:
0 to 65535
Description
The power of the built-in braking resistor is dependent on the drive model and cannot be modified.

H02.23 **Resistance of built-in braking resistor**

Comm. address:	2002-18h	Effective mode:	-
Min. value:	0	Unit:	Ω
Max. value:	65535	Data type:	UInt16
Default value:	50	Change mode:	Read-only

Value range:
0 to 65535
Description
The resistance of the built-in braking resistor is dependent on the drive model and cannot be modified.

Table 17–1 Braking resistor specifications

Drive model	Specifications of built-in braking resistors			Min. allowable resistance of external braking resistor (Ω) (H02.21)
	Resistance (Ω)	Power (Pr) (W)	Processing power Pa (W)	
SV680PS1R6I-*INT	-	-	-	40
SV680PS2R8I-*INT	-	-	-	
SV680PS5R5I-*INT	50	50	40	
SV680PS7R6I-*INT	25	80	64	20
SV680PS012I-*INT				15
SV680PS018I-*INT	20	100	80	20
SV680PS022I-*INT				
SV680PS027I-*INT				
SV680PT5R4I-*INT	100	80	64	60
SV680PT8R4I-*INT	50			45
SV680PT012I-*INT				40
SV680PT017I-*INT	35	100	80	35
SV680PT021I-*INT				25
SV680PT026I-*INT				

H02.24 Resistor heat dissipation coefficient

Comm. address:	2002-19h	Effective mode:	Real time
Min. value:	10	Unit:	%
Max. value:	100	Data type:	UInt16
Default value:	30	Change mode:	Real time

Value range:

10 to 100

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.

Recommendation:

Generally, the value of H02.24 cannot exceed 30% for natural cooling.

The value of H02.24 cannot exceed 50% for forced air cooling.

H02.25 Braking resistor type

Comm. address:	2002-1Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	3	Change mode:	Real time

Value range:

0: Built-in

1: External, natural cooling

2: External, forced air cooling

3: No resistor needed

Description

Defines the resistor type and the mode of absorbing and releasing the braking energy.

0: Built-in

1: External, natural cooling

2: External, forced air cooling

3: No resistor needed

H02.26 Power of external braking resistor

Comm. address:	2002-1Bh	Effective mode:	Real time
Min. value:	1	Unit:	W
Max. value:	65535	Data type:	UInt16
Default value:	40	Change mode:	Real time

Value range:

1 to 65535

Description

Defines the power of the external braking resistor.

H02.27 Resistance of external braking resistor

Comm. address:	2002-1Ch	Effective mode:	Real time
Min. value:	15	Unit:	Ω
Max. value:	1000	Data type:	UInt16
Default value:	50	Change mode:	Real time

Value range:

15 to 1000

Description

Defines the resistance of the external braking resistor.

H02.28 Parameter initialization option

Comm. address:	2002-1Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value 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)

Description

Defines the option for restoring default settings.

0: Parameters in group H02 and above initialized

1: Parameters in group H00, H02 and above initialized

2: All parameters initialized (default values used for model-related parameters)

H02.30 User password

Comm. address:	2002-1Fh	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
Description
Defines the user password.

H02.31 **System parameter initialization**

Comm. address:	2002-20h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0: No operation
1: Restore default settings
2: Clear fault records
Description
Restores default values or clears 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. value:	0	Unit:	-
Max. value:	99	Data type:	UInt16
Default value:	50	Change mode:	Real time

Value range:
0 to 99
Description
Defines the offset of the parameter to be displayed on the keypad.
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 keypad.

H02.35 **Keypad data update frequency**

Comm. address:	2002-24h	Effective mode:	Real time
Min. value:	0	Unit:	Hz
Max. value:	20	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 20
Description
Defines the operating panel data refresh frequency.

H02.38 **Overload time of external resistor**

Comm. address:	2002-27h	Effective mode:	Next power-on
Min. value:	0	Unit:	s
Max. value:	200	Data type:	UInt16
Default value:	40	Change mode:	Real time

Value range:
0 to 200
Description
Defines the overload time threshold of the external braking resistor.

H02.41 **Manufacturer password**

Comm. address:	2002-2Ah	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
Description
Enter the manufacturer password to access the manufacturer-specific parameters.

H02.47 **Delay time from power cable breakage to brake OFF**

Comm. address:	2002-30h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	1000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 1000
Description
Defines the delay time from power cable disconnection to brake OFF.

17.4 H03 Terminal Input Parameters

H03.00 **DI function assignment 1 (activated upon power-on)**

Comm. address:	2003-01h	Effective mode:	Next power-on
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Real time

Value range:

0: 0x00: Corresponding to null
1: 0x01: Corresponding to FunIN.1
2: 0x02: Corresponding to FunIN.2
4: 0x04: Corresponding to FunIN.3
8: 0x08: Corresponding to FunIN.4
16: 0x10: Corresponding to FunIN.5
32: 0x20: Corresponding to FunIN.6
64: 0x40 Corresponding to FunIN.7
128: 0x80: Corresponding to FunIN.8
256: 0x100: Corresponding to FunIN.9
512: 0x200: Corresponding to FunIN.10
1024: 0x400: Corresponding to FunIN.11
2048: 0x800: Corresponding to FunIN.12
4096: 0x1000: Corresponding to FunIN.13
8192: 0x2000: Corresponding to FunIN.14
16384: 0x4000: Corresponding to FunIN.15
32768: 0x8000: Corresponding to FunIN.16

Description

Allows a certain DI function (FunIN.1 to FunIN.16) to be activated immediately at next power-on.

H03.01 **DI function assignment 2 (activated upon power-on)**

Comm. address:	2003-02h	Effective mode:	Next power-on
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Real time

Value range:

0: 0x00: Corresponding to null
1: 0x01: Corresponding to FunIN.17
2: 0x02: Corresponding to FunIN.18
4: 0x04: Corresponding to FunIN.19
8: 0x08: Corresponding to FunIN.20
16: 0x10: Corresponding to FunIN.21
32: 0x20: Corresponding to FunIN.22
64: 0x40: Corresponding to FunIN.23
128: 0x80: Corresponding to FunIN.24
256: 0x100: Corresponding to FunIN.25
512: 0x200: Corresponding to FunIN.26
1024: 0x400: Corresponding to FunIN.27
2048: 0x800: Corresponding to FunIN.28
4096: 0x1000: Corresponding to FunIN.29
16384: 0x4000: Corresponding to FunIN.31
32768: 0x8000: Corresponding to FunIN.32

Description

Allows a certain DI function (FunIN.17 to FunIN.32) to be activated immediately at next power-on.

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

Value range:

0: No assignment

1: S-ON

2: Warning reset signal

3: Gain switchover switch

4: Switchover between main and auxiliary references

5: Multi-reference direction

6: Multi-reference switchover CMD1

7: Multi-reference switchover CMD2

8: Multi-reference switchover CMD3

9: Multi-reference switchover CMD4

10: Mode switchover M1-SEL

11: Mode switchover M2-SEL

12: Zero clamp enable signal

13: Position reference inhibited

14: Positive limit switch

15: Negative limit switch

16: Positive external torque limit

17: Negative external torque limit

18: Forward jog

19: Reverse jog
20: Step enable
21: Hand wheel override signal
22: Hand wheel override signal 2
23: Hand wheel enable signal
24: Electronic gear ratio selection
25: Torque reference direction
26: Speed reference direction
27: Position reference direction
28: Multi-position reference enable
29: Interrupt positioning canceled
31: Home switch
32: Enable homing
33: Disable interrupt positioning
34: Emergency stop
35: Clear position deviation
36: Internal speed limit source
37: Disable pulse reference
38: Touch probe 1
39: Touch probe 2
40: Enable multi-speed
41: Current position as home
42: Axis control command executed immediately
43: Axis control command not executed immediately
44: Clear positioning and command completed signal
45: Enable interrupt positioning
46: Enable process segment
47: Process segment command switchover 1
48: Process segment command switchover 2
49: Process segment command switchover 3
50: Process segment command switchover 4
51: Event trigger process segment 1
52: Event trigger process segment 2
53: Event trigger process segment 3
54: Event trigger process segment 4
55: Pause process segment
56: Gantry torque alignment
57: Enable gantry alignment by DI signal
58: Clear gantry alignment by DI signal
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

Value range:
0: Normally open
1: Closed
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

Value range:
Same as H03.02
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

Value range:
0: Normally open
1: Closed
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:	13	Change mode:	Real time

Value range:
Same as H03.02
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

Value range:
0: Normally open
1: Closed
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:	2	Change mode:	Real time

Value range:
Same as H03.02
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

Value range:
0: Normally open
1: Closed
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:	1	Change mode:	Real time

Value range:
Same as H03.02
Parameter description
Defines the function of DI5.

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

Value range:
0: Normally open
1: Closed

Description
Defines the level logic of DI5 when the function assigned to DI5 is active.

H03.12 **DI6 terminal function selection**

Comm. address:	2003-0Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	59	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
Same as H03.02
Parameter description
Defines the function of DI6.

H03.13 **DI6 terminal logic selection**

Comm. address:	2003-0Eh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0: Normally open
1: Closed
Description
Defines the level logic of DI6 when the function assigned to DI6 is active.

H03.14 **DI7 function selection**

Comm. address:	2003-0Fh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	59	Data type:	UInt16
Default value:	45	Change mode:	Real time

Value range:
Same as H03.02
Parameter description
Defines the function of DI7.

H03.15 **DI7 terminal logic selection**

Comm. address:	2003-10h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0: Normally open
1: Closed
Description
Defines the level logic of DI7 when the function assigned to DI7 is active.

H03.16 **DI8 terminal function selection**

Comm. address:	2003-11h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	59	Data type:	UInt16
Default value:	31	Change mode:	Real time

Value range:
Same as H03.02
Parameter description
Defines the function of DI8.

H03.17 **DI8 terminal logic selection**

Comm. address:	2003-12h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0: Normally open
1: Closed
Description
Defines the level logic of DI8 when the function assigned to DI8 is active.

H03.34 **DI function assignment 3 (activated upon power-on)**

Comm. address:	2003-23h	Effective mode:	Next power-on
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Real time

Value range:
0: 0x00: Corresponding to null
1: 0x01: Corresponding to FunIN.33
2: 0x02: Corresponding to FunIN.34
4: 0x04: Corresponding to FunIN.35
8: 0x08: Corresponding to FunIN.36
16: 0x10: Corresponding to FunIN.37
32: 0x20: Corresponding to FunIN.38

64: 0x40: Corresponding to FunIN.39
128: 0x80: Corresponding to FunIN.40
256: 0x100: Corresponding to FunIN.41
512: 0x200: Corresponding to FunIN.42
1024: 0x400: Corresponding to FunIN.43
2048: 0x800: Corresponding to FunIN.44
4096: 0x1000: Corresponding to FunIN.45
8192: 0x2000: Corresponding to FunIN.46
16384: 0x4000: Corresponding to FunIN.4732768: 0x8000: Corresponding to FunIN.48

Description

Enables a certain DI function (FunIN.33 to FunIN.37) to be activated immediately at next power-on.

H03.35 DI function assignment 4 (activated upon power-on)

Comm. address:	2003-24h	Effective mode:	Next power-on
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Real time

Value range:

0: 0x00: Corresponding to null

1: 0x01: Corresponding to FunIN.49

2: 0x02: Corresponding to FunIN.50

4: 0x04: Corresponding to FunIN.51

8: 0x08: Corresponding to FunIN.52

16: 0x10: Corresponding to FunIN.53

32: 0x20: Corresponding to FunIN.54

64: 0x40: Corresponding to FunIN.55

128: 0x80: Corresponding to FunIN.56

256: 0x100: Corresponding to FunIN.57

512: 0x200: Corresponding to FunIN.58

1024: 0x400: Corresponding to FunIN.59

2048: 0x800: Corresponding to FunIN.60

4096: 0x1000: Corresponding to FunIN.61

8192: 0x2000: Corresponding to FunIN.62

16384: 0x4000: Corresponding to FunIN.63

Description

Enables a certain DI function (FunIN.49 to FunIN.64) to be activated immediately at next power-on.

H03.49 AI1/AI2 dead zone mode

Comm. address:	2003-32h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0 to 1

Description

Defines whether analog input AI1/AI2 is in dead zone mode.

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

Value range:
-5000 to +5000
Description
Defines the actual input voltage of AI1 when the drive sampling voltage is 0 after zero drift calibration.

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

Value range:
0.00 to 655.35
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 false operation caused by interference signals.
The filter function cannot eliminate or suppress the 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

Value range:
0.0 to 1000.0
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

Value range:
-500.0 to +500.0
Description
Zero drift refers to the voltage sampled by the drive relative to GND when the analog input voltage is 0.
Set H0d.10 (AI1 tuning) to 1 (AI1 tuning) to perform automatic tuning on AI1 zero drift. The AI1 zero drift after tuning will be saved into 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

Value range:
-5000 to +5000
Description
Defines the actual input voltage of AI2 when the drive sampling voltage is 0 after zero drift calibration.

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

Value range:
0.00 to 655.35
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 false operation caused by interference signals.
The filter function cannot eliminate or suppress the 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

Value range:
0.0 to 1000.0
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

Value range:
-500.0 to +500.0
Description
Zero drift refers to the voltage sampled by the drive relative to GND when the analog input voltage is 0.
Set H0d.10 (AI2 tuning) to 2 (AI2 tuning) to perform automatic tuning on AI2 zero drift. The AI2 zero drift after tuning will be saved into 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

Value range:
0.00 to 500.00
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

Value range:
0.00 to 500.00
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

Value range:
0.00 to 500.00
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

Value range:
0.00 to 500.00
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

Value range:
0.00 to 500.00
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.

H03.65 **DI6 filter time**

Comm. address:	2003-42h	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

Value range:
0.00 to 500.00
Description
Defines the filter time of DI6. The DI function is active only after the effective level is kept within the time defined by H03.65.

H03.66 **DI7 filter time**

Comm. address:	2003-43h	Effective mode:	Real time
Min. value:	0.00	Unit:	ms
Max. value:	500.00	Data type:	UInt16
Default value:	0.00	Change mode:	Real time

Value range:
0.00 to 500.00
Description
Defines the filter time of DI7. The DI function is active only after the effective level is kept within the time defined by H03.66.

H03.67 **DI8 filter time**

Comm. address:	2003-44h	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

Value range:
0.00 to 500.00
Description
Defines the filter time of DI8. The DI function is active only after the effective level is kept within the time defined by H03.67.

H03.80 **Speed corresponding to analog 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

Value range:
0 to 10000
Description
Defines the corresponding motor speed when the sampling voltage is 10 V.
Speed reference value = Sampling voltage ÷ 10 × H03.80

H03.81 **Torque corresponding to analog 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

Value range:
0.00 to 8.00
Description
Defines the corresponding motor torque when the sampling voltage is 10 V.
Torque reference value = Sampling voltage ÷ 10 × H03.81

17.5 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

Value range:

0: No function
1: Servo ready
2: Motor rotation signal
3: Zero speed signal
4: Speed matching signal
5: Positioning completed
6: Positioning near
7: Torque limited signal
8: Speed limited signal
9: Braking
10: Warning
11: Fault
15: Interrupt positioning completed
16: Homing completed
17: Electrical homing completed
18: Torque reached signal
19: Speed reached signal
21: Enable completed
22: Internal command completed
23: Writing next command allowed
24: Internal motion completed
25: Comparison output
26: Closed-loop state
27: Left limit
28: Right limit
30: Warning or fault output
31: Communication-forced DO
32: EDM output
33: Gantry synchronization

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

Value range:

0: Normally open
1: Closed

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:	5	Change mode:	Real time

Value range:
0: No function
1: Servo ready
2: Motor rotation signal
3: Zero speed signal
4: Speed matching signal
5: Positioning completed
6: Positioning near
7: Torque limited signal
8: Speed limited signal
9: Braking
10: Warning
11: Fault
15: Interrupt positioning completed
16: Homing completed
17: Electrical homing completed
18: Torque reached signal
19: Speed reached signal
21: Enable completed
22: Internal command completed
23: Writing next command allowed
24: Internal motion completed
25: Comparison output
26: Closed-loop state
27: Left limit
28: Right limit
30: Warning or fault output
31: Communication-forced DO
32: EDM output
33: Gantry synchronization

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

Value range:
0: Normally open
1: Closed

Description
Defines the level logic of DO2 when the function assigned to DO2 is active.

H04.04 **DO3 function selection**

Comm. address:	2004-05h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	33	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0: No function
1: Servo ready
2: Motor rotation signal
3: Zero speed signal
4: Speed matching signal
5: Positioning completed
6: Positioning near
7: Torque limited signal
8: Speed limited signal
9: Braking
10: Warning
11: Fault
15: Interrupt positioning completed
16: Homing completed
17: Electrical homing completed
18: Torque reached signal
19: Speed reached signal
21: Enable completed
22: Internal command completed
23: Writing next command allowed
24: Internal motion completed
25: Comparison output
26: Closed-loop state
27: Left limit
28: Right limit
30: Warning or fault output
31: Communication-forced DO
32: EDM output
33: Gantry synchronization

Description
Defines the function of DO3.

H04.05 **DO3 logic**

Comm. address:	2004-06h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16

Default value:	0	Change mode:	Real time

Value range:
0: Normally open
1: Closed
Description
Defines the level logic of DO3 when the function assigned to DO3 is active.

H04.06 **DO4 function selection**

Comm. address:	2004-07h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	33	Data type:	UInt16
Default value:	11	Change mode:	Real time

Value range:
0: No function
1: Servo ready
2: Motor rotation signal
3: Zero speed signal
4: Speed matching signal
5: Positioning completed
6: Positioning near
7: Torque limited signal
8: Speed limited signal
9: Braking
10: Warning
11: Fault
15: Interrupt positioning completed
16: Homing completed
17: Electrical homing completed
18: Torque reached signal
19: Speed reached signal
21: Enable completed
22: Internal command completed
23: Writing next command allowed
24: Internal motion completed
25: Comparison output
26: Closed-loop state
27: Left limit
28: Right limit
30: Warning or fault output
31: Communication-forced DO
32: EDM output
33: Gantry synchronization
Description
Defines the function of DO4.

H04.07 **DO4 logic selection**

Comm. address:	2004-08h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0: Normally open

1: Closed

Description

Defines the level logic of DO4 when the function assigned to DO1 is active.

H04.08 **DO5 terminal function selection**

Comm. address:	2004-09h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	33	Data type:	UInt16
Default value:	16	Change mode:	Real time

Value range:

0: No function
1: Servo ready
2: Motor rotation signal
3: Zero speed signal
4: Speed matching signal
5: Positioning completed
6: Positioning near
7: Torque limited signal
8: Speed limited signal
9: Braking
10: Warning
11: Fault
15: Interrupt positioning completed
16: Homing completed
17: Electrical homing completed
18: Torque reached signal
19: Speed reached signal
21: Enable completed
22: Internal command completed
23: Writing next command allowed
24: Internal motion completed
25: Comparison output
26: Closed-loop state
27: Left limit
28: Right limit
30: Warning or fault output
31: Communication-forced DO
32: EDM output
33: Gantry synchronization

Description

Defines the function of DO5.

H04.09 **DO5 terminal logic selection**

Comm. address:	2004-0Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0: Normally open
1: Closed

Description

Defines the level logic of DO5 when the function assigned to DO5 is active.

H04.22 **DO source**

Comm. address:	2004-17h	Effective mode:	Real time

Min. value: 0
Max. value: 31
Default value: 0
Unit: -
Data type: UInt16
Change mode: Real time

Value range:
bit0: DO1
0: DO1 function output
1: bit0 of H31.04
bit1: DO2
0: DO2 function output
1: bit1 of H31.04
bit2: DO3
0: DO3 function output
1: bit2 of H31.04
bit3: DO4
0: DO4 function output
1: bit3 of H31.04
bit4: DO5
0: DO5 function output
1: bit4 of H31.04

Description
Defines whether the logic of a physical DO terminal is defined by the actual state of the drive or by communication.

H04.22 is displayed in decimal format on the keypad. After H04.22 is converted to a binary equivalent, setting bit(n) of H04.22 to 0 indicates that DO (n+1) logic is determined by the servo drive state. Setting bit(n) of H04.22 to 1 indicates that DO(n+1) logic is determined by communication (H31.04).

Value Range (Decimal)	Setpoint (binary)					DO Logic	
	bit4	bit3	bit2	bit1	bit0	Defined by the drive state	Defined by communication (H31.04)
	DO5	DO4	DO3	DO2	DO1		
0	0	0	0	0	0	DO1 to DO5	None
1	0	0	0	0	1	DO2 to DO5	DO1
...	...	...	...	...	...	...	...
31	1	1	1	1	1	None	DO1 to DO5

H04.23 Communication-forced DO logic in non-operational state

Comm. address: 2004-18h
Min. value: 0
Max. value: 31
Default value: 0
Effective mode: Real time
Unit: -
Data type: UInt16
Change mode: Real time

Value range:

bit0: DO1

0: Status unchanged

1: No output

bit1: DO2

0: Status unchanged

1: No outputbit

2: DO3

0: Status unchanged

1: No output

bit3: DO4

0: Status unchanged

1: No output

bit4: DO5

0: Status unchanged

1: No output

Description

Defines the DO status when communication is disconnected.

H04.24 **DO brake**

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

Value range:

0: Disable

1: Enable

Description

0: Brake control by DO is not enabled. The motor brake can only be controlled by the built-in brake.

1: Brake control by DO is enabled. Configure the DO brake function and disable the SBC 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

Description

Defines the physical value source of AO1.

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

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

Value range:

-10000 to 10000

Description

It sets the actual AO1 output voltage after offset when the theoretical output voltage is 0 V.

H04.52 **AO1 scaling 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

Value range:

-99.99 to +99.99

Description

It sets the actual AO1 output voltage after amplification when theoretical output voltage is 1 V.

17.6 H05 Position Control Parameters

H05.00 **Main position reference source**

Comm. address:	2005-01h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0: Pulse reference

1: Step amount

2: Multi-position reference

Description

Defines the position reference source in the position control mode.

0: Pulse reference

1: Step amount

2: Multi-position reference

H05.01 **Position pulse reference input terminal selection**

Comm. address:	2005-02h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0: Low speed

1: High speed

Description

Sets the physical input terminal based on the input pulse frequency when the pulse reference acts as the position reference source in position control mode.

0: Low speed

1: High speed

H05.02 **Number of position references per motor revolution**

Comm. address:	2005-03h	Effective mode:	Next power-on
Min. value:	0	Unit:	[P/N-N]/[P/Rev]
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	At stop

Value range:

0 to 4294967295

Description

Defines the number of pulses required per revolution of the motor.

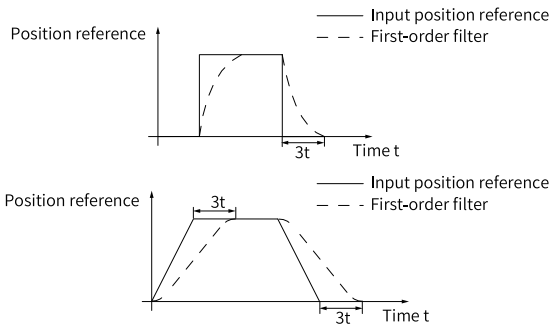
H05.04 **First-order low-pass filter time constant**

Comm. address:	2005-05h	Effective mode:	Real time
Min. 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
Description
Defines the first-order low pass filter time constant of position references.

If position reference P is rectangular wave or trapezoidal wave, the position reference after first-order low pass filtering is as follows:



This function has no effect on the displacement (total pulses of position references). If the setting is excessive, the response delay may be too large. Set the filter time constant based on actual conditions.

H05.05 **Step size**

Comm. address:	2005-06h	Effective mode:	Real time
Min. value:	-9999	Unit:	Reference unit
Max. value:	9999	Data type:	Int16
Default value:	50	Change mode:	At stop

Value range:
-9999 to +9999
Description
Defines the position reference sum when the step reference acts as the main position reference source.

H05.06 **Moving average filter time constant 1**

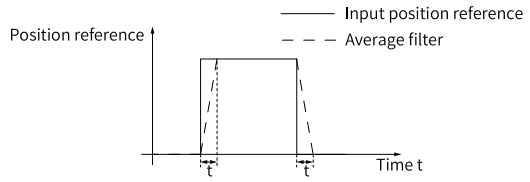
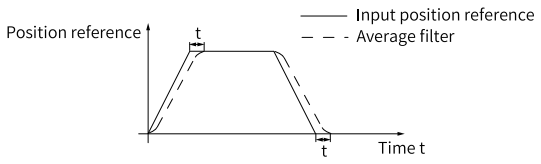
Comm. address:	2005-07h	Effective mode:	Real time
Min. value:	0.0	Unit:	ms
Max. value:	128.0	Data type:	UInt16
Default value:	0.0	Change mode:	At stop

Value range:
0.0 to 128.0

Description

Defines the moving average filter time constant for the first group of position references.

Defines the moving average filter time constant of position references. If position reference P is rectangular wave or trapezoidal wave, the position reference after average filtering is as follows. This function does not affect the displacement value (position reference sum). If the setting is excessive, the response delay may be too large. Set the filter time constant based on actual conditions.

Position reference being rectangular wave	Position reference being trapezoidal wave
	

H05.07 **Electronic gear ratio 1 (numerator)**

Comm. address:	2005-08h	Effective mode:	Real time
Min. value:	1	Unit:	-
Max. value:	1073741824	Data type:	UInt32
Default value:	67108864	Change mode:	Real time

Value range:

1 to 1073741824

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. value:	1	Unit:	-
Max. value:	1073741824	Data type:	UInt32
Default value:	10000	Change mode:	Real time

Value range:

1 to 1073741824

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. value:	1	Unit:	-
Max. value:	1073741824	Data type:	UInt32
Default value:	67108864	Change mode:	Real time

Value range:

1 to 1073741824

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. value:	1	Unit:	-
Max. value:	1073741824	Data type:	UInt32
Default value:	10000	Change mode:	Real time

Value range:

1 to 1073741824

Description

Defines the denominator of electronic gear ratio 2 for encoder unit conversion to user unit.

H05.15 **Pulse input format**

Comm. address:	2005-10h	Effective mode:	Next power-on
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0: Direction + Pulse, positive logic

1: Direction + Pulse, negative logic

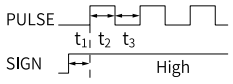
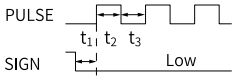
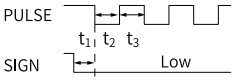
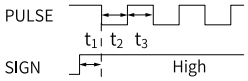
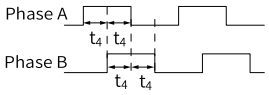
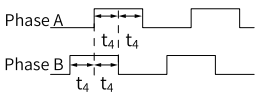
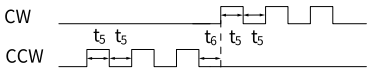
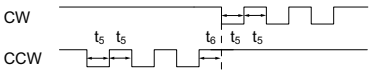
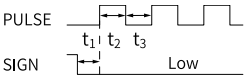
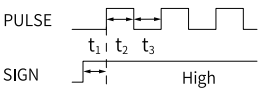
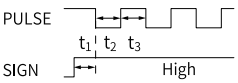
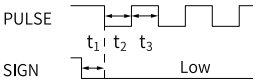
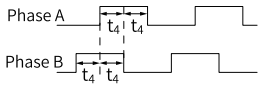
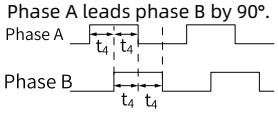
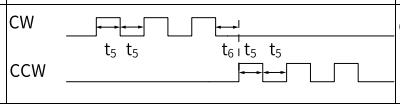
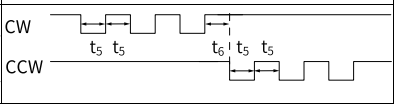
2: Phase A + phase B quadrature pulse, quadrupled frequency

3: CW + CCW

Description

Defines the input pulse form when the pulse reference acts as the main position reference source. See details in *"Table 17-2" on page 777*.

Table 17–2 Pulse forms

H02.02	H05.15	Pulse form	Signal	Diagram of forward pulses	Diagram of reverse pulses
0	0	Pulse + Direction Positive logic	PULSE SIGN		
	1	Pulse + Direction Negative logic	PULSE SIGN		
	2	Phase A + phase B quadrature pulse 4-frequency multiplication	PULSE (phase A) SIGN (phase B)	Phase A leads phase B by 90°. 	Phase B leads phase A by 90°. 
	3	CW + CCW	PULSE (CW) SIGN (CCW)		
1	0	Pulse + Direction Positive logic	PULSE SIGN		
	1	Pulse + Direction Negative logic	PULSE SIGN		
	2	Phase A + phase B quadrature pulse 4-frequency multiplication	PULSE (phase A) SIGN (phase B)	Phase B leads phase A by 90°. 	Phase A leads phase B by 90°. 
	3	CW + CCW	PULSE (CW) SIGN (CCW)		

H05.16 **Clear action selection**

Comm. address:	2005-11h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0: Position deviation cleared upon S-OFF and fault

1: Position deviation cleared upon S-OFF and fault

2: Position deviation cleared upon non-operational state or active DI function 35

Description

Defines the condition for clearing the position deviation.

0: Position deviation cleared upon S-OFF and fault

1: Position deviation cleared upon S-OFF and fault

2: Position deviation cleared upon non-operational state or active DI function 35

H05.17 **Number of encoder frequency-division pulses**

Comm. address:	2005-12h	Effective mode:	Next power-on
Min. value:	0	Unit:	[P/N-N]/[P/Rev]
Max. value:	4194303	Data type:	UInt32
Default value:	2500	Change mode:	At stop

Value range:

0 to 4194303

Description

Defines the number of pulses output by PAO or PBO per motor revolution.

Pulse output resolution = H05.17 × 4

H05.19 **Speed feedforward control**

Comm. address:	2005-14h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	1	Change mode:	At stop

Value range:

0: No speed feedforward

1: Internal speed feedforward

2: H05.72

3: Zero phase

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 completed signal output**

Comm. address:	2005-15h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	10	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0: The 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 being within the time defined by H05.60 and the position reference is 0, the positioning completion signal will be output. After the positioning hold time defined by H05.60 elapses, whether the positioning completion signal is outputted depends on the non-filtered position reference and absolute value of position deviation.
4: Absolute position deviation lower than the setpoint of H05.21 and the filtered position reference being 0 If the positioning hold time keeps being within the time defined by H05.60 and the position reference is 0, the positioning completion signal will be output. After the positioning hold time defined by H05.60 elapses, whether the positioning completion signal is output depends on the filtered position reference and absolute value of position deviation.
5: The absolute position deviation is lower than the H05.21, with zero speed signal ON and position reference being 0.
6: The absolute position deviation is lower than H05.21, with zero speed signal ON and filtered position reference being 0.
7: Positioning completion is judged after the delay defined by H05.60 elapses, with unfiltered position reference being 0. The positioning completion signal ON is output when the non-filtered position reference is 0 and the absolute position deviation is lower than H05.21.
8: Positioning completion is judged after the delay defined by H05.60 elapses and the filtered position reference is 0. The positioning completion signal ON is output when the filtered position reference is 0 and the absolute position deviation is lower than H05.21.
9: Positioning completion is judged after the delay defined by H05.60 elapses when the non-filtered position reference is 0 and the absolute value of position deviation is lower than H05.21. The positioning completion signal ON is output when the non-filtered position reference is 0 and the absolute position deviation is lower than H05.21.
10: Positioning completion is judged after the delay defined by H05.60 elapses when the filtered position reference is 0 and absolute position deviation is lower than H05.21. The positioning completion signal ON is output when the filtered position reference is 0 and the absolute position deviation is lower than H05.21.

Description

Defines the condition for outputting positioning completed/proximity signal. In the position control mode, if the absolute value of the position deviation during operation is within the setpoint of H05.21, the drive outputs the positioning completed/proximity signal. You can set the condition for outputting the positioning completed/proximity signal in H05.20.
0: The 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 being within the time defined by H05.60 and the position reference is 0, the positioning completion signal will be output. After the positioning hold time defined by H05.60 elapses, whether the positioning completion signal is outputted depends on the non-filtered position reference and absolute value of position deviation.
4: Absolute position deviation lower than the setpoint of H05.21 and the filtered position reference being 0 If the positioning hold time keeps being within the time defined by H05.60 and the position reference is 0, the positioning completion signal will be output. After the positioning hold time defined by H05.60 elapses, whether the positioning completion signal is output depends on the filtered position reference and absolute value of position deviation.
5: The absolute position deviation is lower than the H05.21, with zero speed signal ON and position reference being 0.
6: The absolute position deviation is lower than H05.21, with zero speed signal ON and filtered position reference being 0.
7: Positioning completion is judged after the delay defined by H05.60 elapses, with unfiltered position reference being 0. The positioning completion signal ON is output when the non-filtered position reference is 0 and the absolute position deviation is lower than H05.21.
8: Positioning completion is judged after the delay defined by H05.60 elapses and the filtered position reference is 0. The positioning completion signal ON is output when the filtered position reference is 0 and the absolute position deviation is lower than H05.21.
9: Positioning completion is judged after the delay defined by H05.60 elapses when the non-filtered position reference is 0 and the absolute value of position deviation is lower than H05.21. The positioning completion signal ON is output when the non-filtered position reference is 0 and the absolute position deviation is lower than H05.21.
10: Positioning completion is judged after the delay defined by H05.60 elapses when the filtered position reference is 0 and absolute position deviation is lower than H05.21. The positioning completion signal ON is output when the filtered position reference is 0 and the absolute position deviation is lower than H05.21.
Note: This parameter is active only when H02.00 is not set to 8.

H05.21 **Threshold of positioning completion**

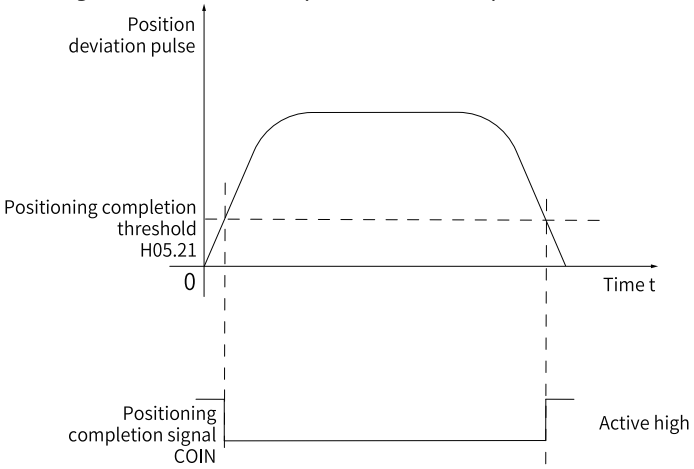
Comm. address:	2005-16h	Effective mode:	Real time
Min. value:	1	Unit:	Encoder unit
Max. value:	65535	Data type:	UInt16
Default value:	46976	Change mode:	Real time

Value range:
1 to 65535

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 8.

H05.22 Threshold of proximity

Comm. address:	2005-17h	Effective mode:	Real time
Min. value:	1	Unit:	Encoder unit
Max. value:	65535	Data type:	UInt16
Default value:	65535	Change mode:	Real time

Value range:

1 to 65535

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 8.

H05.24 Displacement of interrupt positioning

Comm. address:	2005-19h	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit
Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Value range:

-1073741824 to 1073741824

Description

Defines the position reference for interrupt positioning.

H05.26 Constant operating speed in interrupt positioning

Comm. address:	2005-1Bh	Effective mode:	Real time
Min. value:	0	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	UInt16

Default value:	200	Change mode:	Real time

Value range:
0 to 10000
Description
Defines the maximum speed during interrupt positioning.

H05.27 **Acceleration/Deceleration time of interrupt positioning**

Comm. address:	2005-1Ch	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 65535
Description
Defines the time for the motor to change from 0[mm/s]/[rpm] to 1000 [mm/s]/[rpm] at a constant speed during interrupt positioning.

H05.29 **Interrupt positioning cancellation signal**

Comm. address:	2005-1Eh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	1	Change mode:	Real time

Value range:
0: Disable
1: Enable
Description
Defines whether to cancel the interrupt positioning signal.
0: Disable
1: Enable

H05.30 **Homing enable selection**

Comm. address:	2005-1Fh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	8	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0: Disabled
1: Homing enabled through the HomingStart signal input from DI
2: Electrical homing enabled through the HomingStart signal input from DI
3: Homing started immediately upon power-on
4: Homing executed immediately
5: Electrical homing started
6: Current position as home
8: D-triggered position as home

Description

Defines the homing mode and the trigger signal source.

0: Disabled

1: Homing enabled through the HomingStart signal input from DI

2: Electrical homing enabled through the HomingStart signal input from DI

3: Homing started immediately upon power-on

4: Homing executed immediately

5: Electrical homing started

6: Current position as home

8: DI-triggered position as home

Note: When H05.30 is set to 6, the position feedback is the setpoint of H05.36 regardless of the setpoint of H05.40.

H05.31 Mode of home return

Comm. address:	2005-20h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	16	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0: Forward, home switch as deceleration point and home

1: Reverse, home switch as deceleration point and home

2: Forward, Z signal as deceleration point and home

3: Reverse, motor Z signal as deceleration point and home

4: Forward, home switch as deceleration point and Z signal as home

5: Reverse, home switch as deceleration point and Z signal as home

6: Forward, positive limit switch as deceleration point and home

7: Reverse, negative limit switch as deceleration point and home

8: Forward, positive limit switch as deceleration point and Z signal as home

9: Reverse, negative limit switch as deceleration point and Z signal as home

10: Forward, mechanical limit position as deceleration point and home

11: Reverse, mechanical limit position as deceleration point and home

12: Forward, mechanical limit position as deceleration point and Z signal as home

13: Reverse, mechanical limit position as deceleration point and Z signal as home

14: Forward single-turn homing

15: Reverse single-turn homing

16: Nearby single-turn homing

Description

Defines the default motor direction of rotation, deceleration point, and home during homing.
0: Forward, home switch as deceleration point and home
1: Reverse, home switch as deceleration point and home
2: Forward, Z signal as deceleration point and home
3: Reverse, motor Z signal as deceleration point and home
4: Forward, home switch as deceleration point and Z signal as home
5: Reverse, home switch as deceleration point and Z signal as home
6: Forward, positive limit switch as deceleration point and home
7: Reverse, negative limit switch as deceleration point and home
8: Forward, positive limit switch as deceleration point and Z signal as home
9: Reverse, negative limit switch as deceleration point and Z signal as home
10: Forward, mechanical limit position as deceleration point and home
11: Reverse, mechanical limit position as deceleration point and home
12: Forward, mechanical limit position as deceleration point and Z signal as home
13: Reverse, mechanical limit position as deceleration point and Z signal as home
14: Forward single-turn homing
15: Reverse single-turn homing
16: Nearby single-turn homing

H05.32 **Speed in high-speed searching for home switch signal**

Comm. address:	2005-21h	Effective mode:	Real time
Min. value:	0	Unit:	[mm/s]/[rpm]
Max. value:	3000	Data type:	UInt16
Default value:	100	Change mode:	Real time

Value range:
0 to 3000
Description
Defines the motor speed for searching for the deceleration point signal during homing.

H05.33 **Speed in low-speed searching for home switch signal**

Comm. address:	2005-22h	Effective mode:	Real time
Min. value:	0	Unit:	[mm/s]/[rpm]
Max. value:	1000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 1000
Description
Defines the motor speed for searching for the home signal during homing.

H05.34 **Acceleration/Deceleration time during homing**

Comm. address:	2005-23h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	1000	Data type:	UInt16
Default value:	1000	Change mode:	Real time

Value range:
0 to 1000
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.

H05.35 **Home search time limit**

Comm. address:	2005-24h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	10000	Change mode:	Real time

Value range:
0 to 65535
Description
Defines the maximum time for searching the home. The unit is set by H05.66.

H05.36 **Mechanical home offset**

Comm. address:	2005-25h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Value range:
-2147483648 to +2147483647
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. value:	0	Unit:	-
Max. value:	4	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0: Encoder frequency-division output
1: Pulse reference synchronous output
2: Frequency-division output inhibited
3: Second encoder frequency-division output
4: H31.01
Description

Defines the output source of the pulse output terminal.

Setpoint	Output source	Remarks
0	Encoder frequency-division output	The encoder feedback signal is outputted only after being divided by the value of H05.17 during rotation of the motor. Encoder frequency-division output mode is recommended when the host controller is used for closed-loop feedback.
1	Pulse reference synchronous output	The input pulse is synchronously output only when H05.00 is set to 0. When pulses of the multi-axis servo are synchronously tracked, pulse synchronous output is suggested.
2	Frequency-division output inhibited	The pulse output terminal has no output. In this case, frequency-division output terminals act as the input terminals of fully closed-loop external scale signals.
3	Second encoder frequency-division output	The encoder feedback signal is outputted only after being divided by the value of H05.17 during rotation of the motor.
4	H31.01 Reference frequency output	-

H05.39 Electronic gear ratio switchover condition

Comm. address:	2005-28h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0: Switchover after position reference is kept 0 for 2.5 ms

1: Switchover in real time

Description

Defines the switchover condition for the electronic gear ratio. After the fully closed-loop function is enabled and H0F.00 is set to 2, the setpoint is forcibly set to 0.

When H0F.00 is set to 2, the switchover condition is 0 after the position reference is 0 and positioning has been completed for 2.5 ms. When H0F.00 is not 2, The switchover condition is when the position reference is 0 and lasts 2.5 ms

H05.40 Mechanical home offset and action upon overtravel

Comm. address:	2005-29h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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

Description

Defines the offset relationship between the mechanical home and mechanical zero, 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**

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:

bit0: Frequency-division Z output polarity

0: Positive (high level upon active Z pulse)

1: Negative (low level upon active Z pulse)

bit1: 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

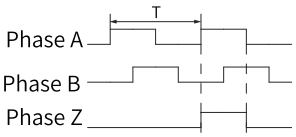
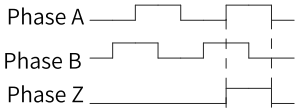
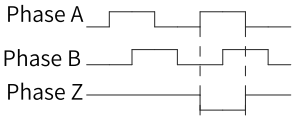
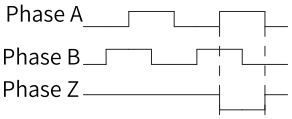
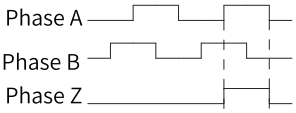
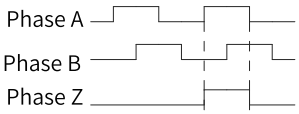
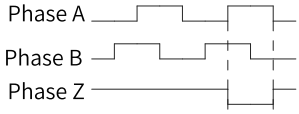
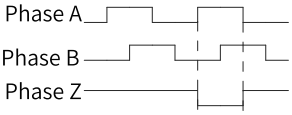
0: Motor Z signal

1: Frequency-division output Z signal

Description

Defines the output level when phase Z of the pulse output terminal is active.

Table 17–3 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°.

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

Setpoint	Output polarity of Z pulse
0	Positive (high level when pulse Z is active)
1	Negative (low level when pulse Z is active)

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

H05.43 **Position pulse edge**

Comm. address:	2005-2Ch	Effective mode:	Next power-on
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0: Rising edge active

1: Falling edge active

Description

Defines the valid edge of pulse reference. When it is set to 0, the falling edge of the pulse is active. When it is set to 1, the rising edge of the pulse is active.

H05.44 **Numerator of frequency-division output reduction ratio**

Comm. address:	2005-2Dh	Effective mode:	Real time
Min. value:	1	Unit:	-
Max. value:	16383	Data type:	UInt16
Default value:	1	Change mode:	At stop

Value range:
1 to 16383
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. value:	1	Unit:	-
Max. value:	8191	Data type:	UInt16
Default value:	1	Change mode:	At stop

Value range:
1 to 8191
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. value:	0	Unit:	-
Max. value:	8	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0: No selection
1: DI1
2: DI2
3: DI3
4: DI4
5: DI5
6: DI6
7: DI7
8: DI8
Description

Defines the starting point for frequency-division output. It is only effective when the frequency-division ratio is greater than 1.
0: No selection
1: DI1
2: DI2
3: DI3
4: DI4
5: DI5
6: DI6
7: DI7
8: DI8

H05.47 Frequency-division Z pulse width

Comm. address:	2005-30h	Effective mode:	Real time
Min. value:	0	Unit:	μs
Max. value:	400	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 400
Description
Defines the minimum output width (μs) of frequency-division output PZ. When the pulse signal is used as master encoder and fully closed-loop encoder, the setpoint 0 indicates the original Z signal will be outputted. Other setpoints indicate the frequency-division Z signal will be outputted.

H05.48 Frequency-division output dead zone setting threshold

Comm. address:	2005-31h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	255	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 255
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 pulse may not be sequential at constant low 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. value:	1	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	1	Change mode:	At stop

Value range:

1 to 65535

Description

Defines the mechanical gear ratio (numerator) in absolute position rotation mode

H05.51 **Mechanical gear ratio in absolute position rotation mode (denominator)**

Comm. address:	2005-34h	Effective mode:	Real time
Min. value:	1	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	1	Change mode:	At stop

Value range:

1 to 65535

Description

Defines the mechanical gear ratio (denominator) in absolute position rotation mode

H05.52 **Pulses per revolution of the load in absolute position rotary mode (low-order 32 bits)**

Comm. address:	2005-35h	Effective mode:	Real time
Min. value:	0	Unit:	Encoder unit
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	At stop

Value range:

0 to 4294967295

Description

Defines the number of pulses per revolution of the rotary load in the absolute position rotary mode (low 32 bits).

H05.54 **Pulses per revolution of the load in absolute position rotary mode (high-order 32 bits)**

Comm. address:	2005-37h	Effective mode:	Real time
Min. value:	0	Unit:	Encoder unit
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	At stop

Value range:

0 to 4294967295

Description

Defines the number of pulses per revolution of the rotary load in the absolute position rotation mode (high-order 32 bits).

H05.58 **Torque threshold in homing upon hit-and-stop**

Comm. address:	2005-3Bh	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	400.0	Data type:	UInt16
Default value:	100.0	Change mode:	Real time

Value range:

0.0 to 400.0

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. value:	0	Unit:	ms
Max. value:	30000	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0 to 30000

Description

When the position deviation remains smaller than the threshold of positioning completed for more than the time set in this parameter, the positioning completed signal can output the valid state.

H05.60 **Hold time of positioning completion**

Comm. address:	2005-3Dh	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	30000	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0 to 30000

Description

Defines the hold time of an active positioning completion signal.

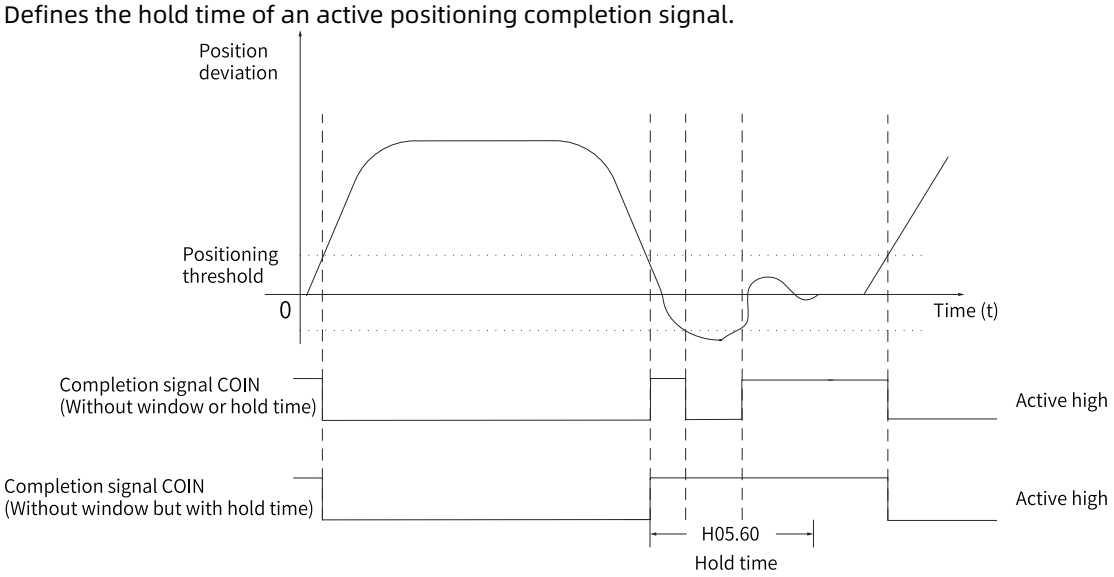


Figure 17-1 Diagram of positioning completed time window and holding time

H05.66 **Homing time unit**

Comm. address:	2005-43h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16

Default value:	2	Change mode:	At stop

Value range:
0: 1 ms
1: 10 ms
2: 100 ms
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 (ms).

H05.67 Offset between zero point and single-turn absolute position

Comm. address:	2005-44h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	Encoder unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	At stop

Value range:
-2147483648 to +2147483647
Description
Displays or defines the offset position relative to the home in the single-turn absolute mode (H0201 = 4).

H05.71 Motor Z signal width

Comm. address:	2005-48h	Effective mode:	Real time
Min. value:	1	Unit:	ms
Max. value:	100	Data type:	UInt16
Default value:	4	Change mode:	Real time

Value range:
1 to 100
Description
Defines the output pulse width when motor Z signal is active.

H05.72 External speed feedforward source selection

Comm. address:	2005-49h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	1	Change mode:	Real time

Value range:
0: 60B1
1: AI1
2: AI2
Description

External speed feedforward source selection
0: 60B1
1: AI1
2: AI2

H05.73 **Homing completion threshold**

Comm. address:	2005-4Ah	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
Description
Defines the position deviation condition that must be met when homing is done.

17.7 H06 Speed Control Parameters

H06.00 **Source of main speed reference A**

Comm. address:	2006-01h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0: H06.03
1: AI1
2: AI2
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. value:	0	Unit:	-
Max. value:	5	Data type:	UInt16
Default value:	1	Change mode:	At stop

Value range:
0: H06.03
1: AI1
2: AI2
5: Multi-speed reference
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. value:	0	Unit:	-
Max. value:	4	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0: Source of main speed reference A
1: Source of auxiliary speed reference B
2: A+B
3: Switchover between A and B
4: Communication

Description
Defines the source of speed references.

Setpoint	Control mode	Remarks
0	Source of main speed reference A	The reference source is defined by H06.00.
1	Source of auxiliary speed reference B	The reference source is defined by H06.01.
2	A + B	The reference source is the product of A + B (H06.00 + H06.01).
3	Switched between A and B	The reference source is switched between A and B as defined by FunIN.4 (Cmd_SEL). State of FunIN.4 (Cmd_ SEL) / Reference Source Inactive / Source of main speed reference A Active / Source of auxiliary speed reference B
4	Communication	The speed reference is defined by operating on H31.09 through communication (unit: 0.001 RPM).

H06.03 **Speed reference set through operating panel**

Comm. address:	2006-04h	Effective mode:	Real time
Min. value:	-10000	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	Int16
Default value:	200	Change mode:	Real time

Value range:
-10000 to 10000

Description
Defines the speed reference set through the keypad.

H06.04 **DI jog speed reference**

Comm. address:	2006-05h	Effective mode:	Real time
Min. value:	0	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	UInt16
Default value:	150	Change mode:	Real time

Value range:
0 to 10000
Description
Defines the DI jog speed reference.

H06.05 **Acceleration ramp time of speed reference**

Comm. address:	2006-06h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 65535
Description
Defines the ramp-up time of speed references.
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 ramp-up/down time is as follows.
Actual ramp-up time t = (Speed reference/1000) x Ramp-up time of speed reference

H06.06 **Deceleration ramp time of speed reference**

Comm. address:	2006-07h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 65535
Description
Defines the ramp-down 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 ramp-up/down time is as follows.
Actual ramp-down time t = (Speed reference/1000) x Ramp-down time of speed reference

H06.07 **Maximum speed limit**

Comm. address:	2006-08h	Effective mode:	Real time
Min. value:	0	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	UInt16
Default value:	7000	Change mode:	Real time

Value range:

0 to 10000

Description

Defines the maximum speed limit.

H06.08 **Positive speed limit**

Comm. address:	2006-09h	Effective mode:	Real time
Min. value:	0	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	UInt16
Default value:	7000	Change mode:	Real time

Value range:

0 to 10000

Description

Defines the positive speed limit.

H06.09 **Negative speed limit**

Comm. address:	2006-0Ah	Effective mode:	Real time
Min. value:	0	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	UInt16
Default value:	7000	Change mode:	Real time

Value range:

0 to 10000

Description

Defines the negative speed limit.

H06.10 **Deceleration unit in quick stop**

Comm. address:	2006-0Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0: Multiplied by 1

1: Multiplied by 10

2: Multiplied by 100

Description

Defines the deceleration unit in emergency stop.

0: Multiplied by 1

1: Multiplied by 10

2: Multiplied by 100

H06.11 **Torque feedforward control**

Comm. address:	2006-0Ch	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	1	Change mode:	Real time

Value range:
0: No torque feedforward
1: Internal torque feedforward
3: Torque feedforward of STune mode 5
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 Ramp-up/down time of jog speed

Comm. address:	2006-0Dh	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 65535
Description
Defines the ramp-up/down time of speed JOG.
It indicates the time for the speed reference to change from 0 rpm to 1000 rpm or from 1000 rpm to 0 rpm.
The formula for calculating the actual ramp-up/down time is as follows.
Actual ramp-up/down time (t) = (Speed reference/1000) x Ramp-up time of speed reference

H06.13 Speed feedforward smoothing filter

Comm. address:	2006-0Eh	Effective mode:	Real time
Min. value:	0	Unit:	μs
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 65535
Description
Defines the speed feedforward smoothing filter time.

H06.15 Speed threshold for zero clamp

Comm. address:	2006-10h	Effective mode:	Real time
Min. value:	0	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 10000
Description
Defines the zero clamp speed threshold.

H06.16 **Threshold of motor rotation state**

Comm. address:	2006-11h	Effective mode:	Real time
Min. value:	0	Unit:	[mm/s]/[rpm]
Max. value:	1000	Data type:	UInt16
Default value:	20	Change mode:	Real time

Value range:
0 to 1000
Description
Defines the threshold of motor rotation state.

H06.17 **Threshold of speed consistency signal**

Comm. address:	2006-12h	Effective mode:	Real time
Min. value:	0	Unit:	[mm/s]/[rpm]
Max. value:	100	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 100
Description
Defines the threshold of speed consistency signal.

H06.18 **Threshold of speed arrival signal**

Comm. address:	2006-13h	Effective mode:	Real time
Min. value:	20	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	UInt16
Default value:	1000	Change mode:	Real time

Value range:
20 to 10000
Description
Defines the threshold of speed arrival signal.

H06.19 **Threshold of zero speed output signal**

Comm. address:	2006-14h	Effective mode:	Real time
Min. value:	1	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
1 to 10000
Description
Defines the threshold of zero speed output signal.

H06.28 **Cogging torque ripple compensation**

Comm. address:	2006-1Dh	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
Description
Used to enable cogging torque fluctuation compensation.

H06.40 **Ramp-down time of ramp 1**

Comm. address:	2006-29h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 65535
Description
Defines the deceleration time of ramp 1, which is the time taking from decelerating from 1000 rpm to 0 rpm.

H06.41 **Ramp-down time of ramp 2**

Comm. address:	2006-2Ah	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 65535
Description
Defines the deceleration time of ramp 2, which is the time taking from decelerating from 1000 rpm to 0 rpm.

H06.50 **Speed S-curve enable switch**

Comm. address:	2006-33h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	1	Change mode:	At stop

Value range:
0: Disable
1: Enable
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. value:	0.0	Unit:	%

Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Value range:
0.0 to 100.0
Description
Eight 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. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Value range:
0.0 to 100.0
Description
Eight 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. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Value range:
0.0 to 100.0
Description
Eight groups of S curve smoothing parameters can be set for each speed reference.
Increasing deceleration time at deceleration segment: The percentage of motor increasing deceleration time in the selected deceleration time.

H06.54 **Decreasing deceleration 1 of speed S-curve deceleration segment**

Comm. address:	2006-37h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Value range:
0.0 to 100.0
Description
Eight 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. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Value range:
0.0 to 100.0
Description
Eight 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. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Value range:
0.0 to 100.0
Description
Eight 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. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Value range:
0.0 to 100.0
Description
Eight groups of S curve smoothing parameters can be set for each speed reference.
Increasing deceleration time at deceleration segment: The percentage of motor increasing deceleration time in the selected deceleration time.

H06.58 **Decreasing deceleration 2 of speed S-curve deceleration segment**

Comm. address:	2006-3Bh	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Value range:
0.0 to 100.0
Description

Eight 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. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Value range:
0.0 to 100.0
Description
Eight 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. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Value range:
0.0 to 100.0
Description
Eight 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. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Value range:
0.0 to 100.0
Description
Eight groups of S curve smoothing parameters can be set for each speed reference.
Increasing deceleration time at deceleration segment: The percentage of motor increasing deceleration time in the selected deceleration time.

H06.62 **Decreasing deceleration 3 of speed S-curve deceleration segment**

Comm. address:	2006-3Fh	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Value range:
0.0 to 100.0
Description
Eight 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. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Value range:
0.0 to 100.0
Description
Eight 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. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Value range:
0.0 to 100.0
Description
Eight 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. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Value range:
0.0 to 100.0
Description
Eight groups of S curve smoothing parameters can be set for each speed reference.
Increasing deceleration time at deceleration segment: The percentage of motor increasing deceleration time in the selected deceleration time.

H06.66 **Decreasing deceleration 4 of speed S-curve deceleration segment**

Comm. address:	2006-43h	Effective mode:	Real time

Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Value range:
0.0 to 100.0
Description
Eight 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. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Value range:
0.0 to 100.0
Description
Eight 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. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Value range:
0.0 to 100.0
Description
Eight 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. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Value range:
0.0 to 100.0
Description
Eight groups of S curve smoothing parameters can be set for each speed reference.
Increasing deceleration time at deceleration segment: The percentage of motor increasing deceleration time in the selected deceleration time.

H06.70 **Decreasing deceleration 5 of speed S-curve deceleration segment**

Comm. address:	2006-47h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Value range:
0.0 to 100.0
Description
Eight 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. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Value range:
0.0 to 100.0
Description
Eight 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. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Value range:
0.0 to 100.0
Description
Eight 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. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Value range:
0.0 to 100.0
Description

Eight groups of S curve smoothing parameters can be set for each speed reference.
Increasing deceleration time at deceleration segment: The percentage of motor increasing deceleration time in the selected deceleration time.

H06.74 **Decreasing deceleration 6 of speed S-curve deceleration segment**

Comm. address:	2006-4Bh	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Value range:
0.0 to 100.0
Description
Eight 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. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Value range:
0.0 to 100.0
Description
Eight 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. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Value range:
0.0 to 100.0
Description
Eight 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. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Value range:
0.0 to 100.0
Description
Eight groups of S curve smoothing parameters can be set for each speed reference.
Increasing deceleration time at deceleration segment: The percentage of motor increasing deceleration time in the selected deceleration time.

H06.78 **Decreasing deceleration 7 of speed S-curve deceleration segment**

Comm. address:	2006-4Fh	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Value range:
0.0 to 100.0
Description
Eight 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. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Value range:
0.0 to 100.0
Description
Eight 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. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Value range:
0.0 to 100.0
Description
Eight 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. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Value range:
0.0 to 100.0
Description
Eight groups of S curve smoothing parameters can be set for each speed reference.
Increasing deceleration time at deceleration segment: The percentage of motor increasing deceleration time in the selected deceleration time.

H06.82 **Decreasing deceleration 8 of speed S-curve deceleration segment**

Comm. address:	2006-53h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	At stop

Value range:
0.0 to 100.0
Description
Eight 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.

17.8 H07 Torque Control Parameters

H07.00 **Sources of main torque reference A**

Comm. address:	2007-01h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0: H07.03
1: AI1
2: AI2
Description
Defines the source of the main torque reference A.
0: H07.03
1: AI1
2: AI2

H07.01 **Sources of auxiliary torque reference B**

Comm. address:	2007-02h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	1	Change mode:	At stop

Value range:
0: H07.03
1: AI1
2: AI2
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. value:	0	Unit:	-
Max. value:	4	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value 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
Description
Defines the torque reference source.

<table>
<tr><th>Setpoint</th><th>Control mode</th><th>Remarks</th></tr>
<tr><td>0</td><td>Sources of main torque reference A</td><td>The reference source is defined by H07.00.</td></tr>
<tr><td>1</td><td>Sources of auxiliary torque reference B</td><td>The reference source is defined by H07.01.</td></tr>
<tr><td>2</td><td>A + B</td><td>The reference source is the product of A+B (H07.00+H07.01).</td></tr>
<tr><td>3</td><td>Switched between A and B</td><td>The reference source is switched between A and B as defined by FunIN.4 (Cmd_SEL).
<table>
<tr><th>State of FunIN.4 (Cmd_ SEL)</th><th>Reference Source</th></tr>
<tr><td>Inactive</td><td>Sources of main torque reference A</td></tr>
<tr><td>Active</td><td>Sources of auxiliary torque reference B</td></tr>
</table></td></tr>
<tr><td>4</td><td>Communication</td><td>The torque reference is defined by operating on H31.11 through communication.</td></tr>
</table>

H07.03 **Torque reference set through operation panel**

Comm. address:	2007-04h	Effective mode:	Real time
Min. value:	-400.0	Unit:	%
Max. value:	400.0	Data type:	Int16
Default value:	0.0	Change mode:	Real time

Value range:
-400.0 to 400.0
Description
Defines the torque reference.

H07.05 **Torque reference filter time constant 1**

Comm. address:	2007-06h	Effective mode:	Real time
Min. value:	0.00	Unit:	ms
Max. value:	30.00	Data type:	UInt16
Default value:	0.50	Change mode:	Real time

Value range:
0.00 to 30.00
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. value:	0.00	Unit:	ms
Max. value:	30.00	Data type:	UInt16
Default value:	0.27	Change mode:	Real time

Value range:
0.00 to 30.00
Description
Defines the torque reference filter time constant 2.

H07.07 **Torque limit source**

Comm. address:	2007-08h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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
Description
Selects 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. value:	1	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	1	Change mode:	Real time

Value range:
1: AI12
: AI2
Description
Sets the AI as the torque limit.
1: AI12
: AI2

H07.09 **Positive internal torque limit**

Comm. address:	2007-0Ah	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	400.0	Data type:	UInt16
Default value:	350.0	Change mode:	Real time

Value range:
0.0 to 400.0
Description
Defines the positive internal torque limit.

H07.10 **Negative internal torque limit**

Comm. address:	2007-0Bh	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	400.0	Data type:	UInt16
Default value:	350.0	Change mode:	Real time

Value range:
0.0 to 400.0
Description
Defines the negative internal torque limit.

H07.11 **Positive external torque limit**

Comm. address:	2007-0Ch	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	400.0	Data type:	UInt16
Default value:	350.0	Change mode:	Real time

Value range:
0.0 to 400.0
Description
Defines the positive external torque limit.

H07.12 **Negative external torque limit**

Comm. address:	2007-0Dh	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	400.0	Data type:	UInt16
Default value:	350.0	Change mode:	Real time

Value range:
0.0 to 400.0
Description
Defines negative external torque limit.

H07.15 **Emergency-stop torque**

Comm. address:	2007-10h	Effective mode:	At stop
Min. value:	0.0	Unit:	%
Max. value:	400.0	Data type:	UInt16
Default value:	100.0	Change mode:	Real time

Value range:
0.0 to 400.0
Description
Defines the torque of emergency stop.

H07.17 **Speed limit source**

Comm. address:	2007-12h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0: Internal speed limit
1: V-LMT
2: H07.19 or H07.20 as defined by DI
Description
Defines the speed limit source.
0: Internal speed limit
1: V-LMT
2: H07.19 or H07.20 as defined by DI
Note: This parameter is active only when H02.00 is not set to 8.

H07.18 **V-LMT selection**

Comm. address:	2007-13h	Effective mode:	Real time
Min. value:	1	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	1	Change mode:	Real time

Value range:
1: AI12
: AI2

Description
Sets the AI as the speed limit.
1: AI12
: AI2

H07.19 Positive speed limit/Speed limit 1 in torque control

Comm. address:	2007-14h	Effective mode:	Real time
Min. value:	0	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	UInt16
Default value:	3000	Change mode:	Real time

Value range:
0 to 10000
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. value:	0	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	UInt16
Default value:	3000	Change mode:	Real time

Value range:
0 to 10000
Description
Defines the negative speed limit/speed limit 2 in torque control.

H07.21 Base value for torque arrival

Comm. address:	2007-16h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	400.0	Data type:	UInt16
Default value:	0.0	Change mode:	Real time

Value range:
0.0 to 400.0
Description
Defines the reference value for torque arrival.

H07.22 Threshold of active torque arrival

Comm. address:	2007-17h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	400.0	Data type:	UInt16
Default value:	20.0	Change mode:	Real time

Value range:
0.0 to 400.0
Description
Defines the threshold of valid torque arrival.

H07.23 **Threshold of inactive torque arrival**

Comm. address:	2007-18h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	400.0	Data type:	UInt16
Default value:	10.0	Change mode:	Real time

Value range:
0.0 to 400.0
Description
Defines the threshold of invalid torque reach.

H07.24 **Field weakening depth**

Comm. address:	2007-19h	Effective mode:	Real time
Min. value:	60	Unit:	%
Max. value:	115	Data type:	UInt16
Default value:	115	Change mode:	Real time

Value range:
60 to 115
Description
Defines the field weakening depth.

H07.25 **Maximum allowable demagnetization current**

Comm. address:	2007-1Ah	Effective mode:	Real time
Min. value:	0	Unit:	%
Max. value:	300	Data type:	UInt16
Default value:	100	Change mode:	Real time

Value range:
0 to 300
Description
Defines the maximum allowable demagnetization current.

H07.26 **Field weakening selection**

Comm. address:	2007-1Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0: Disable
1: Enable
Description
Field weakening selection
0: Disable
1: Enable

H07.27 **Field weakening gain**

Comm. address:	2007-1Ch	Effective mode:	Real time
Min. value:	0.001	Unit:	kHz
Max. value:	1.000	Data type:	UInt16
Default value:	0.030	Change mode:	Real time

Value range:
0.001 to 1.000
Description
Defines the gain of field weakening.

H07.28 **Speed of flux weakening point**

Comm. address:	2007-1Dh	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
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 calibration
bit1: Enable shield compensation data
Description
Torque non-standard feature switch
bit0: Enable motor torque output calibration
bit1: Enable compensation data shielding

H07.36 **Time constant of low-pass filter 2**

Comm. address:	2007-25h	Effective mode:	Real time
Min. value:	0.00	Unit:	ms
Max. value:	10.00	Data type:	UInt16
Default value:	0.00	Change mode:	Real time

Value range:
0.00 to 10.00
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
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. value:	0	Unit:	-
Max. value:	50	Data type:	UInt16
Default value:	16	Change mode:	Real time

Value range:
0 to 50
Description
Defines the attenuation ratio of biquad filter.

H07.40 **Speed limit threshold in torque control mode**

Comm. address:	2007-29h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	300	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 300
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. value:	0.001	Unit:	-
Max. value:	10.000	Data type:	UInt16
Default value:	1.000	Change mode:	Real time

Value range:
0.001 to 10.000

Description
Defines the damping coefficient of biquad low-pass filter.

17.9 H08 Gain Parameters

H08.00 **Speed loop gain**

Comm. address:	2008-01h	Effective mode:	Real time
Min. value:	0.0	Unit:	Hz
Max. value:	2000.0	Data type:	UInt16
Default value:	40.0	Change mode:	Real time

Value range:
0.0 to 2000.0
Description
Defines the response 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 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. value:	0.15	Unit:	ms
Max. value:	512.00	Data type:	UInt16
Default value:	19.89	Change mode:	Real time

Value range:
0.15 to 512.00
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. value:	0.0	Unit:	Hz
Max. value:	2000.0	Data type:	UInt16
Default value:	64.0	Change mode:	Real time

Value range:
0.0 to 2000.0
Description
Defines the proportional gain of the position loop.
Defines the response of the position loop. A high setpoint shortens the positioning time. Note that an excessively high setpoint may cause vibration.
The 1st group of gain parameters include H08.00 (Speed loop gain), H08.01 (Speed loop integral time constant), H08.02, and H07.05 (Filter time constant of torque reference).

H08.03 **2nd speed loop gain**

Comm. address:	2008-04h	Effective mode:	Real time
Min. value:	0.1	Unit:	Hz
Max. value:	2000.0	Data type:	UInt16
Default value:	75.0	Change mode:	Real time

Value range:
0.1 to 2000.0
Description
Defines the 2nd speed loop gain.

H08.04 **2nd speed loop integral time constant**

Comm. address:	2008-05h	Effective mode:	Real time
Min. value:	0.15	Unit:	ms
Max. value:	512.00	Data type:	UInt16
Default value:	10.61	Change mode:	Real time

Value range:
0.15 to 512.00
Description
Defines the 2nd speed loop integral time constant.

H08.05 **2nd position loop gain**

Comm. address:	2008-06h	Effective mode:	Real time
Min. value:	0.1	Unit:	Hz
Max. value:	2000.0	Data type:	UInt16
Default value:	120.0	Change mode:	Real time

Value range:
0.1 to 2000.0
Description
Defines the second gain of the position loop and speed loop. The 2nd group of gain parameters include H08.03 (Speed loop gain), H08.04 (Speed loop integral time constant), H08.05, and H07.06 (Torque reference filter time constant 2).

H08.08 **2nd gain mode setting**

Comm. address:	2008-09h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	1	Change mode:	Real time

Value range:
0: Fixed to the 1st gain set, P and PI switched as defined by bit26 of external 60FEh
1: Switched between the 1st and 2nd gain set as defined by H08.09
Description
Defines the switchover mode of the 2nd gain set.
0: Fixed to the 1st gain set, P and PI switched as defined by bit26 of external 60FEh
1: Switched between the 1st and 2nd gain set as defined by H08.09

H08.09 **Gain switchover condition selection**

Comm. address:	2008-0Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	10	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0: Fixed to the 1st gain set (PS)

1: Switched as defined by bit26 of 60FEh or DI-based switchover

2: Torque reference excessively high (PS)

3: Speed reference excessively high (PS)

4: Speed reference change rate excessively high (PS)

5: Speed reference low/high speed threshold (PS)

6: Position deviation excessively high (P)

7: Position reference available (P)

8: Positioning unfinished (P)

9: Actual speed (P)

10: Position reference available + Actual speed (P)

Description

Defines the gain switchover condition.

Setpoint	Gain Switchover Condition	Remarks
0	Fixed at 1st gain	The 1st gain is always used.
1	Switched based on bit26 of 60FEh or DI	-
2	Large torque reference	If the torque reference absolute value exceeds (Level + Dead time) [%] in the last 1st gain set, the drive switches to the 2nd gain set. If the absolute value of the torque reference is lower than (level - Dead time) [%] and such status lasts within the delay defined by H08.10 (Gain switchover delay) in the 2nd gain, the drive returns to the 1st gain set.
3	Large speed reference	When the absolute value of the speed reference exceeds (level + hysteresis, RPM) in the 1st gain, the drive switches over to the 2nd gain. If the absolute value of the speed reference is lower than (level - Dead time) [rpm] and such status lasts within the delay defined by H08.10 (Gain switchover delay) in the 2nd gain, the drive returns to the 1st gain set.
4	Large speed reference change rate	It is valid only in non-speed control mode. When the absolute value of the speed reference change rate exceeds (level + hysteresis, 10 RPM/s) in the 1st gain, the drive switches over to the 2nd gain. If the absolute value of the speed reference change rate is lower than (level - hysteresis) [10 rpm/s] and such status lasts within the delay defined by H08.10 (Gain switchover delay) in the 2nd gain, the drive returns to the 1st gain set. The drive always uses the 1st gain in speed control mode.
5	Speed reference high/low-speed threshold	When the absolute value of the speed reference exceeds (level - hysteresis, RPM) in the 1st gain, the drive starts to switch over to the 2nd gain and the gain changes gradually. When the absolute value of the speed reference exceeds (level + hysteresis, RPM), the drive completely switches over to the 2nd gain. When the absolute value of the speed reference is smaller than (level + hysteresis, RPM) in the 2nd gain, the drive starts to return to the 1st gain and the gain changes gradually. When the absolute value of the speed reference reaches (level - hysteresis, RPM), the drive completely returns to the 1st gain.

Setpoint	Gain Switchover Condition	Remarks
6	Large position deviation	It is valid only in fully closed-loop position control mode. When the absolute value of the position deviation exceeds (level + hysteresis, encoder unit) in the 1st gain, the drive switches over to the 2nd gain. When the absolute value of the position deviation is lower than (Level - Dead time) [encoder unit] and such status lasts within the delay defined by H08.10 (Gain switchover delay) in the 2nd gain, the drive returns to the 1st gain set. The drive always uses the 1st gain if not in position control or fully closed-loop control.
7	Position reference available	It is valid only in fully closed-loop position control mode. When the position reference is not 0 in the 1st gain, the drive switches to the 2nd gain. When the position reference is 0 and such status lasts within the delay defined by H08.10 (Gain switchover delay) in the 2nd gain, the drive returns to the 1st gain set. The drive always uses the 1st gain if not in position control or fully closed-loop control.
8	Positioning not completed	It is valid only in fully closed-loop position control mode. When positioning is not completed in the 1st gain, the drive switches to the 2nd gain. If positioning is not completed and such status lasts within the delay defined by H08.10 (Gain switchover delay) in the 2nd gain set, the servo drive returns to the 1st gain set. The drive always uses the 1st gain if not in position control or fully closed-loop control.
9	High actual speed	It is valid only in fully closed-loop position control mode. When the absolute value of the actual motor speed exceeds (level + hysteresis, RPM) in the 1st gain, the drive switches over to the 2nd gain. If the absolute value of actual speed is lower than (Level - Dead time) [rpm] and such status lasts within the delay defined by H08.10 (Gain switchover delay) in the 2nd gain set, the drive returns to the 1st gain set. The drive always uses the 1st gain if not in position control or fully closed-loop control.
10	Position reference available + Actual speed	It is valid only in fully closed-loop position control mode. When the position reference is not 0 in the 1st gain, the drive switches to the 2nd gain. If the position reference is 0 and such status lasts within the delay defined by H08.10 (Gain switchover delay) in the 2nd gain set, the 2nd gain set applies. When the position reference is 0 and the delay defined by (H08.10) is reached, if the absolute value of actual speed is lower than (Level) [rpm], the speed loop integral time constant is fixed to the setpoint of H08.04 (2nd speed loop integral time constant), and others return to the 1st gain set. If the absolute value of actual speed does not reach (Level - Dead time) [rpm], the speed integral also returns to the setpoint of H08.01 (Speed loop integral time constant). The drive always uses the 1st gain if not in position control or fully closed-loop control.

H08.10 Gain switchover delay

Comm. address:	2008-0Bh	Effective mode:	Real time
Min. value:	0.0	Unit:	ms
Max. value:	1000.0	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Value range:

0.0 to 1000.0

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. value:	0	Unit:	-
Max. value:	20000	Data type:	UInt16
Default value:	50	Change mode:	Real time

Value range:
0 to 20000
Description
Defines the gain switchover level.
Gain switchover is affected by both the level and the time lag, as defined by H08.09. The unit of gain switchover level varies with the switchover condition.

H08.12 **Gain switchover time lag**

Comm. address:	2008-0Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	20000	Data type:	UInt16
Default value:	30	Change mode:	Real time

Value range:
0 to 20000
Description
Defines the delay for gain switchover.
Gain switchover is affected by both the level and the time lag, as defined by H08.09. The unit of gain switchover delay varies with the switchover condition.
Note:
The value of H08.11 (Gain switchover level) must be higher than or equal to that of H08.12. Otherwise, H08.11 will be set to a value equal to H08.12 automatically.

H08.13 **Position gain switchover time**

Comm. address:	2008-0Eh	Effective mode:	Real time
Min. value:	0.0	Unit:	ms
Max. value:	1000.0	Data type:	UInt16
Default value:	3.0	Change mode:	Real time

Value range:
0.0 to 1000.0
Description
In position control, if H08.05 (2nd position loop gain) is much higher than H08.02 (Position loop gain), set the time for switching from H08.02 to H08.05.
This parameter can be used to reduce the impact caused by an increase in the position loop gain.

H08.15 **Load moment of inertia ratio**

Comm. address:	2008-10h	Effective mode:	Real time
Min. value:	0.00	Unit:	-
Max. value:	120.00	Data type:	UInt16

Default value:	1.00	Change mode:	Real time

Value range:
0.00 to 120.00
Description
Defines the load-to-motor inertia ratio.

When H08.15 is set to 0, it indicates the motor is not connected to the 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. value:	0.0	Unit:	ms
Max. value:	4.0	Data type:	UInt16
Default value:	0.0	Change mode:	Real time

Value range:
0.0 to 4.0
Description
Defines the zero phase delay.

H08.18 **Speed feedforward filter time constant**

Comm. address:	2008-13h	Effective mode:	Real time
Min. value:	0.00	Unit:	ms
Max. value:	64.00	Data type:	UInt16
Default value:	0.50	Change mode:	Real time

Value range:
0.00 to 64.00
Description
Defines the filter time constant of speed feedforward.

H08.19 **Speed feedforward gain**

Comm. address:	2008-14h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	0.0	Change mode:	Real time

Value range:
0.0 to 100.0
Description
In position control and fully closed-loop control, speed feedforward is the product of speed feedforward signal and H08.19 and is part of the speed reference.
Increasing the setpoint improves the response 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.
Tune 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. value:	0.00	Unit:	ms
Max. value:	64.00	Data type:	UInt16
Default value:	0.50	Change mode:	Real time

Value range:
0.00 to 64.00
Description
Defines the filter time constant of torque feedforward.

H08.21 Torque feedforward gain

Comm. address:	2008-16h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	300.0	Data type:	UInt16
Default value:	0.0	Change mode:	Real time

Value range:
0.0 to 300.0
Description
In control modes other than torque control, torque feedforward is the product of torque feedforward signal and H08.21, which is a part of the torque reference.
Increasing the setpoint improves the response to variable speed references.
Increasing the setpoint improves the response to position references and reduces the position deviation during operation at a constant speed.
During parameter tuning, 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. Tune 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 filter option

Comm. address:	2008-17h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0: Inhibited

1: 2 times

2: 4 times

3: 8 times

4: 16 times

Description

Defines the moving average filtering count on the speed feedback.

0: Disable

1: 2 times

2: 4 times

3: 8 times

4: 16 times

Note: The higher the number of filtering times, the lower the speed feedback fluctuation, but the longer the feedback delay will be.

H08.23 Cutoff frequency of speed feedback low-pass filter

Comm. address:	2008-18h	Effective mode:	Real time
Min. value:	100	Unit:	Hz
Max. value:	8000	Data type:	UInt16
Default value:	8000	Change mode:	Real time

Value range:

100 to 8000

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, but the longer the feedback delay can be.

Setting the cutoff frequency to 8000 Hz negates the filtering effect.

H08.24 Pseudo differential feedforward control coefficient

Comm. address:	2008-19h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	200.0	Data type:	UInt16
Default value:	100.0	Change mode:	Real time

Value range:

0.0 to 200.0

Description

Defines the control mode of the speed loop.

When this parameter is set to 100.0, PI control (default mode) is used for speed loop, bringing rapid dynamic response.

When this parameter is set to 0.0, the integral action is activated to filter out low-frequency disturbance. However, the dynamic response is slow.

H08.24 can be used to keep a quick response 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. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0: M-method

1: MT-method

Description

Speed measurement method

0: M-method

1: MT-method

Note: It is active only with setpoint 1 and a pulse encoder.

H08.27 **Cutoff frequency of speed observer**

Comm. address:	2008-1Ch	Effective mode:	Real time
Min. value:	50	Unit:	Hz
Max. value:	600	Data type:	UInt16
Default value:	170	Change mode:	Real time

Value range:

50 to 600

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 large speed feedback noise.

H08.28 **Speed observer inertia calibration coefficient**

Comm. address:	2008-1Dh	Effective mode:	Real time
Min. value:	1	Unit:	%
Max. value:	1600	Data type:	UInt16
Default value:	100	Change mode:	Real time

Value range:

1 to 1600

Description

Defines the speed observer inertia calibration coefficient. If H08.15 is set based on the actual inertia, there is no need to tune this parameter.

H08.29 **Speed observer filter time**

Comm. address:	2008-1Eh	Effective mode:	Real time
Min. value:	0.00	Unit:	ms
Max. value:	10.00	Data type:	UInt16
Default value:	0.80	Change mode:	Real time

Value range:

0.00 to 10.00

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. value:	1	Unit:	Hz
Max. value:	4000	Data type:	UInt16
Default value:	600	Change mode:	Real time

Value range:

1 to 4000

Description

Defines the cutoff frequency of the disturbance observer. Increasing the setpoint improves the responsiveness of the disturbance observer and the compensation effect. Note that an excessively high setpoint may incur resonance.

H08.32 **Disturbance compensation gain**

Comm. address:	2008-21h	Effective mode:	Real time
Min. value:	0	Unit:	%
Max. value:	100	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0 to 100

Description

Defines the compensation gain of the disturbance observer. The setpoint 100% indicates full compensation.

H08.33 **Disturbance observer inertia calibration coefficient**

Comm. address:	2008-22h	Effective mode:	Real time
Min. value:	1	Unit:	%
Max. value:	1600	Data type:	UInt16
Default value:	100	Change mode:	Real time

Value range:

1 to 1600

Description

Defines the disturbance observer inertia calibration coefficient. If H08.15 is set based on the actual inertia, there is no need to tune this parameter.

H08.37 **Phase modulation for medium-frequency jitter suppression 2**

Comm. address:	2008-26h	Effective mode:	Real time
Min. value:	-90	Unit:	°
Max. value:	90	Data type:	Int16
Default value:	0	Change mode:	Real time

Value range:

-90 to +90

Description

Defines the compensation phase of medium-frequency jitter suppression 2.

H08.38 Frequency for medium-frequency jitter suppression 2

Comm. address:	2008-27h	Effective mode:	Real time
Min. value:	0	Unit:	Hz
Max. value:	1000	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0 to 1000

Description

Set this parameter based on actual resonance frequency. The active suppression frequency range for medium-frequency jitter suppression 2 is 100 Hz to 1000 Hz.

H08.39 Compensation gain for medium-frequency jitter suppression 2

Comm. address:	2008-28h	Effective mode:	Real time
Min. value:	0	Unit:	%
Max. value:	300	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0 to 300

Description

Defines the compensation gain for medium-frequency jitter suppression 2. Set this parameter to a value between 40% to 55% in general cases. Setting this parameter to 0 deactivates medium-frequency jitter suppression 2.

H08.40 Speed observer enable

Comm. address:	2008-29h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0: Disable

1: Enable

Description

Defines the bit for enabling the speed observer.

0: Disable

1: Enable

H08.42 Model control enable

Comm. address:	2008-2Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4	Data type:	UInt16

Default value:	0	Change mode:	Real time

Value range:
0: Disable
1: Enable
2: Reserved
3: New model tracking
4: Model tracking B

Description
Enables model tracking control.

H08.43 **Model gain**

Comm. address:	2008-2Ch	Effective mode:	Real time
Min. value:	0.1	Unit:	-
Max. value:	2000.0	Data type:	UInt16
Default value:	40.0	Change mode:	Real time

Value range:
0.1 to 2000.0

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. value:	0.0	Unit:	-
Max. value:	102.4	Data type:	UInt16
Default value:	95.0	Change mode:	Real time

Value range:
0.0 to 102.4

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. value:	0.0	Unit:	-
Max. value:	204.8	Data type:	UInt16
Default value:	102.4	Change mode:	Real time

Value range:
0.0 to 204.8

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. value:	0.0	Unit:	-
Max. value:	204.8	Data type:	UInt16
Default value:	102.4	Change mode:	Real time

Value range:
0.0 to 204.8
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. value:	0.0	Unit:	Hz
Max. value:	300.0	Data type:	UInt16
Default value:	0.0	Change mode:	Real time

Value range:
0.0 to 300.0
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. value:	0	Unit:	%
Max. value:	200	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 200
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. value:	0	Unit:	%
Max. value:	600	Data type:	UInt16
Default value:	100	Change mode:	Real time

Value range:
0 to 600
Description
Tune 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. value:	0.0	Unit:	Hz
Max. value:	300.0	Data type:	UInt16
Default value:	0.0	Change mode:	Real time

Value range:
0.0 to 300.0
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. value:	0	Unit:	%
Max. value:	200	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 200
Description
Defines the compensation gain for medium- and low-frequency suppression 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. value:	0	Unit:	%
Max. value:	600	Data type:	UInt16
Default value:	100	Change mode:	Real time

Value range:
0 to 600
Description
Tune this parameter based on the actual compensation effect.

H08.62 **Position loop integral time constant**

Comm. address:	2008-3Fh	Effective mode:	Real time
Min. value:	0.15	Unit:	-
Max. value:	512.00	Data type:	UInt16
Default value:	512.00	Change mode:	Real time

Value range:
0.15 to 512.00
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. value:	0.15	Unit:	-
Max. value:	512.00	Data type:	UInt16
Default value:	512.00	Change mode:	Real time

Value range:
0.15 to 512.00
Description
Defines the 2nd position loop integral time constant.

H08.64 **Speed observer feedback source**

Comm. address:	2008-41h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0: Observer speed output value
1: Speed observed by the observer
Description
Defines the speed observer feedback source.
0: Observer speed output value
1: Speed observed by the observer

H08.65 **Zero deviation control selection**

Comm. address:	2008-42h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0: Disable
1: Enable
Description
Enables/disables zero deviation control
0: Disable
1: Enable

H08.66 **Moving average filtering of zero-deviation control position**

Comm. address:	2008-43h	Effective mode:	Real time
Min. value:	0.0	Unit:	ms
Max. value:	320.0	Data type:	UInt16
Default value:	5.0	Change mode:	At stop

Value range:
0.0 to 320.0
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. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	100.0	Change mode:	Real time

Value range:
0.0 to 100.0
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. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	100.0	Change mode:	Real time

Value range:
0.0 to 100.0
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. value:	0	Unit:	-
Max. value:	6	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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
Description
Used to enable the encoder pitch fluctuation suppression function.
0: Disable
1: 1st group activated only-adaptive mode. This mode is used to suppress or eliminate the control loop torque fluctuation caused by encoder pitch fluctuation, which can help alleviate speed fluctuation and operation noise.
2: 1st group activated only-hysteresis mode. This mode is used in scenarios featuring a long travel distance and slow speed changes (such as digital printing industry).
3: Two groups activated-adaptive mode. Note that the number of suppressors used depend on the magnitude of torque fluctuation caused by encoder pitch fluctuation.
4. Two groups activated-hysteresis mode. Note that the hysteresis mode is only applicable to scenarios requiring reciprocating movement. The adaptive mode is applicable to scenarios with slow speed changes.

17.10 H09 Auto-tuning Parameters

H09.00 **Auto-tuning mode selection**

Comm. address:	2009-01h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	9	Data type:	UInt16
Default value:	4	Change mode:	Real time

Value 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-tunin

5: STune mode 5

6: Quick positioning mode+Inertia auto-tuning

8: New model tracking+Inertia auto-tuning

9: Model tracking B+Inertia auto-tuning+Friction compensation

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-tunin

5: STune mode 5

6: Quick positioning mode+Inertia auto-tuning

8: New model tracking+Inertia auto-tuning

9: Model tracking B+Inertia auto-tuning+Friction compensation

H09.01 **Stiffness level selection**

Comm. address:	2009-02h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	41	Data type:	UInt16
Default value:	15	Change mode:	Real time

Value range:

0 to 41

Description

Defines the stiffness level of the servo system. The higher the stiffness level, the higher the gains and the quicker the response. But an excessively high stiffness level can cause vibration.

The setpoint 0 indicates the lowest stiffness and 41 indicates the highest stiffness.

H09.02 **Adaptive notch mode selection**

Comm. address:	2009-03h	Effective mode:	Real time
Min. value:	0	Unit:	-

Max. value:	4	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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

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. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0: Disabled

1: Enabled, changing slowly

2: Enabled, changing normally

3: Enabled, changing quickly

Description

Defines whether to enable online inertia auto-tuning and set 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. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0: Bidirectional

1: Unidirectional

Description

Defines the offline inertia auto-tuning mode. The offline inertia auto-tuning function can be enabled through H0d.02.
0: Bidirectional
1: Unidirectional

H09.06 **Maximum speed of inertia auto-tuning**

Comm. address:	2009-07h	Effective mode:	Real time
Min. value:	100	Unit:	[mm/s]/[rpm]
Max. value:	1000	Data type:	UInt16
Default value:	500	Change mode:	At stop

Value range:
100 to 1000
Description
Defines the maximum allowable motor speed reference in offline inertia auto-tuning mode. During inertia auto-tuning, the higher the speed, the more accurate the auto-tuned value. Use the default value in general applications.

H09.07 **Time constant for accelerating to maximum speed during inertia auto-tuning**

Comm. address:	2009-08h	Effective mode:	Real time
Min. value:	10	Unit:	ms
Max. value:	5000	Data type:	UInt16
Default value:	125	Change mode:	At stop

Value range:
10 to 5000
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 upon completion of inertia auto-tuning**

Comm. address:	2009-09h	Effective mode:	Real time
Min. value:	50	Unit:	ms
Max. value:	10000	Data type:	UInt16
Default value:	800	Change mode:	At stop

Value range:
50 to 10000
Description
Defines the time interval 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. value:	0.00	Unit:	[Mm]/[Rev]
Max. value:	100.00	Data type:	UInt16
Default value:	1.00	Change mode:	Real time

Value range:
0.00 to 100.00
Description
Defines the motor rotation distance required for 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, verify that the travel distance of the motor at the stop position is higher 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 **Oscillation threshold**

Comm. address:	2009-0Ch	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Value range:
0.0 to 100.0
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. value:	50	Unit:	Hz
Max. value:	8000	Data type:	UInt16
Default value:	8000	Change mode:	Real time

Value range:
50 to 8000
Description
Defines the center frequency of the notch, which is the mechanical resonance frequency.
If the notch frequency is 8000 Hz in torque control mode, the notch function is disabled.

H09.13 **Bandwidth level of the 1st notch**

Comm. address:	2009-0Eh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	20	Data type:	UInt16
Default value:	2	Change mode:	Real time

Value range:
0 to 20
Description
Defines the bandwidth level of the notch. Use the default setpoint in general cases.
The notch width level indicates 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. value:	0	Unit:	-

Max. value:	99	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 99
Description
Defines the depth level of the notch.
The notch depth level indicates the ratio of input to output at center frequency.
The higher the setpoint, the lower the notch depth and the weaker the mechanical resonance suppression. 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. value:	50	Unit:	Hz
Max. value:	8000	Data type:	UInt16
Default value:	8000	Change mode:	Real time

Value range:
50 to 8000
Description
Defines the frequency of the 2nd notch.

H09.16 **Bandwidth level of the 2nd notch**

Comm. address:	2009-11h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	20	Data type:	UInt16
Default value:	2	Change mode:	Real time

Value range:
0 to 20
Description
Defines the bandwidth level of the 2nd notch.

H09.17 **Depth level of the 2nd notch**

Comm. address:	2009-12h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	99	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 99
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. value:	50	Unit:	Hz
Max. value:	8000	Data type:	UInt16

Default value:	8000	Change mode:	Real time

Value range:
50 to 8000
Description
Defines the frequency of the 3rd notch.

H09.19 **Bandwidth level of the 3rd notch**

Comm. address:	2009-14h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	20	Data type:	UInt16
Default value:	2	Change mode:	Real time

Value range:
0 to 20
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. value:	0	Unit:	-
Max. value:	99	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 99
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. value:	50	Unit:	Hz
Max. value:	8000	Data type:	UInt16
Default value:	8000	Change mode:	Real time

Value range:
50 to 8000
Description
Defines the frequency of the 4th notch.

H09.22 **Bandwidth level of the 4th notch**

Comm. address:	2009-17h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	20	Data type:	UInt16
Default value:	2	Change mode:	Real time

Value range:
0 to 20

Description
Defines the bandwidth level of the 4th notch.

H09.23 **Depth level of the 4th notch**

Comm. address:	2009-18h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	99	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 99
Description
Defines the depth level of the 4th notch.

H09.24 **Auto-tuned resonance frequency**

Comm. address:	2009-19h	Effective mode:	-
Min. value:	0	Unit:	Hz
Max. value:	5000	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 5000
Description
When H09.02 (Adaptive notch mode) is set to 3, the current mechanical resonance frequency is displayed.

H09.32 **Gravity compensation value**

Comm. address:	2009-21h	Effective mode:	Real time
Min. value:	-100.0	Unit:	%
Max. value:	100.0	Data type:	Int16
Default value:	0.0	Change mode:	Real time

Value range:
-100.0 to +100.0
Description
Defines the gravity compensation value. Setting this parameter properly in vertical axis applications can reduce the falling amplitude upon start.

H09.33 **Forward friction compensation value**

Comm. address:	2009-22h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	0.0	Change mode:	Real time

Value range:
0.0 to 100.0
Description
Defines the forward friction compensation value.

H09.34 **Negative friction compensation value**

Comm. address:	2009-23h	Effective mode:	Real time
Min. value:	-100.0	Unit:	%
Max. value:	0.0	Data type:	Int16
Default value:	0.0	Change mode:	Real time

Value range:
-100.0 to 0.0
Description
Defines the negative friction compensation value.

H09.35 **Friction compensation speed**

Comm. address:	2009-24h	Effective mode:	Real time
Min. value:	0.0	Unit:	-
Max. value:	20.0	Data type:	UInt16
Default value:	2.0	Change mode:	Real time

Value range:
0.0 to 20.0
Description
Defines the friction compensation speed.

H09.36 **Friction compensation speed selection**

Comm. address:	2009-25h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x13	Data type:	UInt16
Default value:	0x0	Change mode:	Real time

Value range:
0: Slow mode+Speed reference
1: Slow mode+Model speed
2: Slow mode+Speed feedback
3: Slow mode+Observed speed
16: Quick mode +Speed reference
17: Quick mode +Model speed
18: Quick mode +Speed feedback
19: Quick mode+Observed speed
Description
Friction compensation speed
0: Slow mode+Speed reference
1: Slow mode+Model speed
2: Slow mode+Speed feedback
3: Slow mode+Observed speed
16: Quick mode +Speed reference
17: Quick mode +Model speed
18: Quick mode +Speed feedback
19: Quick mode+Observed speed

H09.37 **Vibration monitoring time**

Comm. address:	2009-26h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	300	Change mode:	Real time

Value range:
0 to 65535
Description
The resonance detection suppression function is turned off automatically after the time defined by this parameter elapses. To enable 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. value:	1.0	Unit:	Hz
Max. value:	100.0	Data type:	UInt16
Default value:	100.0	Change mode:	At stop

Value range:
1.0 to 100.0
Description
Set this parameter based on the actual jitter frequency.

H09.39 **Low-frequency suppression 1 at the mechanical end**

Comm. address:	2009-28h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	2	Change mode:	At stop

Value range:
0 to 3
Description
Defines different low-frequency resonance suppression types at the mechanical end. Type 1 features the shortest delay.

H09.41 **Frequency of the 5th notch**

Comm. address:	2009-2Ah	Effective mode:	Real time
Min. value:	50	Unit:	Hz
Max. value:	8000	Data type:	UInt16
Default value:	8000	Change mode:	Real time

Value range:
50 to 8000
Description
Defines the frequency of the 5th notch.

H09.42 **Bandwidth level of the 5th notch**

Comm. address:	2009-2Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	20	Data type:	UInt16
Default value:	2	Change mode:	Real time

Value range:
0 to 20
Description
Defines the bandwidth level of the 5th notch.

H09.43 **Depth level of the 5th notch**

Comm. address:	2009-2Ch	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	99	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 99
Description
Defines the depth level of the 5th notch.

H09.44 **Frequency of low-frequency suppression 2 at the mechanical end**

Comm. address:	2009-2Dh	Effective mode:	Real time
Min. value:	0.0	Unit:	-
Max. value:	200.0	Data type:	UInt16
Default value:	0.0	Change mode:	At stop

Value range:
0.0 to 200.0
Description
Defines the low-frequency resonance suppression 2 frequency at the mechanical end. Set this parameter based on the actual jitter frequency.

H09.45 **Response of low-frequency resonance suppression 2 at mechanical end**

Comm. address:	2009-2Eh	Effective mode:	Real time
Min. value:	0.01	Unit:	-
Max. value:	10.00	Data type:	UInt16
Default value:	1.00	Change mode:	At stop

Value range:
0.01 to 10.00
Description
Defines the end low-frequency suppression 2 response. Use the default setpoint in general cases. To increase the setpoint, decrease the delay time.

H09.47 **Bandwidth of low-frequency resonance suppression 2 at mechanical end**

Comm. address:	2009-30h	Effective mode:	Real time
Min. value:	0.00	Unit:	-
Max. value:	2.00	Data type:	UInt16
Default value:	1.00	Change mode:	At stop

Value range:
0.00 to 2.00
Description
Defines the bandwidth of low-frequency resonance suppression 2 at the mechanical end. Use the default setpoint in general cases. To increase the setpoint, increase the delay time.

H09.49 **Frequency of low-frequency resonance suppression 3 at the mechanical end**

Comm. address:	2009-32h	Effective mode:	Real time
Min. value:	0.0	Unit:	-
Max. value:	200.0	Data type:	UInt16
Default value:	0.0	Change mode:	At stop

Value range:
0.0 to 200.0
Description
Defines the frequency of low-frequency resonance suppression 3 at mechanical end.

H09.50 **Response of low-frequency resonance suppression 3 at the mechanical end**

Comm. address:	2009-33h	Effective mode:	Real time
Min. value:	0.01	Unit:	-
Max. value:	10.00	Data type:	UInt16
Default value:	1.00	Change mode:	At stop

Value range:
0.01 to 10.00
Description
Defines the response of low-frequency resonance suppression 3 at the mechanical end.

H09.52 **Bandwidth of low-frequency resonance suppression 3 at the mechanical end**

Comm. address:	2009-35h	Effective mode:	Real time
Min. value:	0.00	Unit:	-
Max. value:	2.00	Data type:	UInt16
Default value:	1.00	Change mode:	At stop

Value range:
0.00 to 2.00
Description
Defines the bandwidth of low-frequency resonance suppression 3 at mechanical end.

H09.54 **Resonance detection torque threshold**

Comm. address:	2009-37h	Effective mode:	Real time

Min. value:	0.0	Unit:	%
Max. value:	300.0	Data type:	UInt16
Default value:	50.0	Change mode:	Real time

Value range:
0.0 to 300.0
Description
Defines the vibration threshold. If the torque fluctuation exceeds the setpoint, an error can be reported. Setting this parameter to 0 disables the resonance detection function.

H09.56 **Maximum overshoot allowed by ETune**

Comm. address:	2009-39h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	2936	Change mode:	Real time

Value range:
0 to 65535
Description
Defines the maximum overshoot value allowed during ETune.

H09.57 **STune resonance suppression switchover frequency**

Comm. address:	2009-3Ah	Effective mode:	Real time
Min. value:	0	Unit:	Hz
Max. value:	4000	Data type:	UInt16
Default value:	650	Change mode:	Real time

Value range:
0 to 4000
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. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0: Disable
1: Enable
Description
Resets 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. value:	0.00	Unit:	ms
Max. value:	50.00	Data type:	UInt16
Default value:	1.00	Change mode:	Real time

Value range:
0.00 to 50.00
Description
Defines the STune stop delay judgement.

H09.63 **STune quick convergence speed**

Comm. address:	2009-40h	Effective mode:	Real time
Min. value:	0.00	Unit:	-
Max. value:	50.00	Data type:	UInt16
Default value:	1.00	Change mode:	Real time

Value range:
0.00 to 50.00
Description
Defines the STune quick convergence speed.

H09.71 **Starting frequency**

Comm. address:	2009-48h	Effective mode:	Real time
Min. value:	0	Unit:	Hz
Max. value:	8000	Data type:	UInt16
Default value:	15	Change mode:	Real time

Value range:
0 to 8000
Description
Defines the start frequency for high-performance sweep tuning.

H09.72 **Termination frequency**

Comm. address:	2009-49h	Effective mode:	Real time
Min. value:	0	Unit:	Hz
Max. value:	8000	Data type:	UInt16
Default value:	8000	Change mode:	Real time

Value range:
0 to 8000
Description
Defines the end frequency for high-performance sweep tuning.

H09.73 **Frequency subdivision**

Comm. address:	2009-4Ah	Effective mode:	Real time
Min. value:	0	Unit:	-

Max. value:	500	Data type:	UInt16
Default value:	50	Change mode:	Real time

Value range:
0 to 500
Description
Defines the frequency resolution of high-performance tuning in the low frequency band (start frequency-start frequency 2). The higher the setpoint, the lower the resolution is.

H09.74 **Excitation amplitude**

Comm. address:	2009-4Bh	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	400.0	Data type:	UInt16
Default value:	15.0	Change mode:	Real time

Value range:
0.0 to 400.0
Description
Defines the sweeping excitation amplitude for high-performance tuning.

H09.75 **Starting frequency 2**

Comm. address:	2009-4Ch	Effective mode:	Real time
Min. value:	0	Unit:	Hz
Max. value:	8000	Data type:	UInt16
Default value:	500	Change mode:	Real time

Value range:
0 to 8000
Description
Defines the start frequency for high-performance tuning in medium- and high-frequency bands.

H09.76 **Frequency subdivision 2**

Comm. address:	2009-4Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1000	Data type:	UInt16
Default value:	500	Change mode:	Real time

Value range:
0 to 1000
Description
Defines the frequency resolution of high-performance tuning in the low frequency band (start frequency 2 to end 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. value:	0	Unit:	-
Max. value:	6	Data type:	UInt16

Default value:	0	Change mode:	Real time

Value range:
0: Disable
1: First-order low-pass
2: Second-order low-pass
3
: Notch4: Lead-lag
5: User-defined

Description
Used to select biquad filter mode.
0: Disable
1: First-order low-pass
2: Second-order low-pass
3
: Notch4: Lead-lag
5: User-defined

H09.78 **Biquad filter numerator frequency**

Comm. address:	2009-4Fh	Effective mode:	Real time
Min. value:	0	Unit:	Hz
Max. value:	16000	Data type:	UInt16
Default value:	8000	Change mode:	Real time

Value range:
0 to 16000

Description
Defines the biquad filter numerator frequency.

H09.79 **Damping coefficient of biquad filter numerator**

Comm. address:	2009-50h	Effective mode:	Real time
Min. value:	0.001	Unit:	-
Max. value:	10.000	Data type:	UInt16
Default value:	1.000	Change mode:	Real time

Value range:
0.001 to 10.000

Description
Defines the damping coefficient of biquad filter numerator.

H09.80 **Biquad filter denominator frequency**

Comm. address:	2009-51h	Effective mode:	Real time
Min. value:	0	Unit:	Hz
Max. value:	16000	Data type:	UInt16
Default value:	8000	Change mode:	Real time

Value range:
0 to 16000

Description
Defines the biquad filter denominator frequency.

H09.81 **Damping coefficient of biquad filter denominator**

Comm. address:	2009-52h	Effective mode:	Real time
Min. value:	0.001	Unit:	-
Max. value:	10.000	Data type:	UInt16
Default value:	1.000	Change mode:	Real time

Value range:
0.001 to 10.000
Description
Defines the damping coefficient of biquad filter denominator.

H09.82 **Vibration frequency 1**

Comm. address:	2009-53h	Effective mode:	Real time
Min. value:	0.0	Unit:	Hz
Max. value:	300.0	Data type:	UInt16
Default value:	0.0	Change mode:	Real time

Value range:
0.0 to 300.0
Description
Defines the vibration frequency 1.

H09.83 **Resonance frequency 1**

Comm. address:	2009-54h	Effective mode:	Real time
Min. value:	0.0	Unit:	Hz
Max. value:	300.0	Data type:	UInt16
Default value:	0.0	Change mode:	Real time

Value range:
0.0 to 300.0
Description
Defines the resonance frequency 1.

H09.84 **Vibration damping 1**

Comm. address:	2009-55h	Effective mode:	Real time
Min. value:	0.00	Unit:	-
Max. value:	0.50	Data type:	UInt16
Default value:	0.05	Change mode:	Real time

Value range:
0.00 to 0.50
Description
Defines the vibration damping 1.

H09.85 **Resonance damping 1**

Comm. address:	2009-56h	Effective mode:	Real time
Min. value:	0.00	Unit:	-
Max. value:	0.50	Data type:	UInt16
Default value:	0.05	Change mode:	Real time

Value range:
0.00 to 0.50
Description
Defines resonance damping 1.

H09.86 **Vibration frequency 2**

Comm. address:	2009-57h	Effective mode:	Real time
Min. value:	0.0	Unit:	Hz
Max. value:	300.0	Data type:	UInt16
Default value:	0.0	Change mode:	Real time

Value range:
0.0 to 300.0
Description
Defines the vibration frequency 2.

H09.87 **Resonance frequency 2**

Comm. address:	2009-58h	Effective mode:	Real time
Min. value:	0.0	Unit:	Hz
Max. value:	300.0	Data type:	UInt16
Default value:	0.0	Change mode:	Real time

Value range:
0.0 to 300.0
Description
Defines the resonance frequency 2.

H09.88 **Vibration damping 2**

Comm. address:	2009-59h	Effective mode:	Real time
Min. value:	0.00	Unit:	-
Max. value:	0.50	Data type:	UInt16
Default value:	0.05	Change mode:	Real time

Value range:
0.00 to 0.50
Description
Defines the vibration damping 2.

H09.89 **Resonance damping 2**

Comm. address:	2009-5Ah	Effective mode:	Real time
Min. value:	0.00	Unit:	-

Max. value:	0.50	Data type:	UInt16
Default value:	0.05	Change mode:	Real time

Value range:
0.00 to 0.50
Description
Defines resonance damping 2.

H09.92 Model friction compensation enable

Comm. address:	2009-5Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	1	Change mode:	Real time

Value range:
0: Disable
1: Enable
Description
Model friction compensation

H09.93 Model friction compensation coefficient

Comm. address:	2009-5Eh	Effective mode:	Real time
Min. value:	0.00	Unit:	%/1000 rpm
Max. value:	50.00	Data type:	UInt16
Default value:	0.00	Change mode:	Real time

Value range:
0.00 to 50.00
Description
Defines the model friction compensation coefficient.

H09.94 Model tracking gain proportional coefficient in STune

Comm. address:	2009-5Fh	Effective mode:	Real time
Min. value:	0.00	Unit:	-
Max. value:	30.00	Data type:	UInt16
Default value:	2.00	Change mode:	Real time

Value range:
0.00 to 30.00
Description
Tune H08.43 (model gain). Gain tuning is available only in STune8.

H09.95 Auto-tuning of jitter suppression at the mechanical end

Comm. address:	2009-60h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0: Disable
1: Enable
2: Clear resonance suppression parameters
Description
-

H09.98 **Auto-tuning of vibration suppression function**

Comm. address:	2009-63h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0: Disable
1: Auto-tuning of fast vibration suppression
2: Auto-tuning of slow vibration suppression
Description
0: Disable
1: Auto-tuning of fast vibration suppression
2: Auto-tuning of slow vibration suppression

17.11 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
Description
Inovance provides servo drives of single-phase 200 V, three-phase 200 V, and three-phase 400 V. When the input voltage fluctuates violently or phase loss occurs, the servo drive flexibly selects the protection mode according to the setting of H0A.00.
0: Enable
1: Disable

H0A.01 **Absolute position limit**

Comm. address:	200A-02h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0: Disable
1: Enable
2: Enable after homing
Description
Defines the activation condition for enabling the software limit function and the software limit.
0: Disable
1: Enable
2: Enable after homing

H0A.04 **Motor overload protection gain**

Comm. address:	200A-05h	Effective mode:	Real time
Min. value:	50	Unit:	-
Max. value:	300	Data type:	UInt16
Default value:	100	Change mode:	Real time

Value range:
50 to 300
Description
Defines the motor overload duration before E620.0 is reported when H32.70 is set to 0.
You can change the setpoint based on motor temperature to reduce or prolong the time to trigger overload protection. The setpoint 50% indicates the trigger time is reduced by 50%. The setpoint 150% indicates the trigger time is prolonged by 50%.
Set this parameter based on the actual heating condition of the motor, and take caution during use.

H0A.08 **Overspeed threshold**

Comm. address:	200A-09h	Effective mode:	Real time
Min. value:	0	Unit:	[mm/s]/[rpm]
Max. value:	20000	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 20000
Description
Defines the overspeed threshold of the motor.

Setpoint	Overspeed Threshold	Condition for Reporting E500.0
0	Max. motor speed × 1.2	If the speed feedback exceeds the overspeed threshold several times, the drive reports E500.0 (Motor overspeed).
1 to 20000	If H0A-08 ≥ (Maximum motor speed × 1.2): the overspeed threshold equals the maximum motor speed × 1.2.	
	If H0A-08 < (Maximum motor speed × 1.2): the overspeed threshold equals H0A.08.	

H0A.09 **Max. pulse input frequency in position control**

Comm. address:	200 A-0Ah	Effective mode:	Real time

Min. value:	100	Unit:	kHz
Max. value:	16000	Data type:	UInt16
Default value:	16000	Change mode:	At stop

Value range:
100 to 16000
Description
Defines the maximum frequency of input pulses when the position reference source is pulse reference (H05.00 = 0) in position control mode.
When the actual pulse input frequency exceeds the value of H0A.09, the drive reports EB01.0 (Position reference input error).

H0A.10 Threshold of excessive local position deviation

Comm. address:	200A-0Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4294967295	Data type:	UInt32
Default value:	219895614	Change mode:	Real time

Value range:
0 to 4294967295
Description
Defines the threshold for excessive position deviation in the position control mode. The unit is 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:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	1	Change mode:	At stop

Value range:
0: Disable
1: Enable runaway protection scheme 1
2: Enable runaway protection scheme 2
Description
Defines whether to enable runaway protection.
0: Hide E234 when the motor drives a vertical axis or is driven by the load
1: Enable runway protection scheme 1
2: Enable runway protection scheme 2

H0A.13 Angle auto-tuning mode

Comm. address:	200A-0Eh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	10	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value 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

Description

Defines the 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 cores. It is applicable to ROT and DDR motors, not DDL motors.

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:	200 A-12h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0: Pulse unit1

: Reference unit

Description

Sets the unit for determining the threshold of excessive position deviation, positioning completion, and positioning proximity.

0: Pulse unit1

: Reference unit

H0A.18 **IGBT over-temperature threshold**

Comm. address:	200A-13h	Effective mode:	Real time
Min. value:	120	Unit:	℃
Max. value:	175	Data type:	UInt16
Default value:	140	Change mode:	Real time

Value range:

120 to 175

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. value:	0.00	Unit:	μs
Max. value:	6.30	Data type:	UInt16
Default value:	2.00	Change mode:	Real time

Value range:
0.00 to 6.30
Description
Defines the filter time of touch probe 1.

H0A.20 **Filter time constant of probe 2**

Comm. address:	200A-15h	Effective mode:	Real time
Min. value:	0.00	Unit:	μs
Max. value:	6.30	Data type:	UInt16
Default value:	2.00	Change mode:	Real time

Value range:
0.00 to 6.30
Description
Defines the filter time of touch probe 2.

H0A.21 **STO function selection switch**

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: Not hide E150.0 fault
bit2: Hide E150.5 fault
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 the corresponding DO has no output. 1: The keypad displays "E150.0" after the STO function is triggered. In this case, the dive reports the fault and the corresponding DO outputs the fault signal.
bit2: E150.5 fault mask selection 0 - Not masked; 1 - Masked

H0A.23 **TZ signal filter time**

Comm. address:	200A-18h	Effective mode:	Next power-on
Min. value:	0	Unit:	25 ns
Max. value:	31	Data type:	UInt16
Default value:	15	Change mode:	At stop

Value range:
0 to 31
Description
Defines the TZ signal filter time.

H0A.24 **Filter time constant of low-speed pulse input terminal**

Comm. address:	200 A-19h	Effective mode:	Next power-on
Min. value:	0	Unit:	25 ns
Max. value:	255	Data type:	UInt16
Default value:	30	Change mode:	At stop

Value range:
0 to 255
Description
Defines the filter time constant of low-speed pulse input terminal which is enabled (H05.01 = 0) when the position reference source is pulse input (H05.00 = 0) in the position control mode. When peak interference exists in the low-speed pulse input terminal, set this parameter to suppress peak interference and prevent motor malfunction due to interference signal inputted to the servo drive.

H0A.25 **Speed display DO low-pass filter time**

Comm. address:	200A-1Ah	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	5000	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 5000
Description
Defines the low-pass filter time constant of the speed information for speed feedback and position references.

H0A.26 **Motor overload mask**

Comm. address:	200A-1Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0: Show motor overload alarm (E909.0) and fault (E620.0)
1: Hide motor overload alarm (E909.0) and fault (E620.0)
Description
Defines whether to enable motor overload detection.
0: Show motor overload alarm (E909.0) and fault (E620.0)
1: Hide motor overload alarm (E909.0) and fault (E620.0)

H0A.27 **Moving average filter time for speed display DO**

Comm. address:	200A-1Ch	Effective mode:	Real time

Min. value:	0	Unit:	ms
Max. value:	100	Data type:	UInt16
Default value:	50	Change mode:	At stop

Value range:
0 to 100
Description
Defines the moving average filter time constant of the speed information for speed feedback and position references.

H0A.28 **ABZ encoder pulse signal filter time**

Comm. address:	200 A-1Dh	Effective mode:	Next power-on
Min. value:	0	Unit:	25 ns
Max. value:	255	Data type:	UInt16
Default value:	2	Change mode:	At stop

Value range:
0 to 255
Description
Defines the pulse signal filter time of the ABZ encoder that is used as the primary encoder.

H0A.29 **Fully closed-loop encoder (ABZ) filter time**

Comm. address:	200A-1Eh	Effective mode:	Next power-on
Min. value:	0	Unit:	25 ns
Max. value:	65535	Data type:	UInt16
Default value:	4111	Change mode:	At stop

Value range:
bit0-bit7: Fully closed loop encoder (ABZ) pulse signal filtering time
bit8-bit15: Fully closed loop encoder (ABZ) wire breakage filter time
Description
bit0 to bit7: Fully closed-loop encoder (ABZ) pulse signal filter time.
bit8 to bit15: Fully closed-loop encoder (ABZ) disconnection filter time.

H0A.30 **Filter time constant of high-speed pulse input terminal**

Comm. address:	200 A-1Fh	Effective mode:	Next power-on
Min. value:	0	Unit:	ns
Max. value:	255	Data type:	UInt16
Default value:	2	Change mode:	At stop

Value range:
0 to 255
Description
Defines the filter time constant of high-speed pulse input terminal.

H0A.32 **Over-temperature protection time window upon stall**

Comm. address:	200A-21h	Effective mode:	Real time
Min. value:	10	Unit:	ms

Max. value:	65535	Data type:	UInt16
Default value:	200	Change mode:	Real time

Value range:
10 to 65535
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 **Over-temperature protection selection upon stall**

Comm. address:	200A-22h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	1	Change mode:	Real time

Value range:
0: Disable
1: Enable
Description
Enables or disables the detection for E630.0 (Motor stall over-temperature protection).
0: Disable
1: Enable

H0A.36 **Encoder multi-turn overflow fault mask**

Comm. address:	200A-25h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0: Disable
1: Enable
Description
Defines whether to mask the encoder multi-turn overflow fault in absolute position linear mode (H02.01 = 1).
0: Disable
1: Enable

H0A.37 **Filter time for ABZ encoder open-circuit detection**

Comm. address:	200 A-26h	Effective mode:	Next power-on
Min. value:	0	Unit:	25 ns
Max. value:	255	Data type:	UInt16
Default value:	200	Change mode:	At stop

Value range:
0 to 255
Description
Defines the disconnection detection filter time of the ABZ encoder that is used as the master 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 logic

0: Probe edge trigger coupled with DI logic

1: Probe edge trigger not coupled with DI logic

bit4: Touch probe 2 independent compensation

0: Disable

1: Enable

Description

Selects overtravel and probe compensation functions.

H0A.41 **Positive software position limit**

Comm. address:	200A-2Ah	Effective mode:	Real time
Min. value:	-2147483648	Unit:	Encoder unit
Max. value:	2147483647	Data type:	Int32
Default value:	2147483647	Change mode:	At stop

Value range:

-2147483648 to +2147483647

Description

When the absolute position counter (H0b.07) is larger than H0A.41, the drive reports E950.0 (Forward overtravel) and stops accordingly.

H0A.43 **Negative software position limit**

Comm. address:	200A-2Ch	Effective mode:	Real time
Min. value:	-2147483648	Unit:	Encoder unit
Max. value:	2147483647	Data type:	Int32
Default value:	-2147483648	Change mode:	At stop

Value range:

-2147483648 to +2147483647

Description

When the absolute position counter (H0b.07) is smaller than H0A.43, the drive reports E952.0 (Reverse overtravel) and stops accordingly.

H0A.50 **Encoder communication fault tolerance threshold**

Comm. address:	200A-33h	Effective mode:	Next power-on
Min. value:	0	Unit:	-
Max. value:	31	Data type:	UInt16
Default value:	31	Change mode:	Real time

Value range:
0 to 31
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 filter times**

Comm. address:	200A-34h	Effective mode:	Real time
Min. value:	3	Unit:	55 ms
Max. value:	36	Data type:	UInt16
Default value:	20	Change mode:	Real time

Value range:
3 to 36
Description
Phase loss fault is reported when phase loss keeps active for a period longer than that defined by H0A.51.

H0A.52 **Encoder temperature protection threshold**

Comm. address:	200A-35h	Effective mode:	Real time
Min. value:	0	Unit:	℃
Max. value:	175	Data type:	UInt16
Default value:	120	Change mode:	Real time

Value range:
0 to 175
Description
Defines the temperature threshold for encoder over-temperature protection.

H0A.53 **Probe DI ON compensation time**

Comm. address:	200A-36h	Effective mode:	Real time
Min. value:	-3000	Unit:	25 ns
Max. value:	3000	Data type:	Int16
Default value:	200	Change mode:	Real time

Value range:
-3000 to 3000
Description
Compensates for the action time when the touch probe is switched on.

H0A.54 **Probe DI OFF compensation time**

Comm. address:	200 A-37h	Effective mode:	Real time
Min. value:	-3000	Unit:	25 ns
Max. value:	3000	Data type:	Int16
Default value:	1512	Change mode:	Real time

Value range:
-3000 to 3000
Description
Compensates 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. value:	100.0	Unit:	%
Max. value:	400.0	Data type:	UInt16
Default value:	200.0	Change mode:	Real time

Value range:
100.0 to 400.0
Description
Defines the current threshold for runaway protection detection.

H0A.56 **Fault reset delay**

Comm. address:	200A-39h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	60000	Data type:	UInt16
Default value:	10000	Change mode:	Real time

Value range:
0 to 60000
Description
Defines the fault reset delay.

H0A.57 **Runaway speed threshold**

Comm. address:	200A-3Ah	Effective mode:	Real time
Min. value:	1	Unit:	[mm/s]/[rpm]
Max. value:	1000	Data type:	UInt16
Default value:	50	Change mode:	Real time

Value range:
1 to 1000
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. value:	0.1	Unit:	ms

Max. value:	100.0	Data type:	UInt16
Default value:	2.0	Change mode:	Real time

Value range:
0.1 to 100.0
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. value:	10	Unit:	ms
Max. value:	1000	Data type:	UInt16
Default value:	30	Change mode:	Real time

Value range:
10 to 1000
Description
The runaway fault (E234.0) will be 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. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	1	Change mode:	Real time

Value range:
0: Disable
1: Any fault
2: Designated fault
3: Triggered by designated condition
Description
Defines the condition for triggering black box sampling.
0: Disable
1: Any fault
2: Designated fault
3: Triggered by designated condition

H0A.61 **Specified fault code**

Comm. address:	200A-3Eh	Effective mode:	Real time
Min. value:	0.0	Unit:	-
Max. value:	6553.5	Data type:	UInt16
Default value:	0.0	Change mode:	Real time

Value range:
0.0 to 6553.5
Description
Defines the fault code for triggering the black box function.

H0A.62 **Trigger source**

Comm. address:	200A-3Fh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	25	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 25
Description
Defines the fault code for triggering the black box function through the specified channel.

H0A.63 **Trigger level**

Comm. address:	200A-40h	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
Description
Defines the trigger level for triggering the black box function through the specified channel.

H0A.65 **Trigger level selection**

Comm. address:	200A-42h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0: Rising edge
1: Equal
2: Falling edge
3: Edge-triggered
Description
Defines the 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. value:	0	Unit:	%
Max. value:	100	Data type:	UInt16
Default value:	75	Change mode:	Real time

Value range:

0 to 100

Description

Defines the pre-trigger position for triggering black box sampling.

H0A.67 **Sampling frequency**

Comm. address:	200A-44h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0: Current loop

1: Position loop

2: Main cycle

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. value:	0	Unit:	[mm/s]/[rpm]
Max. value:	20000	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0 to 20000

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. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	4098	Change mode:	Real time

Value range:

0 to 65535

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 fallback 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. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10000	Change mode:	At stop

Value range:
0 to 65535
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. value:	1	Unit:	ms
Max. value:	5	Data type:	UInt16
Default value:	1	Change mode:	Real time

Value range:
1 to 5
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. value:	1	Unit:	ms
Max. value:	1000	Data type:	UInt16
Default value:	100	Change mode:	Real time

Value range:
1 to 1000
Description
Defines the delay from the moment the inconsistent 24 V 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. value:	0	Unit:	ms
Max. value:	25	Data type:	UInt16
Default value:	20	Change mode:	Real time

Value range:
0 to 25
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 operation1
: Host controller executes torque limit
2: Servo executes torque limit
Description
Defines whether to enable voltage drop protection.
0: No operation1
: Host controller executes torque limit
2: Servo executes torque limit

H0A.82 **Voltage drop torque limit**

Comm. address:	200 A-53h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	100.0	Data type:	UInt16
Default value:	50.0	Change mode:	Real time

Value range:
0.0 to 100.0
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
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
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
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
Description
Defines the open circuit detection filter time.

H0A.87 **Number of Hall status fault filtering times**

Comm. address:	200 A-58h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1000	Data type:	UInt16
Default value:	1	Change mode:	Real time

Value range:
0 to 1000
Description
Defines the number of hall status fault filtering times.

H0A.88 **Alarm selection**

Comm. address:	200 A-59h	Effective mode:	Next power-on
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 3
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 (971.0) 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
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. value:	0	Unit:	ms
Max. value:	100	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 100
Description
Defines the low-pass filter time constant for displayed speed values.

H0A.91 **Moving average filter time for torque display**

Comm. address:	200A-5Ch	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	100	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 100
Description
Defines the moving average filter time constant for displayed torque values.

H0A.92 **Moving average filter time for position display**

Comm. address:	200A-5Dh	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	100	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 100
Description
Defines the moving average filter time constant for displayed position values.

H0A.93 **Voltage display low-pass filter time**

Comm. address:	200A-5Eh	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	250	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 250
Description
Defines the low-pass filter time constant for displayed voltage values.

H0A.94 **Thermal display low-pass filter time**

Comm. address:	200A-5Fh	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	250	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 250
Description
Defines the low-pass filter time constant for thermal values.

17.12 H0b Monitoring Parameters

H0b.00 **Actual motor speed**

Comm. address:	200b-01h	Effective mode:	-
Min. value:	-32767	Unit:	[mm/s]/[rpm]
Max. value:	32767	Data type:	Int16
Default value:	0	Change mode:	Read-only

Value range:
-32767 to +32767
Description
Displays the actual motor speed after round-off, which is accurate to 1 [mm/s]/[rpm].
You can set in H0A.25 (Speed display DO low-pass filter time) the filter time constant for H0b.00.

H0b.01 **Speed reference**

Comm. address:	200b-02h	Effective mode:	-
Min. value:	-32767	Unit:	[mm/s]/[rpm]
Max. value:	32767	Data type:	Int16
Default value:	0	Change mode:	Read-only

Value range:
-32767 to +32767
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. value:	-3276.7	Unit:	%
Max. value:	3276.7	Data type:	Int16
Default value:	0.0	Change mode:	Read-only

Value range:
-3276.7 to +3276.7

Description
Displays the current torque reference in units of 0.1%. The value 100.0% corresponds to the rated torque of the motor.

H0b.03 **Monitored DI states**

Comm. address:	200b-04h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Description
Displays the level states of the 8 DI terminals without filtering.
Upper LED segments ON: high level (indicated by "1"); Lower LED segments ON: low level (indicated by "0")

H0b.05 **Monitored DO states**

Comm. address:	200b-06h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Description
Displays the level status of five DOs 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. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Value range:
-2147483648 to +2147483647
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. value:	0.0	Unit:	°
Max. value:	360.0	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Value range:
0.0 to 360.0
Description
Displays present mechanical angle (encoder unit) of the motor. The setpoint 0 indicates the mechanical angle is 0°.
Actual mechanical angle = 360° × 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. value:	0.0	Unit:	°
Max. value:	360.0	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Value range:
0.0 to 360.0
Description
Displays the present electrical angle of the motor, which is accurate to 0.1°.
The electrical angle variation range is ±360.0° during rotation. If the motor has four pairs of poles, each revolution generates four rounds of angle change from 0° to 359°. Similarly, if the motor has five pairs of poles, each revolution generates five rounds of angle change from 0° to 359°.

H0b.12 Average load ratio

Comm. address:	200b-0Dh	Effective mode:	-
Min. value:	0.0	Unit:	%
Max. value:	800.0	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Value range:
0.0 to 800.0
Description
Displays the percentage of the average load torque to the rated torque of the motor, which is accurate to 0.1%. The value 100.0% corresponds to the rated torque of the motor.

H0b.13 Input reference counter

Comm. address:	200b-0Eh	Effective mode:	-
Min. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Value range:
-2147483648 to +2147483647
Description
Counts and displays the number of position references not divided or multiplied by the electronic gear ratio during operation.
This parameter is a 32-bit integer, which is displayed as a decimal on the keypad.

H0b.15 **Position following error (encoder unit)**

Comm. address:	200b-10h	Effective mode:	-
Min. value:	-2147483648	Unit:	Encoder unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Value range:
-2147483648 to +2147483647

Description
Counts and displays the position deviation value after being divided or multiplied by the electronic gear ratio in position control mode.
This parameter is a 32-bit integer, which is displayed as a decimal on the keypad.
Note:
H0b.15 can be cleared when the condition defined in H05.16 is met.

H0b.17 **Feedback pulse counter**

Comm. address:	200b-12h	Effective mode:	-
Min. value:	-2147483648	Unit:	Encoder unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Value range:
-2147483648 to +2147483647

Description
Counts the position pulses fed back by the encoder in any 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. value:	0.0	Unit:	s
Max. value:	429496729.5	Data type:	UInt32
Default value:	0.0	Change mode:	Read-only

Value range:
0.0 to 429496729.5

Description
Records the total operation time of the drive.
This parameter is a 32-bit integer, which is displayed as a decimal on the keypad.
Note:
If multiple power cycles are performed on the drive within a short period of time, there may be a one-hour deviation between the value of this parameter and the actual time.

H0b.21 **AI1 voltage display**

Comm. address:	200b-16h	Effective mode:	-
Min. value:	-327.67	Unit:	V
Max. value:	327.67	Data type:	Int16
Default value:	0.00	Change mode:	Read-only

Value range:
-327.67 to 327.67
Description
Displays the actual sampling voltage of AI1.

H0b.22 AI2 voltage display

Comm. address:	200b-17h	Effective mode:	-
Min. value:	-327.67	Unit:	V
Max. value:	327.67	Data type:	Int16
Default value:	0.00	Change mode:	Read-only

Value range:
-327.67 to 327.67
Description
Displays the actual sampling voltage of AI2.

H0b.24 Effective value of phase current

Comm. address:	200b-19h	Effective mode:	-
Min. value:	0.0	Unit:	A
Max. value:	6553.5	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Value range:
0.0 to 6553.5
Description
Displays the RMS value of the phase current of the motor in unit of 0.1 A.

H0b.25 Angle obtained upon voltage injection auto-tuning

Comm. address:	200b-1Ah	Effective mode:	-
Min. value:	0.0	Unit:	°
Max. value:	360.0	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Value range:
0.0 to 360.0
Description
Displays angle obtained upon voltage injection auto-tuning.

H0b.26 Bus voltage

Comm. address:	200b-1Bh	Effective mode:	-
Min. value:	0.0	Unit:	V
Max. value:	6553.5	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Value range:
0.0 to 6553.5
Description
Displays the rectified DC bus voltage of the main circuit input voltage in units of 0.1 V.

H0b.27 **Module temperature**

Comm. address:	200b-1Ch	Effective mode:	-
Min. value:	-20	Unit:	℃
Max. value:	200	Data type:	Int16
Default value:	0	Change mode:	Read-only

Value range:
-20 to 200
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 from FPGA**

Comm. address:	200b-1Dh	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Value range:
0x0 to 0xFFFF
Description
Displays the absolute encoder fault information generated by FPGA.

H0b.29 **Axis status information generated by FPGA**

Comm. address:	200b-1Eh	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Value range:
0x0 to 0xFFFF
Description
Displays the axis status information generated by FPGA.

H0b.30 **Axis fault information generated by FPGA**

Comm. address:	200b-1Fh	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Value range:
0x0 to 0xFFFF
Description
Displays the axis fault information generated by FPGA.

H0b.31 **Encoder fault information**

Comm. address:	200b-20h	Effective mode:	-

Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Value range:
0x0 to 0xFFFF
Description
Displays the encoder fault information.

H0b.33 **Fault record**

Comm. address:	200b-22h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	19	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0: Active 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
Description

Used to view the latest 20 faults of the drive.
0: Active 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. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Value range:
0x0 to 0xFFFF
Description
Displays the fault code of the selected fault.

H0b.35 **Timestamp of the selected fault**

Comm. address:	200b-24h	Effective mode:	-
Min. value:	0.0	Unit:	s
Max. value:	429496729.5	Data type:	UInt32
Default value:	0.0	Change mode:	Read-only

Value range:
0.0 to 429496729.5
Description
Displays the time stamp of the selected fault.

H0b.37 **Motor speed upon the selected fault**

Comm. address:	200b-26h	Effective mode:	-
Min. value:	-32767	Unit:	[mm/s]/[rpm]

Max. value:	32767	Data type:	Int16
Default value:	0	Change mode:	Read-only

Value range:
-32767 to +32767
Description
Displays the motor speed upon occurrence of the selected fault.

H0b.38 Motor phase U current upon selected fault

Comm. address:	200b-27h	Effective mode:	-
Min. value:	-3276.7	Unit:	A
Max. value:	3276.7	Data type:	Int16
Default value:	0.0	Change mode:	Read-only

Value range:
-3276.7 to +3276.7
Description
Displays the motor phase U current upon the selected fault.

H0b.39 Motor phase V current upon displayed fault

Comm. address:	200b-28h	Effective mode:	-
Min. value:	-3276.7	Unit:	A
Max. value:	3276.7	Data type:	Int16
Default value:	0.0	Change mode:	Read-only

Value range:
-3276.7 to +3276.7
Description
Displays the motor phase V current upon the selected fault.

H0b.40 Bus voltage upon occurrence of the selected fault

Comm. address:	200b-29h	Effective mode:	-
Min. value:	0.0	Unit:	V
Max. value:	6553.5	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Value range:
0.0 to 6553.5
Description
Displays the bus voltage upon the selected fault.

H0b.41 Input terminal state upon selected fault

Comm. address:	200b-2Ah	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:

0 to 65535

Description

Displays the input terminal state upon the selected fault.

H0b.43 Output terminal state upon selected fault

Comm. address:	200b-2Ch	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:

0 to 65535

Description

Displays the output terminal status upon the selected fault.

H0b.45 Internal fault code

Comm. address:	200b-2Eh	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Value range:

0x0 to 0xFFFF

Description

Displays the internal fault code.

H0b.46 Absolute encoder fault information generated by FPGA upon selected fault

Comm. address:	200b-2Fh	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Value range:

0x0 to 0xFFFF

Description

Displays the absolute encoder fault information generated by FPGA upon occurrence of the selected fault.

H0b.47 System status information generated by FPGA upon selected fault

Comm. address:	200b-30h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Value range:

0x0 to 0xFFFF

Description

Displays the system status information generated by FPGA upon the selected fault.

H0b.48 **System fault information sent by FPGA upon selected fault**

Comm. address:	200b-31h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Value range:
0x0 to 0xFFFF
Description
Displays the system fault information generated by FPGA upon the selected fault.

H0b.49 **Encoder fault information upon the selected fault**

Comm. address:	200b-32h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Value range:
0x0 to 0xFFFF
Description
Displays the encoder fault information upon occurrence of the selected fault.

H0b.51 **Internal fault code upon the selected fault**

Comm. address:	200b-34h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Value range:
0x0 to 0xFFFF
Description
Displays the internal fault code upon the selected fault.

H0b.52 **FPGA timeout fault standard bit upon selected fault**

Comm. address:	200b-35h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Value range:
0x0 to 0xFFFF
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. value:	-2147483648	Unit:	Reference unit

Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Value range:
-2147483648 to +2147483647

Description
Displays the position error before being processed by the electronic gear ratio in the position control mode.
Position deviation (reference unit) is the value obtained after encoder position deviation calculation. The precision is compromised during division operation.
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. value:	-214748364.8	Unit:	[mm/s]/[rpm]
Max. value:	214748364.7	Data type:	Int32
Default value:	0.0	Change mode:	Read-only

Value range:
-214748364.8 to +214748364.7

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.
H0A.25 can be used to set the filter time constant of the speed feedback.

H0b.57 Control circuit bus voltage

Comm. address:	200b-3Ah	Effective mode:	-
Min. value:	0.0	Unit:	V
Max. value:	6553.5	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Value range:
0.0 to 6553.5

Description
Displays the bus voltage of the control circuit.

H0b.58 Mechanical absolute position (32 low-order bits)

Comm. address:	200b-3Bh	Effective mode:	-
Min. value:	0	Unit:	Encoder unit
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	Read-only

Value range:
0 to 4294967295

Description
Displays the low 32 low-order bit values (encoder unit) of the mechanical position feedback when the absolute encoder is used.

H0b.60 **Mechanical absolute position (32 high-order bits)**

Comm. address:	200b-3Dh	Effective mode:	-
Min. value:	-2147483648	Unit:	Encoder unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Value range:

-2147483648 to +2147483647

Description

Displays the 32 high-order bit values (encoder unit) of the mechanical position feedback when the absolute encoder is used.

H0b.63 **NotRdy state**

Comm. address:	200b-40h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	9	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:

0: Normal

1: Control circuit error

2: Main circuit input error

3: Bus undervoltage

4: Soft start failed

5: Encoder initialization not done

6: Short circuit to ground failed

7: Others

8: STO9

: Initialization of fully closed-loop encoder not done

Description

Displays the reason for NotRdy state.

0: Normal

1: Control circuit error

2: Main circuit input error

3: Bus undervoltage

4: Soft start failed

5: Encoder initialization not done

6: Short circuit to ground failed

7: Others

8: STO9

: Initialization of fully closed-loop encoder not done

H0b.64 **Real-time input position reference counter**

Comm. address:	200b-41h	Effective mode:	-
Min. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32

Default value:	0	Change mode:	Read-only

Value range:
-2147483648 to +2147483647
Description
Displays the value of the pulse reference counter before being divided or multiplied by the electronic gear ratio. This value is independent of the servo drive status and the control mode.

H0b.66 Encoder temperature

Comm. address:	200b-43h	Effective mode:	-
Min. value:	-32768	Unit:	℃
Max. value:	32767	Data type:	Int16
Default value:	0	Change mode:	Read-only

Value range:
-32768 to +32767
Description
Displays the encoder temperature.

H0b.67 Load rate of braking resistor

Comm. address:	200b-44h	Effective mode:	-
Min. value:	0.0	Unit:	%
Max. value:	200.0	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Value range:
0.0 to 200.0
Description
Displays the load rate of the braking resistor.

H0b.70 Number of the absolute encoder revolutions

Comm. address:	200b-47h	Effective mode:	-
Min. value:	-32768	Unit:	Rev
Max. value:	32767	Data type:	Int16
Default value:	0	Change mode:	Read-only

Value range:
-32768 to +32767
Description
Displays the number of absolute encoder revolutions.

H0b.71 Position of absolute encoder within one turn

Comm. address:	200b-48h	Effective mode:	-
Min. value:	0	Unit:	Encoder unit
Max. value:	2147483647	Data type:	UInt32
Default value:	0	Change mode:	Read-only

Value range:

0 to 2147483647

Description

Displays the single-turn position feedback of the absolute encoder.

H0b.74 **System fault information generated by FPGA**

Comm. address:	200b-4Bh	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Value range:

0x0 to 0xFFFF

Description

Displays the system fault information generated by FPGA.

H0b.77 **Encoder position (32 low-order bits)**

Comm. address:	200b-4Eh	Effective mode:	-
Min. value:	0	Unit:	Encoder unit
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	Read-only

Value range:

0 to 4294967295

Description

Displays the 32 low-order bits of the position feedback of the absolute encoder.

H0b.79 **Encoder position (32 high-order bits)**

Comm. address:	200b-50h	Effective mode:	-
Min. value:	-2147483648	Unit:	Encoder unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Value range:

-2147483648 to +2147483647

Description

Displays the 32 high-order bits of the position feedback of the absolute encoder.

H0b.81 **Single-turn position of the rotating load (low-order 32 bits)**

Comm. address:	200b-52h	Effective mode:	-
Min. value:	0	Unit:	Encoder unit
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	Read-only

Value range:

0 to 4294967295

Description

Displays the 32 low-order bits of the rotary load position feedback when the absolute system works in rotation mode.

H0b.83 Single-turn position of the rotating load (32 high-order bits)

Comm. address:	200b-54h	Effective mode:	-
Min. value:	-2147483648	Unit:	Encoder unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Value range:
-2147483648 to +2147483647
Description
Displays the 32 high-order bits of the position feedback of the rotating load when the absolute system works in rotary mode.

H0b.85 Single-turn position of the rotary load (reference unit)

Comm. address:	200b-56h	Effective mode:	-
Min. value:	0	Unit:	Reference unit
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	Read-only

Value range:
0 to 4294967295
Description
Displays the 32 high-order bits of the position feedback of the rotating load when the absolute system works in rotary mode.

H0b.87 IGBT junction temperature

Comm. address:	200b-58h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	200	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 200
Description
Displays the IGBT junction temperature.

H0b.90 Group number of the abnormal parameter

Comm. address:	200b-5Bh	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Value range:
0x0 to 0xFFFF
Description
Displays the group number of the abnormal parameter.

H0b.91 **Offset within the group of the abnormal parameter**

Comm. address:	200b-5Ch	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Description
Displays the offset within the group of the abnormal parameter.

H0b.92 **Hall state view**

Comm. address:	200b-5Dh	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Description
Displays the Hall state.

H0b.93 **Closed loop state**

Comm. address:	200b-5Eh	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0: Half closed loop
1: Fully closed loop
Description
Displays the closed loop state in position control mode.
0: Half closed loop
1: Fully closed loop

H0b.94 **Single power-on time**

Comm. address:	200b-5Fh	Effective mode:	-
Min. value:	0.0	Unit:	s
Max. value:	429496729.5	Data type:	UInt32
Default value:	0.0	Change mode:	Read-only

Value range:
0.0 to 429496729.5
Description
Displays the individual power-on time of the drive.

H0b.96 **Single power-on time upon the selected fault**

Comm. address:	200b-61h	Effective mode:	-
Min. value:	0.0	Unit:	s
Max. value:	429496729.5	Data type:	UInt32
Default value:	0.0	Change mode:	Read-only

Value range:
0.0 to 429496729.5
Description
Displays the single-shot power-on time upon occurrence of the selected fault.

H0b.98 **Dynamic braking resistor load rate**

Comm. address:	200b-63h	Effective mode:	-
Min. value:	0.0	Unit:	%
Max. value:	200.0	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Value range:
0.0 to 200.0
Description
Displays the load rate of dynamic braking resistor.

17.13 H0C Fault and Protection Parameters 2

H0C.53 **Probe DI ON compensation time 2**

Comm. address:	200C-36h	Effective mode:	Real time
Min. value:	-3000	Unit:	25 ns
Max. value:	3000	Data type:	Int16
Default value:	200	Change mode:	Real time

Value range:
-3000 to 3000
Description
Compensates for the action time when touch probe 2 is switched on. (active when bit4 of H0A.40 = 1)

H0C.54 **Probe DI OFF compensation time 2**

Comm. address:	200C-37h	Effective mode:	Real time
Min. value:	-3000	Unit:	25 ns
Max. value:	3000	Data type:	Int16
Default value:	1512	Change mode:	Real time

Value range:
-3000 to 3000
Description
Compensates for the action time when touch probe 2 is switched off. (active when bit4 of H0A.40 = 1)

H0C.71 **Internal function switch 2**

Comm. address:	200C-48h	Effective mode:	Next power-on
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	512	Change mode:	Real time

Value range:
0 to 65535
Description
bit9: Switch for disabling FPGA encoder feedback overspeed threshold

H0C.72 **Internal function switch 3**

Comm. address:	200C-49h	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
Description
bit6: Fault level switchover
0: Supported
1: Not supported

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
Description
bit1: Anti-voltage dip function, which automatically switches to the baud rate of 2 M at power-on, preventing E136 and E740 (Voltage dip) alarms.
0: ON
1: OFF
bit2: Overcurrent detection scheme switchover
0: New scheme 202/203
1: Old scheme 201
bit4: Whether E601.3 is enabled after E740.0 is reported and homing is completed in incremental mode
0: ON
1: OFF

H0C.80 **Fault level register**

Comm. address:	200C-51h	Effective mode:	Next power-on
Min. value:	0	Unit:	-

Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
bit0 to bit3: E234.0
0: Default
1: No.1 non-resettable
2: No.1 resettable
bit4 to bit7: EB00.0
0: Default
2: No.1 resettable
4: No.2 resettable
bit8 to bit11: EB00.1
0: Default
2: No.1 resettable
4: No.2 resettable
bit12 to bit15: E234.1
0: Default
1: No.1 non-resettable
2: No.1 resettable

Description
bit0 to bit3: E234.0 supports escalation/deescalation of No. 1 non-resettable and resettable faults.
bit4 to bit7: EB00.0 supports the escalation/deescalation of No. 1 and No. 2 resettable faults.
bit8 to bit11: EB00.1 supports the escalation/deescalation of No. 1 and No. 2 resettable faults.
bit12 to bit15: E234.1 supports escalation/deescalation of No. 1 non-resettable and resettable faults.

17.14 H0d Auxiliary Function Parameters

H0d.00 **Software reset**

Comm. address:	200d-01h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0: No operation
1: Software reset

Description
0: No operation
1: Enable
Programs in the drive are reset automatically (similar to the program reset upon power-on) after the software reset function is enabled, without the need for a power cycle.

H0d.01 **Fault Reset**

Comm. address:	200d-02h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0: No operation
1: Fault reset
Description
0: No operation
1: Enable
When a No. 1 or No. 2 resettable fault occurs, you can enable the fault reset function in the non-operational state after rectifying the fault cause, stopping the keypad from displaying the fault and allowing the drive to enter the "rdy" state.
When a No. 3 alarm occurs, you can enable the fault reset function directly, regardless of the servo drive status.

H0d.02 **Inertia auto-tuning**

Comm. address:	200d-03h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 65
Description
Used to enable offline inertia auto-tuning through the keypad. In parameter display mode, switch to H0d.02 and press the SET key to enable offline inertia auto-tuning.

H0d.04 **Encoder ROM read/write**

Comm. address:	200d-05h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0: No operation
1: Write to ROM
2: Read from ROM
3: ROM failure
Description

For Inovance encoders, parameters written to the ROM area can be activated only after the USB and control power supplies are restarted. Ensure that the drive is powered on during parameter writing.
0: No operation
1: Write to ROM
2: Read from ROM
3: ROM failure

H0d.05 **Emergency stop**

Comm. address:	200d-06h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0: No operation
1: Emergency stop
Description
Enable the emergency stop through parameters.
0: No operation
1: Enable
Note: The stop mode corresponding to H0d.05 is defined by H02.05 or 605Ch.

H0d.06 **Current loop auto-tuning test**

Comm. address:	200d-07h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	6	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0: No operation
1: Enable current loop auto-tuning
2: Enable current loop step test (static)
3: Enable current loop step test
Description
0: No operation
1: Enable current loop auto-tuning
2: Enable current loop step test (static)
3: Enable current loop step test

H0d.10 **Automatic tuning of analog channel**

Comm. address:	200d-0Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0: No operation

1: Adjust AI1

2: Adjust AI2

Description

When auto-tuning of the analog channel is enabled, the drive automatically calibrates the zero drift voltage of the analog channel to improve signal detection accuracy.

0: No operation

1: Adjust AI1

2: Adjust AI2

H0d.12 Phase U/V current balance calibration enable

Comm. address:	200d-0Dh	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

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 enable switch

0: Disable

1: Enable

bit1: Forced DO enable switch

0: Disable

1: Enable

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

H0d.18 Setpoint of forced DI value

Comm. address:	200d-13h	Effective mode:	Real time

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

Value range:
0x0 to 0xFF
Description
Defines whether the DI functions set in group H03 is active when forced DI is activated (H0d.17 = 1 or 3).
The value of H0d.18 is displayed as a hexadecimal on the keypad. When it is converted to a binary value, "bit(n) = 1" indicates the level logic of DI function is high level, and "bit(n) = 0" indicates the level logic of the DI function is low level.

H0d.19 Setpoint of forced DO value

Comm. address:	200d-14h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x1F	Data type:	UInt16
Default value:	0x0	Change mode:	Real time

Value range:
0x0 to 0x1F
Description
Defines whether the DO functions assigned in group H04 are active when forced DO is active (H0d.17 = 2 or 3).
The value of H0d.19 is displayed as a hexadecimal on the keypad. When it is converted to a binary value, "bit(n) = 1" indicates the DO function is active, and "bit(n) = 0" indicates the DO function is inactive.

H0d.20 Absolute encoder reset

Comm. address:	200d-15h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0: No operation
1: Reset fault
2: Reset fault and multi-turn data
3: Reset Inovance 2nd encoder fault
4: Reset Inovance 2nd encoder fault and multi-turn data
Description
You can reset the encoder error or the multi-turn data fed back by the encoder by setting H0d.20.
0: No operation
1: Reset fault
2: Reset fault and multi-turn data
3: Reset Inovance 2nd encoder fault
4: Reset Inovance 2nd encoder fault and multi-turn data

H0d.21 **Read error status bit of Nikon and EnDat2.2 encoders**

Comm. address:	200d-16h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0: Not read

1: Read

Description

Used to read the error status bit of Nikon encoder and EnDat2.2 encoder.

0: Not read

1: Read

H0d.23 **Motor cogging torque fluctuation auto-tuning enable**

Comm. address:	200d-18h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0: Disable

1: Enable

Description

Used to enable motor cogging torque fluctuation auto-tuning.

0: Disable

1: Enable

2: Auto-tuning failed (cannot be set, only for display)

H0d.29 **Motor parameter auto-tuning**

Comm. address:	200d-1Eh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0: Disable

1: Enable

Description

Resistance/Inductance auto-tuning

0: Disable

1: Enable

17.15 H0E Communication Function Parameters

H0E.00 **Node address**

Comm. address:	200E-01h	Effective mode:	Real time

Min. value:	1	Unit:	-
Max. value:	127	Data type:	UInt16
Default value:	1	Change mode:	At stop

Value range:
1 to 127
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:	1	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
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. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	1	Change mode:	Real time

Value range:
0: Not save
1: Save
Description
Defines whether to save objects written through software tool (commissioning protocol) to EEPROM, including parameters and object dictionaries.
0: Parameters not saved to EEPROM
1: Parameters saved to EEPROM

H0E.04 **Save objects written through communication to EEPROM (excluding commissioning protocol)**

Comm. address:	200E-05h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0: Not save

1: Save

Description

You can use this parameter to determine whether to save communication-written data in EEPROM (excluding the commissioning protocol) (CANopen, CANlink, Ethernet COE, and Modbus485). The data includes the function code and object dictionary.

0: Parameters not saved to EEPROM

1: Parameters saved to EEPROM

H0E.07 **Object dictionary unit selection**

Comm. address:	200E-08h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0: Reference unit system (p/s, p/s^2)

1: User unit system (0.01 [mm/s]/[rpm], ms)

Description

Servo unit system switchover:

0: Use reference unit system. The unit is p/s for speed-type object dictionaries or p/s^2 for acceleration-type object dictionaries.

1: Use the user unit system. The speed type object dictionary unit is 0.01 [mm/s]/[rpm], and the acceleration type object dictionary unit is the time (ms) taken to change from 0 [mm/s]/[rpm] to 1000 [mm/s]/[rpm].

H0E.10 **CAN selection**

Comm. address:	200E-0Bh	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: Pulse/Axis control command

1: Enhanced axis control command

2: CANopen

Description

CAN function selection

0: Pulse/Axis control command

1: Enhanced axis control command

2: CANopen

H0E.11 **CAN baud rate**

Comm. address:	200E-0Ch	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	7	Data type:	UInt16
Default value:	5	Change mode:	At stop

Value range:

0: 20 kbps

1: 50 kbps

2: 100 kbps

3: 125 kbps

4: 250 kbps

5: 500 kbps

6: 1 Mbps

7: 1 Mbps - non-standard

Description

Defines the communication rate between the drive and the host controller in the CANlink or CANopen mode.

0: 20 kbps

1: 50 kbps

2: 100 kbps

3: 125 kbps

4: 250 kbps

5: 500 kbps

6: 1 Mbps

7: 1 Mbps-customized

Note: The communication rate set in the servo drive must be the same as that in the host controller. Otherwise, communication can fail. If H0E.11 is set to 6, the baud rate is 1 Mbps. 80% sampling points are used to match most PLCs with a 1 Mbps standard baud rate.

If H0E.11 is set to 7, the baud rate is 1 Mbps. 70% sampling points are used to match most PLCs with a 1 Mbps non-standard (deviated) baud rate. Reducing sampling points can also reduce error frames.

H0E.12 **Excessive IP position command increment count**

Comm. address:	200E-0Dh	Effective mode:	Real time
Min. value:	1	Unit:	-
Max. value:	30	Data type:	UInt16
Default value:	20	Change mode:	Real time

Value range:

1 to 30

Description

Used to set the threshold of excessive IP position command increment events. EB01.2 is reported based on this threshold.

H0E.13 **CANopen sync period error limit**

Comm. address:	200E-0Eh	Effective mode:	Real time

Min. value:	0	Unit:	-
Max. value:	5	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0: 1/4
1: 1/2
2: 3/4
3: 1
4: 2
5: Disabled

Description
Used to set CANopen sync cycle error limit.
0: 1/4
1: 1/2
2: 3/4
3: 1
4: 2
5: Disabled

H0E.14 CANopen communication state display

Comm. address:	200E-0Fh	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	9	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 9

Description
Displays CANopen communication status.

H0E.17 Get the count of received NMT frames with incorrect length

Comm. address:	200E-12h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535

Description
Displays the number of received NMT frames with incorrect length.

H0E.18 Get the count of received NMT frames with incorrect command

Comm. address:	200E-13h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Description
Displays the number of received NMT frames with incorrect command.

H0E.19 **Count of received heartbeat frames with incorrect length**

Comm. address:	200E-14h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Description
Displays the number of received heartbeat frames with incorrect length.

H0E.80 **Modbus baud rate**

Comm. address:	200E-51h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	9	Data type:	UInt16
Default value:	9	Change mode:	Real time

Value 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
Description
Defines the communication rate between the servo drive and the host controller. The baud rate set in the drive must be the same as that in the host controller. Otherwise, communication can 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. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	3	Change mode:	Real time

Value 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)

Description

Defines the data verification method for communication between the drive and host controller.

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. value:	0	Unit:	ms
Max. value:	20	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0 to 20

Description

Defines the delay from the moment when the slave receives a reference to the moment when the slave returns a response.

H0E.83 **Modbus communication timeout**

Comm. address:	200E-54h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	600	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0 to 600

Description

Defines Modbus communication timeout period.

H0E.84 **Modbus communication data sequence**

Comm. address:	200E-55h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16

Default value:	1	Change mode:	Real time

Value range:
0: High-order bits are followed by low-order bits.
1: Low-order bits are followed by high-order bits.
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. value:	0.00	Unit:	-
Max. value:	655.35	Data type:	UInt16
Default value:	0.00	Change mode:	Read-only

Value range:
0.00 to 655.35
Description
Displays the communication version.

H0E.97 **Communication monitoring parameter 1**

Comm. address:	200E-62h	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
Description
Defines communication monitoring parameter 1.

H0E.98 **Communication monitoring parameter 2**

Comm. address:	200E-63h	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
Description
Defines communication monitoring parameter 2.

17.16 H0F Fully Closed-loop Parameters

H0F.00 **Encoder feedback mode**

Comm. address:	200F-01h	Effective mode:	Next power-on

Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0: Internal encoder feedback
1: External encoder feedback
2: Inner/Outer loop switchover
Description
Defines the encoder feedback signal source in fully closed-loop control.
0: Internal feedback (Position feedback signals come from the built-in encoder of the servo motor)
1: External encoder feedback (Position feedback signals come from the fully closed-loop external encoder).
Electronic gear ratio 1 is used.
2: Inner/Outer loop switchover: The DI assigned with FunIN.24 (GEAR_SEL, electronic gear ratio switchover) switches between the inner and outer position closed loops. FunIN.24:
Inactive, internal encoder feedback, with electronic gear ratio 1 used
Active: Internal encoder feedback, with electronic gear ratio 2 used

H0F.01 **Fully closed-loop encoder application mode**

Comm. address:	200F-02h	Effective mode:	Next power-on
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0: Standard operating direction
1: Reverse operating direction
Description
Defines the feedback pulse counting direction of internal and external encoders when the motor rotates in 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. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0: Incremental mode
1: Absolute linear mode
Description

Defines the fully closed-loop encoder absolute value.
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. value:	0	Unit:	-
Max. value:	4	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0: Quadrature pulse
1: Inovance
2: BiSS-C
3: EnDat2.2
4: SSI

Description
Defines the fully closed-loop encoder feedback type.
0: Quadrature pulse
1: Inovance
2: BiSS-C (only for DDL motors)
3: EnDat 2.2 (only for DDL motors)
4: SSI (only for DDL motors)

H0F.04 **Number of fully closed-loop encoder pulses per revolution**

Comm. address:	200F-05h	Effective mode:	Next power-on
Min. value:	1	Unit:	-
Max. value:	2147483647	Data type:	UInt32
Default value:	10000	Change mode:	At stop

Value range:
1 to 2147483647

Description
Defines the pulses fed back by the external encoder per revolution of the motor.
This parameter defines the quantity relationship between feedback pulses from the external encoder and those from the internal encoder.
Calculate the value of this parameter based on mechanical parameters. When rigid connection is applied between the motor and the external encoder (scale), you can also set this parameter using the following method:
1. Manually rotate the motor and observe H0F.18 (Feedback pulse counter of internal encoder) in the meantime. After ensuring that the motor has rotated for a full turn (H0F.18 = Motor resolution), calculate the change of H0F.20 (Feedback pulse counter of external encoder) and use the absolute value of the change as the value of H0F.04.
2. Assume values of H0F.18 and H0F.20 are X1 and Y1 before the motor rotates and X2 and Y2 after the motor rotates, then the following formula applies: H0F.04 = Motor resolution × (Y2 – Y1) ÷ (X2 – X1) The calculated data must be positive. If not, perform the first step again.
For non-rigid connection, an error may exist in the calculation result.

Note:
Ensure H0F.04 is set properly. Otherwise, EB02.0 (Position deviation too large in fully closed loop) may occur after the drive operates.

H0F.06 **Fully closed-loop encoder interface**

Comm. address:	200F-07h	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: CN21
: CN7
Description
Defines the drive interface used by the fully closed-loop encoder.
0: CN21
: CN7

H0F.08 **Excessive deviation threshold in compound control mode**

Comm. address:	200F-09h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2147483647	Data type:	UInt32
Default value:	1000	Change mode:	Real time

Value range:
0 to 2147483647
Description
Defines the position deviation threshold at which the drive reports EB02.0 (Excessive position deviation in fully closed-loop mode).
When H0F.08 is set to 0, the drive does not detect EB02.0 and always clears the fully closed-loop position deviation.

H0F.10 **Deviation clear in compound control**

Comm. address:	200F-0Bh	Effective mode:	Real time
Min. value:	0	Unit:	Rev
Max. value:	100	Data type:	UInt16
Default value:	1	Change mode:	Real time

Value range:
0 to 100
Description
Defines the number of motor revolutions after which the fully closed-loop position deviation is cleared during operation of the drive. The number of revolutions is expressed by the internal encoder feedback pulses in H0F.18. The number of motor revolutions will not be cleared to 0 when the drive is in the non-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
Description
Defines the time constant for compound vibration suppression in fully closed-loop control when external encoder feedback (H0F.00 = 1 or 2) is used.
Increase the setpoint gradually and check the response change in fully closed-loop mode.
When the stiffness of the transmission mechanism between fully closed loop and internal loop is insufficient, set the time constant properly to improve system stability, which is to generate the effect of internal loop temporarily and form a fully closed loop again after the system is stabilized. Ignore this parameter if the stiffness is sufficient.

If H0F.13 is set to 0, no EB02.1 alarms are detected.

H0F.16 **Pulse deviation display in compound control mode**

Comm. address:	200F-11h	Effective mode:	-
Min. value:	-2147483648	Unit:	Encoder unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Value range:
-2147483648 to +2147483647
Description
Counts and displays the position deviation absolute value in fully closed loop control.
Pulse deviation in compound control = Absolute position feedback of external encoder - Converted value of absolute position feedback of internal encoder
Align the inner and outer loop feedbacks each time the deviation is cleared.

H0F.18 **Internal position pulse feedback display**

Comm. address:	200F-13h	Effective mode:	-
Min. value:	-2147483648	Unit:	Encoder unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Value range:
-2147483648 to +2147483647
Description
Counts and displays the number of feedback pulses of the internal encoder (after being divided or multiplied by the electronic gear ratio, in internal encoder unit).

H0F.20 **Fully closed-loop encoder position pulse feedback display**

Comm. address:	200F-15h	Effective mode:	-
Min. value:	-2147483648	Unit:	Encoder unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Value range:
-2147483648 to +2147483647
Description
Counts and displays the number of feedback pulses of the external encoder (after being divided or multiplied by the electronic gear ratio, in external encoder unit).

H0F.22 **Quadrature pulse phase Z detection inactive in fully closed-loop mode**

Comm. address:	200F-17h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0: Detected
1: Not detected
Description
Quadrature pulse phase Z detection selection in fully closed-loop mode
0: Detected
1: Not detected

H0F.23 **Absolute homing offset of BiSS-C/SSI/EnDat2.2 encoder in fully closed-loop mode**

Comm. address:	200F-18h	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
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 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. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0: Motor Z signal
1: External feedback Z signal
Description
Defines the source of 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/EnDat2.2 encoder in fully closed-loop mode**

Comm. address:	200F-1Bh	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
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
Description
Defines the time between the first falling edge and the first rising edge of the clock signal for EnDat and SSI encoders.

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
Description
BiSS-C:

0: CRC check value not inverted by bit

1: CRC check value inverted by bit
SSI:

0: Even parity

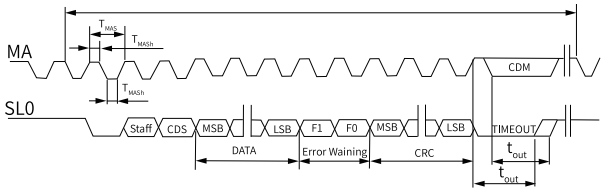
1: Odd parity

H0F.30 **Valid bits of BiSS-C/SSI/EnDat2.2 encoder position feedback during communication in fully closed-loop mode**

Comm. address:	200F-1Fh	Effective mode:	Next power-on

Min. value:	0	Unit:	-
Max. value:	127	Data type:	UInt16
Default value:	29	Change mode:	At stop

Value range:
0 to 127
Description
Defines the BiSS-C/SSI/EnDat 2.2 valid bits of encoder communication position feedback in full closed-loop mode.



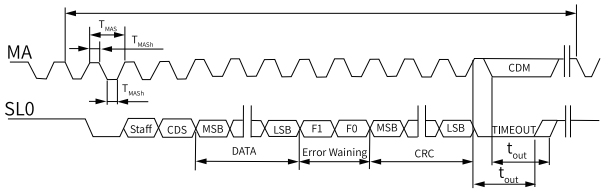
- DATA: Position data, CRC: 6-digit CRC check code
- $100ns \leqslant T_{MAS} \leqslant 2t_{out} 25ns \leqslant T_{MASh} \leqslant t_{out} 25ns \leqslant T_{MASh} \leqslant t_{out}$
- t_{out}= 1.5 MA clock cycle
- MA: master clock output; SL0: slave data output
  Transmission speed up to 10 Mbps
- CDM: 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
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. value:	0	Unit:	kHz
Max. value:	10000	Data type:	UInt16
Default value:	2000	Change mode:	Real time

Value range:
0 to 10000
Description
Defines BiSS-C/SSI/EnDat encoder communication frequency in fully closed-loop mode.

H0F.33 **SSI/EnDat 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
Description
Defines the time between the first falling edge and the first rising edge of the clock signal for EnDat 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
Description
Used to enable the detection on error 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
Description
Defines the error bit polarity of BiSS-C protocol.

H0F.40 **Communication encoder fault Information in full closed-loop mode**

Comm. address:	200F-29h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:

0 to 65535

Description

Displays the communication encoder fault information in fully closed-loop mode.

Table 17–4 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	Serial encoder CRC error in fully closed-loop mode (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	Not assigned
13 [3]	Serial encoder counting increment error in fully closed-loop mode (algorithm[1])
14 to 15	Not assigned
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 17–5 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	Not assigned
9	EnDat additional data 1 CRC error
10	EnDat additional data 2 CRC error
11 to 12	Not assigned
13 [3]	Serial encoder counting increment error in fully closed-loop mode (algorithm)
14	EnDat class 3 fault (RX end)
15	EnDat class 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 17–6 Matching BiSS-C and SSI encoders

bit	Name
0	Encoder communication timeout error in fully closed-loop mode (RX end)
1	Not assigned
2	Serial encoder CRC error in fully closed-loop mode (RX end)[2]
3 to 10	Not assigned
7	Encoder single-turn resolution error in fully closed-loop mode (TX end)
11 to 12	Not assigned
13 [3]	Serial encoder counting increment error in fully closed-loop mode (algorithm)
14 to 15	Not assigned
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 fully closed-loop encoder version**

Comm. address:	200F-2Ah	Effective mode:	-
Min. value:	0.0	Unit:	-
Max. value:	6553.5	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Value range:
0.0 to 6553.5
Description
Displays Inovance fully closed-loop encoder version.

H0F.42 **Inovance fully closed-loop encoder resolution**

Comm. address:	200F-2Bh	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	Read-only

Value range:
0 to 4294967295
Description
Displays Inovance fully closed-loop encoder resolution.

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
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 parity bit selection in fully closed-loop mode**

Comm. address:	200F-34h	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: No check
1: Check applied
Description
SSI encoder parity bit selection in fully closed-loop mode
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
Description
SSI encoder code system in full closed-loop mode
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. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	1	Change mode:	At stop

Value range:
0：Binary
1：Gray code

Description

SSI encoder status word code system in fully closed-loop mode

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. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0: Disable

1: Enable

Description

SSI encoder parity check in fully closed-loop mode

0: Disable

1: Enable

H0F.55 **Encoder communication timeout count in fully closed-loop mode**

Comm. address:	200F-38h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:

0 to 65535

Description

Encoder communication timeout count in fully closed-loop mode

H0F.56 **Defines the number of encoder CRC errors in fully closed-loop mode.**

Comm. address:	200F-39h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:

0 to 65535

Description

Defines the number of encoder CRC errors 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. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:

0 to 65535

Description

Communication frame stop bit error count of the encoder in fully closed-loop mode

17.17 H11 Multi-position Parameters

H11.00 **Multi-position running mode**

Comm. address:	2011-01h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	5	Data type:	UInt16
Default value:	1	Change mode:	At stop

Value range:

0: Individual operation (number of displacements defined by H11.01)

1: Cyclic operation (number of displacement defined by H11.01)

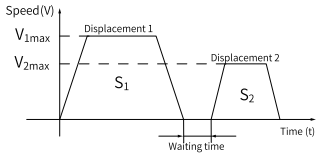
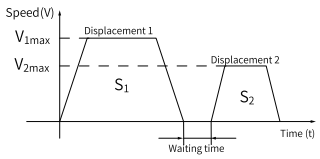
2: DI-based operation (defined by DI)

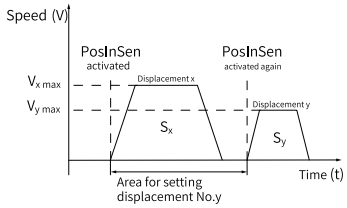
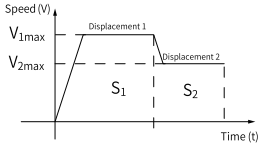
3: Sequential operation

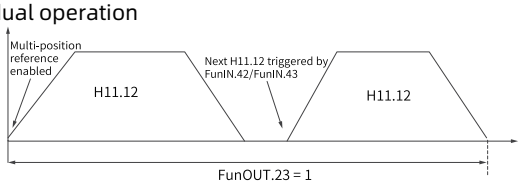
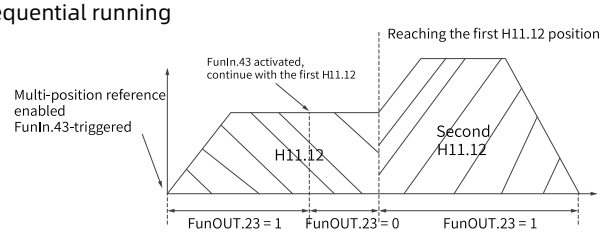
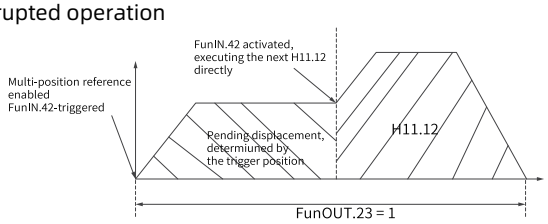
5: Axis-controlled continuous operation

Description

Defines the multi-position operating mode when the main position reference source is multi-position references (H05.00 set to 2) in position control mode.

Setpoint	Operating mode	Remarks	Operation curve
0	Stop after a single-shot operation	The servo drive stops at one round of running. The servo drive automatically switches to the next speed with a larger number. You can set the interval time between positions. The multi-position reference 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
1	Cyclic running	The servo drive repeats running from the 1st position after one round of running. The servo drive automatically switches to the next speed with a larger number. You can set the interval time between positions. The multi-position reference 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

Setpoint	Operating mode	Remarks	Operation curve
2	DI switchover	The servo drive continues running when the position number is updated. The speed number is determined by the DI terminal logic. The interval time between positions is determined by the command delay of the host controller. The multi-position reference 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
3	Sequential running	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 servo drive automatically switches to the next speed with a larger number. There is no interval time between positions. The multi-position reference 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

Setpoint	Operating mode	Remarks	Operation curve
5	Axis-controlled continuous operation	The drive 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 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.

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 completed (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.

The S-ON signal must be 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 position references in multi-position mode**

Comm. address:	2011-02h	Effective mode:	Real time
Min. value:	1	Unit:	-
Max. value:	16	Data type:	UInt16
Default value:	1	Change mode:	At stop

Value range:

1 to 16

Description

Defines the total number of position references in the multi-position mode. You can set different displacements, operating speeds, and acceleration/deceleration time for each position.

H11.00 ≠ 2: Positions 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 positions. The displacement number is a 4-bit binary value. bit 0 to bit 3 correspond to CMD1 to CMD4.

The displacement number is a 4-bit binary value. The relationship between the displacement numbers and CMD1 to CMD4 is shown in the following table.

FunIN.9	FunIN.8	FunIN.7	FunIN.6	Segment No.
CMD4	CMD3	CMD2	CMD1	
0	0	0	0	1
0	0	0	1	2
...				
1	1	1	1	16

H11.02 **Starting position number after pause**

Comm. address:	2011-03h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0: Continue to execute the remaining positions

1: Start from position 1

Description

It sets the starting position number when the multi-function running recovers after a pause.

0: Continue to execute the unexecuted positions: For example, if H11.01 is set to 16 and the drive pauses at position 2, after the drive recovers from the pause, it will start from position 3.

1: Start from position 1: For example, if H11.01 is set to 16 and the drive pauses at position 2, after the drive recovers from the pause, it will start from position 1.

Causes of pause:

1. The 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 "valid" to "invalid".

H11.03 **Waiting time unit**

Comm. address:	2011-04h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0: ms
1: s
Description
Sets the unit of the acceleration/deceleration time and waiting time during the multi-position running.
Acceleration/Deceleration time: The time for the motor to change from 0 [mm/s]/[rpm] to 1000 [mm/s]/[rpm] at a constant speed.
Waiting time: time interval from ending of the current position reference to starting of the next position reference

H11.04 **Displacement reference type**

Comm. address:	2011-05h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0: Relative displacement reference
1: Absolute displacement reference
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 position number in sequential operation**

Comm. address:	2011-06h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	16	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 16
Description
Defines whether to perform cyclic operation and the starting displacement number after the first cycle of operation in the sequential operation mode (H11.00 = 3).
0: The drive executes the positions defined by H11.01 only once and then stops. The motor is in the locked state.
1 to 16: Cyclic operation applies. The drive starts from the position number 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. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	65535	Change mode:	Real time

Value range:
0 to 65535
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. value:	0	Unit:	[mm/s]/[rpm]
Max. value:	6000	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 6000
Description
Defines the starting speed of displacement 1.

H11.11 **Stop speed of displacement 1**

Comm. address:	2011-0Ch	Effective mode:	Real time
Min. value:	0	Unit:	[mm/s]/[rpm]
Max. value:	6000	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 6000
Description
Defines the stop speed of displacement 1.

H11.12 **Displacement of position 1**

Comm. address:	2011-0Dh	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit
Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Value range:
-1073741824 to 1073741824
Description
Sets the 1st displacement in multi-position operation (in reference unit).

H11.14 **Maximum running speed of position 1**

Comm. address:	2011-0Fh	Effective mode:	Real time
Min. value:	1	Unit:	[mm/s]/[rpm]

Max. value:	10000	Data type:	UInt16
Default value:	200	Change mode:	Real time

Value range:
1 to 10000
Description
Defines the maximum running speed in position 1.
The maximum speed is the average operating speed when the motor is not in the acceleration/deceleration process. If H11.12 is set to an excessively low value, the actual motor speed will be lower than H11.14.

H11.15 **Acceleration/Deceleration time of position 1**

Comm. address:	2011-10h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 65535
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 (Maximum running speed of 1st displacement):

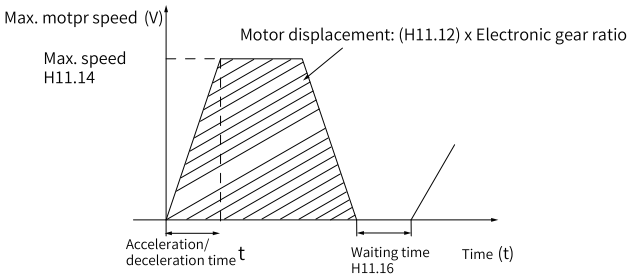
$$t = \frac{(H11.14) \times (H11.15)}{1000}$$

Note: The mechanical rigidity must be proper and the speed loop can follow the position reference.

H11.16 **Waiting time after completion of position 1**

Comm. address:	2011-11h	Effective mode:	Real time
Min. value:	0	Unit:	ms(s)
Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 10000
Description
Defines the waiting time from completion of the position 1 to the start of the next position.



H11.17 **2nd displacement**

Comm. address:	2011-12h	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit
Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Value range:
-1073741824 to 1073741824
Description
Same as displacement 1

H11.19 **Maximum running speed of 2nd displacement**

Comm. address:	2011-14h	Effective mode:	Real time
Min. value:	1	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	UInt16
Default value:	200	Change mode:	Real time

Value range:
1 to 10000
Description
Same as the max. speed of displacement 1

H11.20 **Acceleration/Deceleration time of 2nd displacement**

Comm. address:	2011-15h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 65535
Description
Same as the acceleration/deceleration time of displacement 1

H11.21 **Waiting time after 2nd displacement**

Comm. address:	2011-16h	Effective mode:	Real time
Min. value:	0	Unit:	ms(s)
Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 10000
Description
Same as the waiting time after displacement 1

H11.22 **3rd displacement**

Comm. address:	2011-17h	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit

Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Value range:
-1073741824 to 1073741824
Description
Same as displacement 1

H11.24 Max. running speed of 3rd displacement

Comm. address:	2011-19h	Effective mode:	Real time
Min. value:	1	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	UInt16
Default value:	200	Change mode:	Real time

Value range:
1 to 10000
Description
Same as the max. speed of displacement 1

H11.25 Acceleration/Deceleration time of 3rd displacement

Comm. address:	2011-1Ah	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 65535
Description
Same as the acceleration/deceleration time of displacement 1

H11.26 Waiting time after 3rd displacement

Comm. address:	2011-1Bh	Effective mode:	Real time
Min. value:	0	Unit:	ms(s)
Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 10000
Description
Same as the waiting time after displacement 1

H11.27 4th displacement

Comm. address:	2011-1Ch	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit
Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Value range:

-1073741824 to 1073741824

Description

Same as displacement 1

H11.29 **Max. running speed of 4th displacement**

Comm. address:	2011-1Eh	Effective mode:	Real time
Min. value:	1	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	UInt16
Default value:	200	Change mode:	Real time

Value range:

1 to 10000

Description

Same as the max. speed of displacement 1

H11.30 **Acceleration/Deceleration time in position 4**

Comm. address:	2011-1Fh	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:

0 to 65535

Description

Same as the acceleration/deceleration time of displacement 1

H11.31 **Waiting time after 4th displacement**

Comm. address:	2011-20h	Effective mode:	Real time
Min. value:	0	Unit:	ms(s)
Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:

0 to 10000

Description

Same as the waiting time after displacement 1

H11.32 **5th displacement**

Comm. address:	2011-21h	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit
Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Value range:

-1073741824 to 1073741824

Description

Same as displacement 1

H11.34 **Max. running speed of 5th displacement**

Comm. address:	2011-23h	Effective mode:	Real time
Min. value:	1	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	UInt16
Default value:	200	Change mode:	Real time

Value range:
1 to 10000
Description
Same as the max. speed of displacement 1

H11.35 **Acceleration/Deceleration time of 5th displacement**

Comm. address:	2011-24h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 65535
Description
Same as the acceleration/deceleration time of displacement 1

H11.36 **Waiting time after 5th displacement**

Comm. address:	2011-25h	Effective mode:	Real time
Min. value:	0	Unit:	ms(s)
Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 10000
Description
Same as the waiting time after displacement 1

H11.37 **6th displacement**

Comm. address:	2011-26h	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit
Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Value range:
-1073741824 to 1073741824
Description
Same as displacement 1

H11.39 **Max. running speed of 6th displacement**

Comm. address:	2011-28h	Effective mode:	Real time
Min. value:	1	Unit:	[mm/s]/[rpm]

Max. value:	10000	Data type:	UInt16
Default value:	200	Change mode:	Real time

Value range:
1 to 10000
Description
Same as the max. speed of displacement 1

H11.40 Acceleration/Deceleration time of 6th displacement

Comm. address:	2011-29h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 65535
Description
Same as the acceleration/deceleration time of displacement 1

H11.41 Waiting time after 6th displacement

Comm. address:	2011-2Ah	Effective mode:	Real time
Min. value:	0	Unit:	ms(s)
Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 10000
Description
Same as the waiting time after displacement 1

H11.42 7th displacement

Comm. address:	2011-2Bh	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit
Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Value range:
-1073741824 to 1073741824
Description
Same as displacement 1

H11.44 Max. running speed of 7th displacement

Comm. address:	2011-2Dh	Effective mode:	Real time
Min. value:	1	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	UInt16
Default value:	200	Change mode:	Real time

Value range:

1 to 10000

Description

Same as the max. speed of displacement 1

H11.45 **Acceleration/Deceleration time of 7th displacement**

Comm. address:	2011-2Eh	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:

0 to 65535

Description

Same as the acceleration/deceleration time of displacement 1

H11.46 **Waiting time after 7th displacement**

Comm. address:	2011-2Fh	Effective mode:	Real time
Min. value:	0	Unit:	ms(s)
Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:

0 to 10000

Description

Same as the waiting time after displacement 1

H11.47 **8th displacement**

Comm. address:	2011-30h	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit
Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Value range:

-1073741824 to 1073741824

Description

Same as displacement 1

H11.49 **Max. running speed of 8th displacement**

Comm. address:	2011-32h	Effective mode:	Real time
Min. value:	1	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	UInt16
Default value:	200	Change mode:	Real time

Value range:

1 to 10000

Description

Same as the max. speed of displacement 1

H11.50 **Acceleration/Deceleration time of 8th displacement**

Comm. address:	2011-33h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 65535
Description
Same as the acceleration/deceleration time of displacement 1

H11.51 **Waiting time after 8th displacement**

Comm. address:	2011-34h	Effective mode:	Real time
Min. value:	0	Unit:	ms(s)
Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 10000
Description
Same as the waiting time after displacement 1

H11.52 **9th displacement**

Comm. address:	2011-35h	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit
Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Value range:
-1073741824 to 1073741824
Description
Same as displacement 1

H11.54 **Max. running speed of 9th displacement**

Comm. address:	2011-37h	Effective mode:	Real time
Min. value:	1	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	UInt16
Default value:	200	Change mode:	Real time

Value range:
1 to 10000
Description
Same as the max. speed of displacement 1

H11.55 **Acceleration/Deceleration time of 9th displacement**

Comm. address:	2011-38h	Effective mode:	Real time
Min. value:	0	Unit:	ms

Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 65535
Description
Same as the acceleration/deceleration time of displacement 1

H11.56 Waiting time after 9th displacement

Comm. address:	2011-39h	Effective mode:	Real time
Min. value:	0	Unit:	ms(s)
Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 10000
Description
Same as the waiting time after displacement 1

H11.57 10th displacement

Comm. address:	2011-3Ah	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit
Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Value range:
-1073741824 to 1073741824
Description
Same as displacement 1

H11.59 Maximum running speed in position 10

Comm. address:	2011-3Ch	Effective mode:	Real time
Min. value:	1	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	UInt16
Default value:	200	Change mode:	Real time

Value range:
1 to 10000
Description
Same as the max. speed of displacement 1

H11.60 Acceleration/Deceleration time of 10th displacement

Comm. address:	2011-3Dh	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:

0 to 65535

Description

Same as the acceleration/deceleration time of displacement 1

H11.61 **Waiting time after 10th displacement**

Comm. address:	2011-3Eh	Effective mode:	Real time
Min. value:	0	Unit:	ms(s)
Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:

0 to 10000

Description

Same as the waiting time after displacement 1

H11.62 **11th displacement**

Comm. address:	2011-3Fh	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit
Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Value range:

-1073741824 to 1073741824

Description

Same as displacement 1

H11.64 **Max. running speed of 11th displacement**

Comm. address:	2011-41h	Effective mode:	Real time
Min. value:	1	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	UInt16
Default value:	200	Change mode:	Real time

Value range:

1 to 10000

Description

Same as the max. speed of displacement 1

H11.65 **Acceleration/Deceleration time of 11th displacement**

Comm. address:	2011-42h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:

0 to 65535

Description

Same as the acceleration/deceleration time of displacement 1

H11.66 **Waiting time after 11th displacement**

Comm. address:	2011-43h	Effective mode:	Real time
Min. value:	0	Unit:	ms(s)
Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 10000
Description
Same as the waiting time after displacement 1

H11.67 **12th displacement**

Comm. address:	2011-44h	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit
Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Value range:
-1073741824 to 1073741824
Description
Same as displacement 1

H11.69 **Maximum running speed in position 12**

Comm. address:	2011-46h	Effective mode:	Real time
Min. value:	1	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	UInt16
Default value:	200	Change mode:	Real time

Value range:
1 to 10000
Description
Same as the max. speed of displacement 1

H11.70 **Acceleration/Deceleration time of 12th displacement**

Comm. address:	2011-47h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 65535
Description
Same as the acceleration/deceleration time of displacement 1

H11.71 **Waiting time after 12th displacement**

Comm. address:	2011-48h	Effective mode:	Real time
Min. value:	0	Unit:	ms(s)

Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 10000
Description
Same as the waiting time after displacement 1

H11.72 **13th displacement**

Comm. address:	2011-49h	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit
Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Value range:
-1073741824 to 1073741824
Description
Same as displacement 1

H11.74 **Max. running speed of 13th displacement**

Comm. address:	2011-4Bh	Effective mode:	Real time
Min. value:	1	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	UInt16
Default value:	200	Change mode:	Real time

Value range:
1 to 10000
Description
Same as the max. speed of displacement 1

H11.75 **Acceleration/Deceleration time of 13th displacement**

Comm. address:	2011-4Ch	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 65535
Description
Same as the acceleration/deceleration time of displacement 1

H11.76 **Waiting time after 13th displacement**

Comm. address:	2011-4Dh	Effective mode:	Real time
Min. value:	0	Unit:	ms(s)
Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:

0 to 10000

Description

Same as the waiting time after displacement 1

H11.77 **14th displacement**

Comm. address:	2011-4Eh	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit
Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Value range:

-1073741824 to 1073741824

Description

Same as displacement 1

H11.79 **Max. running speed of 14th displacement**

Comm. address:	2011-50h	Effective mode:	Real time
Min. value:	1	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	UInt16
Default value:	200	Change mode:	Real time

Value range:

1 to 10000

Description

Same as the max. speed of displacement 1

H11.80 **Acceleration/Deceleration time of 14th displacement**

Comm. address:	2011-51h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:

0 to 65535

Description

Same as the acceleration/deceleration time of displacement 1

H11.81 **Waiting time after 14th displacement**

Comm. address:	2011-52h	Effective mode:	Real time
Min. value:	0	Unit:	ms(s)
Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:

0 to 10000

Description

Same as the waiting time after displacement 1

H11.82 **15th displacement**

Comm. address:	2011-53h	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit
Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Value range:
-1073741824 to 1073741824
Description
Same as displacement 1

H11.84 **Max. running speed of 15th displacement**

Comm. address:	2011-55h	Effective mode:	Real time
Min. value:	1	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	UInt16
Default value:	200	Change mode:	Real time

Value range:
1 to 10000
Description
Same as the max. speed of displacement 1

H11.85 **Acceleration/Deceleration time of 15th displacement**

Comm. address:	2011-56h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 65535
Description
Same as the acceleration/deceleration time of displacement 1

H11.86 **Waiting time after 15th displacement**

Comm. address:	2011-57h	Effective mode:	Real time
Min. value:	0	Unit:	ms(s)
Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 10000
Description
Same as the waiting time after displacement 1

H11.87 **16th displacement**

Comm. address:	2011-58h	Effective mode:	Real time
Min. value:	-1073741824	Unit:	Reference unit

Max. value:	1073741824	Data type:	Int32
Default value:	10000	Change mode:	Real time

Value range:
-1073741824 to 1073741824
Description
Same as displacement 1

H11.89 **Max. running speed of 16th displacement**

Comm. address:	2011-5Ah	Effective mode:	Real time
Min. value:	1	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	UInt16
Default value:	200	Change mode:	Real time

Value range:
1 to 10000
Description
Same as the max. speed of displacement 1

H11.90 **Acceleration/Deceleration time of 16th displacement**

Comm. address:	2011-5Bh	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 65535
Description
Same as the acceleration/deceleration time of displacement 1

H11.91 **Waiting time after 16th displacement**

Comm. address:	2011-5Ch	Effective mode:	Real time
Min. value:	0	Unit:	ms(s)
Max. value:	10000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 10000
Description
Same as the waiting time after displacement 1

17.18 H12 Multi-speed Parameters

H12.00 **Multi-speed operation mode**

Comm. address:	2012-01h	Effective mode:	Real time
Min. value:	0	Unit:	-

Max. value:	2	Data type:	UInt16
Default value:	1	Change mode:	At stop

Value range:

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

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 speed control mode.

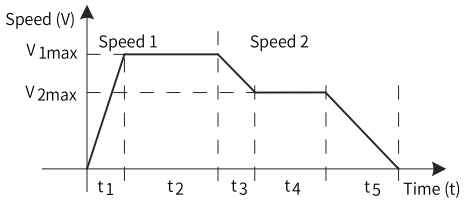
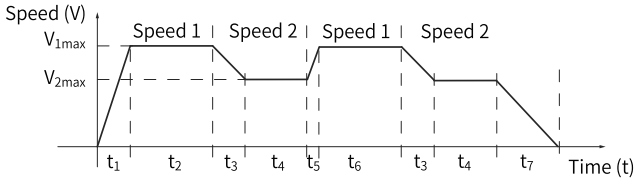
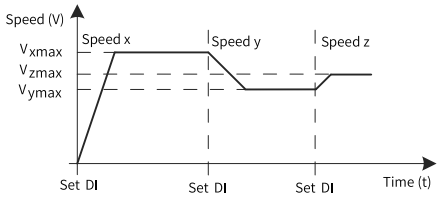
0: Stop after one cycle of operation, and automatically switches to the next speed.

1: Cyclic operation (start from speed 1 after each cycle of operation), which automatically switches to the next speed. Cyclic operation remains active as long as the S-ON signal of the drive is active.

2: Switched by DI: The drive can run continuously when it is enabled. The speed number is determined by DI terminal logic. The running time of each speed reference is only determined by the interval time of speed number switchover. FunIN.5 (DlR-SEL) can be used to switch the direction of the speed reference.

Ensure that the servo ON signal is active during operation of each speed reference. Otherwise, the drive immediately stops according to the mode set in H02.05.

The speed reach signal (FunOUT.19: V-Arr) is active when a certain speed reference is reached.

Setpoint	Operating mode	Remarks	Operation curve
0	Stop after a single-shot operation	The servo drive stops at one round of running. 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
1	Cyclic running	The servo drive repeats from the 1st speed after each round of running. The servo drive automatically switches to the next speed with a larger number. The cyclic running state remains if the servo ON signal is active.	 V_{1max} , V_{2max} : maximum values of the 1st and 2nd speeds
2	Switchover by DI	The servo drive continues running when the servo ON signal is active. The speed number is determined by the DI terminal logic. The running time of each speed reference is determined by the time interval for speed number switchover. The speed reference direction can be switched over through FunIN.5 (DlR-SEL).	 x and y: speed number (The relationship between the speed number and the DI logic is described below.) V_x and V_y : speed references for speeds x and y The speed number determined by DI does not change, which means the speed reference operates continuously regardless of the reference operating time.

H12.01 **Number of speed references in multi-speed mode**

Comm. address:	2012-02h	Effective mode:	Real time
Min. value:	1	Unit:	-
Max. value:	16	Data type:	UInt16
Default value:	16	Change mode:	At stop

Value range:
1 to 16

Description
Defines the total number of speed references in multi-speed mode. You can set different speeds, operation time, and acceleration/deceleration time (four groups available) for each speed number.

H12.00 ≠ 2: Speeds are switched automatically in a sequence from 1 to H12.01.
H12.00 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 positions. The displacement number is a 4-bit binary value. bit 0 to bit 3 correspond to CMD1 to CMD4.

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

The value of CMD(n) is 1 upon active DI logic and 0 upon inactive DI logic.

H12.02 **Operation time unit**

Comm. address:	2012-03h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0: s
1: min
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. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 65535
Description
Four groups of acceleration/deceleration time can be selected for each speed number.
The acceleration time refers to the time for the motor to change 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. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 65535
Description
Four groups of acceleration/deceleration time can be selected for each speed number.
The deceleration time refers to the time for the motor to change 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. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	50	Change mode:	Real time

Value range:
0 to 65535
Description
Four groups of acceleration/deceleration time can be selected for each speed number.
The acceleration time refers to the time for the motor to change 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. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	50	Change mode:	Real time

Value range:
0 to 65535
Description
Four groups of acceleration/deceleration time can be selected for each speed number.
The deceleration time refers to the time for the motor to change 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. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	100	Change mode:	Real time

Value range:
0 to 65535
Description
Four groups of acceleration/deceleration time can be selected for each speed number.
The acceleration time refers to the time for the motor to change 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. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	100	Change mode:	Real time

Value range:
0 to 65535
Description
Four groups of acceleration/deceleration time can be selected for each speed number.
The deceleration time refers to the time for the motor to change 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. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	150	Change mode:	Real time

Value range:
0 to 65535
Description
Four groups of acceleration/deceleration time can be selected for each speed number.
The acceleration time refers to the time for the motor to change 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. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	150	Change mode:	Real time

Value range:
0 to 65535
Description
Four groups of acceleration/deceleration time can be selected for each speed number.
The deceleration time refers to the time for the motor to change from 1000 [mm/s]/[rpm] to 0 [mm/s]/[rpm] at a constant speed.

H12.20 **1st speed reference**

Comm. address:	2012-15h	Effective mode:	Real time
Min. value:	-10000	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	Int16
Default value:	0	Change mode:	Real time

Value range:
-10000 to 10000
Description
Defines speed reference 1.

H12.21 **Operation time of the 1st speed reference**

Comm. address:	2012-16h	Effective mode:	Real time
Min. value:	0.0	Unit:	s(m)
Max. value:	6553.5	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Value range:
0.0 to 6553.5
Description
It sets the operation time of the 1st speed reference.
Operation time = Time taken in switching from the last speed reference to current speed reference + Operation time at constant speed of current segment.
If the operating time is set to 0, the drive skips this speed reference automatically.
As long as H12.00 is set to 2 and the speed number determined by the external DI does not change, the drive continues operating at the speed defined by this speed reference, without being affected by the reference operating time.

H12.22 **1st speed rise/drop and curve smoothing parameter time**

Comm. address:	2012-17h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	256	Change mode:	Real time

Value range:
bit0 to bit7: Acceleration/deceleration time
0: Zero acceleration/deceleration time
1: Acceleration/deceleration time 1
2: Acceleration/deceleration time 2
3: Acceleration/deceleration time 3
4: Acceleration/deceleration time 4
bit8-bit15: S curve smoothing parameter
1: Smoothing parameter 1
2: Smoothing parameter 2
3: Smoothing parameter 3
4: Smoothing parameter 4
5: Smoothing parameter 5
6: Smoothing parameter 6
7: Smoothing parameter 7
8: Smoothing parameter 8
Description
bit0 to bit7: Acceleration/deceleration time
Defines the acceleration/deceleration time of speed reference 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
bit2: Acceleration/Deceleration time 2; Acceleration time: H12.05;
Deceleration time: H12.06

bit3: Acceleration/Deceleration time 3; Acceleration time: H12.07;

Deceleration time: H12.08
bit4: Acceleration/Deceleration time 4; Acceleration time: H12.09;

Deceleration time: H12.10
bit8 to bit15: S curve smoothing parameters
1: Smoothing parameter 1: Increasing acceleration time of acceleration segment: H06.51

Decreasing acceleration time of acceleration segment: H06.52
Decreasing deceleration time of deceleration segment: H06.53
Decreasing acceleration time at acceleration segment: H06.54
2: Smoothing parameter 2: Increasing acceleration time of acceleration segment: H06.55

Decreasing acceleration time of acceleration segment: H06.56
Decreasing deceleration time of deceleration segment: H06.57
Decreasing acceleration time of acceleration segment: H06.58
3: Smoothing parameter 3: Increasing acceleration time of acceleration segment: H06.59

Decreasing acceleration time of acceleration segment: H06.60
Decreasing deceleration time of deceleration segment: H06.61
Increasing acceleration time of acceleration segment: H06.62
4: Smoothing parameter 4: Increasing acceleration time of acceleration segment: H06.63

Decreasing acceleration time of acceleration segment: H06.64
Decreasing deceleration time of deceleration segment: H06.65
Decreasing acceleration time at acceleration segment: H06.66
5: Smoothing parameter 5: Increasing acceleration time of acceleration segment: H06.67

Decreasing acceleration time of acceleration segment: H06.68
Decreasing deceleration time of deceleration segment: H06.69
Decreasing acceleration time at acceleration segment: H06.70
6: Smoothing parameter 6: Increasing acceleration time of acceleration segment: H06.71

Decreasing acceleration time of acceleration segment: H06.72
Decreasing deceleration time of deceleration segment: H06.73
Decreasing acceleration time at acceleration segment: H06.74
7: Smoothing parameter 7: Increasing acceleration time of acceleration segment: H06.75

Decreasing acceleration time of acceleration segment: H06.76
Decreasing deceleration time of deceleration segment: H06.77
Decreasing acceleration time at acceleration segment: H06.78
8: Smoothing parameter 8: Increasing acceleration time of acceleration segment: H06.79

Decreasing acceleration time of acceleration segment: H06.80
Decreasing deceleration time of deceleration segment: H06.81
Decreasing acceleration time at acceleration segment: H06.82

H12.23 **2nd speed reference**

Comm. address:	2012-18h	Effective mode:	Real time
Min. value:	-10000	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	Int16
Default value:	100	Change mode:	Real time

Value range:
-10000 to 10000
Description
Same as reference 1.

H12.24 **Operation time of the 2nd speed reference**

Comm. address:	2012-19h	Effective mode:	Real time
Min. value:	0.0	Unit:	s(m)
Max. value:	6553.5	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Value range:
0.0 to 6553.5
Description
Same as the operating time of speed 1.

H12.25 **2nd speed rise/drop time and curve smoothing parameter time**

Comm. address:	2012-1Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	256	Change mode:	Real time

Value range:
bit0 to bit7: Acceleration/deceleration time
0: Zero acceleration/deceleration time
1: Acceleration/deceleration time 1
2: Acceleration/deceleration time 2
3: Acceleration/deceleration time 3
4: Acceleration/deceleration time 4
bit8-bit15: S curve smoothing parameter
1: Smoothing parameter 1
2: Smoothing parameter 2
3: Smoothing parameter 3
4: Smoothing parameter 4
5: Smoothing parameter 5
6: Smoothing parameter 6
7: Smoothing parameter 7
8: Smoothing parameter 8
Description
Same as the acceleration/deceleration time of speed 1

H12.26 **3rd speed reference**

Comm. address:	2012-1Bh	Effective mode:	Real time
Min. value:	-10000	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	Int16
Default value:	300	Change mode:	Real time

Value range:
-10000 to 10000
Description
Same as reference 1.

H12.27 **Operation time of the 3rd speed reference**

Comm. address:	2012-1Ch	Effective mode:	Real time
Min. value:	0.0	Unit:	s(m)
Max. value:	6553.5	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Value range:
0.0 to 6553.5
Description
Same as the operating time of speed 1.

H12.28 **3rd speed rise/drop time and curve smoothing parameter time**

Comm. address:	2012-1Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	256	Change mode:	Real time

Value range:
bit0 to bit7: Acceleration/deceleration time
0: Zero acceleration/deceleration time
1: Acceleration/deceleration time 1
2: Acceleration/deceleration time 2
3: Acceleration/deceleration time 3
4: Acceleration/deceleration time 4
bit8-bit15: S curve smoothing parameter
1: Smoothing parameter 1
2: Smoothing parameter 2
3: Smoothing parameter 3
4: Smoothing parameter 4
5: Smoothing parameter 5
6: Smoothing parameter 6
7: Smoothing parameter 7
8: Smoothing parameter 8
Description
Same as the acceleration/deceleration time of speed 1

H12.29 **4th speed reference**

Comm. address:	2012-1Eh	Effective mode:	Real time
Min. value:	-10000	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	Int16
Default value:	500	Change mode:	Real time

Value range:
-10000 to 10000
Description
Same as reference 1.

H12.30 **Operation time of the 4th speed reference**

Comm. address:	2012-1Fh	Effective mode:	Real time
Min. value:	0.0	Unit:	s(m)
Max. value:	6553.5	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Value range:
0.0 to 6553.5
Description
Same as the operating time of speed 1.

H12.31 **4th speed rise/drop time and curve smoothing parameter time**

Comm. address:	2012-20h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	256	Change mode:	Real time

Value range:
bit0 to bit7: Acceleration/deceleration time
0: Zero acceleration/deceleration time
1: Acceleration/deceleration time 1
2: Acceleration/deceleration time 2
3: Acceleration/deceleration time 3
4: Acceleration/deceleration time 4
bit8-bit15: S curve smoothing parameter
1: Smoothing parameter 1
2: Smoothing parameter 2
3: Smoothing parameter 3
4: Smoothing parameter 4
5: Smoothing parameter 5
6: Smoothing parameter 6
7: Smoothing parameter 7
8: Smoothing parameter 8
Description
Same as the acceleration/deceleration time of speed 1

H12.32 **5th speed reference**

Comm. address:	2012-21h	Effective mode:	Real time
Min. value:	-10000	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	Int16
Default value:	700	Change mode:	Real time

Value range:
-10000 to 10000
Description
Same as reference 1.

H12.33 **Operation time of the 5th speed reference**

Comm. address:	2012-22h	Effective mode:	Real time
Min. value:	0.0	Unit:	s(m)
Max. value:	6553.5	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Value range:
0.0 to 6553.5
Description
Same as the operating time of speed 1.

H12.34 **5th speed rise/drop time and curve smoothing parameter time**

Comm. address:	2012-23h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	256	Change mode:	Real time

Value range:
bit0 to bit7: Acceleration/deceleration time
0: Zero acceleration/deceleration time
1: Acceleration/deceleration time 1
2: Acceleration/deceleration time 2
3: Acceleration/deceleration time 3
4: Acceleration/deceleration time 4
bit8-bit15: S curve smoothing parameter
1: Smoothing parameter 1
2: Smoothing parameter 2
3: Smoothing parameter 3
4: Smoothing parameter 4
5: Smoothing parameter 5
6: Smoothing parameter 6
7: Smoothing parameter 7
8: Smoothing parameter 8
Description
Same as the acceleration/deceleration time of speed 1

H12.35 **6th speed reference**

Comm. address:	2012-24h	Effective mode:	Real time
Min. value:	-10000	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	Int16
Default value:	900	Change mode:	Real time

Value range:
-10000 to 10000
Description
Same as reference 1.

H12.36 **Operation time of the 6th speed reference**

Comm. address:	2012-25h	Effective mode:	Real time
Min. value:	0.0	Unit:	s(m)
Max. value:	6553.5	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Value range:
0.0 to 6553.5
Description
Same as the operating time of speed 1.

H12.37 **6th speed rise/drop time and curve smoothing parameter time**

Comm. address:	2012-26h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	256	Change mode:	Real time

Value range:
bit0 to bit7: Acceleration/deceleration time
0: Zero acceleration/deceleration time
1: Acceleration/deceleration time 1
2: Acceleration/deceleration time 2
3: Acceleration/deceleration time 3
4: Acceleration/deceleration time 4
bit8-bit15: S curve smoothing parameter
1: Smoothing parameter 1
2: Smoothing parameter 2
3: Smoothing parameter 3
4: Smoothing parameter 4
5: Smoothing parameter 5
6: Smoothing parameter 6
7: Smoothing parameter 7
8: Smoothing parameter 8
Description
Same as the acceleration/deceleration time of speed 1

H12.38 **7th speed reference**

Comm. address:	2012-27h	Effective mode:	Real time
Min. value:	-10000	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	Int16
Default value:	600	Change mode:	Real time

Value range:
-10000 to 10000
Description
Same as reference 1.

H12.39 **Operation time of the 7th speed reference**

Comm. address:	2012-28h	Effective mode:	Real time
Min. value:	0.0	Unit:	s(m)
Max. value:	6553.5	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Value range:
0.0 to 6553.5
Description
Same as the operating time of speed 1.

H12.40 **7th speed rise/drop time and curve smoothing parameter time**

Comm. address:	2012-29h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	256	Change mode:	Real time

Value range:
bit0 to bit7: Acceleration/deceleration time
0: Zero acceleration/deceleration time
1: Acceleration/deceleration time 1
2: Acceleration/deceleration time 2
3: Acceleration/deceleration time 3
4: Acceleration/deceleration time 4
bit8-bit15: S curve smoothing parameter
1: Smoothing parameter 1
2: Smoothing parameter 2
3: Smoothing parameter 3
4: Smoothing parameter 4
5: Smoothing parameter 5
6: Smoothing parameter 6
7: Smoothing parameter 7
8: Smoothing parameter 8
Description
Same as the acceleration/deceleration time of speed 1

H12.41 **8th speed reference**

Comm. address:	2012-2Ah	Effective mode:	Real time
Min. value:	-10000	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	Int16
Default value:	300	Change mode:	Real time

Value range:
-10000 to 10000
Description
Same as reference 1.

H12.42 **Operation time of the 8th speed reference**

Comm. address:	2012-2Bh	Effective mode:	Real time
Min. value:	0.0	Unit:	s(m)
Max. value:	6553.5	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Value range:
0.0 to 6553.5
Description
Same as the operating time of speed 1.

H12.43 **8th speed rise/drop time and curve smoothing parameter time**

Comm. address:	2012-2Ch	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	256	Change mode:	Real time

Value range:
bit0 to bit7: Acceleration/deceleration time
0: Zero acceleration/deceleration time
1: Acceleration/deceleration time 1
2: Acceleration/deceleration time 2
3: Acceleration/deceleration time 3
4: Acceleration/deceleration time 4
bit8-bit15: S curve smoothing parameter
1: Smoothing parameter 1
2: Smoothing parameter 2
3: Smoothing parameter 3
4: Smoothing parameter 4
5: Smoothing parameter 5
6: Smoothing parameter 6
7: Smoothing parameter 7
8: Smoothing parameter 8
Description
Same as the acceleration/deceleration time of speed 1

H12.44 **9th speed reference**

Comm. address:	2012-2Dh	Effective mode:	Real time
Min. value:	-10000	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	Int16
Default value:	100	Change mode:	Real time

Value range:
-10000 to 10000
Description
Same as reference 1.

H12.45 **Operation time of the 9th speed reference**

Comm. address:	2012-2Eh	Effective mode:	Real time
Min. value:	0.0	Unit:	s(m)
Max. value:	6553.5	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Value range:
0.0 to 6553.5
Description
Same as the operating time of speed 1.

H12.46 **9th speed rise/drop time and curve smoothing parameter time**

Comm. address:	2012-2Fh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	256	Change mode:	Real time

Value range:
bit0 to bit7: Acceleration/deceleration time
0: Zero acceleration/deceleration time
1: Acceleration/deceleration time 1
2: Acceleration/deceleration time 2
3: Acceleration/deceleration time 3
4: Acceleration/deceleration time 4
bit8-bit15: S curve smoothing parameter
1: Smoothing parameter 1
2: Smoothing parameter 2
3: Smoothing parameter 3
4: Smoothing parameter 4
5: Smoothing parameter 5
6: Smoothing parameter 6
7: Smoothing parameter 7
8: Smoothing parameter 8
Description
Same as the acceleration/deceleration time of speed 1

H12.47 **10th speed reference**

Comm. address:	2012-30h	Effective mode:	Real time
Min. value:	-10000	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	Int16
Default value:	-100	Change mode:	Real time

Value range:
-10000 to 10000
Description
Same as reference 1.

H12.48 **Operation time of the 10th speed reference**

Comm. address:	2012-31h	Effective mode:	Real time
Min. value:	0.0	Unit:	s(m)
Max. value:	6553.5	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Value range:
0.0 to 6553.5
Description
Same as the operating time of speed 1.

H12.49 **10th speed rise/drop time and curve smoothing parameter time**

Comm. address:	2012-32h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	256	Change mode:	Real time

Value range:
bit0 to bit7: Acceleration/deceleration time
0: Zero acceleration/deceleration time
1: Acceleration/deceleration time 1
2: Acceleration/deceleration time 2
3: Acceleration/deceleration time 3
4: Acceleration/deceleration time 4
bit8-bit15: S curve smoothing parameter
1: Smoothing parameter 1
2: Smoothing parameter 2
3: Smoothing parameter 3
4: Smoothing parameter 4
5: Smoothing parameter 5
6: Smoothing parameter 6
7: Smoothing parameter 7
8: Smoothing parameter 8
Description
Same as the acceleration/deceleration time of speed 1

H12.50 **11th speed reference**

Comm. address:	2012-33h	Effective mode:	Real time
Min. value:	-10000	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	Int16
Default value:	-300	Change mode:	Real time

Value range:
-10000 to 10000
Description
Same as reference 1.

H12.51 **Running time of the 11th speed reference**

Comm. address:	2012-34h	Effective mode:	Real time
Min. value:	0.0	Unit:	s(m)
Max. value:	6553.5	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Value range:
0.0 to 6553.5
Description
Same as the operating time of speed 1.

H12.52 **11th speed rise/drop time and curve smoothing parameter time**

Comm. address:	2012-35h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	256	Change mode:	Real time

Value range:
bit0 to bit7: Acceleration/deceleration time
0: Zero acceleration/deceleration time
1: Acceleration/deceleration time 1
2: Acceleration/deceleration time 2
3: Acceleration/deceleration time 3
4: Acceleration/deceleration time 4
bit8-bit15: S curve smoothing parameter
1: Smoothing parameter 1
2: Smoothing parameter 2
3: Smoothing parameter 3
4: Smoothing parameter 4
5: Smoothing parameter 5
6: Smoothing parameter 6
7: Smoothing parameter 7
8: Smoothing parameter 8
Description
Same as the acceleration/deceleration time of speed 1

H12.53 **12th speed reference**

Comm. address:	2012-36h	Effective mode:	Real time
Min. value:	-10000	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	Int16
Default value:	-500	Change mode:	Real time

Value range:
-10000 to 10000
Description
Same as reference 1.

H12.54 **Operation time of the 12th speed reference**

Comm. address:	2012-37h	Effective mode:	Real time
Min. value:	0.0	Unit:	s(m)
Max. value:	6553.5	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Value range:
0.0 to 6553.5
Description
Same as the operating time of speed 1.

H12.55 **12th speed rise/drop time and curve smoothing parameter time**

Comm. address:	2012-38h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	256	Change mode:	Real time

Value range:
bit0 to bit7: Acceleration/deceleration time
0: Zero acceleration/deceleration time
1: Acceleration/deceleration time 1
2: Acceleration/deceleration time 2
3: Acceleration/deceleration time 3
4: Acceleration/deceleration time 4
bit8-bit15: S curve smoothing parameter
1: Smoothing parameter 1
2: Smoothing parameter 2
3: Smoothing parameter 3
4: Smoothing parameter 4
5: Smoothing parameter 5
6: Smoothing parameter 6
7: Smoothing parameter 7
8: Smoothing parameter 8
Description
Same as the acceleration/deceleration time of speed 1

H12.56 **13th speed reference**

Comm. address:	2012-39h	Effective mode:	Real time
Min. value:	-10000	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	Int16
Default value:	-700	Change mode:	Real time

Value range:
-10000 to 10000
Description
Same as reference 1.

H12.57 **Operation time of the 13th speed reference**

Comm. address:	2012-3Ah	Effective mode:	Real time
Min. value:	0.0	Unit:	s(m)
Max. value:	6553.5	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Value range:
0.0 to 6553.5
Description
Same as the operating time of speed 1.

H12.58 **13th speed rise/drop time and curve smoothing parameter time**

Comm. address:	2012-3Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	256	Change mode:	Real time

Value range:
bit0 to bit7: Acceleration/deceleration time
0: Zero acceleration/deceleration time
1: Acceleration/deceleration time 1
2: Acceleration/deceleration time 2
3: Acceleration/deceleration time 3
4: Acceleration/deceleration time 4
bit8-bit15: S curve smoothing parameter
1: Smoothing parameter 1
2: Smoothing parameter 2
3: Smoothing parameter 3
4: Smoothing parameter 4
5: Smoothing parameter 5
6: Smoothing parameter 6
7: Smoothing parameter 7
8: Smoothing parameter 8
Description
Same as the acceleration/deceleration time of speed 1

H12.59 **14th speed reference**

Comm. address:	2012-3Ch	Effective mode:	Real time
Min. value:	-10000	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	Int16
Default value:	-900	Change mode:	Real time

Value range:
-10000 to 10000
Description
Same as reference 1.

H12.60 **Operation time of the 14th speed reference**

Comm. address:	2012-3Dh	Effective mode:	Real time
Min. value:	0.0	Unit:	s(m)
Max. value:	6553.5	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Value range:
0.0 to 6553.5
Description
Same as the operating time of speed 1.

H12.61 **14th speed rise/drop time and curve smoothing parameter time**

Comm. address:	2012-3Eh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	256	Change mode:	Real time

Value range:
bit0 to bit7: Acceleration/deceleration time
0: Zero acceleration/deceleration time
1: Acceleration/deceleration time 1
2: Acceleration/deceleration time 2
3: Acceleration/deceleration time 3
4: Acceleration/deceleration time 4
bit8-bit15: S curve smoothing parameter
1: Smoothing parameter 1
2: Smoothing parameter 2
3: Smoothing parameter 3
4: Smoothing parameter 4
5: Smoothing parameter 5
6: Smoothing parameter 6
7: Smoothing parameter 7
8: Smoothing parameter 8
Description
Same as the acceleration/deceleration time of speed 1

H12.62 **15th speed reference**

Comm. address:	2012-3Fh	Effective mode:	Real time
Min. value:	-10000	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	Int16
Default value:	-600	Change mode:	Real time

Value range:
-10000 to 10000
Description
Same as reference 1.

H12.63 **Operation time of the 15th speed reference**

Comm. address:	2012-40h	Effective mode:	Real time
Min. value:	0.0	Unit:	s(m)
Max. value:	6553.5	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Value range:
0.0 to 6553.5
Description
Same as the operating time of speed 1.

H12.64 **15th speed rise/drop time and curve smoothing parameter time**

Comm. address:	2012-41h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	256	Change mode:	Real time

Value range:
bit0 to bit7: Acceleration/deceleration time
0: Zero acceleration/deceleration time
1: Acceleration/deceleration time 1
2: Acceleration/deceleration time 2
3: Acceleration/deceleration time 3
4: Acceleration/deceleration time 4
bit8-bit15: S curve smoothing parameter
1: Smoothing parameter 1
2: Smoothing parameter 2
3: Smoothing parameter 3
4: Smoothing parameter 4
5: Smoothing parameter 5
6: Smoothing parameter 6
7: Smoothing parameter 7
8: Smoothing parameter 8
Description
Same as the acceleration/deceleration time of speed 1

H12.65 **16th speed reference**

Comm. address:	2012-42h	Effective mode:	Real time
Min. value:	-10000	Unit:	[mm/s]/[rpm]
Max. value:	10000	Data type:	Int16
Default value:	-300	Change mode:	Real time

Value range:
-10000 to 10000
Description
Same as reference 1.

H12.66 **Operation time of the 16th speed reference**

Comm. address:	2012-43h	Effective mode:	Real time
Min. value:	0.0	Unit:	s(m)
Max. value:	6553.5	Data type:	UInt16
Default value:	5.0	Change mode:	Real time

Value range:
0.0 to 6553.5
Description
Same as the operating time of speed 1.

H12.67 **16th speed rise/drop time and curve smoothing parameter time**

Comm. address:	2012-44h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	256	Change mode:	Real time

Value range:
bit0 to bit7: Acceleration/deceleration time
0: Zero acceleration/deceleration time
1: Acceleration/deceleration time 1
2: Acceleration/deceleration time 2
3: Acceleration/deceleration time 3
4: Acceleration/deceleration time 4
bit8-bit15: S curve smoothing parameter
1: Smoothing parameter 1
2: Smoothing parameter 2
3: Smoothing parameter 3
4: Smoothing parameter 4
5: Smoothing parameter 5
6: Smoothing parameter 6
7: Smoothing parameter 7
8: Smoothing parameter 8
Description
Same as the acceleration/deceleration time of speed 1

17.19 H14 Gantry Synchronization Parameters

H14.00 **Gantry communication state**

Comm. address:	2014-01h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:

0 to 1

Description

The gantry communication state is used to check whether the communication is established between the two axes after the gantry function is enabled.

H14.01 **Gantry alignment state**

Comm. address:	2014-02h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:

0 to 1

Description

After the gantry is aligned, the gantry alignment state is set to 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

Value range:

0: Not apply

1: Enable

Description

Gantry function selection switch

0: Disable

1: Enable

H14.03 **Gantry axis property (master/slave)**

Comm. address:	2014-04h	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: Slave axis

1: Master axis

Description

Used to select the gantry axis property.

0: Slave axis

1: Master axis

H14.04 **Mechanical property of the gantry**

Comm. address:	2014-05h	Effective mode:	Next power-on
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16

Default value:	0	Change mode:	At stop

Value range:

0: Rigid gantry scheme 1 - Dual-axis position control

1: Flexible gantry scheme 1 - Dual-axis position control

2: Rigid gantry scheme 2 - Slave axis torque control on master axis position

3: Flexible gantry scheme 2 - Slave axis torque control on master axis position

Description

Gantry mechanical properties are related to the gantry frame mechanical structure type, which is classified into rigid beam connection and flexible beam connection.

0: Rigid beam gantry (Axes may be stuck 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

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

Value range:

0: Disable

1: Enable

2: Enabled through DI

Description

After gantry synchronization is enabled, H14.08 to H14.11 will be activated.

0: Disable

1: Enable

2: Enabled through 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

Value range:

0.0 to 300.0

Description

Defines the gantry synchronization position loop proportional gain, which is active only in the slave axis.

H14.09 Gantry synchronization 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

Value range:
0.5 to 1000.0
Description
Defines the gantry synchronization 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

Value range:
0.0 to 300.0
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

Value range:
0.5 to 1000.0
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

Value range:
0.0 to 6000.0
Description
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

Value range:
0.0 to 3000.0
Description
Gantry alignment speed

H14.14 **Gantry alignment acceleration/deceleration time**

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

Value range:
0 to 1000
Description
Gantry alignment acceleration/deceleration time

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

Value range:
0: Disable
1: Enable
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:	Next power-on
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	1	Change mode:	At stop

Value range:
0: Not apply
1: Aligned by default upon initial power-on of two axes
Description
The gantry is aligned by default upon power-on.
0: Default alignment disabled
1: Dual-axis alignment applied by default upon initial power-on

H14.21 **Gantry alignment mode**

Comm. address:	2014-16h	Effective mode:	Next power-on
Min. value:	0	Unit:	-
Max. value:	4	Data type:	UInt16

Default value:	0	Change mode:	At stop

Value range:

0: Gantry homing alignment

2: Gantry torque alignment

3: Gantry enable alignment

4: Gantry DI alignment

Description

Two gantry axes alignment mode selection

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

Value range:

0: Disable

1: Torque alignment auto-tuning

2: Position auto-tuning

Description

Used to set whether to perform deviation value auto-tuning on the master/slave axis home when the gantry property (H14.04) is flexible gantry.

0: Disable

1: Torque alignment auto-tuning

2: Position auto-tuning

Note: When using this parameter, both the master and slave axes must be set.

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

Value range:

0: Disable

1: Enable

2: Enabled by DI

3: Enabled upon power-on

Description

Used to enable torque alignment in the gantry alignment mode.
0: Disable
1: Enable
2: Enabled by DI
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

Value range:
0.0 to 300.0
Description
Defines the torque in the 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

Value range:
1 to 2
Description
Defines the alignment count in the 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

Value range:
0.0 to 3000.0
Description
Defines the speed in the gantry torque alignment mode.

H14.30 Gantry torque alignment timeout alarm time

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

Value range:
1 to 65535

Description
Gantry torque alignment timeout alarm time

H14.31 **Acceleration/Deceleration time in 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

Value range:
0 to 1000
Description
Acceleration/Deceleration time in gantry torque alignment

H14.32 **Zero speed threshold in 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

Value range:
0.0 to 100.0
Description
Defines the zero speed threshold in gantry torque alignment.

H14.33 **Position loop cycle count for gantry torque alignment mechanical limit judgment**

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

Value range:
0 to 65535
Description
Position loop cycle count for gantry torque alignment mechanical limit judgment

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

Value range:
-2147483648 to +2147483647
Description
The position deviation between current axis and pairing axis (in encoder unit) in the 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

Value range:
-32767 to +32767
Description
Defines the speed difference between current axis and pairing axis in the gantry mode.

H14.38 **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

Value range:
-3276.7 to +3276.7
Description
Current axis torque reference

H14.39 **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

Value range:
-3276.7 to +3276.7
Description
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

Value range:
-32767 to +32767
Description
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

Value range:
-32767 to +32767
Description
Pairing axis motor speed

H14.44 Excessive gantry position deviation alarm time threshold

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

Value range:
0.5 to 1000.0
Description
Excessive gantry position deviation alarm time threshold

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

Value range:
0 to 4294967295
Description
Defines the gantry position alarm threshold.

H14.47 Excessive gantry position deviation alarm enable

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

Value range:
0: Disable
1: Enable
Description
Excessive gantry position deviation alarm enable
0: Disable
1: Enable

H14.48 Excessive gantry torque deviation alarm time threshold

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

Value range:
0.5 to 1000.0
Description
Defines the excessive gantry torque deviation alarm time threshold.

H14.49 Excessive gantry torque deviation alarm threshold

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

Value range:
0.0 to 800.0
Description
Defines the excessive gantry torque deviation alarm threshold.

H14.50 Excessive gantry torque deviation alarm enable

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

Value range:
0: Disable
1: Enable
Description
Used to enable or disbale excessive gantry torque deviation alarm.
0: Disable
1: Enable

H14.52 Gantry mismatch parameter

Comm. address:	2014-35h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	1451	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 1451
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

Value range:
0: No operation
1: Enable
2: Enable dual-axis homing for scheme 2
Description
Flexible gantry homing - Slave axis homing position aligned to home offset
0: No operation
1: Enable
2: Enable dual-axis homing for scheme 2

H14.74 **Gantry scheme 2 slave axis enable**

Comm. address:	2014-4Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0: Disable
1: Enable
Description
0: Slave axis not respond to position references in gantry scheme 2
1: Slave axis respond to position references in gantry scheme 2

17.20 H15 Machine Tool Parameters

H15.00 **Forward friction compensation torque**

Comm. address:	2015-01h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	50.0	Data type:	UInt16
Default value:	0.0	Change mode:	Real time

Value range:
0.0 to 50.0
Description
-

H15.01 **Negative friction compensation torque**

Comm. address:	2015-02h	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	50.0	Data type:	UInt16
Default value:	0.0	Change mode:	Real time

Value range:
0.0 to 50.0
Description
-

H15.02 **Forward friction torque filter time constant**

Comm. address:	2015-03h	Effective mode:	Real time
Min. value:	0.10	Unit:	ms
Max. value:	100.00	Data type:	UInt16
Default value:	0.10	Change mode:	Real time

Value range:
0.10 to 100.00
Description
-

H15.03 **Negative friction torque filter time constant**

Comm. address:	2015-04h	Effective mode:	Real time
Min. value:	0.10	Unit:	ms
Max. value:	100.00	Data type:	UInt16
Default value:	0.10	Change mode:	Real time

Value range:
0.10 to 100.00
Description
-

H15.04 **Friction torque compensation speed reference source**

Comm. address:	2015-05h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x4	Data type:	UInt16
Default value:	0x2	Change mode:	Real time

Value range:
0: Speed reference
1: Model speed
2: Speed feedback
3: Observation speed
4: Speed reference
Description
-

H15.05 **Friction torque compensation delay time**

Comm. address:	2015-06h	Effective mode:	Real time
Min. value:	0.00	Unit:	ms
Max. value:	300.00	Data type:	UInt16
Default value:	0.00	Change mode:	Real time

Value range:
0.00 to 300.00
Description
-

H15.06 **Friction torque compensation effective speed threshold**

Comm. address:	2015-07h	Effective mode:	Real time
Min. value:	0.0	Unit:	rpm
Max. value:	20.0	Data type:	UInt16
Default value:	0.1	Change mode:	Real time

Value range:
0.0 to 20.0
Description
-

H15.15 **Backlash compensation enable**

Comm. address:	2015-10h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0: Disable
1: Ramp
Description
-

H15.16 **Backlash compensation speed reference source**

Comm. address:	2015-11h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x4	Data type:	UInt16
Default value:	0x4	Change mode:	Real time

Value range:
0: Speed reference
1: Model speed
2: Speed feedback
3: Observation speed
4: Speed reference
Description
-

H15.17 **Minimum speed threshold of backlash compensation**

Comm. address:	2015-12h	Effective mode:	Real time
Min. value:	0.0	Unit:	rpm
Max. value:	20.0	Data type:	UInt16
Default value:	2.0	Change mode:	Real time

Value range:
0.0 to 20.0
Description
-

H15.18 **Number of pulses of backlash compensation**

Comm. address:	2015-13h	Effective mode:	Real time
Min. value:	0	Unit:	p
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 65535
Description
Note: The values of H15.18, H15.21, and H15.23 must meet the following requirement: H15.18/H15.21 (H15.23) > 16.

H15.19 **Backlash delay**

Comm. address:	2015-14h	Effective mode:	Real time
Min. value:	0.0	Unit:	ms
Max. value:	300.0	Data type:	UInt16
Default value:	0.0	Change mode:	Real time

Value range:
0.0 to 300.0
Description
-

H15.21 **Forward backlash compensation time**

Comm. address:	2015-16h	Effective mode:	Real time
Min. value:	0.1	Unit:	ms
Max. value:	300.0	Data type:	UInt16
Default value:	0.1	Change mode:	Real time

Value range:
0.1 to 300.0
Description
Note: The values of H15.18, H15.21, and H15.23 must meet the following requirement: H15.18/H15.21 (H15.23) > 16.

H15.23 **Reverse backlash compensation time**

Comm. address:	2015-18h	Effective mode:	Real time
Min. value:	0.1	Unit:	ms
Max. value:	300.0	Data type:	UInt16
Default value:	0.1	Change mode:	Real time

Value range:
0.1 to 300.0
Description
Note: The values of H15.18, H15.21, and H15.23 must meet the following requirement: H15.18/H15.21 (H15.23) > 16.

H15.25 **Filter time constant of average backlash compensation value**

Comm. address:	2015-1Ah	Effective mode:	Real time
Min. value:	0.0	Unit:	ms
Max. value:	50.0	Data type:	UInt16
Default value:	0.0	Change mode:	At stop

Value range:
0.0 to 50.0
Description
Defines the moving average filter time constant of position references.

17.21 H17 VDI/DO Parameters

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

Value range:
0: No assignment
1: S-ON
2: Warning reset signal
3: Gain switchover switch
4: Switchover between main and auxiliary commands
5: Multi-reference direction
6: Multi-reference switchover CMD1
7: Multi-reference switchover CMD2
8: Multi-reference switchover CMD3
9: Multi-reference switchover CMD4
10: Mode switchover M1-SEL
11: Mode switchover M2-SEL
12: Zero clamp enable signal
13: Position reference inhibited
14: Positive limit switch
15: Reverse limit switch
16: Positive external torque limit
17: Negative external torque limit
18: Forward jog
19: Reverse jog
20: Step enable

21: Hand wheel override signal 1
22: Hand wheel override signal 2
23: Hand wheel enable signal
24: Electronic gear ratio selection
25: Torque reference direction
26: Speed reference direction
27: Position reference direction
28: Multi-position reference enable
29: Interrupt positioning canceled
31: Home switch
32: Enable homing
33: Disable interrupt positioning
34: Emergency stop
35: Clear position deviation
36: Internal speed limit source
37: Disable pulse reference
40: Enable multi-speed
41: Current position as home
42: Axis control command executed immediately
43: Axis control command not executed immediately
44: Positioning and command completed signal clear
46: Process segment enable
47: Process segment command switchover 1
48: Process segment command switchover 2
49: Process segment command switchover 3
50: Process segment command switchover 4
51: Event trigger process segment 1
52: Event trigger process segment 2
53: Event trigger process segment 3
54: Event trigger process segment
55: Pause process segment
56: Gantry torque alignment
57: Enable gantry alignment by DI signal
58: Clear gantry alignment by DI signal
59: Enable gantry synchronization

Parameter description

Defines the VDI1 function.

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

Value range:

0: Active when the written value is 1
1: Active when the written value changes from 0 to 1

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

Value range:
Same as H17.00.
Parameter description
Same as H17.00.

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

Value range:
0: Active when the written value is 1
1: Active when the written value changes from 0 to 1
Description
Same as parameter H17.01.

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

Value range:
Same as H17.00.
Parameter description
Same as H17.00.

H17.05 **VDI3 logic level 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

Value range:
0: Active when the written value is 1
1: Active when the written value changes from 0 to 1
Description
Same as parameter H17.01.

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

Value range:
Same as H17.00.
Parameter description
Same as H17.00.

H17.07 **VDI4 logic level 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

Value range:
0: Active when the written value is 1
1: Active when the written value changes from 0 to 1
Description
Same as parameter H17.01.

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

Value range:
Same as H17.00.
Parameter description
Same as H17.00.

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

Value range:
0: Active when the written value is 1
1: Active when the written value changes from 0 to 1
Description
Same as parameter H17.01.

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

Value range:
Same as H17.00.
Parameter description
Same as H17.00.

H17.11 **VDI6 logic level 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

Value range:
0: Active when the written value is 1
1: Active when the written value changes from 0 to 1
Description
Same as parameter H17.01.

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

Value range:
Same as H17.00.
Parameter description
Same as H17.00.

H17.13 **VDI7 logic level 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

Value range:
0: Active when the written value is 1
1: Active when the written value changes from 0 to 1
Description
Same as parameter H17.01.

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

Value range:
Same as H17.00.
Parameter description
Same as H17.00.

H17.15 **VDI8 logic level 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

Value range:
0: Active when the written value is 1
1: Active when the written value changes from 0 to 1
Description
Same as parameter H17.01.

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

Value range:
Same as H17.00.
Parameter description
Same as H17.00.

H17.17 **VDI9 logic level 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

Value range:
0: Active when the written value is 1
1: Active when the written value changes from 0 to 1
Description
Same as parameter H17.01.

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

Value range:
Same as H17.00.
Parameter description
Same as H17.00.

H17.19 **VDI10 logic level 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

Value range:
0: Active when the written value is 1
1: Active when the written value changes from 0 to 1
Description
Same as parameter H17.01.

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

Value range:
Same as H17.00.
Parameter description
Same as H17.00.

H17.21 **VDI11 logic level 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

Value range:
0: Active when the written value is 1
1: Active when the written value changes from 0 to 1
Description
Same as parameter H17.01.

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

Value range:
Same as H17.00.
Parameter description
Same as H17.00.

H17.23 **VDI12 logic level 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

Value range:
0: Active when the written value is 1
1: Active when the written value changes from 0 to 1
Description
Same as parameter H17.01.

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

Value range:
Same as H17.00.
Parameter description
Same as H17.00.

H17.25 **VDI13 logic level 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

Value range:
0: Active when the written value is 1
1: Active when the written value changes from 0 to 1
Description
Same as parameter H17.01.

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

Value range:
Same as H17.00.
Parameter description
Same as H17.00.

H17.27 **VDI14 logic level 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

Value range:
0: Active when the written value is 1
1: Active when the written value changes from 0 to 1
Description
Same as parameter H17.01.

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

Value range:
Same as H17.00.
Parameter description
Same as H17.00.

H17.29 **VDI15 logic level 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

Value range:
0: Active when the written value is 1
1: Active when the written value changes from 0 to 1
Description
Same as parameter H17.01.

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

Value range:
Same as H17.00.
Parameter description
Same as H17.00.

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

Value range:
0: Active when the written value is 1
1: Active when the written value changes from 0 to 1
Description
Same as parameter H17.01.

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

Value range:
0x0 to 0xFFFF
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

Value range:

0: No assignment
1: Servo ready
2: Motor rotation
3: Zero speed
4: Speed matching
5: Positioning completed
6: Proximity
7: Torque limited
8: Speed limited
9: Brake
10: Alarm
11: Fault
15: Interrupt positioning completed
16: Homing completed
17: Electrical homing completed
18: Torque reach
19: Speed reach
21: Enable completed
22: Internal command completed
23: Writing next command allowed
24: Internal motion completed
26: Closed-loop state
27: Left limit
28: Right limit
30: Alarm or fault output
32: EDM output
33: Gantry alignment

Description

Defines the function of VDO1.

H17.34 **VDO1 logic level 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

Value range:

0: Output 1 upon active logic
1: Output 0 upon active logic

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

Value range:
0: No assignment
1: Servo ready
2: Motor rotation
3: Zero speed
4: Speed matching
5: Positioning completed
6: Proximity
7: Torque limited
8: Speed limited
9: Brake
10: Alarm
11: Fault
15: Interrupt positioning completed
16: Homing completed
17: Electrical homing completed
18: Torque reach
19: Speed reach
21: Enable completed
22: Internal command completed
23: Writing next command allowed
24: Internal motion completed
26: Closed-loop state
27: Left limit
28: Right limit
30: Alarm or fault output
32: EDM output
33: Gantry alignment

Description
Same as parameter H17.33.

H17.36 VDO2 logic level 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

Value range:
0: Output 1 upon active logic
1: Output 0 upon active logic

Description
Same as parameter 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

Value range:
0: No assignment
1: Servo ready
2: Motor rotation
3: Zero speed
4: Speed matching
5: Positioning completed
6: Proximity
7: Torque limited
8: Speed limited
9: Brake
10: Alarm
11: Fault
15: Interrupt positioning completed
16: Homing completed
17: Electrical homing completed
18: Torque reach
19: Speed reach
21: Enable completed
22: Internal command completed
23: Writing next command allowed
24: Internal motion completed
26: Closed-loop state
27: Left limit
28: Right limit
30: Alarm or fault output
32: EDM output
33: Gantry alignment

Description
Same as parameter H17.33.

H17.38 **VDO3 logic level 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

Value range:
0: Output 1 upon active logic
1: Output 0 upon active logic

Description
Same as parameter 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

Value range:
0: No assignment
1: Servo ready
2: Motor rotation
3: Zero speed
4: Speed matching
5: Positioning completed
6: Proximity
7: Torque limited
8: Speed limited
9: Brake
10: Alarm
11: Fault
15: Interrupt positioning completed
16: Homing completed
17: Electrical homing completed
18: Torque reach
19: Speed reach
21: Enable completed
22: Internal command completed
23: Writing next command allowed
24: Internal motion completed
26: Closed-loop state
27: Left limit
28: Right limit
30: Alarm or fault output
32: EDM output
33: Gantry alignment

Description
Same as parameter H17.33.

H17.40 **VDO4 logic level 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

Value range:
0: Output 1 upon active logic
1: Output 0 upon active logic

Description
Same as parameter 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

Value range:
0: No assignment
1: Servo ready
2: Motor rotation
3: Zero speed
4: Speed matching
5: Positioning completed
6: Proximity
7: Torque limited
8: Speed limited
9: Brake
10: Alarm
11: Fault
15: Interrupt positioning completed
16: Homing completed
17: Electrical homing completed
18: Torque reach
19: Speed reach
21: Enable completed
22: Internal command completed
23: Writing next command allowed
24: Internal motion completed
26: Closed-loop state
27: Left limit
28: Right limit
30: Alarm or fault output
32: EDM output
33: Gantry alignment

Description
Same as parameter H17.33.

H17.42 **VDO5 logic level 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

Value range:
0: Output 1 upon active logic
1: Output 0 upon active logic
Description
Same as parameter 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

Value range:
0: No assignment
1: Servo ready
2: Motor rotation
3: Zero speed
4: Speed matching
5: Positioning completed
6: Proximity
7: Torque limited
8: Speed limited
9: Brake
10: Alarm
11: Fault
15: Interrupt positioning completed
16: Homing completed
17: Electrical homing completed
18: Torque reach
19: Speed reach
21: Enable completed
22: Internal command completed
23: Writing next command allowed
24: Internal motion completed
26: Closed-loop state
27: Left limit
28: Right limit
30: Alarm or fault output
32: EDM output
33: Gantry alignment
Description
Same as parameter H17.33.

H17.44 VDO6 logic level 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

Value range:
0: Output 1 upon active logic
1: Output 0 upon active logic
Description
Same as parameter 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

Value range:
0: No assignment
1: Servo ready
2: Motor rotation
3: Zero speed
4: Speed matching
5: Positioning completed
6: Proximity
7: Torque limited
8: Speed limited
9: Brake
10: Alarm
11: Fault
15: Interrupt positioning completed
16: Homing completed
17: Electrical homing completed
18: Torque reach
19: Speed reach
21: Enable completed
22: Internal command completed
23: Writing next command allowed
24: Internal motion completed
26: Closed-loop state
27: Left limit
28: Right limit
30: Alarm or fault output
32: EDM output
33: Gantry alignment
Description
Same as parameter H17.33.

H17.46 **VDO7 logic level 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

Value range:

0: Output 1 upon active logic

1: Output 0 upon active logic

Description

Same as parameter 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

Value range:

0: No assignment

1: Servo ready

2: Motor rotation

3: Zero speed

4: Speed matching

5: Positioning completed

6: Proximity

7: Torque limited

8: Speed limited

9: Brake

10: Alarm

11: Fault

15: Interrupt positioning completed

16: Homing completed

17: Electrical homing completed

18: Torque reach

19: Speed reach

21: Enable completed

22: Internal command completed

23: Writing next command allowed

24: Internal motion completed

26: Closed-loop state

27: Left limit

28: Right limit

30: Alarm or fault output

32: EDM output

33: Gantry alignment

Description
Same as parameter H17.33.

H17.48 VDO8 logic level

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

Value range:
0: Output 1 upon active logic
1: Output 0 upon active logic
Description
Same as parameter 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

Value range:

0: No assignment
1: Servo ready
2: Motor rotation
3: Zero speed
4: Speed matching
5: Positioning completed
6: Proximity
7: Torque limited
8: Speed limited
9: Brake
10: Alarm
11: Fault
15: Interrupt positioning completed
16: Homing completed
17: Electrical homing completed
18: Torque reach
19: Speed reach
21: Enable completed
22: Internal command completed
23: Writing next command allowed
24: Internal motion completed
26: Closed-loop state
27: Left limit
28: Right limit
30: Alarm or fault output
32: EDM output
33: Gantry alignment

Description

Same as parameter H17.33.

H17.50 VDO9 logic level 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

Value range:

0: Output 1 upon active logic
1: Output 0 upon active logic

Description

Same as parameter 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

Value range:
0: No assignment
1: Servo ready
2: Motor rotation
3: Zero speed
4: Speed matching
5: Positioning completed
6: Proximity
7: Torque limited
8: Speed limited
9: Brake
10: Alarm
11: Fault
15: Interrupt positioning completed
16: Homing completed
17: Electrical homing completed
18: Torque reach
19: Speed reach
21: Enable completed
22: Internal command completed
23: Writing next command allowed
24: Internal motion completed
26: Closed-loop state
27: Left limit
28: Right limit
30: Alarm or fault output
32: EDM output
33: Gantry alignment

Description
Same as parameter H17.33.

H17.52 VDO10 logic level 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

Value range:
0: Output 1 upon active logic
1: Output 0 upon active logic

Description
Same as parameter 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

Value range:
0: No assignment
1: Servo ready
2: Motor rotation
3: Zero speed
4: Speed matching
5: Positioning completed
6: Proximity
7: Torque limited
8: Speed limited
9: Brake
10: Alarm
11: Fault
15: Interrupt positioning completed
16: Homing completed
17: Electrical homing completed
18: Torque reach
19: Speed reach
21: Enable completed
22: Internal command completed
23: Writing next command allowed
24: Internal motion completed
26: Closed-loop state
27: Left limit
28: Right limit
30: Alarm or fault output
32: EDM output
33: Gantry alignment

Description
Same as parameter H17.33.

H17.54 **VDO11 logic level 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

Value range:
0: Output 1 upon active logic
1: Output 0 upon active logic

Description
Same as parameter 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

Value range:
0: No assignment
1: Servo ready
2: Motor rotation
3: Zero speed
4: Speed matching
5: Positioning completed
6: Proximity
7: Torque limited
8: Speed limited
9: Brake
10: Alarm
11: Fault
15: Interrupt positioning completed
16: Homing completed
17: Electrical homing completed
18: Torque reach
19: Speed reach
21: Enable completed
22: Internal command completed
23: Writing next command allowed
24: Internal motion completed
26: Closed-loop state
27: Left limit
28: Right limit
30: Alarm or fault output
32: EDM output
33: Gantry alignment

Description
Same as parameter H17.33.

H17.56 **VDO12 logic level 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

Value range:
0: Output 1 upon active logic
1: Output 0 upon active logic

Description
Same as parameter 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

Value range:
0: No assignment
1: Servo ready
2: Motor rotation
3: Zero speed
4: Speed matching
5: Positioning completed
6: Proximity
7: Torque limited
8: Speed limited
9: Brake
10: Alarm
11: Fault
15: Interrupt positioning completed
16: Homing completed
17: Electrical homing completed
18: Torque reach
19: Speed reach
21: Enable completed
22: Internal command completed
23: Writing next command allowed
24: Internal motion completed
26: Closed-loop state
27: Left limit
28: Right limit
30: Alarm or fault output
32: EDM output
33: Gantry alignment

Description
Same as parameter H17.33.

H17.58 **VDO13 logic level 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

Value range:
0: Output 1 upon active logic
1: Output 0 upon active logic
Description
Same as parameter 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

Value range:
0: No assignment
1: Servo ready
2: Motor rotation
3: Zero speed
4: Speed matching
5: Positioning completed
6: Proximity
7: Torque limited
8: Speed limited
9: Brake
10: Alarm
11: Fault
15: Interrupt positioning completed
16: Homing completed
17: Electrical homing completed
18: Torque reach
19: Speed reach
21: Enable completed
22: Internal command completed
23: Writing next command allowed
24: Internal motion completed
26: Closed-loop state
27: Left limit
28: Right limit
30: Alarm or fault output
32: EDM output
33: Gantry alignment
Description
Same as parameter H17.33.

H17.60 VDO14 logic level 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

Value range:
0: Output 1 upon active logic
1: Output 0 upon active logic
Description
Same as parameter 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

Value range:
0: No assignment
1: Servo ready
2: Motor rotation
3: Zero speed
4: Speed matching
5: Positioning completed
6: Proximity
7: Torque limited
8: Speed limited
9: Brake
10: Alarm
11: Fault
15: Interrupt positioning completed
16: Homing completed
17: Electrical homing completed
18: Torque reach
19: Speed reach
21: Enable completed
22: Internal command completed
23: Writing next command allowed
24: Internal motion completed
26: Closed-loop state
27: Left limit
28: Right limit
30: Alarm or fault output
32: EDM output
33: Gantry alignment
Description
Same as parameter H17.33.

H17.62 **VDO15 logic level 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

Value range:

0: Output 1 upon active logic

1: Output 0 upon active logic

Description

Same as parameter 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

Value range:

0: No assignment

1: Servo ready

2: Motor rotation

3: Zero speed

4: Speed matching

5: Positioning completed

6: Proximity

7: Torque limited

8: Speed limited

9: Brake

10: Alarm

11: Fault

15: Interrupt positioning completed

16: Homing completed

17: Electrical homing completed

18: Torque reach

19: Speed reach

21: Enable completed

22: Internal command completed

23: Writing next command allowed

24: Internal motion completed

26: Closed-loop state

27: Left limit

28: Right limit

30: Alarm or fault output

32: EDM output

33: Gantry alignment

Description
Same as parameter H17.33.

H17.64 VDO16 logic level 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

Value range:
0: Output 1 upon active logic
1: Output 0 upon active logic
Description
Same as parameter H17.34.

H17.90 Communication VDI enable

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

Value range:
0: Disable
1: Enable
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 Default VDI selection after power-on

Comm. address:	2017-5Ch	Effective mode:	Next power-on
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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

Description

Configures the initial value of VDI upon power-on.
bit0 corresponds to VDI1.
bit1 corresponds to VDI2.
...
bit15 corresponds to VDI16.

H17.92 **Communication VDO enable**

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

Value range:

0: Disable
1: Enable

Description

To use the VDO function:
1. Enable VDO through H17.92.
2. Set the default level after power-on in H17.93.
3. Set the function of the VDO through parameters in group H17.
4: Read the output level of the VDO in H17.32.

H17.93 **Default VDO selection 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

Value 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

Description

Configures the initial value of VDO upon power-on.
bit0 corresponds to VDO1.
bit1 corresponds to VDO2.
...
bit15 corresponds to VDO16.

17.22 H18 Position Comparison Output Parameters

H18.00 **Position compare output enable**

Comm. address:	2018-01h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0: Disable
1: Enable (rising edge triggered)

Description

0: Disable
1: Enable (rising edge triggered)

H18.01 **Position compare output feedback source**

Comm. address:	2018-02h	Effective mode:	Next power-on
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0: Motor encoder feedback

1: Fully closed-loop position feedback

Description

Defines the position compare output feedback source.

0: Motor encoder feedback

1: Fully closed-loop position feedback

H18.02 **Position compare value resolution**

Comm. address:	2018-03h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	7	Data type:	UInt16
Default value:	1	Change mode:	Real time

Value 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

Description

Defines the position compare value 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 compare mode**

Comm. address:	2018-04h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0: Single compare mode

1: Cyclic compare mode

2: Fixed cyclic compare mode

Description

Defines the position compare mode.

0: Single compare mode

1: Cyclic compare mode

2: Fixed cyclic compare mode

H18.04 **Current position as zero**

Comm. address:	2018-05h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0: Disable
1: Enable (rising edge triggered)
Description
Current position as zero

H18.05 **Position compare output width**

Comm. address:	2018-06h	Effective mode:	Real time
Min. value:	0.1	Unit:	ms
Max. value:	204.7	Data type:	UInt16
Default value:	0.1	Change mode:	Real time

Value range:
0.1 to 204.7
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 logic1: 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
Description
0: Positive, output high level upon active logic; 1: Negative, output low level upon active logic
bit 0: OCZ output logic
bit1: Z output logic
bit2: A/B output logic

H18.07 **Start point of position compare**

Comm. address:	2018-08h	Effective mode:	Real time

Min. value:	1	Unit:	-
Max. value:	40	Data type:	UInt16
Default value:	1	Change mode:	Real time

Value range:
1 to 40
Description
Defines the start point of position compare.

H18.08 **End point of position compare**

Comm. address:	2018-09h	Effective mode:	Real time
Min. value:	1	Unit:	-
Max. value:	40	Data type:	UInt16
Default value:	1	Change mode:	Real time

Value range:
1 to 40
Description
Defines the end point of position compare.

H18.09 **Current status of position compare**

Comm. address:	2018-0Ah	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	1024	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 1024
Description
Displays the current state of position compare.

H18.10 **Real-time position of position compare**

Comm. address:	2018-0Bh	Effective mode:	-
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Value range:
-2147483648 to +2147483647
Description
Displays the real-time position of position compare.

H18.12 **Zero offset of position compare**

Comm. address:	2018-0Dh	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
Description
Displays the zero offset of position compare.

H18.14 **Position compare output delay compensation**

Comm. address:	2018-0Fh	Effective mode:	Next power-on
Min. value:	-12.00	Unit:	μs
Max. value:	12.00	Data type:	Int16
Default value:	0.00	Change mode:	Real time

Value range:
-12.00 to 12.00
Description
Compensates the delay caused by hardware signal output.

H18.15 **Fixed cyclic cycle count**

Comm. address:	2018-10h	Effective mode:	Real time
Min. value:	1	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	1	Change mode:	Real time

Value range:
1 to 65535
Description
Defines the number of fixed value 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
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.

H18.17 **Fixed mode completion count**

Comm. address:	2018-12h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Description
Displays the number of fixed value mode cycles.

17.23 H19 Target Position Parameters

H19.00 **Target value of position compare 1**

Comm. address:	2019-01h	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
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:
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 to bit6: Reserved
bit7: DO1 output
bit8: DO2 output
bit9: DO3 output
bit10: DO4 output
bit11: DO5 output
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output
Description
Defines the attribute setting of position comparison point 1.
bit0: 1: Enable forward traversing; 0: Disable.

bit1: 1: Enable negative traversing; 0: Disable.
bit2 to bit6: N/A.
bit7: 1: Enable DO1 output; 0: Disable.
bit8: 1: Enable DO2 output; 0: Disable.
bit9: 1: Enable DO3 output; 0: Disable.
bit10: 1: Enable DO4 output; 0: Disable.
bit11: 1: Enable DO5 output; 0: Disable.
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 compare 2**

Comm. address:	2019-04h	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
Description
Same as parameter H19.00.

H19.05 **Property value of position compare 2**

Comm. address:	2019-06h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved
bit7: DO1 output
bit8: DO2 output
bit9: DO3 output
bit10: DO4 output
bit11: DO5 output
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output
Description
Same as parameter H19.02.

H19.06 **Target value of position compare 3**

Comm. address:	2019-07h	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
Description
Same as parameter H19.00.

H19.08 Property value of position compare 3

Comm. address:	2019-09h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved
bit7: DO1 output
bit8: DO2 output
bit9: DO3 output
bit10: DO4 output
bit11: DO5 output
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output
Description
Same as parameter H19.02.

H19.09 Target value of position compare 4

Comm. address:	2019-0Ah	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
Description
Same as parameter H19.00.

H19.11 Property value of position compare 4

Comm. address:	2019-0Ch	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved
bit7: DO1 output
bit8: DO2 output
bit9: DO3 output
bit10: DO4 output
bit11: DO5 output
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Description

Same as parameter H19.02.

H19.12 **Target value of position compare 5**

Comm. address:	2019-0Dh	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

Description

Same as parameter H19.00.

H19.14 **Property value of position compare 5**

Comm. address:	2019-0Fh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved
bit7: DO1 output
bit8: DO2 output
bit9: DO3 output
bit10: DO4 output
bit11: DO5 output
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Description

Same as parameter H19.02.

H19.15 **Target value of position compare 6**

Comm. address:	2019-10h	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
Description
Same as parameter H19.00.

H19.17 **Property value of position compare 6**

Comm. address:	2019-12h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved
bit7: DO1 output
bit8: DO2 output
bit9: DO3 output
bit10: DO4 output
bit11: DO5 output
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output
Description
Same as parameter H19.02.

H19.18 **Target value of position compare 7**

Comm. address:	2019-13h	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
Description
Same as parameter H19.00.

H19.20 **Property value of position compare 7**

Comm. address:	2019-15h	Effective mode:	Real time
Min. value:	0	Unit:	-

Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved

bit7: DO1 output

bit8: DO2 output

bit9: DO3 output

bit10: DO4 output

bit11: DO5 output

bit12: Frequency-division A output

bit13: Frequency-division B output

bit14: Frequency-division Z output

bit15: Frequency-division OCZ output

Description

Same as parameter H19.02.

H19.21 **Target value of position compare 8**

Comm. address:	2019-16h	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

Description

Same as parameter H19.00.

H19.23 **Property value of position compare 8**

Comm. address:	2019-18h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved
bit7: DO1 output
bit8: DO2 output
bit9: DO3 output
bit10: DO4 output
bit11: DO5 output
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Description

Same as parameter H19.02.

H19.24 **Target value of position compare 9**

Comm. address:	2019-19h	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

Description

Same as parameter H19.00.

H19.26 **Property value of position compare 9**

Comm. address:	2019-1Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved
bit7: DO1 output
bit8: DO2 output
bit9: DO3 output
bit10: DO4 output
bit11: DO5 output
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Description

Same as parameter H19.02.

H19.27 **Target value of position compare 10**

Comm. address:	2019-1Ch	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
Description
Same as parameter H19.00.

H19.29 **Property value of position compare 10**

Comm. address:	2019-1Eh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved
bit7: DO1 output
bit8: DO2 output
bit9: DO3 output
bit10: DO4 output
bit11: DO5 output
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output
Description
Same as parameter H19.02.

H19.30 **Target value of position compare 11**

Comm. address:	2019-1Fh	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
Description
Same as parameter H19.00.

H19.32 **Property value of position compare 11**

Comm. address:	2019-21h	Effective mode:	Real time
Min. value:	0	Unit:	-

Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved

bit7: DO1 output

bit8: DO2 output

bit9: DO3 output

bit10: DO4 output

bit11: DO5 output

bit12: Frequency-division A output

bit13: Frequency-division B output

bit14: Frequency-division Z output

bit15: Frequency-division OCZ output

Description

Same as parameter H19.02.

H19.33 **Target value of position compare 12**

Comm. address:	2019-22h	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

Description

Same as parameter H19.00.

H19.35 **Property value of position compare 12**

Comm. address:	2019-24h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved
bit7: DO1 output
bit8: DO2 output
bit9: DO3 output
bit10: DO4 output
bit11: DO5 output
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Description

Same as parameter H19.02.

H19.36 Target value of position compare 13

Comm. address:	2019-25h	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

Description

Same as parameter H19.00.

H19.38 Property value of position compare 13

Comm. address:	2019-27h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved
bit7: DO1 output
bit8: DO2 output
bit9: DO3 output
bit10: DO4 output
bit11: DO5 output
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Description

Same as parameter H19.02.

H19.39 **Target value of position compare 14**

Comm. address:	2019-28h	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
Description
Same as parameter H19.00.

H19.41 **Property value of position compare 14**

Comm. address:	2019-2Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved
bit7: DO1 output
bit8: DO2 output
bit9: DO3 output
bit10: DO4 output
bit11: DO5 output
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output
Description
Same as parameter H19.02.

H19.42 **Target value of position compare 15**

Comm. address:	2019-2Bh	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
Description
Same as parameter H19.00.

H19.44 **Property value of position compare 15**

Comm. address:	2019-2Dh	Effective mode:	Real time
Min. value:	0	Unit:	-

Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved

bit7: DO1 output

bit8: DO2 output

bit9: DO3 output

bit10: DO4 output

bit11: DO5 output

bit12: Frequency-division A output

bit13: Frequency-division B output

bit14: Frequency-division Z output

bit15: Frequency-division OCZ output

Description

Same as parameter H19.02.

H19.45 **Target value of position compare 16**

Comm. address:	2019-2Eh	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

Description

Same as parameter H19.00.

H19.47 **Property value of position compare 16**

Comm. address:	2019-30h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved
bit7: DO1 output
bit8: DO2 output
bit9: DO3 output
bit10: DO4 output
bit11: DO5 output
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Description

Same as parameter H19.02.

H19.48 **Target value of position compare 17**

Comm. address:	2019-31h	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

Description

Same as parameter H19.00.

H19.50 **Property value of position compare 17**

Comm. address:	2019-33h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved
bit7: DO1 output
bit8: DO2 output
bit9: DO3 output
bit10: DO4 output
bit11: DO5 output
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Description

Same as parameter H19.02.

H19.51 **Target value of position compare 18**

Comm. address:	2019-34h	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
Description
Same as parameter H19.00.

H19.53 **Property value of position compare 18**

Comm. address:	2019-36h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved
bit7: DO1 output
bit8: DO2 output
bit9: DO3 output
bit10: DO4 output
bit11: DO5 output
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output
Description
Same as parameter H19.02.

H19.54 **Target value of position compare 19**

Comm. address:	2019-37h	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
Description
Same as parameter H19.00.

H19.56 **Property value of position compare 19**

Comm. address:	2019-39h	Effective mode:	Real time
Min. value:	0	Unit:	-

Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved

bit7: DO1 output

bit8: DO2 output

bit9: DO3 output

bit10: DO4 output

bit11: DO5 output

bit12: Frequency-division A output

bit13: Frequency-division B output

bit14: Frequency-division Z output

bit15: Frequency-division OCZ output

Description

Same as parameter H19.02.

H19.57 **Target value of position compare 20**

Comm. address:	2019-3Ah	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

Description

Same as parameter H19.00.

H19.59 **Property value of position compare 20**

Comm. address:	2019-3Ch	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved
bit7: DO1 output
bit8: DO2 output
bit9: DO3 output
bit10: DO4 output
bit11: DO5 output
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Description

Same as parameter H19.02.

H19.60 **Target value of position compare 21**

Comm. address:	2019-3Dh	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

Description

Same as parameter H19.00.

H19.62 **Property value of position compare 21**

Comm. address:	2019-3Fh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved
bit7: DO1 output
bit8: DO2 output
bit9: DO3 output
bit10: DO4 output
bit11: DO5 output
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Description

Same as parameter H19.02.

H19.63 **Target value of position compare 22**

Comm. address:	2019-40h	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
Description
Same as parameter H19.00.

H19.65 **Property value of position compare 22**

Comm. address:	2019-42h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved
bit7: DO1 output
bit8: DO2 output
bit9: DO3 output
bit10: DO4 output
bit11: DO5 output
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output
Description
Same as parameter H19.02.

H19.66 **Target value of position compare 23**

Comm. address:	2019-43h	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
Description
Same as parameter H19.00.

H19.68 **Property value of position compare 23**

Comm. address:	2019-45h	Effective mode:	Real time
Min. value:	0	Unit:	-

Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved

bit7: DO1 output

bit8: DO2 output

bit9: DO3 output

bit10: DO4 output

bit11: DO5 output

bit12: Frequency-division A output

bit13: Frequency-division B output

bit14: Frequency-division Z output

bit15: Frequency-division OCZ output

Description

Same as parameter H19.02.

H19.69 **Target value of position compare 24**

Comm. address:	2019-46h	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

Description

Same as parameter H19.00.

H19.71 **Property value of position comparison 24**

Comm. address:	2019-48h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved
bit7: DO1 output
bit8: DO2 output
bit9: DO3 output
bit10: DO4 output
bit11: DO5 output
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Description

Same as parameter H19.02.

H19.72 **Target value of position compare 25**

Comm. address:	2019-49h	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

Description

Same as parameter H19.00.

H19.74 **Property value of position compare 25**

Comm. address:	2019-4Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved
bit7: DO1 output
bit8: DO2 output
bit9: DO3 output
bit10: DO4 output
bit11: DO5 output
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Description

Same as parameter H19.02.

H19.75 **Target value of position compare 26**

Comm. address:	2019-4Ch	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
Description
Same as parameter H19.00.

H19.77 **Property value of position compare 26**

Comm. address:	2019-4Eh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved
bit7: DO1 output
bit8: DO2 output
bit9: DO3 output
bit10: DO4 output
bit11: DO5 output
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output
Description
Same as parameter H19.02.

H19.78 **Target value of position compare 27**

Comm. address:	2019-4Fh	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
Description
Same as parameter H19.00.

H19.80 **Property value of position compare 27**

Comm. address:	2019-51h	Effective mode:	Real time
Min. value:	0	Unit:	-

Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved

bit7: DO1 output

bit8: DO2 output

bit9: DO3 output

bit10: DO4 output

bit11: DO5 output

bit12: Frequency-division A output

bit13: Frequency-division B output

bit14: Frequency-division Z output

bit15: Frequency-division OCZ output

Description

Same as parameter H19.02.

H19.81 **Target value of position compare 28**

Comm. address:	2019-52h	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

Description

Same as parameter H19.00.

H19.83 **Property value of position compare 28**

Comm. address:	2019-54h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved
bit7: DO1 output
bit8: DO2 output
bit9: DO3 output
bit10: DO4 output
bit11: DO5 output
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Description

Same as parameter H19.02.

H19.84 **Target value of position compare 29**

Comm. address:	2019-55h	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

Description

Same as parameter H19.00.

H19.86 **Property value of position comparison 29**

Comm. address:	2019-57h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved
bit7: DO1 output
bit8: DO2 output
bit9: DO3 output
bit10: DO4 output
bit11: DO5 output
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Description

Same as parameter H19.02.

H19.87 **Target value of position compare 30**

Comm. address:	2019-58h	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
Description
Same as parameter H19.00.

H19.89 **Property value of position comparison 30**

Comm. address:	2019-5Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved
bit7: DO1 output
bit8: DO2 output
bit9: DO3 output
bit10: DO4 output
bit11: DO5 output
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output
Description
Same as parameter H19.02.

H19.90 **Target value of position comparison 31**

Comm. address:	2019-5Bh	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
Description
Same as parameter H19.00.

H19.92 **Attribute value of position comparison 31**

Comm. address:	2019-5Dh	Effective mode:	Real time
Min. value:	0	Unit:	-

Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved

bit7: DO1 output

bit8: DO2 output

bit9: DO3 output

bit10: DO4 output

bit11: DO5 output

bit12: Frequency-division A output

bit13: Frequency-division B output

bit14: Frequency-division Z output

bit15: Frequency-division OCZ output

Description

Same as parameter H19.02.

H19.93 **Target value of position comparison 32**

Comm. address:	2019-5Eh	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

Description

Same as parameter H19.00.

H19.95 **Attribute value of position comparison 32**

Comm. address:	2019-60h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved
bit7: DO1 output
bit8: DO2 output
bit9: DO3 output
bit10: DO4 output
bit11: DO5 output
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Description

Same as parameter H19.02.

H19.96 **Target value of position comparison 33**

Comm. address:	2019-61h	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

Description

Same as parameter H19.00.

H19.98 **Attribute value of position comparison 33**

Comm. address:	2019-63h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved
bit7: DO1 output
bit8: DO2 output
bit9: DO3 output
bit10: DO4 output
bit11: DO5 output
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Description

Same as parameter H19.02.

H19.99 **Target value of position comparison 34**

Comm. address:	2019-64h	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
Description
Same as parameter H19.00.

H19.101 **Attribute value of position comparison 34**

Comm. address:	2019-66h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved
bit7: DO1 output
bit8: DO2 output
bit9: DO3 output
bit10: DO4 output
bit11: DO5 output
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output
Description
Same as parameter H19.02.

H19.102 **Target value of position comparison 35**

Comm. address:	2019-67h	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
Description
Same as parameter H19.00.

H19.104 **Attribute value of position comparison 35**

Comm. address:	2019-69h	Effective mode:	Real time
Min. value:	0	Unit:	-

Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved

bit7: DO1 output

bit8: DO2 output

bit9: DO3 output

bit10: DO4 output

bit11: DO5 output

bit12: Frequency-division A output

bit13: Frequency-division B output

bit14: Frequency-division Z output

bit15: Frequency-division OCZ output

Description

Same as parameter H19.02.

H19.105 **Target value of position comparison 36**

Comm. address:	2019-6Ah	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

Description

Same as parameter H19.00.

H19.107 **Attribute value of position comparison 36**

Comm. address:	2019-6Ch	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved
bit7: DO1 output
bit8: DO2 output
bit9: DO3 output
bit10: DO4 output
bit11: DO5 output
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Description

Same as parameter H19.02.

H19.108 Target value of position comparison 37

Comm. address:	2019-6Dh	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

Description

Same as parameter H19.00.

H19.110 Attribute value of position comparison 37

Comm. address:	2019-6Fh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved
bit7: DO1 output
bit8: DO2 output
bit9: DO3 output
bit10: DO4 output
bit11: DO5 output
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Description

Same as parameter H19.02.

H19.111 **Target value of position comparison 38**

Comm. address:	2019-70h	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
Description
Same as parameter H19.00.

H19.113 **Attribute value of position comparison 38**

Comm. address:	2019-72h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved
bit7: DO1 output
bit8: DO2 output
bit9: DO3 output
bit10: DO4 output
bit11: DO5 output
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output
Description
Same as parameter H19.02.

H19.114 **Target value of position comparison 39**

Comm. address:	2019-73h	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
Description
Same as parameter H19.00.

H19.116 **Attribute value of position comparison 39**

Comm. address:	2019-75h	Effective mode:	Real time
Min. value:	0	Unit:	-

Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved

bit7: DO1 output

bit8: DO2 output

bit9: DO3 output

bit10: DO4 output

bit11: DO5 output

bit12: Frequency-division A output

bit13: Frequency-division B output

bit14: Frequency-division Z output

bit15: Frequency-division OCZ output

Description

Same as parameter H19.02.

H19.117 **Target value of position comparison 40**

Comm. address:	2019-76h	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

Description

Same as parameter H19.00.

H19.119 **Attribute value of position comparison 40**

Comm. address:	2019-78h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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 to bit6: Reserved
bit7: DO1 output
bit8: DO2 output
bit9: DO3 output
bit10: DO4 output
bit11: DO5 output
bit12: Frequency-division A output
bit13: Frequency-division B output
bit14: Frequency-division Z output
bit15: Frequency-division OCZ output

Description

Same as parameter H19.02.

17.24 H1E Oscilloscope Variables

H1E.61 **Black box status**

Comm. address:	201E-3Eh	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

Description

-

H1E.69 **Sampling frequency**

Comm. address:	201E-46h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:

0 to 65535

Description

-

H1E.80 **Black box function mode**

Comm. address:	201E-51h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	1	Change mode:	Read-only

Value range:

0: Disable

1: Any fault

2: Designated fault

3: Triggered by designated condition

Description

Defines the condition for triggering black box sampling.

H1E.81 **Specified fault code**

Comm. address:	201E-52h	Effective mode:	-
Min. value:	0.0	Unit:	-
Max. value:	6553.5	Data type:	UInt16
Default value:	0.0	Change mode:	Read-only

Value range:

0.0 to 6553.5

Description

Defines the fault code for triggering the black box function.

H1E.82 **Trigger source**

Comm. address:	201E-53h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	22	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:

0 to 22

Description

Defines the fault code for triggering the black box function through the specified channel.

H1E.83 **Trigger level**

Comm. address:	201E-54h	Effective mode:	-
Min. value:	-2147483648	Unit:	-
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Value range:

-2147483648 to +2147483647

Description

Defines the trigger level for triggering the black box function through the specified channel.

H1E.85 **Trigger level selection**

Comm. address:	201E-56h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:

0: Rising edge

1: Equal

2: Falling edge

3: Edge-triggered

Description

Defines the mode for triggering the black box function through H0A.63.

H1E.86 **Trigger position**

Comm. address:	201E-57h	Effective mode:	-
Min. value:	0	Unit:	%
Max. value:	100	Data type:	UInt16
Default value:	75	Change mode:	Read-only

Value range:

0 to 100

Description

Defines the pre-trigger position for triggering black box sampling.

H1E.87 **Sampling frequency**

Comm. address:	201E-58h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:

0: Current loop

1: Position loop

2: Main cycle

Description

Defines the frequency sampling mode during black box sampling.

H1E.88 **Triggering offset calculation for the black box**

Comm. address:	201E-59h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:

0 to 65535

Description

Defines the waveform offset the moment when the black box is triggered.

H1E.89 **Pre-triggering the black box**

Comm. address:	201E-5Ah	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Description
Defines the pre-trigger position of the black box.

H1E.90 **Defines the servo operating time.**

Comm. address:	201E-5Bh	Effective mode:	-
Min. value:	0.0	Unit:	-
Max. value:	429496729.5	Data type:	UInt32
Default value:	0.0	Change mode:	Read-only

Value range:
0.0 to 429496729.5
Description
Defines the servo operating time.

H1E.92 **Black box log selected**

Comm. address:	201E-5Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	20	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 20
Description
Black box information mapped to fault log

H1E.93 **Black box information mapped to fault log**

Comm. address:	201E-5Eh	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	20	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 20
Description
Black box log selected

H1E.94 **Used to read black box logs.**

Comm. address:	201E-5Fh	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Description
Used to read black box logs.

17.25 H1F Software Tool Parameters

H1F.90 **DI function state 1 read through communication**

Comm. address:	201F-5Bh	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
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. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
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. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
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. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
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 state 1 read through communication**

Comm. address:	201F-5Fh	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
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 state 2 read through communication**

Comm. address:	201F-60h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Description
bit0 corresponds to DO function 17
bit1 corresponds to DO function 18
bit2 corresponds to DO function 19
...
By analogy

17.26 H21 Current Loop Gain Switchover Parameters

H21.00 **Current loop gain switchover enable**

Comm. address:	2021-01h	Effective mode:	Real time

Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0: Disable
1: Enable
Description
Used to enable or disable current loop gain switchover.
0: Disable
1: Enable

17.27 H22 Process Segment Parameters

H22.00 **Process segment command trigger**

Comm. address:	2022-01h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1000	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 1000
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) is reported when a value between 16 and 999 is 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
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
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. value:	0	Unit:	-
Max. value:	7	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value 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

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.

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

H22.04 Positive software limit

Comm. address:	2022-05h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32
Default value:	2147483647	Change mode:	Real time

Value range:

-2147483648 to +2147483647

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 limit

Comm. address:	2022-07h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32
Default value:	-2147483648	Change mode:	Real time

Value range:

-2147483648 to +2147483647

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. value:	0	Unit:	-

Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
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. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Description
bit0:
0: Keep interrupt positioning
state1: Exit interrupt positioning state when triggering technology segment

H22.10 **Process segment state**

Comm. address:	2022-0Bh	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
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. value:	0.1	Unit:	[mm/s]/[rpm]
Max. value:	6000.0	Data type:	UInt16
Default value:	50.0	Change mode:	Real time

Value range:
0.1 to 6000.0
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 excessively small in the positioning mode, the actual motor speed will be lower than the setpoint of H22.19.

H22.20 **Target speed setpoint 1**

Comm. address:	2022-15h	Effective mode:	Real time
Min. value:	0.1	Unit:	[mm/s]/[rpm]
Max. value:	6000.0	Data type:	UInt16
Default value:	200.0	Change mode:	Real time

Value range:
0.1 to 6000.0
Description
Same as parameter H22.19.

H22.21 **Target speed setpoint 2**

Comm. address:	2022-16h	Effective mode:	Real time
Min. value:	0.1	Unit:	[mm/s]/[rpm]
Max. value:	6000.0	Data type:	UInt16
Default value:	500.0	Change mode:	Real time

Value range:
0.1 to 6000.0
Description
Same as parameter H22.19.

H22.22 **Target speed setpoint 3**

Comm. address:	2022-17h	Effective mode:	Real time
Min. value:	0.1	Unit:	[mm/s]/[rpm]
Max. value:	6000.0	Data type:	UInt16
Default value:	1000.0	Change mode:	Real time

Value range:
0.1 to 6000.0
Description
Same as parameter H22.19.

H22.23 **Target speed setpoint 4**

Comm. address:	2022-18h	Effective mode:	Real time
Min. value:	0.1	Unit:	[mm/s]/[rpm]
Max. value:	6000.0	Data type:	UInt16
Default value:	1500.0	Change mode:	Real time

Value range:
0.1 to 6000.0
Description
Same as parameter H22.19.

H22.24 **Target speed setpoint 5**

Comm. address:	2022-19h	Effective mode:	Real time
Min. value:	0.1	Unit:	[mm/s]/[rpm]
Max. value:	6000.0	Data type:	UInt16
Default value:	2000.0	Change mode:	Real time

Value range:
0.1 to 6000.0
Description
Same as parameter H22.19.

H22.25 **Target speed setpoint 6**

Comm. address:	2022-1Ah	Effective mode:	Real time
Min. value:	0.1	Unit:	[mm/s]/[rpm]
Max. value:	6000.0	Data type:	UInt16
Default value:	2500.0	Change mode:	Real time

Value range:
0.1 to 6000.0
Description
Same as parameter H22.19.

H22.26 **Target speed 7**

Comm. address:	2022-1Bh	Effective mode:	Real time
Min. value:	0.1	Unit:	[mm/s]/[rpm]
Max. value:	6000.0	Data type:	UInt16
Default value:	3000.0	Change mode:	Real time

Value range:
0.1 to 6000.0
Description
Same as parameter H22.19.

H22.35 **Acceleration/Deceleration time**

Comm. address:	2022-24h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	50	Change mode:	Real time

Value range:
0 to 65535
Description
Eight groups of acceleration/deceleration time are available for each process segment command.
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.

H22.36 **Acceleration/Deceleration time 1**

Comm. address:	2022-25h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	200	Change mode:	Real time

Value range:
0 to 65535
Description
Same as parameter H22.35.

H22.37 **Acceleration/Deceleration time 2**

Comm. address:	2022-26h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	500	Change mode:	Real time

Value range:
0 to 65535
Description
Same as parameter H22.35.

H22.38 **Acceleration/Deceleration time 3**

Comm. address:	2022-27h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	1000	Change mode:	Real time

Value range:
0 to 65535
Description
Same as parameter H22.35.

H22.39 **Acceleration/Deceleration time 4**

Comm. address:	2022-28h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	1500	Change mode:	Real time

Value range:
0 to 65535
Description
Same as parameter H22.35.

H22.40 **Acceleration/Deceleration time 5**

Comm. address:	2022-29h	Effective mode:	Real time
Min. value:	0	Unit:	ms

Max. value:	65535	Data type:	UInt16
Default value:	2000	Change mode:	Real time

Value range:
0 to 65535
Description
Same as parameter H22.35.

H22.41 Acceleration/Deceleration time 6

Comm. address:	2022-2Ah	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	2500	Change mode:	Real time

Value range:
0 to 65535
Description
Same as parameter H22.35.

H22.42 Acceleration/Deceleration time 7

Comm. address:	2022-2Bh	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	3000	Change mode:	Real time

Value range:
0 to 65535
Description
Same as parameter H22.35.

H22.51 Delay after completion of the process segment

Comm. address:	2022-34h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 65535
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 the current command to the operation of the next command in the process segment. For details, see "Process segment mode" in the user guide.

H22.52 Delay 1 after completion of the process segment

Comm. address:	2022-35h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16

Default value:	50	Change mode:	Real time

Value range:
0 to 65535
Description
Same as parameter H22.51

H22.53 **Delay time 2 after completion of the process segment**

Comm. address:	2022-36h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	200	Change mode:	Real time

Value range:
0 to 65535
Description
Same as parameter H22.51

H22.54 **Delay time 3 after completion of the process segment**

Comm. address:	2022-37h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	500	Change mode:	Real time

Value range:
0 to 65535
Description
Same as parameter H22.51

H22.55 **Delay time 4 after completion of the process segment**

Comm. address:	2022-38h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	1000	Change mode:	Real time

Value range:
0 to 65535
Description
Same as parameter H22.51

H22.56 **Delay time 5 after completion of the process segment**

Comm. address:	2022-39h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	1500	Change mode:	Real time

Value range:
0 to 65535

Description
Same as parameter H22.51

H22.57 **Delay time 6 after completion of the process segment**

Comm. address:	2022-3Ah	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	2000	Change mode:	Real time

Value range:
0 to 65535
Description
Same as parameter H22.51

H22.58 **Delay time 7 after completion of the process segment**

Comm. address:	2022-3Bh	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	3000	Change mode:	Real time

Value range:
0 to 65535
Description
Same as parameter 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

Value range:
-32768 to +32767
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 to 35). See section "Homing Function" 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" for details.

H22.71 **Speed in high-speed searching for home switch signal**

Comm. address:	2022-48h	Effective mode:	Real time
Min. value:	0	Unit:	[mm/s]/[rpm]
Max. value:	3000	Data type:	UInt16
Default value:	100	Change mode:	Real time

Value range:
0 to 3000

Description
Defines the motor speed for searching for the deceleration point signal during homing.

H22.72 **Speed in low-speed searching for home switch signal**

Comm. address:	2022-49h	Effective mode:	Real time
Min. value:	0	Unit:	[mm/s]/[rpm]
Max. value:	1000	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 1000
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. value:	0	Unit:	ms
Max. value:	1000	Data type:	UInt16
Default value:	1000	Change mode:	Real time

Value range:
0 to 1000
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. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	10000	Change mode:	Real time

Value range:
0 to 65535
Description
Defines the maximum time for searching the home.

H22.75 **Mechanical home offset**

Comm. address:	2022-4Ch	Effective mode:	Real time
Min. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Value range:
-2147483648 to +2147483647
Description
Defines the absolute position of the motor after homing.

H22.79 **Relative/Absolute homing**

Comm. address:	2022-50h	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
Description
Defines the offset relationship between the mechanical home and mechanical zero, 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. value:	0	Unit:	-
Max. value:	65534	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 65534
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 "Process segment mode" in the user guide.

H22.84 **Jump count threshold 1**

Comm. address:	2022-55h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65534	Data type:	UInt16
Default value:	20	Change mode:	Real time

Value range:
0 to 65534
Description
Same as parameter H22.83.

H22.85 **Jump judgment count 2**

Comm. address:	2022-56h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65534	Data type:	UInt16
Default value:	40	Change mode:	Real time

Value range:
0 to 65534

Description
Same as parameter H22.83.

H22.86 Jump judgment count 3

Comm. address:	2022-57h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65534	Data type:	UInt16
Default value:	80	Change mode:	Real time

Value range:
0 to 65534
Description
Same as parameter H22.83.

H22.87 Jump judgment count 4

Comm. address:	2022-58h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65534	Data type:	UInt16
Default value:	160	Change mode:	Real time

Value range:
0 to 65534
Description
Same as parameter H22.83.

H22.88 Jump judgment count 5

Comm. address:	2022-59h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65534	Data type:	UInt16
Default value:	320	Change mode:	Real time

Value range:
0 to 65534
Description
Same as parameter H22.83.

H22.89 Jump judgment count 6

Comm. address:	2022-5Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65534	Data type:	UInt16
Default value:	640	Change mode:	Real time

Value range:
0 to 65534
Description
Same as parameter H22.83.

H22.90 **Jump judgment count 7**

Comm. address:	2022-5Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65534	Data type:	UInt16
Default value:	1280	Change mode:	Real time

Value range:
0 to 65534
Description
Same as parameter H22.83.

17.28 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
Description
For details, see the description of homing methods in each process segment mode.

H23.02 **Homing data**

Comm. address:	2023-03h	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
Description
Not in use.

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
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.
For details about the functions in each mode, see the description of each process segment mode in "Process Segment Mode".

H23.06 **Data of process segment 1**

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
Description
Different modes selected in process segment 1 correspond to different process segment data. For details, see the description of each process segment mode in "Process Segment Mode".

H23.08 **Definition of process segment 2**

Comm. address:	2023-09h	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
Description
Same as segment 1.

H23.10 **Data of process segment 2**

Comm. address:	2023-0Bh	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
Description
Same as segment 1.

H23.12 **Definition of process segment 3**

Comm. address:	2023-0Dh	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
Description
Same as segment 1.

H23.14 **Data of process segment 3**

Comm. address:	2023-0Fh	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
Description
Same as segment 1.

H23.16 **Definition of process segment 4**

Comm. address:	2023-11h	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
Description
Same as segment 1.

H23.18 **Data of process segment 4**

Comm. address:	2023-13h	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
Description
Same as segment 1.

H23.20 **Definition of process segment 5**

Comm. address:	2023-15h	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
Description
Same as segment 1.

H23.22 **Data of process segment 5**

Comm. address:	2023-17h	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
Description
Same as segment 1.

H23.24 **Definition of process segment 6**

Comm. address:	2023-19h	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
Description
Same as segment 1.

H23.26 **Data of process segment 6**

Comm. address:	2023-1Bh	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
Description
Same as segment 1.

H23.28 **Definition of process segment 7**

Comm. address:	2023-1Dh	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
Description
Same as segment 1.

H23.30 **Data of process segment 7**

Comm. address:	2023-1Fh	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
Description
Same as segment 1.

H23.32 **Definition of process segment 8**

Comm. address:	2023-21h	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
Description
Same as segment 1.

H23.34 **Data of process segment 8**

Comm. address:	2023-23h	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
Description
Same as segment 1.

H23.36 **Definition of process segment 9**

Comm. address:	2023-25h	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
Description
Same as segment 1.

H23.38 **Data of process segment 9**

Comm. address:	2023-27h	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

Description

Same as segment 1.

H23.40 **Definition of process segment 10**

Comm. address:	2023-29h	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

Description

Same as segment 1.

H23.42 **Data of process segment 10**

Comm. address:	2023-2Bh	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

Description

Same as segment 1.

H23.44 **Definition of process segment 11**

Comm. address:	2023-2Dh	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

Description

Same as segment 1.

H23.46 **Data of process segment 11**

Comm. address:	2023-2Fh	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

Description

Same as segment 1.

H23.48 **Definition of process segment 12**

Comm. address:	2023-31h	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
Description
Same as segment 1.

H23.50 **Data of process segment 12**

Comm. address:	2023-33h	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
Description
Same as segment 1.

H23.52 **Definition of process segment 13**

Comm. address:	2023-35h	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
Description
Same as segment 1.

H23.54 **Data of process segment 13**

Comm. address:	2023-37h	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
Description
Same as segment 1.

H23.56 **Definition of process segment 14**

Comm. address:	2023-39h	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
Description
Same as segment 1.

H23.58 **Data of process segment 14**

Comm. address:	2023-3Bh	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
Description
Same as segment 1.

H23.60 **Definition of process segment 15**

Comm. address:	2023-3Dh	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
Description
Same as segment 1.

H23.62 **Data of process segment 15**

Comm. address:	2023-3Fh	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
Description
Same as segment 1.

17.29 H30 Variables Read Through Communication

H30.00 **Servo state read through communication**

Comm. address:	2030-01h	Effective mode:	-
Min. value:	0	Unit:	-

Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Description
Displays the current operating state of the servo for interaction with the background.

H30.01 **DO function state 1 read through communication**

Comm. address:	2030-02h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
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 state 2 read through communication**

Comm. address:	2030-03h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Description
bit0 corresponds to DO function 17
bit1 corresponds to DO function 18
bit2 corresponds to DO function 19
...
By analogy

H30.03 **Input pulse reference sampling value read through communication**

Comm. address:	2030-04h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Description
Displays the input pulse reference sampling value.

H30.12 **1st encoder accumulative communication timeout upon occurrence of the selected fault**

Comm. address:	2030-0Dh	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Description
Displays the communication timeout count of the 1st encoder upon the selected fault.

H30.13 **1st encoder accumulative communication CRC or frame stop errors upon occurrence of the selected fault**

Comm. address:	2030-0Eh	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Description
Displays the number of 1st encoder communication CRC errors upon occurrence of the selected fault.

H30.14 **1st encoder rising-edge triggered communication timeouts upon occurrence of the selected fault**

Comm. address:	2030-0Fh	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	255	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 255
Description
Displays the number of 1st encoder rising-edge triggered communication timeouts upon occurrence of the selected fault.

H30.15 **Drive 5 V voltage monitoring value upon occurrence of the selected fault**

Comm. address:	2030-10h	Effective mode:	-
Min. value:	0.00	Unit:	V
Max. value:	655.35	Data type:	UInt16
Default value:	0.00	Change mode:	Read-only

Value range:
0.00 to 655.35
Description
Displays the drive internal 5 V voltage monitoring value upon the occurrence of the selected fault.

H30.16 **1St encoder accumulative communication timeout**

Comm. address:	2030-11h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Description
Records the number of timeout errors in primary encoder communication upon power-on.

H30.17 **1st encoder accumulative communication CRC or frame stop errors**

Comm. address:	2030-12h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Description
Records the number of communication CRC check errors of the primary encoder upon power-on.

H30.18 **Peak value among 1st encoder consecutive communication timeouts**

Comm. address:	2030-13h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Description
Defines the maximum value of timeout error during communication of the primary encoder.

H30.28 **1st encoder rising-edge triggered communication timeouts**

Comm. address:	2030-1Dh	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Description
Records the number of 1st encoder rising-edge triggered communication timeouts upon the current power-on.

H30.29 **Drive 5 V voltage monitoring value**

Comm. address:	2030-1Eh	Effective mode:	-

Min. value:	0.00	Unit:	V
Max. value:	655.35	Data type:	UInt16
Default value:	0.00	Change mode:	Read-only

Value range:
0.00 to 655.35
Description
Displays the drive internal 5 V voltage monitoring value.

17.30 H31 References Set Through Communication

H31.00 **VDI virtual level set through communication**

Comm. address:	2031-01h	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
Description
When H17.90 is set to 1, the VDI state is defined by this parameter.
The VDI logic is determined by H17.91 (Default VDI virtual level value upon power-on) upon initial power-on. Thereafter, the VDI logic is determined by H31.00.
"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. value:	0	Unit:	Hz
Max. value:	16000000	Data type:	UInt32
Default value:	0	Change mode:	Real time

Value range:
0 to 16000000
Description
When H05.38 is set to 4, H31.01 defines the frequency (quadrature multiplication) of the frequency-division output port.

H31.04 **DO state set through communication**

Comm. address:	2031-05h	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

Description
You can set this parameter as the DO output status source through H04.22.

H31.05 **AO status set through communication**

Comm. address:	2031-06h	Effective mode:	Real time
Min. value:	-10000	Unit:	mV
Max. value:	10000	Data type:	Int16
Default value:	0	Change mode:	Real time

Value range:
-10000 to 10000
Description
Set H04.50 to 10 to define H31.05 as the source of AO (unit: mV).

H31.09 **Speed reference set through communication**

Comm. address:	2031-0Ah	Effective mode:	Real time
Min. value:	-9999.000	Unit:	[mm/s]/[rpm]
Max. value:	9999.000	Data type:	Int32
Default value:	0.000	Change mode:	Real time

Value range:
-9999.000 to 9999.000
Description
Set H06.02 to 4 to define the speed reference in 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. value:	-100.000	Unit:	%
Max. value:	100.000	Data type:	Int32
Default value:	0.000	Change mode:	Real time

Value range:
-100.000 to 100.000
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.

17.31 H32 Direct Drive Parameters

H32.00 **Encoder interpolater mismatch alarm (E124)**

Comm. address:	2032-01h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	1	Change mode:	At stop

Value range:

0: Disable

1: Enable

Description

The T2 interpolator matches the HipFace 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. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0: Default encoder interface

1: Switching the encoder interface

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. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0: Disable

1: Enable

Description

Angle auto-tuning starts after the drive switches to the rdy state and the time defined by H32.41 elapses.

0: Disable

1: Enable

H32.03 **Angle auto-tuning switch controlled by control word**

Comm. address:	2032-04h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0: Disable

1: Control word 6

2: Control word 7

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:
bit1: E602.9
Description
When angle auto-tuning is not performed on the incremental encoder, the related alarm is generated based on the setting.
bit1: E602.9

H32.05 **Pre-positioning retract enable**

Comm. address:	2032-06h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0: Disable
1: Enable
Description
After this function is enabled, the drive retracts a certain distance after angle auto-tuning through pre-positioning is done.
0: Disable
1: Enable

H32.06 **Position feedback processing enable**

Comm. address:	2032-07h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0: Disable
1: Enable
Description
Used to align the position feedback to the position before angle auto-tuning for incremental encoders.
0: Disable
1: Enable

H32.07 **Incremental homing mode**

Comm. address:	2032-08h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	9	Data type:	UInt16
Default value:	1	Change mode:	At stop

Value range:

0: Z signal short-circuited

1: Short-circuited only at the first time

Description

Incremental communication encoder, Z signal selection upon homing

0: Z signal short-circuited

1: Position latched after the first short circuit

Note: The Z signal width needs to be set by H3208.

H32.08 **Homing signal width**

Comm. address:	2032-09h	Effective mode:	Real time
Min. value:	100	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	800	Change mode:	At stop

Value range:

100 to 65535

Description

The setpoint is active after the position is latched by Z signal.

H32.10 **Max. reference current in angle auto-tuning through inching**

Comm. address:	2032-0Bh	Effective mode:	At stop
Min. value:	10.0	Unit:	%
Max. value:	300.0	Data type:	UInt16
Default value:	100.0	Change mode:	At stop

Value range:

10.0 to 300.0

Description

Defines the maximum reference current during auto-tuning.

H32.13 **Threshold for motor rotation in angle auto-tuning through inching (ROT/DDR)**

Comm. address:	2032-0Eh	Effective mode:	At stop
Min. value:	0.001	Unit:	deg
Max. value:	20.000	Data type:	UInt16
Default value:	0.200	Change mode:	At stop

Value range:

0.001 to 20.000

Description

Defines the threshold for rotation during auto-tuning.
The default value applies to most scenarios. Modify this parameter accordingly when a specific motion amplitude is required. The lower the setpoint, the smaller the motor rotation during auto-tuning, but an excessively low setpoint may lead to increased 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. value:	0.1	Unit:	[mm/s]/[rpm]
Max. value:	100.0	Data type:	UInt16
Default value:	1.0	Change mode:	At stop

Value range:
0.1 to 100.0
Description
Defines the threshold for determining whether the motor is at a standstill during auto-tuning.
The default value applies to most scenarios.

H32.15 Motor action threshold (DDL) in angle auto-tuning through inching

Comm. address:	2032-10h	Effective mode:	At stop
Min. value:	0.001	Unit:	mm
Max. value:	20.000	Data type:	UInt16
Default value:	0.200	Change mode:	At stop

Value range:
0.001 to 20.000
Description
Defines the threshold for rotation during auto-tuning.
The default value applies to most scenarios. Modify this parameter accordingly when a specific motion amplitude is required. The lower the setpoint, the smaller the motor rotation during auto-tuning, but an excessively low setpoint may lead to increased auto-tuning error.

H32.16 Motor standstill threshold (DDL) in angle auto-tuning through inching

Comm. address:	2032-11h	Effective mode:	At stop
Min. value:	0.1	Unit:	mm/s
Max. value:	100.0	Data type:	UInt16
Default value:	1.0	Change mode:	At stop

Value range:
0.1 to 100.0
Description
Defines the threshold for determining whether the motor is at a standstill during auto-tuning.
The default value applies to most scenarios.

H32.18 Motor standstill threshold in angle auto-tuning through inching

Comm. address:	2032-13h	Effective mode:	At stop
Min. value:	0.1	Unit:	s
Max. value:	10.0	Data type:	UInt16

Default value:	1.0	Change mode:	At stop

Value range:
0.1 to 10.0
Description
Defines the threshold for determining whether the motor is at a standstill during auto-tuning.
The default value applies to most scenarios.

H32.20 Max. reference current in angle auto-tuning through pre-positioning (closed-loop)

Comm. address:	2032-15h	Effective mode:	At stop
Min. value:	10.0	Unit:	%
Max. value:	300.0	Data type:	UInt16
Default value:	100.0	Change mode:	At stop

Value range:
10.0 to 300.0
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. value:	0.0	Unit:	deg
Max. value:	360.0	Data type:	UInt16
Default value:	0.0	Change mode:	At stop

Value range:
0.0 to 360.0
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. value:	10.0	Unit:	deg
Max. value:	170.0	Data type:	UInt16
Default value:	90.0	Change mode:	At stop

Value range:
10.0 to 170.0
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. value:	0.1	Unit:	[mm/s]/[rpm]
Max. value:	100.0	Data type:	UInt16
Default value:	1.0	Change mode:	At stop

Value range:
0.1 to 100.0
Description
Defines the threshold for determining whether the motor is at a standstill during auto-tuning. The default value applies to most scenarios.

H32.25 **Motor stop threshold (DDL) in angle auto-tuning through pre-positioning (closed-loop)**

Comm. address:	2032-1Ah	Effective mode:	At stop
Min. value:	0.1	Unit:	mm/s
Max. value:	100.0	Data type:	UInt16
Default value:	1.0	Change mode:	At stop

Value range:
0.1 to 100.0
Description
Defines the threshold for determining whether the motor is at a standstill during auto-tuning. The default value applies to most scenarios.

H32.26 **Damping in angle auto-tuning through pre-positioning (closed-loop)**

Comm. address:	2032-1Bh	Effective mode:	At stop
Min. value:	0.00	Unit:	[N/(m/s)]/[N·m/rpm]
Max. value:	655.35	Data type:	UInt16
Default value:	0.00	Change mode:	At stop

Value range:
0.00 to 655.35
Description
Defines the motor auto-tuning action damping coefficient. A proper coefficient allows a smooth action process without shock.
1. The setpoint is related to the load characteristics. The higher the load, the higher the coefficient must be.
2. Violent shock 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. value:	0.1	Unit:	s
Max. value:	10.0	Data type:	UInt16
Default value:	0.5	Change mode:	At stop

Value range:
0.1 to 10.0
Description
Defines the threshold for determining whether the motor is at a standstill during auto-tuning. The default value applies to most scenarios.

H32.30 **Max. reference current in angle auto-tuning through position lock**

Comm. address:	2032-1Fh	Effective mode:	At stop
Min. value:	10.0	Unit:	%
Max. value:	300.0	Data type:	UInt16
Default value:	100.0	Change mode:	At stop

Value range:
10.0 to 300.0
Description
Defines the maximum reference current 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. value:	0.001	Unit:	deg
Max. value:	20.000	Data type:	UInt16
Default value:	0.200	Change mode:	At stop

Value range:
0.001 to 20.000
Description
Defines the threshold for rotation during auto-tuning.
The default value applies to most scenarios. Modify this parameter accordingly when a specific motion amplitude is required. The lower the setpoint, the smaller the motor rotation during auto-tuning, but an excessively low setpoint may lead to increased 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. value:	0.1	Unit:	[mm/s]/[rpm]
Max. value:	100.0	Data type:	UInt16
Default value:	1.0	Change mode:	At stop

Value range:
0.1 to 100.0
Description
Defines the threshold for determining whether the motor is at a standstill during auto-tuning.
The default value applies to most scenarios.

H32.35 **Motor action threshold (DDL) in angle auto-tuning through position lock**

Comm. address:	2032-24h	Effective mode:	At stop
Min. value:	0.001	Unit:	mm
Max. value:	20.000	Data type:	UInt16
Default value:	0.200	Change mode:	At stop

Value range:
0.001 to 20.000
Description

Defines the threshold for rotation during auto-tuning.
The default value applies to most scenarios. Modify this parameter accordingly when a specific motion amplitude is required. The lower the setpoint, the smaller the motor rotation during auto-tuning, but an excessively low setpoint may lead to increased 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. value:	0.1	Unit:	mm/s
Max. value:	100.0	Data type:	UInt16
Default value:	1.0	Change mode:	At stop

Value range:
0.1 to 100.0
Description
Defines the threshold for determining whether the motor is at a standstill during auto-tuning.
The default value applies to most scenarios.

H32.37 Angle gain in angle auto-tuning through position lock

Comm. address:	2032-26h	Effective mode:	At stop
Min. value:	0	Unit:	deg/(p/s)
Max. value:	10000	Data type:	UInt16
Default value:	1000	Change mode:	At stop

Value range:
0 to 10000
Description
Defines the angle gain during auto-tuning. A proper setpoint can improve the auto-tuning accuracy. The default value applies to most applications.

H32.38 Inertia ratio in angle auto-tuning through position lock

Comm. address:	2032-27h	Effective mode:	At stop
Min. value:	0.00	Unit:	-
Max. value:	120.00	Data type:	UInt16
Default value:	0.00	Change mode:	At stop

Value range:
0.00 to 120.00
Description
Defines the inertia ratio gain during auto-tuning. A proper setpoint ensures a smooth and jitter-free auto-tuning process and reduces the auto-tuning action range.
1. The setpoint is related to the load characteristics. The actual inertia ratio applies to most applications.
2. An excessively low setpoint can lead to a large movement value during auto-tuning, which is normal. An excessively high setpoint can lead to oscillation caused by gain mismatch.

H32.39 Gain class in angle auto-tuning through position lock

Comm. address:	2032-28h	Effective mode:	At stop

Min. value:	4	Unit:	level
Max. value:	31	Data type:	UInt16
Default value:	12	Change mode:	At stop

Value range:
4 to 31
Description
Defines the gain level of the loop used in 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. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
1. Left limit being positive limit
2. Left limit being negative limit
Description
Motors with left and right limits are supported. After the parameter is set, the left and right limit is enabled.
1. Left limit being positive limit
2. Left limit being negative limit

H32.41 **Angle auto-tuning delay upon power-on**

Comm. address:	2032-2Ah	Effective mode:	Real time
Min. value:	0	Unit:	s
Max. value:	65535	Data type:	UInt16
Default value:	3	Change mode:	Real time

Value range:
0 to 65535
Description
Defines the automatic angle auto-tuning delay upon power-on.

H32.45 **Black box channel 21 function**

Comm. address:	2032-2Eh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0: Real-time target position (607Ah)
1: Electrical angle
Description

Used to switch the function of the black box monitoring channel 21.
0: Real-time target position (607Ah)
1: Electrical angle

H32.50 32-bit range compatibility enable

Comm. address:	2032-33h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	99	Data type:	UInt16
Default value:	1	Change mode:	At stop

Value range:
0 to 99
Description
32-bit range processing enable

H32.51 Hall auto-tuning mode

Comm. address:	2032-34h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0: Open-loop Hall auto-tuning
1: Closed-loop Hall auto-tuning
Description
Defines the Hall auto-tuning mode.

H32.52 Maximum current for Hall auto-tuning

Comm. address:	2032-35h	Effective mode:	Real time
Min. value:	10	Unit:	%
Max. value:	300	Data type:	UInt16
Default value:	100	Change mode:	At stop

Value range:
10 to 300
Description
Defines the maximum auto-tuning current of 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. value:	0.1	Unit:	s
Max. value:	10.0	Data type:	UInt16
Default value:	1.0	Change mode:	At stop

Value range:
0.1 to 10.0

Description
Defines the threshold for determining whether the motor is at a standstill during auto-tuning. The default value applies to most scenarios.

H32.54 Hall auto-tuning selection

Comm. address:	2032-37h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
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. value:	0	Unit:	-
Max. value:	7	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 7
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. value:	0	Unit:	ms
Max. value:	10	Data type:	UInt16
Default value:	5	Change mode:	Real time

Value range:
0 to 10
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. value:	0	Unit:	[mm/s]/[rpm]
Max. value:	65535	Data type:	UInt16
Default value:	2	Change mode:	At stop

Value range:
0 to 65535

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. value:	0.0	Unit:	%
Max. value:	300.0	Data type:	UInt16
Default value:	120.0	Change mode:	At stop

Value range:
0.0 to 300.0
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. value:	0	Unit:	ms
Max. value:	2000	Data type:	UInt16
Default value:	10	Change mode:	At stop

Value range:
0 to 2000
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. value:	0.00	Unit:	-
Max. value:	120.00	Data type:	UInt16
Default value:	0.00	Change mode:	At stop

Value range:
0.00 to 120.00
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. value:	4	Unit:	-
Max. value:	31	Data type:	UInt16
Default value:	12	Change mode:	At stop

Value range:
4 to 31

Description
Defines the stiffness level of Hall position closed-loop angle auto-tuning.

H32.62 **Electrical angle save flag**

Comm. address:	2032-3Fh	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
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. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
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. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
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. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535

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. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
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. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
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. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
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. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0: Internal motor overload curve

1: External motor overload curve

2: Current limit overload protection

3: Hide motor overload protection

Description

Defines the motor overload protection mode.

0: Internal motor overload curve

1: External motor overload curve

2: Current limit overload protection

3: Hide motor overload protection

H32.73 Overload current limit thermal threshold current

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

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. value:	100.0	Unit:	%
Max. value:	750.0	Data type:	UInt16
Default value:	300.0	Change mode:	At stop

Value range:

100.0 to 750.0

Description

Defines the ratio of the peak current that can be reached by the motor to the rated current of the motor.

H32.75 Max. current duration of overload protection

Comm. address:	2032-4Ch	Effective mode:	Real time
Min. value:	0.01	Unit:	s
Max. value:	655.35	Data type:	UInt16
Default value:	1.00	Change mode:	At stop

Value range:

0.01 to 655.35

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. value:	0.01	Unit:	-
Max. value:	655.35	Data type:	UInt16
Default value:	1.00	Change mode:	At stop

Value range:

0.01 to 655.35

Description

It is related to the maximum duration of the maximum current. The higher the setpoint, the longer the duration can be.

H32.77 Current limit alarm threshold of overload protection

Comm. address:	2032-4Eh	Effective mode:	Real time
Min. value:	0.0	Unit:	%
Max. value:	750.0	Data type:	UInt16
Default value:	0.0	Change mode:	At stop

Value range:

0.0 to 750.0

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. value:	0.0	Unit:	%
Max. value:	750.0	Data type:	UInt16
Default value:	0.0	Change mode:	At stop

Value range:

0.0 to 750.0

Description

A fault can 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. 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

Description

Defines the thermal threshold current of overload.

H32.80 **Overload heating current interval**

Comm. address:	2032-51h	Effective mode:	Next power-on
Min. value:	0.1	Unit:	%
Max. value:	204.8	Data type:	UInt16
Default value:	6.4	Change mode:	At stop

Value range:
0.1 to 204.8
Description
Defines the overload heating current interval.

H32.81 **Overload cooling current interval**

Comm. address:	2032-52h	Effective mode:	Next power-on
Min. value:	0.1	Unit:	%
Max. value:	204.8	Data type:	UInt16
Default value:	6.4	Change mode:	At stop

Value range:
0.1 to 204.8
Description
Defines the overload cooling current interval.

H32.82 **Overload heating curve length**

Comm. address:	2032-53h	Effective mode:	Next power-on
Min. value:	1	Unit:	-
Max. value:	200	Data type:	UInt16
Default value:	1	Change mode:	At stop

Value range:
1 to 200
Description
Defines the overload heating curve length.

H32.83 **Overload cooling curve length**

Comm. address:	2032-54h	Effective mode:	Next power-on
Min. value:	1	Unit:	-
Max. value:	200	Data type:	UInt16
Default value:	1	Change mode:	At stop

Value range:
1 to 200
Description
Defines the overload cooling curve length.

17.32 H33 Compensation Parameters

H33.00 **Compensation data BUFFER0**

Comm. address:	2033-01h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Description
Defines the compensation data BUFFER0.

H33.01 **Compensation data BUFFER 1**

Comm. address:	2033-02h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Description
Defines the compensation data BUFFER 1.

H33.02 **Compensation data BUFFER 2**

Comm. address:	2033-03h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Description
Defines the compensation data BUFFER2.

H33.03 **Compensation data BUFFER3**

Comm. address:	2033-04h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Description
Defines the compensation data BUFFER3.

H33.04 **Compensation data BUFFER4**

Comm. address:	2033-05h	Effective mode:	Real time

Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Description
Defines the compensation data BUFFER4.

H33.05 **Compensation data BUFFER5**

Comm. address:	2033-06h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Description
Defines the compensation data BUFFER5.

H33.06 **Compensation data BUFFER6**

Comm. address:	2033-07h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Description
Defines the compensation data BUFFER6.

H33.07 **Compensation data BUFFER 7**

Comm. address:	2033-08h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Description
Defines the compensation data BUFFER7.

H33.08 **Compensation data BUFFER 8**

Comm. address:	2033-09h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Description
Defines the compensation data BUFFER8.

H33.09 **Compensation data BUFFER 9**

Comm. address:	2033-0Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Description
Defines the compensation data BUFFER9.

H33.10 **Compensation data BUFFER 10**

Comm. address:	2033-0Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Description
Defines the compensation data BUFFER10.

H33.11 **Compensation data BUFFER 11**

Comm. address:	2033-0Ch	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Description
Defines the compensation data BUFFER11.

H33.12 **Compensation data BUFFER 12**

Comm. address:	2033-0Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Description
Defines the compensation data BUFFER12.

H33.13 **Compensation data BUFFER 13**

Comm. address:	2033-0Eh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Description
Defines the compensation data BUFFER13.

H33.14 **Compensation data BUFFER 14**

Comm. address:	2033-0Fh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Description
Defines the compensation data BUFFER14

H33.15 **Compensation data BUFFER 15**

Comm. address:	2033-10h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Description
Defines the compensation data BUFFER15.

H33.16 **Compensation data BUFFER 16**

Comm. address:	2033-11h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Description
Defines the compensation data BUFFER16.

H33.17 **Compensation data BUFFER 17**

Comm. address:	2033-12h	Effective mode:	Real time
Min. value:	0	Unit:	-

Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Description
Defines the compensation data BUFFER17.

H33.18 Compensation data BUFFER 18

Comm. address:	2033-13h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Description
Defines the compensation data BUFFER18.

H33.19 Compensation data BUFFER 19

Comm. address:	2033-14h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Description
Defines the compensation data BUFFER19.

H33.20 Compensation data BUFFER 20

Comm. address:	2033-15h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Description
Defines the compensation data BUFFER20.

H33.21 Compensation data BUFFER 21

Comm. address:	2033-16h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0 to 65535

Description

Defines the compensation data BUFFER21.

H33.22 Compensation data BUFFER 22

Comm. address:	2033-17h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0 to 65535

Description

Defines the compensation data BUFFER22.

H33.23 Compensation data BUFFER 23

Comm. address:	2033-18h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0 to 65535

Description

Defines the compensation data BUFFER23.

H33.24 Compensation data BUFFER 24

Comm. address:	2033-19h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0 to 65535

Description

Defines the compensation data BUFFER24.

H33.25 Compensation data BUFFER 25

Comm. address:	2033-1Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0 to 65535

Description

Defines the compensation data BUFFER25.

H33.26 **Compensation data BUFFER 26**

Comm. address:	2033-1Bh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Description
Defines the compensation data BUFFER26.

H33.27 **Compensation data BUFFER 27**

Comm. address:	2033-1Ch	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Description
Defines the compensation data BUFFER27.

H33.28 **Compensation data BUFFER 28**

Comm. address:	2033-1Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Description
Defines the compensation data BUFFER28.

H33.29 **Compensation data BUFFER 29**

Comm. address:	2033-1Eh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Description
Defines the compensation data BUFFER29.

H33.30 **Compensation data BUFFER 30**

Comm. address:	2033-1Fh	Effective mode:	Real time
Min. value:	0	Unit:	-

Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Description
Defines the compensation data BUFFER30.

H33.31 Compensation data BUFFER 31

Comm. address:	2033-20h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Description
Defines the compensation data BUFFER31.

H33.32 Compensation data BUFFER 32

Comm. address:	2033-21h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Description
Defines the compensation data BUFFER32.

H33.33 Compensation data BUFFER 33

Comm. address:	2033-22h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Description
Defines the compensation data BUFFER33.

H33.34 Compensation data BUFFER 34

Comm. address:	2033-23h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0 to 65535

Description

Defines the compensation data BUFFER34.

H33.35 **Compensation data BUFFER 35**

Comm. address:	2033-24h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0 to 65535

Description

Defines the compensation data BUFFER35.

H33.36 **Compensation data BUFFER 36**

Comm. address:	2033-25h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0 to 65535

Description

Defines the compensation data BUFFER36.

H33.37 **Compensation data BUFFER 37**

Comm. address:	2033-26h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0 to 65535

Description

Defines the compensation data BUFFER37.

H33.38 **Compensation data BUFFER 38**

Comm. address:	2033-27h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0 to 65535

Description

Defines the compensation data BUFFER38.

H33.39 **Compensation data BUFFER 39**

Comm. address:	2033-28h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Description
Defines the compensation data BUFFER39.

H33.40 **Current compensation BUFFER group number**

Comm. address:	2033-29h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 65535
Description
Current compensation BUFFER group number

H33.41 **Compensation data count**

Comm. address:	2033-2Ah	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	32767	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 32767
Description
Defines the compensation data count.

H33.44 **Data command**

Comm. address:	2033-2Dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	1	Change mode:	At stop

Value range:
0 to 1
Description
Sets the data command.

H33.45 **Data storage position**

Comm. address:	2033-2Eh	Effective mode:	Real time
Min. value:	0	Unit:	-

Max. value:	2	Data type:	UInt16
Default value:	1	Change mode:	At stop

Value range:
0: Servo RAM
1: Servo FLASH
2: Encoder FLASH
Description
Defines the 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. value:	0	Unit:	-
Max. value:	3	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 3
Description
Sets the data clear function.

H33.47 **Software tool writing status**

Comm. address:	2033-30h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 2
Description
Displays the write status of the software tool. 0: Idle; 1: Writing BUFFER; 2: Writing BUFFER completed.

H33.48 **Servo reading status**

Comm. address:	2033-31h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Description
Displays the read status of the servo. 0: Idle; 1: Reading BUFFER; 2: Reading BUFFER completed.

H33.49 **Software tool reading status**

Comm. address:	2033-32h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	2	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 2
Description
Displays the read status of the software tool. 0: Idle; 1: Reading BUFFER; 2: Reading BUFFER completed.

H33.50 **Servo writing status**

Comm. address:	2033-33h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Description
Displays the write status of the servo. 0: Idle; 1: Writing BUFFER; 2: Writing BUFFER completed.

H33.51 **Data transmission completion flag**

Comm. address:	2033-34h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 1
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. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
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. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 1
Description
Used to enable accuracy compensation.

H33.61 Accuracy compensation sum

Comm. address:	2033-3Eh	Effective mode:	Next power-on
Min. value:	0	Unit:	count
Max. value:	2048	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 2048
Description
Total accuracy compensation points

H33.62 Starting offset address of accuracy compensation

Comm. address:	2033-3Fh	Effective mode:	Next power-on
Min. value:	-21474836.48	Unit:	[Mm]/[deg]
Max. value:	21474836.47	Data type:	Int32
Default value:	0.00	Change mode:	At stop

Value range:
-21474836.48 to 21474836.47
Description
Defines the position of the compensation home of the direct-drive motor with incremental encoder at the coordinate home of the mechanical system.

H33.64 Accuracy compensation data interval

Comm. address:	2033-41h	Effective mode:	Next power-on
Min. value:	-327.67	Unit:	[Mm]/[deg]
Max. value:	327.67	Data type:	Int16
Default value:	0.00	Change mode:	At stop

Value range:
-327.67 to 327.67
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. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	At stop

Value range:
0x0 to 0xFFFF
Description
Records the phase sequence when generating accuracy compensation table.

H33.66 **Reference direction for generating accuracy compensation table**

Comm. address:	2033-43h	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 to 1
Description
Records the reference direction for generating the accuracy compensation table.

H33.67 **Servo homing completed.**

Comm. address:	2033-44h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Description
Accuracy compensation homing completed signal

H33.68 **Current acting index of accuracy compensation**

Comm. address:	2033-45h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
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 minus 2).

H33.69 **Forced homing enable**

Comm. address:	2033-46h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:
0 to 1

Description
Used to start accuracy compensation homing forcibly.

H33.70 Forced homing mode

Comm. address:	2033-47h	Effective mode:	Next power-on
Min. value:	-32768	Unit:	-
Max. value:	32767	Data type:	Int16
Default value:	-2	Change mode:	At stop

Value range:
-32768 to +32767
Description
Records the homing mode during accuracy compensation generation.

H33.71 Forced homing at low speed

Comm. address:	2033-48h	Effective mode:	Next power-on
Min. value:	0	Unit:	[mm/s]/[rpm]
Max. value:	1000	Data type:	UInt16
Default value:	10	Change mode:	At stop

Value range:
0 to 1000
Description
Records the homing speed during accuracy compensation generation.

H33.72 Single-turn absolute position of accuracy compensation home of absolute encoder

Comm. address:	2033-49h	Effective mode:	Next power-on
Min. value:	0	Unit:	Encoder unit
Max. value:	4294967295	Data type:	UInt32
Default value:	0	Change mode:	At stop

Value range:
0 to 4294967295
Description
Defines the single-turn absolute value of direct-drive motor compensation home of absolute encoder.

H33.74 Min. pulse width of frequency-division output accuracy compensation

Comm. address:	2033-4Bh	Effective mode:	Next power-on
Min. value:	2	Unit:	count
Max. value:	7	Data type:	UInt16
Default value:	3	Change mode:	At stop

Value range:
2 to 7
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. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0: [um]/[arcsec]

1: [mm]/[mrad]

Description

Defines the accuracy compensation data unit.

For DDL: 0 - um; 1 - mm

For DDR: 0 - arcsec; 2 - mrad

H33.80 **Motor cogging torque ripple compensation data storage position**

Comm. address:	2033-51h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	1	Data type:	UInt16
Default value:	0	Change mode:	At stop

Value range:

0: Stored in the encoder

1: Stored in the Flash

Description

Defines the position to save the cogging torque fluctuation compensation data.

H33.81 **Defines the motor cogging torque fluctuation compensation sum.**

Comm. address:	2033-52h	Effective mode:	Real time
Min. value:	0	Unit:	count
Max. value:	65535	Data type:	UInt16
Default value:	2000	Change mode:	At stop

Value range:

0 to 65535

Description

Defines the motor cogging torque fluctuation compensation sum.

17.33 H34 Servo Motor Parameters 2

H34.12 **Error types supported by Endat2.2 encoders**

Comm. address:	2034-0Dh	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Value range:

0x0 to 0xFFFF

Description

bit0: Light source fault; bit1: Analog signal amplitude error; bit2: Position information error; bit3: Voltage excessively high; bit4: Voltage excessively low; bit5: Overcurrent; bit6: Battery fault

H34.13 **Alarm types supported by EnDat2.2 encoders**

Comm. address:	2034-0Eh	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Value range:

0x0 to 0xFFFF

Description

bit0: Transmission rate excessively high; bit1: Temperature limit violated; 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 in position; bit8: Value change excessively low

H34.14 **Error values outputted by EnDat2.2 encoders**

Comm. address:	2034-0Fh	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Value range:

0x0 to 0xFFFF

Description

bit0: Light source fault; bit1: Analog signal amplitude error; bit2: Position information error; bit3: Voltage excessively high; bit4: Voltage excessively low; bit5: Overcurrent; bit6: Battery fault

H34.15 **Alarm values outputted by EnDat2.2 encoders**

Comm. address:	2034-10h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Value range:

0x0 to 0xFFFF

Description

bit0: Transmission rate excessively high; bit1: Temperature limit violated; 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 in position; bit8: Value change excessively low

17.34 H3A Servo Version Number Parameters

H3A.00 **MCU software version - VR version**

Comm. address:	203 A-01h	Effective mode:	-
Min. value:	0.00	Unit:	-
Max. value:	655.35	Data type:	UInt16
Default value:	0.00	Change mode:	Read-only

Value range:
0.00 to 655.35
Description
Displays the VR version of MCU software, with two decimal places.

H3A.01 **MCU software version - C SPC version**

Comm. address:	203 A-02h	Effective mode:	-
Min. value:	0.000	Unit:	-
Max. value:	65.535	Data type:	UInt16
Default value:	0.000	Change mode:	Read-only

Value range:
0.000 to 65.535
Description
Displays the C SPC version of MCU software, with three decimal places.

H3A.02 **MCU software version - non-standard version**

Comm. address:	203 A-03h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Value range:
0x0 to 0xFFFF
Description
Displays the non-standard version of MCU software.

H3A.03 **MCU software version - test and trial versions**

Comm. address:	203 A-04h	Effective mode:	-
Min. value:	0.000	Unit:	-
Max. value:	65.535	Data type:	UInt16
Default value:	0.000	Change mode:	Read-only

Value range:
0.000 to 65.535
Description
Displays the test and trial versions of MCU software (with three decimal places).

H3A.04 **MCU software version - software version**

Comm. address:	203 A-05h	Effective mode:	-

Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Description
Displays the MCU software version.

H3A.05 **FPGA software version - VR version**

Comm. address:	203 A-06h	Effective mode:	-
Min. value:	0.00	Unit:	-
Max. value:	655.35	Data type:	UInt16
Default value:	0.00	Change mode:	Read-only

Value range:
0.00 to 655.35
Description
Displays the VR version of FPGA software, with two decimal places.

H3A.06 **FPGA version: C SPC version**

Comm. address:	203 A-07h	Effective mode:	-
Min. value:	0.000	Unit:	-
Max. value:	65.535	Data type:	UInt16
Default value:	0.000	Change mode:	Read-only

Value range:
0.000 to 65.535
Description
Displays the C SPC version of FPGA software, with three decimal places.

H3A.07 **FPGA software version - non-standard version**

Comm. address:	203 A-08h	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Description
Displays the non-standard version of FPGA software.

H3A.08 **FPGA software version: test and trial versions**

Comm. address:	203 A-09h	Effective mode:	-
Min. value:	0.000	Unit:	-
Max. value:	65.535	Data type:	UInt16
Default value:	0.000	Change mode:	Read-only

Value range:
0.000 to 65.535
Description
Displays the test and trial versions of FPGA (with three decimal places).

H3A.09 **FPGA software - software version**

Comm. address:	203 A-0Ah	Effective mode:	-
Min. value:	0	Unit:	-
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
0 to 65535
Description
Displays the FPGA software version.

17.35 1000h Object Dictionary

1005h **SYNC message COB-ID**

Comm. address:	1005h	Effective mode:	Real time
Min. value:	0x80	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x80	Change mode:	Real time

Value range:
0x80 to 0xFFFFFFFF
Description
Only 0x80 and 0x40000080 can be written to the synchronization message.
If 0x80 is written, the synchronization generator does not work.
If 0x40000080 is written, the synchronization generator is activated.
To activate the synchronization generator, set 1006h to a non-zero value first.

1006h **Synchronization cycle**

Comm. address:	1006h	Effective mode:	Real time
Min. value:	0	Unit:	μs
Max. value:	2147483647	Data type:	UInt32
Default value:	0	Change mode:	Real time

Value range:
0 to 2147483647
Description
It is valid only for the synchronization generator. The unit is μs.

100Ch **Node daemon running time**

Comm. address:	100Ch	Effective mode:	Real time
Min. value:	0	Unit:	ms

Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 65535
Description
Defines the node daemon running time, in ms.

100dh **Lifetime factor**

Comm. address:	100dh	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	255	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 255
Description
This parameter must be used together with the node daemon function and must be set to a value greater than 1.

1014h **Emergency message COB-ID**

Comm. address:	1014h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x80	Change mode:	Real time

Value range:
0x0 to 0xFFFFFFFF
Description
The most significant bit indicates whether to disable the emergency message of the device. Only "0x80+Node_ID" can be written to this bit to enable the device emergency message.
Writing "0x80000080+Node_ID" disables the emergency message.
When the emergency message is activated, its COB-ID must be the same as that of the object.

1016.01h **Consumer heartbeat time 1**

Comm. address:	1016-01h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF
Description
Parameters include the address of the monitored node and actual consumer time. The heartbeat time must be longer than the heartbeat producer time (unit: ms) of the corresponding node. Do not set different consumer times for the same node.
bit0 to bit15: Monitoring time
bit16 to bit23: The monitored address
bit24 to bit31: Reserved (0)

1016.02h **Consumer heartbeat time 2**

Comm. address:	1016-02h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF
Description
Same as 1016.01h.

1016.03h **Consumer heartbeat time 3**

Comm. address:	1016-03h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF
Description
Same as 1016.01h.

1016.04h **Consumer heartbeat time 4**

Comm. address:	1016-04h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF
Description
Same as 1016.01h.

1016.05h **Consumer heartbeat time 5**

Comm. address:	1016-05h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF
Description
Same as 1016.01h.

1017h **Producer heartbeat time**

Comm. address:	1017h	Effective mode:	Real time
Min. value:	0	Unit:	ms

Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 65535
Description
Defines the heartbeat production time of the slave, in ms.

1400.01h COB-ID of RPDO1

Comm. address:	1400-01h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x200	Change mode:	Real time

Value range:
0x0 to 0xFFFFFFFF
Description
Only the most significant bit can be modified. When the most significant bit is 0, the PDO is active. When the most significant bit is 1, the PDO is inactive.
The default settings are as follows:
1400h: 0x00000200 + Node_ID
1401h: 0x80000300 + Node_ID
1402h: 0x80000400 + Node_ID
1403h: 0x80000500 + Node_ID

1400.02h Transmission type of RPDO1

Comm. address:	1400-02h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	255	Data type:	UInt16
Default value:	255	Change mode:	Real time

Value range:
0 to 255
Description
This parameter can be modified only when PDO is inactive.
Different values correspond to different PDO transmission types, as shown below.
0: Not circle synchronous data
1 to 240: Circle synchronous data
254 and 255: Not circle asynchronous data

1401.01h COB-ID of RPDO2

Comm. address:	1401-01h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x300	Change mode:	Real time

Value range:
0x0 to 0xFFFFFFFF

Description
Same as 1400.01h.

1401.02h **Transmission type of RPDO2**

Comm. address:	1401-02h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	255	Data type:	UInt16
Default value:	255	Change mode:	Real time

Value range:
0 to 255
Description
Same as 1400.02h.

1402.01h **COB-ID of RPDO3**

Comm. address:	1402-01h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x80000400	Change mode:	Real time

Value range:
0x0 to 0xFFFFFFFF
Description
Same as 1400.01h.

1402.02h **Transmission type of RPDO3**

Comm. address:	1402-02h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	255	Data type:	UInt16
Default value:	255	Change mode:	Real time

Value range:
0 to 255
Description
Same as 1400.02h.

1403.01h **COB-ID of RPDO4**

Comm. address:	1403-01h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x80000500	Change mode:	Real time

Value range:
0x0 to 0xFFFFFFFF
Description
Same as 1400.01h.

1403.02h **Transmission type of RPDO4**

Comm. address:	1403-02h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	255	Data type:	UInt16
Default value:	255	Change mode:	Real time

Value range:
0 to 255
Description
Same as 1400.02h.

1600.00h **Number of valid mapping objects in RPDO1**

Comm. address:	1600-00h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4	Data type:	UInt16
Default value:	3	Change mode:	Real time

Value range:
0 to 4
Description
This object can be modified only when PDO is invalid. When the value 0 is written, the mapping objects of other sub-indexes are cleared.

1600.01h **Mapping object 1 of RPDO1**

Comm. address:	1600-01h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x60400010	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF
Description
The total length of a mapped object cannot exceed 64 bits. Mapping based on bytes instead of bits is supported. The mapped object index and sub-index must be in the object dictionary list, in a writable state, and mappable.
Write sub-indexes in the following format:
bit16 to bit31: Index
bit8 to bit15: Sub-index
bit0 to bit7: Object length

1600.02h **Mapping object 2 of RPDO1**

Comm. address:	1600-02h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x60FF0020	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF

Description
Same as 1600.01h.

1600.03h **Mapping object 3 of RPDO1**

Comm. address:	1600-03h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x60600008	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF
Description
Same as 1600.01h.

1600.04h **Mapping object 4 of RPDO1**

Comm. address:	1600-04h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF
Description
Same as 1600.01h.

1601.00h **Number of valid mapped objects in RPDO2**

Comm. address:	1601-00h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4	Data type:	UInt16
Default value:	2	Change mode:	Real time

Value range:
0 to 4
Description
This object can be modified only when PDO is invalid. When the value 0 is written, the mapping objects of other sub-indexes are cleared.

1601.01h **1st mapped object in RPDO2**

Comm. address:	1601-01h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x607A0020	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF
Description

The total length of a mapped object cannot exceed 64 bits. Mapping based on bytes instead of bits is supported. The mapped object index and sub-index must be in the object dictionary list, in a writable state, and mappable.
Write sub-indexes in the following format:
bit16 to bit31: Index
bit8 to bit15: Sub-index
bit0 to bit7: Object length

1601.02h 2nd mapped object in RPDO2

Comm. address:	1601-02h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x60810020	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF
Description
Same as 1601.01h.

1601.03h 3rd mapped object in RPDO2

Comm. address:	1601-03h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF
Description
Same as 1601.01h.

1601.04h 4th mapped object in RPDO2

Comm. address:	1601-04h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF
Description
Same as 1601.01h.

1602.00h Number of valid mapped objects in RPDO3

Comm. address:	1602-00h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0 to 4

Description

This object can be modified only when PDO is invalid. When the value 0 is written, the mapping objects of other sub-indexes are cleared.

1602.01h **1st mapped object in RPDO3**

Comm. address:	1602-01h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Real time

Value range:

0x0 to 0x7FFFFFFF

Description

The total length of a mapped object cannot exceed 64 bits. Mapping based on bytes instead of bits is supported. The mapped object index and sub-index must be in the object dictionary list, in a writable state, and mappable.

Write sub-indexes in the following format:

bit16 to bit31: Index

bit8 to bit15: Sub-index

bit0 to bit7: Object length

1602.02h **2nd mapped object in RPDO3**

Comm. address:	1602-02h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Real time

Value range:

0x0 to 0x7FFFFFFF

Description

Same as 1602.01h.

1602.03h **3rd mapped object in RPDO3**

Comm. address:	1602-03h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Real time

Value range:

0x0 to 0x7FFFFFFF

Description

Same as 1602.01h.

1602.04h **4th mapped object in RPDO3**

Comm. address:	1602-04h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32

Default value:	0x0	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF
Description
Same as 1602.01h.

1603.00h Number of valid mapped objects in RPDO4

Comm. address:	1603-00h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 4
Description
This object can be modified only when PDO is invalid. When the value 0 is written, the mapping objects of other sub-indexes are cleared.

1603.01h 1st mapped object in RPDO4

Comm. address:	1603-01h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF
Description
The total length of a mapped object cannot exceed 64 bits. Mapping based on bytes instead of bits is supported. The mapped object index and sub-index must be in the object dictionary list, in a writable state, and mappable.
Write sub-indexes in the following format:
bit16 to bit31: Index
bit8 to bit15: Sub-index
bit0 to bit7: Object length

1603.02h 2nd mapped object in RPDO4

Comm. address:	1603-02h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF
Description
Same as 1603.01h.

1603.03h **3rd mapped object in RPDO4**

Comm. address:	1603-03h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF
Description
Same as 1603.01h.

1603.04h **4th mapped object in RPDO4**

Comm. address:	1603-04h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF
Description
Same as 1603.01h.

1800.01h **COB-ID of TPDO1**

Comm. address:	1800-01h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x40000180	Change mode:	Real time

Value range:
0x0 to 0xFFFFFFFF
Description
Only the most significant bit and second most significant bit can be changed.
When the most significant bit is 0, the PDO is active. When the most significant bit is 1, the PDO is inactive.
The second most significant bit defines whether the PDO can be triggered by a remote frame.
You are recommended to set this bit to 1 to disable the remote frame to trigger the PDO.
The default settings are as follows:
1800h: 0x40000180 + Node_ID
1801h: 0xC0000280 + Node_ID
1802h: 0xC0000380 + Node_ID
1803h: 0xC0000480 + Node_ID

1800.02h **Transmission type of TPDO1**

Comm. address:	1800-02h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	255	Data type:	UInt16
Default value:	255	Change mode:	Real time

Value range:
0 to 255
Description
This parameter can be modified only when PDO is inactive. Different values correspond to different PDO transmission types, as shown below.
0: Not circle synchronous data
1 to 240: Circle synchronous data
254 and 255: Not circle asynchronous data

1800.03h Inhibit time of TPDO1

Comm. address:	1800-03h	Effective mode:	Real time
Min. value:	0	Unit:	100 μs
Max. value:	65535	Data type:	UInt16
Default value:	500	Change mode:	Real time

Value range:
0 to 65535
Description
This parameter can be modified only when PDO is inactive.
The unit is 100 μs. The value 0 indicates that the inhibit time is invalid.

1800.05h Event counter of TPDO1

Comm. address:	1800-05h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 65535
Description
This parameter can be modified only when PDO is inactive.
The unit is ms. When the parameter is set to 0, the event timer is invalid.

1801.01h COB-ID of TPDO2

Comm. address:	1801-01h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0x40000280	Change mode:	Real time

Value range:
0x0 to 0xFFFFFFFF
Description
Same as 1800.01h.

1801.02h Transmission type of TPDO2

Comm. address:	1801-02h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	255	Data type:	UInt16

Default value:	255	Change mode:	Real time

Value range:
0 to 255
Description
Same as 1800.02h.

1801.03h Inhibit time of TPDO2

Comm. address:	1801-03h	Effective mode:	Real time
Min. value:	0	Unit:	100 μs
Max. value:	65535	Data type:	UInt16
Default value:	500	Change mode:	Real time

Value range:
0 to 65535
Description
Same as 1800.03h.

1801.05h Event counter of TPDO2

Comm. address:	1801-05h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 65535
Description
Same as 1800.05h.

1802.01h COB-ID of TPDO3

Comm. address:	1802-01h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0xC0000380	Change mode:	Real time

Value range:
0x0 to 0xFFFFFFFF
Description
Same as 1800.01h.

1802.02h Transmission type of TPDO3

Comm. address:	1802-02h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	255	Data type:	UInt16
Default value:	255	Change mode:	Real time

Value range:
0 to 255

Description
Same as 1800.02h.

1802.03h **Inhibit time of TPDO3**

Comm. address:	1802-03h	Effective mode:	Real time
Min. value:	0	Unit:	100 μs
Max. value:	65535	Data type:	UInt16
Default value:	500	Change mode:	Real time

Value range:
0 to 65535
Description
Same as 1800.03h.

1802.05h **Event counter of TPDO3**

Comm. address:	1802-05h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 65535
Description
Same as 1800.05h.

1803.01h **COB-ID of TPDO4**

Comm. address:	1803-01h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32
Default value:	0xC0000480	Change mode:	Real time

Value range:
0x0 to 0xFFFFFFFF
Description
Same as 1800.01h.

1803.02h **Transmission type of TPDO4**

Comm. address:	1803-02h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	255	Data type:	UInt16
Default value:	255	Change mode:	Real time

Value range:
0 to 255
Description
Same as 1800.02h.

1803.03h **Inhibit time of TPDO4**

Comm. address:	1803-03h	Effective mode:	Real time
Min. value:	0	Unit:	100 μs
Max. value:	65535	Data type:	UInt16
Default value:	500	Change mode:	Real time

Value range:
0 to 65535
Description
Same as 1800.03h.

1803.05h **Event counter of TPDO4**

Comm. address:	1803-05h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 65535
Description
Same as 1800.05h.

1A00.00h **Number of valid mapped objects in TPDO1**

Comm. address:	1A00-00h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4	Data type:	UInt16
Default value:	3	Change mode:	Real time

Value range:
0 to 4
Description
This object can be modified only when PDO is invalid. When the value 0 is written, the mapping objects of other sub-indexes are cleared.

1A00.01h **Mapping object 1 of TPDO1**

Comm. address:	1A00-01h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x60410010	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF
Description
The total length of a mapped object cannot exceed 64 bits. Mapping based on bytes instead of bits is supported. The mapped object index and sub-index must be in the object dictionary list, in a writable state, and mappable.
Write sub-indexes in the following format:
bit16 to bit31: Index

bit8 to bit15: Sub-index
bit0 to bit7: Object length

1A00.02h **Mapping object 2 of TPDO1**

Comm. address:	1A00-02h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x60FD0020	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF
Description
Same as 1A00.01h.

1A00.03h **Mapping object 3 of TPDO1**

Comm. address:	1A00-03h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x60610008	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF
Description
Same as 1A00.01h.

1A00.04h **Mapping object 4 of TPDO1**

Comm. address:	1A00-04h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF
Description
Same as 1A00.01h.

1A01.00h **Number of valid mapped objects in TPDO2**

Comm. address:	1A01-00h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4	Data type:	UInt16
Default value:	2	Change mode:	Real time

Value range:
0 to 4
Description
This object can be modified only when PDO is invalid. When the value 0 is written, the mapping objects of other sub-indexes are cleared.

1A01.01h **1st mapped object in TPDO2**

Comm. address:	1A01-01h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x60640020	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF
Description
The total length of a mapped object cannot exceed 64 bits. Mapping based on bytes instead of bits is supported. The mapped object index and sub-index must be in the object dictionary list, in a writable state, and mappable.
Write sub-indexes in the following format:
bit16 to bit31: Index
bit8 to bit15: Sub-index
bit0 to bit7: Object length

1A01.02h **2nd mapped object in TPDO2**

Comm. address:	1A01-02h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x606C0020	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF
Description
Same as 1A01.01h.

1A01.03h **3rd mapped object in TPDO2**

Comm. address:	1A01-03h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF
Description
Same as 1A01.01h.

1A01.04h **4th mapped object in TPDO2**

Comm. address:	1A01-04h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF

Description
Same as 1A01.01h.

1A02.00h Number of valid mapped objects in TPDO3

Comm. address:	1A02-00h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 4
Description
This object can be modified only when PDO is invalid. When the value 0 is written, the mapping objects of other sub-indexes are cleared.

1A02.01h 1st mapped object in TPDO3

Comm. address:	1A02-01h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF
Description
The total length of a mapped object cannot exceed 64 bits. Mapping based on bytes instead of bits is supported. The mapped object index and sub-index must be in the object dictionary list, in a writable state, and mappable.
Write sub-indexes in the following format:
bit16 to bit31: Index
bit8 to bit15: Sub-index
bit0 to bit7: Object length

1A02.02h 2nd mapped object in TPDO3

Comm. address:	1A02-02h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF
Description
Same as 1A02.01h.

1A02.03h 3rd mapped object in TPDO3

Comm. address:	1A02-03h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32

Default value:	0x0	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF
Description
Same as 1A02.01h.

1A02.04h 4th mapped object in TPDO3

Comm. address:	1A02-04h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF
Description
Same as 1A02.01h.

1A03.00h Number of valid mapped objects in TPDO4

Comm. address:	1A03-00h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	4	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 4
Description
This object can be modified only when PDO is invalid. When the value 0 is written, the mapping objects of other sub-indexes are cleared.

1A03.01h 1st mapped object in TPDO4

Comm. address:	1A03-01h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF
Description
The total length of a mapped object cannot exceed 64 bits. Mapping based on bytes instead of bits is supported. The mapped object index and sub-index must be in the object dictionary list, in a writable state, and mappable.
Write sub-indexes in the following format:
bit16 to bit31: Index
bit8 to bit15: Sub-index
bit0 to bit7: Object length

1A03.02h **2nd mapped object in TPDO4**

Comm. address:	1A03-02h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF
Description
Same as 1A03.01h.

1A03.03h **3rd mapped object in TPDO4**

Comm. address:	1A03-03h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF
Description
Same as 1A03.01h.

1A03.04h **4th mapped object in TPDO4**

Comm. address:	1A03-04h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0x7FFFFFFF	Data type:	UInt32
Default value:	0x0	Change mode:	Real time

Value range:
0x0 to 0x7FFFFFFF
Description
Same as 1A03.01h.

17.36 6000h Object Dictionary

603Fh **Error code**

Comm. address:	603Fh	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Value range:
0x0 to 0xFFFF
Description
When an error described in the DSP402 profile occurs on the drive, 603Fh is as 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 an 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. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Real time

Value range:
0x0 to 0xFFFF
Description
For details about the control word, see *"11.3.1 Control Word 6040h" on page 322*.

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

Value range:
0x0 to 0xFFFF
Description
For details about the control word, see *"11.3.2 Status Word 6041h" on page 323*.

605Ah **Quick stop mode**

Comm. address:	605Ah	Effective mode:	At stop
Min. value:	0	Unit:	-
Max. value:	7	Data type:	Int16
Default value:	2	Change mode:	Real time

Value 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
Description

Defines the deceleration mode of the motor for stopping rotating upon quick stop and the motor state after stop.
0: Coast to stop, keeping de-energized state
1: Ramp to stop as defined by 6084h/609Ah (HM), keeping de-energized state
2: Ramp to stop as defined by 6085h, keeping de-energized state
3: Stop at emergency stop torque, keeping de-energized state
5: Ramp to stop as defined by 6084h/609Ah (HM), keeping position lock state
6: Ramp to stop as defined by 6085h, keeping position lock state
7: Stop at emergency stop torque, keeping position lock state
Note: If the setpoint of 605Ah is lower than 4 after the braking is enabled, 605Ah will be forcibly set to 2 (Ramp to stop as defined by 6085h, keeping de-energized state).

605Ch **Stop mode at servo S-ON OFF**

Comm. address:	605Ch	Effective mode:	At stop
Min. value:	-4	Unit:	-
Max. value:	2	Data type:	Int16
Default value:	0	Change mode:	Real time

Value 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, 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
Description
Defines the deceleration mode of the motor for stopping rotating upon S-OFF and the motor state after stop.
-4: Ramp to stop as defined by 6085h, keeping dynamic braking state
-3: Stop at zero speed, keeping dynamic braking state
-2: Ramp to stop as defined by 6084h/609Ah, keeping dynamic braking state
-1: Dynamic braking stop, keeping dynamic braking state
0: Coast to stop, keeping de-energized state
1: Ramp to stop as defined by 6084h/609Ah, keeping de-energized state
2: Dynamic braking stop, keeping de-energized state
Note: After the brake is enabled, 605Ch will be forcibly set to -4 (Ramp to stop as defined by 6085h, keeping dynamic braking state).

605Dh **Halt mode**

Comm. address:	605Dh	Effective mode:	At stop
Min. value:	1	Unit:	-
Max. value:	3	Data type:	Int16
Default value:	1	Change mode:	Real time

Value 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

Description

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

PP/PV/HM mode:

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

PT mode:

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

605Eh **Stop mode at No. 2 fault**

Comm. address:	605Eh	Effective mode:	At stop
Min. value:	-5	Unit:	-
Max. value:	4	Data type:	Int16
Default value:	2	Change mode:	Real time

Value 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

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 de-energized state
Note: After the brake is enabled, 605Eh will be forcibly set to -3 (Stop at emergency-stop torque as defined by 6085h, keeping de-energized state).

6060h **Servo drive mode selection**

Comm. address:	6060h	Effective mode:	Real time
Min. value:	0	Unit:	-
Max. value:	10	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
1: Profile position (PP) mode
3: Profile velocity (PV) mode
4: Profile torque (PT) mode
6: Homing (HM) mode
7: Interpolation (IP) mode
Description
Defines the operation mode of the servo drive.
0: N/A (internally forced to PP mode)
1: Profile position (PP) mode
3 Profile velocity (PV) mode
4 Profile torque (PT) mode
6: Homing (HM) mode
7: Interpolation (IP) mode
Other: N/A
If an unsupported operation mode is selected through an SDO, an SDO error will be reported.
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. value:	0	Unit:	-
Max. value:	10	Data type:	UInt16
Default value:	0	Change mode:	Read-only

Value range:
1: Profile position (PP) mode
3: Profile velocity (PV) mode
4: Profile torque (PT) mode
6: Homing (HM) mode
7: Interpolation (IP) mode
Description

Indicates the actual operation mode of the drive.
0: Profile position (PP) mode
1: Profile position (PP) mode
3 Profile velocity (PV) mode
4 Profile torque (PT) mode
6: Homing (HM) mode
7: Interpolation (IP) mode

6062h **Position reference**

Comm. address:	6062h	Effective mode:	-
Min. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Value range:
-2147483648 to +2147483647
Description
Indicates the real-time position reference (reference unit).

6063h **Position feedback**

Comm. address:	6063h	Effective mode:	-
Min. value:	-2147483648	Unit:	Encoder unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Value range:
-2147483648 to +2147483647
Description
Indicates the absolute position feedback (encoder unit) of the motor in real time.

6064h **Position feedback**

Comm. address:	6064h	Effective mode:	-
Min. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Value range:
-2147483648 to +2147483647
Description
Indicates the absolute position feedback (in reference unit) in real time.
User position feedback (6064h) × Gear ratio (6091h) = Motor position feedback (6063h)

6065h **Threshold of excessive position deviation**

Comm. address:	6065h	Effective mode:	Real time
Min. value:	0	Unit:	Reference unit
Max. value:	4294967295	Data type:	UInt32
Default value:	219895614	Change mode:	Real time

Value range:
0 to 4294967295
Description
Defines the threshold of excessive position deviation (reference unit).
When the difference value between 6062h and 6064h remains above ±6065h for the time defined by 6066h, B00.0 (Position deviation too large) is reported.

6066h **Time to trigger excessive position deviation**

Comm. address:	6066h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 65535
Description
Defines the time to trigger excessive position deviation alarms, which must be used together with 6065h.

6067h **Position reach threshold**

Comm. address:	6067h	Effective mode:	Real time
Min. value:	0	Unit:	Reference unit
Max. value:	4294967295	Data type:	UInt32
Default value:	46976	Change mode:	Real time

Value range:
0 to 4294967295
Description
Defines the position reach threshold.
If the difference between 6062h and 6064h is within ±6067h and such state lasts for the time defined by 6068h, the position is reached. In this case, bit10 of 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 mode.

6068h **Position reach window time**

Comm. address:	6068h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 65535
Description
Defines the window time for position reach, which must be used together with 6067h.

606Ch **Actual speed**

Comm. address:	606Ch	Effective mode:	-
Min. value:	-2147483648	Unit:	Reference unit/s

Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Value range:
-2147483648 to +2147483647
Description
Indicates the actual speed feedback value.

606Dh **Velocity window**

Comm. address:	606Dh	Effective mode:	Real time
Min. value:	0	Unit:	rpm
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:
0 to 65535
Description
Defines the threshold for speed reach.
If the difference value between the target speed 60FFh and the actual speed 606Ch is within ±606Dh and such state lasts for the time defined by 606Eh, the speed is reached and bit10 of the status word 6041h is set to 1 in profile velocity (PV) mode.
This flag bit takes effect only when the servo drive is enabled in PV mode.

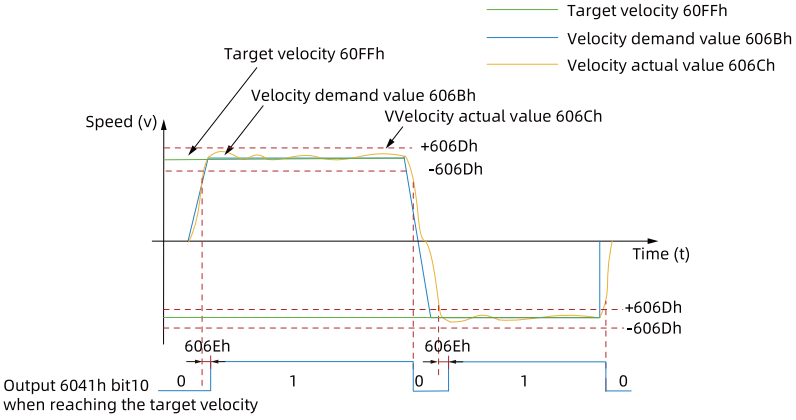
606Eh **Velocity window time**

Comm. address:	606Eh	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:
0 to 65535
Description
Defines the window time for speed arrival, which must be used together with 606Dh.

Defines the time window for speed reach. If the difference value between the target speed 60FFh and the actual speed 606Ch is within ±606Dh and the time reaches 606Eh, the speed is reached and bit 10 of the status word 6041h is set to 1 in the profile velocity (PV) mode.

This flag bit takes effect only when the servo drive is enabled in PV mode.



606Fh **Zero speed signal threshold**

Comm. address:	606Fh	Effective mode:	Real time
Min. value:	0	Unit:	rpm
Max. value:	65535	Data type:	UInt16
Default value:	10	Change mode:	Real time

Value range:

0 to 65535

Description

Defines the threshold for determining whether the user velocity is 0.

When 606Ch is within ±606Fh and the time reaches the value set by 6070h, the user velocity is 0.

When either condition is not met, the user velocity is not 0.

This flag bit is valid only in PV mode.

This flag bit is unrelated to the enable/disable state of the servo drive.

6070h **Velocity threshold time**

Comm. address:	6070h	Effective mode:	Real time
Min. value:	0	Unit:	ms
Max. value:	65535	Data type:	UInt16
Default value:	0	Change mode:	Real time

Value range:

0 to 65535

Description

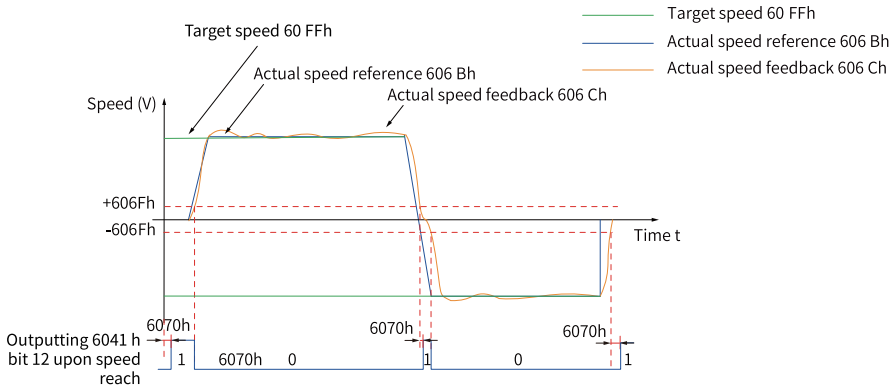
Defines the window time for determining whether the user velocity is 0, which must be used together with 606Fh.

When 606Ch is within ±606Fh and the time reaches the value set by 6070h, the user velocity is 0.

When either condition is not met, the user velocity is not 0.

This flag bit is valid only in PV mode.

This flag bit is unrelated to the enable/disable state of the servo drive.



6071h **Target torque**

Comm. address:	6071h	Effective mode:	Real time
Min. value:	-4000	Unit:	0.10%
Max. value:	4000	Data type:	Int16

Default value:	0	Change mode:	Real time

Value range:
-4000 to 4000
Description
Defines the target torque of the drive in profile torque mode.
The value 1000 corresponds to the rated torque of the motor.

6072h **Maximum torque**

Comm. address:	6072h	Effective mode:	Real time
Min. value:	0	Unit:	0.10%
Max. value:	4000	Data type:	UInt16
Default value:	3500	Change mode:	Real time

Value range:
0 to 4000
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. value:	-4000	Unit:	0.10%
Max. value:	4000	Data type:	Int16
Default value:	0	Change mode:	Read-only

Value range:
-4000 to 4000
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. value:	-4000	Unit:	0.10%
Max. value:	4000	Data type:	Int16
Default value:	0	Change mode:	Read-only

Value range:
-4000 to 4000
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. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32

Default value:	0	Change mode:	Real time

Value range:
-2147483648 to +2147483647
Description
Defines the target position of the servo drive in profile position mode.
When bit6 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 bit6 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. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Value range:
-2147483648 to +2147483647
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 in the following conditions: The device is powered on, the homing operation is completed, and bit15 of 6041h is set to 1.
After homing is completed, the position actual value (6064h) will be the same as the value of 607Ch.
If 607Ch is outside the value of 607Dh (Software absolute position limit), E09.1 (Home setting error) will be reported.

607D.01h **Min. position limit**

Comm. address:	607D-01h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32
Default value:	-2147483648	Change mode:	Real time

Value range:
-2147483648 to +2147483647
Description
Defines the minimum software absolute position limit relative to the mechanical zero point.
Minimum software absolute position limit = (607D.01h)
The software internal position limit is used to determine the absolute position. When homing is not performed, the software internal position limit is invalid.
The condition for activating the software absolute 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. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32
Default value:	2147483647	Change mode:	Real time

Value range:
-2147483648 to +2147483647
Description
Defines the maximum software absolute position limit relative to the mechanical zero point.
Maximum software absolute position limit = (607D.02h)

607Eh **Reference polarity**

Comm. address:	607Eh	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFF	Data type:	UInt16
Default value:	0x0	Change mode:	Real time

Value range:
0x0 to 0xFF
Description
Defines the polarity of position or speed references.
When bit7 is 1, it indicates the position reference is multiplied by "-1" and the motor direction is reversed in the standard position mode or interpolation mode.
When bit6 is 1, it indicates the speed reference (60FFh) is multiplied by "-1" and the motor direction is reversed in the speed mode.
When bit5 is 1, it indicates the torque demand value (6071h) is multiplied by "-1" and the motor direction is reversed in the torque mode.
Other bits are not assigned.

607Fh **Maximum speed**

Comm. address:	607Fh	Effective mode:	Real time
Min. value:	0	Unit:	Reference unit/s
Max. value:	4294967295	Data type:	UInt32
Default value:	4294967295	Change mode:	Real time

Value range:
0 to 4294967295
Description
Defines the maximum operating speed in user-defined unit.
Set a proper gear ratio (8:1 recommended) when using a 26-bit encoder. Otherwise, the motor speed is limited to 3840 rpm.

6081h **Profile velocity**

Comm. address:	6081h	Effective mode:	Real time
Min. value:	0	Unit:	Reference unit/s
Max. value:	4294967295	Data type:	UInt32

Default value:	111848106	Change mode:	Real time

Value range:
0 to 4294967295
Description
Defines the constant operating speed of the current displacement reference in 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. value:	0	Unit:	Reference unit/s²
Max. value:	4294967295	Data type:	UInt32
Default value:	4294967295	Change mode:	Real time

Value range:
0 to 4294967295
Description
Defines the acceleration rate in the acceleration phase of the displacement reference in profile position mode.
The following formula applies if a motor equipped with a 23-bit encoder needs to run at 400 rpm (6081h: 400 × 8388608 ÷ 60) with an acceleration rate of 400 rpm/s (6083h: 400 × 8388608 ÷ 60) and a deceleration rate of 200 rpm/s (6084h: 200 × 8388608 ÷ 60) under a gear ratio of 1:1: Acceleration time tup = Δ6081h ÷ Δ6083h = 1 (s); Deceleration time tdown = Δ6081h ÷ Δ6084h = 2 (s).

6084h **Profile deceleration**

Comm. address:	6084h	Effective mode:	Real time
Min. value:	0	Unit:	Reference unit/s²
Max. value:	4294967295	Data type:	UInt32
Default value:	4294967295	Change mode:	Real time

Value range:
0 to 4294967295
Description
Defines the deceleration rate in the deceleration phase of the displacement reference in profile position mode.
The following formula applies if a motor equipped with a 23-bit encoder needs to run at 400 rpm (6081h: 400 × 8388608 ÷ 60) with an acceleration rate of 400 rpm/s (6083h: 400 × 8388608 ÷ 60) and a deceleration rate of 200 rpm/s (6084h: 200 × 8388608 ÷ 60) under a gear ratio of 1:1: Acceleration time tup = Δ6081h ÷ Δ6083h = 1 (s); Deceleration time tdown = Δ6081h ÷ Δ6084h = 2 (s).

6085h **Quick stop deceleration**

Comm. address:	6085h	Effective mode:	Real time
Min. value:	0	Unit:	Reference unit/s²
Max. value:	4294967295	Data type:	UInt32
Default value:	2147483647	Change mode:	Real time

Value range:
0 to 4294967295
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.

6087h **Torque ramp**

Comm. address:	6087h	Effective mode:	Real time
Min. value:	0	Unit:	0.1%/s
Max. value:	4294967295	Data type:	UInt32
Default value:	4294967295	Change mode:	Real time

Value range:
0 to 4294967295
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 ramp 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 is set to 1, 2, 5, or 6, or 605Dh is set to 1 or 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 minimum torque ramp slope is calculated internally based on 6072/60E0/60E1 and H0A.72. Set 6087h to a value higher than the minimum torque ramp slope inside the drive. Otherwise, the drive decelerates according to the minimum ramp slope.

6091.01h **Motor resolution**

Comm. address:	6091-01h	Effective mode:	Real time
Min. value:	1	Unit:	-
Max. value:	4294967295	Data type:	UInt32
Default value:	1	Change mode:	At stop

Value range:
1 to 4294967295
Description
Defines the numerator of the gear ratio.
The gear ratio is used to establish the relationship between the number of motor shaft revolutions and the number of load shaft revolutions.
The relationship between motor position feedback (encoder unit) and load shaft position feedback (reference unit) is as follows:
Motor position feedback = Load shaft position feedback × Gear ratio
The relationship between motor speed (rpm) and the load shaft speed (reference unit/s) is as follows:
Motor speed (rpm) = Load shaft speed × 6091h × 60/Encoder resolution
The relationship between the motor acceleration (rpm/ms) and the load shaft acceleration (reference unit/s2) is as follows.
Motor acceleration (rpm/ms) = Load shaft acceleration × 6091h × 1000/Encoder resolution/60

6091.02h **Load shaft resolution**

Comm. address:	6091-02h	Effective mode:	Real time
Min. value:	1	Unit:	-
Max. value:	4294967295	Data type:	UInt32
Default value:	1	Change mode:	At stop

Value range:
1 to 4294967295
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
Description
Defines the homing method.
-3: Nearby 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 deceleration point signal**

Comm. address:	6099-01h	Effective mode:	Real time
Min. value:	0	Unit:	Reference unit/s
Max. value:	4294967295	Data type:	UInt32
Default value:	111848106	Change mode:	At stop

Value range:
0 to 4294967295
Description
Defines the speed during searching for the deceleration point. A large value can be set to prevent prolonged homing time and homing timeout fault E601.0.

6099.02h **Speed during search for home signal**

Comm. address:	6099-02h	Effective mode:	Real time
Min. value:	0	Unit:	Reference unit/s
Max. value:	4294967295	Data type:	UInt32
Default value:	11184810	Change mode:	At stop

Value range:
0 to 4294967295
Description
Defines the speed in searching for the home signal. Set this sub-index to a low value to avoid overshoot during stop at high speed, preventing excessive deviation between the stop position and the preset mechanical home.

609Ah **Homing acceleration**

Comm. address:	609Ah	Effective mode:	Real time
Min. value:	0	Unit:	Reference unit/s²
Max. value:	4294967295	Data type:	UInt32
Default value:	4294967295	Change mode:	Real time

Value range:
0 to 4294967295
Description
Defines the acceleration in homing mode.

60B8h **Touch probe mode**

Comm. address:	60B8h	Effective mode:	Real time
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Real time

Value range:
0x0 to 0xFFFF
Description

bit	Name	Description
0	Touch probe 1 enable: 0: Disable 1: Enable	bit 0 to bit 5: settings related to touch probe 1 When a DI is used to trigger the touch probe function, the DI source cannot be changed once the touch probe function is enabled. For absolute encoders, Z signal refers to the zero point of the single-turn motor position feedback.
1	Touch probe 1 trigger mode 0: Single trigger mode (Latches the position at the first trigger event.) 1: Continuous trigger mode	
2	Touch probe 1 trigger signal selection 0: DI signal 1: Z signal	
3	N/A	
4	Touch probe 1 rising edge 0: Latching at rising edge disabled 1: Latching at rising edge enabled	
5	Touch probe 1 falling edge 0: Latching at falling edge disabled 1: Latching at falling edge enabled	
6 to 7	N/A	-

bit	Name	Description
8	Touch probe 2 enable: 0: Disable 1: Enable	bit 8 to bit 13: settings related to touch probe 2
9	Touch probe 2 trigger mode 0: Single trigger mode (Latches the position at the first trigger event.) 1: Continuous trigger mode	
10	Touch probe 2 trigger signal selection 0: DI signal 1: Z signal	
11	N/A	
12	Touch probe 2 rising edge 0: Latching at rising edge disabled 1: Latching at rising edge enabled	
13	Touch probe 2 falling edge 0: Latching at falling edge disabled 1: Latching at falling edge enabled	
14 to 15	N/A	-

60B9h **Probe status**

Comm. address:	60B9h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Value range:

0x0 to 0xFFFF

Description

Defines the functions of touch probe 1 and touch probe 2.

See the following table for descriptions of each bit of 60B9h.

bit	Name	Description
0	Touch probe 1 enable: 0: Disable 1: Enable	bit0 to bit2: State of probe 1
1	Touch probe 1 latching on a rising edge 0: No rising edge value latched 1: Rising edge value latched	
2	Touch probe 1 latching on a falling edge 0: No falling edge value latched 1: Falling edge value latched	
3 to 5	N/A	-
6 to 7	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
8	Touch probe 2 enable: 0: Disable 1: Enable	bit8 to bit10: State of probe 2
9	Touch probe 2 latching on a rising edge 0: No rising edge value latched 1: Rising edge value latched	
10	Touch probe 2 latching on a falling edge 0: No falling edge value latched 1: Falling edge value latched	
11 to 13	N/A	-
14 to 15	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

60BAh **Position value at probe 1 rising edge**

Comm. address:	60BAh	Effective mode:	-
Min. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Value range:

-2147483648 to +2147483647

Description

Indicates the position feedback value (reference unit) latched at the rising edge of probe 1 signal.

60BBh **Position value at probe 1 falling edge**

Comm. address:	60BBh	Effective mode:	-
Min. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32

Default value:	0	Change mode:	Read-only

Value range:
-2147483648 to +2147483647
Description
Indicates the position feedback value (reference unit) latched at the falling edge of probe 1 signal.

60BCh **Position value of probe 2 rising edge**

Comm. address:	60BCh	Effective mode:	-
Min. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Value range:
-2147483648 to +2147483647
Description
Indicates the position feedback value (reference unit) latched at the rising edge of probe 2 signal.

60BDh **Position value of probe 2 falling edge**

Comm. address:	60BDh	Effective mode:	-
Min. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Value range:
-2147483648 to +2147483647
Description
Indicates the position feedback value (reference unit) latched at the falling edge of probe 2 signal.

60C1.01h **Interpolation displacement**

Comm. address:	60C1-01h	Effective mode:	Real time
Min. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Value range:
-2147483648 to +2147483647
Description
Sets the displacement reference in interpolation mode.
In interpolation mode, 60C1.01h must be set to synchronize PDO and the transmission type must be set to 1.
When each sync period reaches, the host controller sends a displacement reference to the slave.

60C2.01h **Interpolation period time constant**

Comm. address:	60C2-01h	Effective mode:	Real time

Min. value:	1	Unit:	-
Max. value:	20	Data type:	UInt16
Default value:	1	Change mode:	Real time

Value range:
1 to 20
Description
Defines the interpolation period time constant.
The synchronization cycle can be set only after the drive stops.

60C2.02h **Interpolation period time unit**

Comm. address:	60C2-02h	Effective mode:	Real time
Min. value:	-3	Unit:	-
Max. value:	-3	Data type:	Int8
Default value:	-3	Change mode:	Real time

Value range:
-3
Description
Defines the interpolation period time unit.
The value "-3" indicates that the unit is ms. Therefore, the actual interpolation period (ms) is the value of 60C2.01h.

60C5h **Maximum acceleration**

Comm. address:	60C5h	Effective mode:	Real time
Min. value:	0	Unit:	Reference unit/s²
Max. value:	4294967295	Data type:	UInt32
Default value:	4294967295	Change mode:	Real time

Value range:
0 to 4294967295
Description
Defines the maximum permissible acceleration of the acceleration segment in profile position mode, profile velocity mode, and homing mode.
The setpoint 0 will be forcibly changed to 1.

60C6h **Max. deceleration**

Comm. address:	60C6h	Effective mode:	Real time
Min. value:	0	Unit:	Reference unit/s²
Max. value:	4294967295	Data type:	UInt32
Default value:	4294967295	Change mode:	Real time

Value range:
0 to 4294967295
Description
Defines the maximum permissible deceleration of the deceleration segment in profile position mode, profile velocity mode, and homing mode.
The setpoint 0 will be forcibly changed to 1.

60D5h **Touch probe 1 rising edge counter**

Comm. address:	60D5h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Value range:
0x0 to 0xFFFF
Description
The counting value is added by "1" each time this object is triggered.

60D6h **Touch probe 1 falling edge counter**

Comm. address:	60D6h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Value range:
0x0 to 0xFFFF
Description
The counting value is incremented by "1" each time this object is triggered.

60D7h **Touch probe 2 rising edge counter**

Comm. address:	60D7h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Value range:
0x0 to 0xFFFF
Description
The counting value is added by "1" each time this object is triggered.

60D8h **Touch probe 2 falling edge counter**

Comm. address:	60D8h	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFF	Data type:	UInt16
Default value:	0x0	Change mode:	Read-only

Value range:
0x0 to 0xFFFF
Description
The counting value is incremented by "1" each time this object is triggered.

60E0h **Positive torque limit**

Comm. address:	60E0h	Effective mode:	Real time
Min. value:	0	Unit:	0.10%

Max. value:	4000	Data type:	UInt16
Default value:	3500	Change mode:	Real time

Value range:
0 to 4000
Description
Defines the maximum positive torque limit.

60E1h **Negative torque limit**

Comm. address:	60E1h	Effective mode:	Real time
Min. value:	0	Unit:	0.10%
Max. value:	4000	Data type:	UInt16
Default value:	3500	Change mode:	Real time

Value range:
0 to 4000
Description
Defines the maximum negative torque of the drive.

60F4h **Following error actual value**

Comm. address:	60F4h	Effective mode:	-
Min. value:	-2147483648	Unit:	Reference unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Value range:
-2147483648 to +2147483647
Description
Indicates the position deviation (reference unit).

60FCh **Position reference**

Comm. address:	60FCh	Effective mode:	-
Min. value:	-2147483648	Unit:	Encoder unit
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Read-only

Value range:
-2147483648 to +2147483647
Description
Indicates the position reference (encoder unit).
If no alarm is detected when the S-ON signal is active, the relationship between the position reference in reference unit and that in encoder unit is as follows:
60FCh (in encoder unit) = 6062h (in reference unit) × Electronic gear ratio (6091h)

60FDh **DI state**

Comm. address:	60FDh	Effective mode:	-
Min. value:	0x0	Unit:	-
Max. value:	0xFFFFFFFF	Data type:	UInt32

Default value:	0x0	Change mode:	Read-only

Value range:
0x0 to 0xFFFFFFFF
Description
Indicates the current DI logic of the drive.
0: Inactive
1: Active
The signal indicated by each bit is described as follows:
Bit signal
0: Reverse overtravel signal active
1: Forward overtravel signal active
2: Home signal active
3 to 15: N/A
16: DI1 input active
17: DI2 input active
18: DI3 input active
19: DI4 input active
20: DI5 input active
21: DI6 input active
22: DI7 input active
23: DI8 input active
24 to 26: N/A
27: STO1 signal input
28: STO2 signal input
29: EDM output active
30: Z signal active
31: N/A

60FFh **PV target velocity**

Comm. address:	60FFh	Effective mode:	Real time
Min. value:	-2147483648	Unit:	Reference unit/s
Max. value:	2147483647	Data type:	Int32
Default value:	0	Change mode:	Real time

Value range:
-2147483648 to +2147483647
Description
Defines the target speed in the 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

Description

Indicates the DO logic.

The signal indicated by each bit is described as follows:

Description of bits

0 to 15: N/A

16: Forced DO1 output (0: OFF; 1: ON), generating output only when DO function 31 is assigned and bit16 of 60FE.02 is set to 1

17: Forced DO2 output (0: OFF; 1: ON), generating output only when DO function 31 is assigned and bit17 of 60FE.02 is set to 1

18: Forced DO3 output (0: OFF; 1: ON), generating output only when DO function 31 is assigned and bit18 of 60FE.02 is set to 1

19: Forced DO4 output (0: OFF; 1: ON), generating output only when DO function 31 is assigned and bit19 of 60FE.02 is set to 1

20: Forced DO5 output (0: OFF; 1: ON), generating output only when DO function 31 is assigned and bit20 of 60FE.02 is set to 1

21 to 25: N/A

26: P/PI switched during gain switchover, active only when bit26 of 60FE.02 is set to 1

27 to 31: N/A

60FE.02h **Physical output selection**

Comm. address:	60FE-02h	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

Description

0 to 15: N/A

16: Forced DO1 output enable

17: Forced DO2 output enable

18: Forced DO3 output enable

19: Forced DO4 output enable

20: Forced DO5 output enable

19 to 25: N/A

26: P/PI switchover enable

27 to 31: N/A

18 Safety Parameters

18.1 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.

18.2 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.

18.3 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.

H20.70 **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.

19 Troubleshooting

19.1 Fault Levels and Display

Faults and alarms of the servo drive are divided into three levels based on severity: No. 1 > No. 2 > No. 3, as shown below.

- No. 1 non-resettable fault
- No. 1 resettable fault
- No. 2 resettable fault
- No. 3 resettable alarm

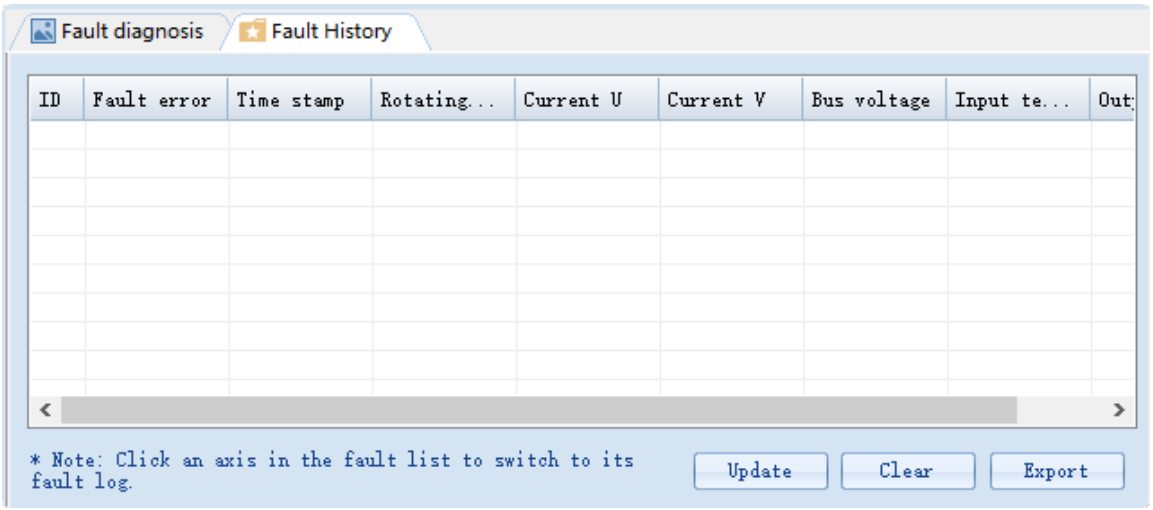
Note

"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

19.2 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

19.3 Troubleshooting

19.3.1 List of Fault Codes

No.1 non-resettable faults:

Table 19–1 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
E101.4	Error in upper and lower limits check during safety parameter initialization	1	No	0x0101	0x41010101

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Auxiliary code (203Fh)
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
E140.1	MCU key calculation failed	1	No	0x0140	0x02400140
E140.4	The signature verification fails.	1	No	0x0140	0x03400140
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

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Auxiliary code (203Fh)
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	A gantry communication CRC error occurs.	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
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

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Auxiliary code (203Fh)
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
EEE0.0	The gantry pairing axis is faulty.	1	No	0x0EE0	0x0EE00EE0

No.1 resettable faults:

Table 19–2 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

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Auxiliary code (203Fh)
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
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

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Auxiliary code (203Fh)
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 opening anomaly	1	Yes	0x0243	0x02430243
E243.1	Brake closing anomaly	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
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

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Auxiliary code (203Fh)
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
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
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 over-temperature	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

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Auxiliary code (203Fh)
E939.0	Motor power cable disconnected	1	Yes	0x0939	0x09390939
EB00.0	Excessive position deviation	1	Yes	0x8611	0x0B000B00

No.2 resettable faults

Table 19–3 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
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

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Auxiliary code (203Fh)
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
E994.0	Station No. conflict	2	Yes	0x0994	0x09940994
EB00.1	Position deviation overflow	2	Yes	0x8611	0x1B000B00
EB01.0	Position reference increment too large	2	Yes	0x6320	0x0B010B01
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
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
ED03.0	CANlink disconnected	2	Yes	0x0D03	0x0D030D03
ED04.0	CANopen communication timeout	2	Yes	0x0D04	0x0D040D04
ED05.0	CANopen communication initialized	2	Yes	0x0D05	0x0D050D05
ED08.0	CANopen bus PDO transmission length error	2	Yes	0x0D08	0x0D080D08
ED11.0	CANopen sync cycle error too large	2	Yes	0x0D11	0x0D110D11
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

19.3.2 List of Alarm Codes

Alarm

Table 19–4 Alarm List

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Auxiliary code (203Fh)
E108.0	Storage parameter write error	3	Yes	0x5530	0x01080108
E108.1	Storage parameter read error	3	Yes	0x5530	0x11080108
E108.2	Verification error on the data written to EEPROM	3	Yes	0x5530	0x21080108
E108.3	Verification error on data read from EEPROM	3	Yes	0x5530	0x31080108
E108.4	A single piece of data is stored too many times	3	Yes	0x0108	0x41080108
E108.5	Safety module EEPROM write timeout	3	Yes	0x0108	0x51080108
E108.6	Safety module EEPROM read timeout	3	Yes	0x0108	0x61080108
E108.7	Safety module EEPROM write check error	3	Yes	0x0108	0x71080108
E108.8	Safety module EEPROM read check error	3	Yes	0x0108	0x81080108
E110.0	Frequency-division pulse output setting error	3	Yes	0x0110	0x01100110
E115.0	SSM parameter setting error alarm	3	Yes	0x0115	0x01150115
E116.0	SLS speed limit violation alarm	3	Yes	0x0116	0x01160116
E116.1	SDI tolerance limit violation alarm	3	Yes	0x0116	0x11160116
E120.3	Drive and motor power not match	3	Yes	0x7122	0x31200120
E121.0	Invalid S-ON command	3	Yes	0x0121	0x01210121
E126.3	PR process segment parameter outside the upper/lower limit	3	Yes	0x0126	0x31260126
E244.0	Abnormal input torque reference	3	Yes	0x0244	0x02440244
E244.1	An error occurs during internal torque/ speed limit calculation	3	Yes	0x0244	0x12440244
E247.0	Torque saturation alarm	3	Yes	0x0247	0x02470247
E510.0	Frequency division pulse output overspeed	3	Yes	0x0510	0x05100510
E600.0	Inertia auto-tuning failure	3	Yes	0x0600	0x06000600
E601.0	Homing alarm	3	Yes	0x0601	0x06010601
E601.1	Homing switch error	3	Yes	0x0601	0x16010601
E601.2	Homing mode setting error	3	Yes	0x6320	0x26010601
E601.3	Position feedback alarm	3	No	0x0601	0x36010601
E601.4	Gantry homing mode setting error	3	Yes	0x0601	0x46010601
E602.9	Angle auto-tuning not performed on incremental encoder	3	Yes	0x0602	0x96022602
E607.0	Excessive gantry torque deviation	3	Yes	0x0607	0x06070607

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Auxiliary code (203Fh)
E608.0	Incorrect master-to-slave parameter setting	3	Yes	0x0608	0x06080608
E609.0	Data storage timeout	3	Yes	0x0609	0x06090609
E609.1	Data storage overflow	3	Yes	0x0609	0x16090609
E609.2	Data storage failure	3	Yes	0x0609	0x26090609
E609.3	Data erasure failure	3	Yes	0x0609	0x36090609
E621.1	Overload current limit torque reached	3	Yes	0x0621	0x16210621
E631.4	P-MOS short circuit	3	Yes	0x0631	0x46310631
E631.5	N-MOS short circuit	3	Yes	0x0631	0x56310631
E730.0	Encoder battery alarm	3	Yes	0x7305	0x07300730
E730.1	Inovance secondary encoder battery undervoltage	3	Yes	0x7305	0x17300730
E831.1	Excessive AI1 zero offset	3	Yes	0x0831	0x18310831
E831.2	Excessive AI2 zero offset	3	Yes	0x0831	0x28310831
E834.1	AI1 overvoltage alarm	3	Yes	0x0834	0x18340834
E834.2	AI2 overvoltage alarm	3	Yes	0x0834	0x28340834
E900.0	DI emergency braking	3	Yes	0x0900	0x09000900
E902.0	Invalid DI/VDI setting	3	Yes	0x6320	0x09020902
E902.1	Invalid DO/VDO setting	3	Yes	0x0902	0x19020902
E902.2	Invalid torque arrival setting	3	Yes	0x0902	0x29020902
E909.0	Motor overload alarm	3	Yes	0x3230	0x09090909
E910.0	Control circuit overvoltage	3	Yes	0x3210	0x09100910
E920.0	Braking resistor overloaded	3	Yes	0x3210	0x09200920
E921.0	Dynamic braking resistor overload alarm	3	Yes	0x3210	0x09210921
E922.0	Excessively low resistance of the external braking resistor	3	Yes	0x6320	0x09220922
E924.0	Braking transistor over-temperature	3	Yes	0x3230	0x09240924
E940.0	The controlled motor changes. It is recommended to restore default values before use.	3	Yes	0x0940	0x09400940
E941.0	Modified parameters activated at next power-on	3	No	0x6320	0x09410941
E942.0	Parameter stored too frequent	3	Yes	0x7600	0x09420942
E950.0	Forward overtravel	3	Yes	0x5443	0x09500950
E952.0	Reverse overtravel	3	Yes	0x5444	0x09520952
E954.0	Position reference overflow	3	Yes	0x0954	0x09540954
E956.0	Forward position reference overtravel in process segment position mode	3	Yes	0x0956	0x09560956
E958.0	Reverse position reference overtravel in process segment position mode	3	Yes	0x0958	0x09580958

Fault code	Fault name	Fault level	Resettable	Error code (603Fh)	Auxiliary code (203Fh)
E971.0	Undervoltage alarm from voltage drop protection	3	Yes	0x0971	0x09710971
E980.0	Frequency-division output overflow	3	Yes	0x0980	0x09800980
E990.0	Pulse input overspeed alarm	3	Yes	0x0990	0x09900990
E991.1	SIGN pulse connection error	3	Yes	0x0991	0x19910991
EA34.9	Missing Hall configurations during Hall auto-tuning	3	Yes	0x0A34	0x9A340A34
EA41.0	Torque fluctuation compensation failure	3	Yes	0X0A41	0x0A410A41

19.3.3 Description of Fault Codes

19.3.3.1 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.

Cause	Verification method	Solution
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.
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 panel is 9). 2. Check whether the FGPA version of H01.01 is 9xx.x (the 4th digit on the panel is 9).	Contact Inovance for technical support. Update the FPGA or MCU software.

E104.1: MCU operation timeout (MCU crashed)

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 SV680P 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 SV680P series servo drive and a 26-bit servo motor 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:

Process segment number error

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:

Internal operation mode error of the process segment

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:

Position reference type error in process segment position 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.	Observe whether the difference lasts for a period of time 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.	Observe 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.	Observe 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 SV680P series servo drive and servo motor are used.	Replace the servo drive and motor.
2. A parameter check error occurs, or no parameter is saved in the serial incremental encoder ROM.	1. Check whether the encoder cable provided by Inovance is used. Cables are connected securely without scratching, breaking or poor contact on both ends. 2. Measure signals PS+, PS-, +5V and GND on both ends of the encoder cable and observe whether signals at both ends are consistent. For signal assignment, see Chapter "Wiring" in the hardware guide.	1. Use the encoder cable provided by Inovance. Ensure motor terminals are connected securely and servo drive screws are tightened properly. Use a new encoder cable if necessary. 2. Route encoder cables and power cables (R/S/T, U/V/W) through different routes.
3. The drive is faulty.	The fault persists after the servo drive is restarted.	Replace the servo drive.

E136.1: Encoder ROM motor parameter read error

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 dimension 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:

Accuracy compensation data error

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:

Cogging fluctuation compensation data check failure

Troubleshooting:

Cause	Verification method	Solution
1. The cogging fluctuation compensation data is lost, leading to check failure. 2. The 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:

Gantry synchronization compensation data check 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:

Overload compensation data check 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.

E140.1: MCU key calculation failed

Fault cause:

The encryption integrated circuit version is not correct.

Troubleshooting:

Cause	Verification method	Solution
The communication between the MCU and encryption integrated circuit is abnormal.	Check whether the fault persists after restart.	Contact the manufacturer to re-program the encryption software.

E140.4: Signature verification failure

Fault cause:

The encryption integrated circuit signature verification failed.

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.

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 alarm occurs.

Troubleshooting:

Cause	Verification method	Solution
The 5 V voltage supplied to the STO Buffer is abnormal due to undervoltage or overvoltage.	Check whether the fault can be removed by a restart. If not, the 5V voltage supplied to the buffer is abnormal.	Replace the servo drive.

E150.3: STO input circuit hardware diagnosis failure

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
1. 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:

SCI communication error between two MCUs of the safety module

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
1. The servo drive is faulty.	Switch off the S-ON signal and rotate the motor shaft manually. Check whether the value of H0b.17 (Electrical angle) changes as motor shaft rotates. Disconnect the motor cables and check whether the fault persists at next power-on.	Replace the servo drive.

E203.0: Current feedback closed-loop error of the power cable

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
1. 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 sizes C/D/E exceeds 1/4 of the value of H01.07.
3. Overcurrent occurs on phase P and phase N of drives in size 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 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 occurrence of the 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 off and on again.
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 too heavy. 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 properly through H07.09/H07.10 or P models, or 60E0h/60E1h/6072h for N models. 2. Check whether the motor load is excessive due to mechanical factors. 3. Reduce the acceleration/ deceleration speed or operating speed. 4. Re-calculate the device power rating needed. 5. Increase the runaway threshold properly or mask this fault without affecting safety performance and operation.
2: Abnormal collision, triggering a runway false alarm.	Check whether a collision occurs on site. If yes: 1. Check whether 607Ah and 6064h are not aligned in the host controller program and whether the host controller commands jump abnormally. 2. Check whether the electronic gear ratio of the drive is excessively high. 3. Check whether the host controller instructions are planned properly and whether the trajectory overlaps with other mechanisms. 4. For DB-free models, check whether the stop distance at zero speed is too large. 5. Check whether the motor runs beyond the specifications, resulting in excessively long deceleration distance.	1. Align 607Ah and 6064h to avoid data error. This parameter applies to the CSP mode of the N model and the IP mode of the C model. 2. Set a proper electronic gear ratio. 3. Optimize the instruction planning of the host controller or increase the safety distance between mechanisms. 4. For models without dynamic brake, you can install a dynamic brake box or decrease the safety distance for stop at zero speed. 5. Reduce the acceleration/ deceleration speed and operating speed to avoid operation beyond specifications, or re-calculate the device power rating needed.
3. The gravity load in vertical axis scenarios is too large, triggering a runway false alarm.	Check whether the load of the vertical axis is too heavy. 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 hide 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. Damaged power cable.	Check whether the power cable is aged, corroded, connected loosely, or broken.	Re-solder, tighten, or replace the power cable.
8. Damaged motor or drive.	Check whether the motor and drive are damaged. Perform cross-verification to check whether the fault follows.	Replace the motor or drive.

E240.0: Excessive deviation between the observed value and feedback values of the electrical angle

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: Incorrect feedback value from the encoder. 3. Observation alarms are enabled during angle auto-tuning. During angle auto-tuning, excessive deviation is observed if the speed threshold condition is met. 4. The observed deviation during acceleration/deceleration is large. 5. Large deviations in the inductance and resistance parameters of the motor, reducing the angle observation accuracy. 6. Unstable loop operation caused by improper gain parameter settings, reducing the electrical angle observation accuracy.	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 observation 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 opening anomaly

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 whether the brake is wired properly. If the load is not the cause for this error, replace the motor.

E243.1: Brake applied improperly

Fault cause:

Brake closing anomaly

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 too heavy and the motor is running out of specification.	1. Reduce the acceleration/ deceleration rate as appropriate. 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 hard limit signal is wired to the incorrect terminal.	Check whether the hard limit signal is connected to the correct terminal.	Wire the limit signal to the correct terminal.

E308.0: Pulse encoder phase A disconnected

Fault cause:

Pulse encoder phase A 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 wiring of the encoder. 2. Check whether the motor code (H00.00) is set properly or matches the actual encoder type.	1. Re-connect the encoder and perform a restart. 2. Check whether the motor code (H00.00) is set properly or matches the actual encoder type.

E308.1: Pulse encoder phase B disconnected

Fault cause:

Pulse encoder phase B disconnected

Troubleshooting:

Cause	Verification method	Solution
The encoder phase B is connected improperly.	Check the encoder wiring.	Re-connect the encoder and perform a restart.

E308.2: Phase Z of the pulse encoder disconnected (no alarm reported for the encoder without Z)

Fault cause:

Pulse encoder phase Z disconnected (no alarm reported for encoders without phase Z)

Troubleshooting:

Cause	Verification method	Solution
1. The encoder phase Z is connected improperly. 2. The encoder type is set improperly. Only phases A and B of the encoder are used.	1. Check whether Z signal is wired properly. 2. Check whether there is Z signal output.	1. Perform wiring again. 2. Re-install the motor and select phase A/B encoder in the encoder configuration interface.

E320.0: braking resistor overload

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 excessively high bleeder current. 2. Check whether the motor is being driven by external force, leading to excessively high bleeder current. 3. Replace the servo drive.

E320.1: Enclosure temperature of the braking resistor excessively high

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 excessively high bleeder current. 2. Check whether the motor is being driven by external force in the reverse direction, leading to excessively high bleeder current. 3. Replace the servo drive.

E321.0: Dynamic brake resistor overload

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 correctly 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.

E605.0: Motor overspeed upon S-ON

Fault cause:

The motor speed exceeds the rated speed when the servo drive in sizes 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 H14.30.	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 correctly 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. 1. The current feedback cannot reach the reference value because the motor power cables are disconnected or in poor contact.	Check whether the motor power cables are disconnected or in poor contact.	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 servo drive model (H01.10) and motor model properly according to section "Servo Drive Model and Nameplate" in SV680P-INT Series Servo Drive Hardware Guide.
6. The motor is stalled due to mechanical problems, resulting in excessive load during operation.	Check the reference and motor speed (H0b.00) through the software tool or 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 powered off and on again.	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) keeps exceeding 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.	Replace with a servo drive of higher capacity and a matching servo 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 restart.	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 too large, 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.

E994.0: Station number conflict

Fault cause:

CANlink station number conflict

Troubleshooting:

Cause	Verification method	Solution
CANlink station number conflict	Check the setpoint of H0E.00.	Rectify the value of H0E.00.

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. 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.	CSP: 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) References in torque control mode: H0b.02 (Internal torque reference) Check whether the operation reference is not 0, but the motor speed is 0 in the corresponding mode.	Eliminate mechanical factors.
4. The servo drive gains are too low.	Check the position loop gain and speed loop gain of the drive: 1st gain set: H08.00 to H08.02; 2nd gain set: H08.03 to H08.05	Adjust the gain values manually or perform gain auto-tuning.
5. The position reference increment is excessive.	Position control mode: In CSP mode, check the gear ratio 6091.01h/6091.02h to determine the position reference increment for an individual synchronization period and convert it to 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.	CSP: 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.

EB01.0: Position reference increment too large

Fault cause:

Position reference increment too large

Troubleshooting:

Cause	Verification method	Solution
The pulse reference increment exceeds the excessive reference threshold three times consecutively.	Check whether the baud rate of pulse reference input exceeds the value of H0A.09.	1. Increase the value of H0A.09. 2. Reduce the baud rate of pulse input.

EB01.1: Individual position reference increment too large

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 enabling 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 enabling 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.

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 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
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.

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 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 if the electronic gear ratio 1 is within the range of 0.001–4000 × Encoder resolution ÷ 10000.	Change the values of H05.07 and H05.09.

EB03.2: Electronic gear ratio 2 beyond the limit

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.

ED03.0: CANlink communication failure

Fault cause:

The master is offline.

Troubleshooting:

Cause	Verification method	Solution
The master is offline.	1. Increase the heartbeat threshold of the master. 2. Check the wiring of components.	Capture frames to ensure that the master station is online.

ED04.0: CANopen communication timeout

Fault cause:

The slave reaches the time configured by the consumer or the node guarding time.

Troubleshooting:

Cause	Verification method	Solution
The slave reaches the time configured by the consumer or the node guarding time.	Check whether the heartbeat frame cycle of the host controller is normal by frame grab.	Check whether all CAN nodes are online, or check the CANopen configuration, and reset the node or communication.

ED05.0: CANopen communication initialized

Fault cause:

After the motor is enabled, errors such as slave offline, heartbeat abnormal, load ratio too high, data frame loss, and false master reset occurred when NMT changes to the initialization state.

Troubleshooting:

Cause	Verification method	Solution
After the motor is enabled, errors such as slave offline, heartbeat abnormal, load ratio too high, data frame loss, and false master reset occurred when NMT changes to the initialization state.	Check whether the reset frame is received during operation by capturing frames.	Reset the NMT node. When changing the NMT, disable the output stage. 1. Use shielded cables to prevent interference. 2. Ensure the drive is grounded properly. 3. Ensure the load rate is proper. 4. Ensure the set suppression time is correct if asynchronous transmission is configured. 5. Ensure the reset frame is not triggered inadvertently by the host controller. 6. Ensure the termination resistor is installed.

ED08.0: CANopen bus PDO transmission length error

Fault cause:

The length of the content transmitted by the PDO is inconsistent with the mapping length during configuration.

Troubleshooting:

Cause	Verification method	Solution
The length of the content transmitted by the PDO is inconsistent with the mapping length during configuration.	Check whether the PDO transmission length is consistent with the configuration by capturing frames.	Re-configure the PDO and reset the node or communication.

ED11.0: CANopen sync period error too large

Fault cause:

The sync cycle error exceeds the setpoint.

Troubleshooting:

Cause	Verification method	Solution
The sync cycle error exceeds the setpoint.	Sample the synchronization signal through the software tool and calculate whether the period is higher than the fault threshold.	Check the settings of 60C2.01h and 60C2.02h and ensure the synchronization period is set properly. Ensure the synchronization cycle of the host controller is set correctly and consistent with the setting of 60C2h. Check the wiring between the slave and the master.

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 set electronic gear ratio exceeds the preceding range.	The gear ratio 6091.01h/6091.02h exceeds the preceding range.	Keep the gear ratio within the preceding range.

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.

19.3.3.2 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

19.3.4 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 off and on the drive again, 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 off and on the drive again, 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 off and on the drive again, 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 off and on the drive again, 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 hex). 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 off and on again to check whether the new safety parameter settings take effect.	1. Power off and restart, and retry to modify the parameters. 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 off and on again to check whether parameters can be read.	1. Power off and restart, and retry to read the parameters. 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 off and on again 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:

PR process segment parameter outside the upper/lower limit

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 input torque reference is abnormal.	1. Adjust the input torque reference. 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 too heavy and the motor is running out of specification.	1. Reduce the acceleration/ deceleration rate as appropriate. 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...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.	1. The torque jitters upon stop at internal detection (not FFT). 2. 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 at reverse speed applies.	If a hardware DI is used, check whether the corresponding DI function is allocated to a certain DI in group H03 and check the wiring of this DI. Change the DI logic manually and observe the value of H0b.03 (monitored DI status) to monitor whether the servo drive receives corresponding DI level changes. If the home signal is Z signal, but it cannot be found, check the condition of the Z signal.
2. The home-searching time is too short.	Check whether the value of H05.35 is excessively low.	Increase the value of H05.35.
3. The speed for homing ON/OFF 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 a wrong homing mode (H05.31).	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 shielded twisted pairs and shorten the circuit length. Increase AI1 input filter time.
2. The servo drive is faulty.	Disconnect AI1 and measure whether the actual terminal voltage exceeds 0.5 V.	If not, replace the drive.

E831.2: AI2 zero offset too large

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 shielded twisted pairs and shorten the circuit length. Increase 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 shielded twisted pairs and shorten the circuit length. Increase AI1 input filter time.
2. The input voltage is too high.	Measure whether the actual terminal voltage exceeds 11.5 V.	Adjust the input voltage to a value lower than 11.5 V.

E834.2: AI2 overvoltage

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 shielded twisted pairs and shorten the circuit length. Increase AI2 input filter time.
2. The input voltage is too high.	Measure whether the actual terminal voltage exceeds 11.5 V.	Adjust the input voltage to a value lower than 11.5 V.

E900.0: DI emergency braking

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 correct servo drive model (H01.10) and motor model.
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 SV680P-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.

Cause	Verification method	Solution
6. The input voltage of the main circuit exceeds the specifications.	Measure whether the main circuit input voltage on the drive side complies with the following specifications: 200 V servo drive: Valid value: 200 V to 240 V Allowable deviation: -10% to +10% (180 V to 264 V) 400 V servo drive: Valid value: 380V to 480V Allowable deviation: -10% to +10% (342 V to 528 V)	Replace or adjust the power supply according to the specified range.
7. The load moment of inertia ratio is excessively high. 8. The motor speed is excessively high and deceleration is not done within the set time. The motor is in the continuous deceleration status during cyclic operation. 9. The capacity of the drive or braking resistor is not sufficient.	1. Perform inertia auto-tuning or calculate total mechanical inertia according to mechanical parameters. Check whether the actual load inertia ratio exceeds 30. For details, see *" Inertia Auto-Tuning" on page 257*. 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 (allowed minimum resistance of external braking resistor).

Troubleshooting:

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

E924.0: Braking transistor overtemperature

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:

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 off and on again.

E942.0: Frequent parameter storage

Fault cause:

The number of parameters modified at a time exceeds 700.

Troubleshooting:

Cause	Verification method	Solution
Too many parameters are modified and saved to EEPROM at a brief interval.	Check whether parameters are modified through the host controller at a brief interval.	Check the operation mode. For parameters that need not be saved to EEPROM, set H0E.01 properly.

E950.0: Forward overtravel alarm

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 software position limit is set in H0A.01.	Use proper servo drive references to ensure the load travel range is within the software position limit.

E952.0: Reverse overtravel alarm

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 software position limit is set in H0A.01.	Use proper servo drive references to ensure the load travel range is within the software position limit.

E954.0: Position command overflow

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.

E990.0: Pulse input overspeed alarm

Fault cause:

A pulse input overspeed alarm is reported.

Troubleshooting:

Cause	Verification method	Solution
The pulse position reference keeps exceeding the maximum speed for a period longer than the time threshold of excessive pulse position reference increment.	Check whether the input pulse frequency is too high.	Reduce the frequency to a value below 4 M.

E991.1: SIGN pulse connection error

Fault cause:

If 24V is connected to SIGN+ and 0V to SIGN- without a current limiting resistor, a high current may be generated between SIGN+ and SIGN-, leading to voltage on the sensing resistor, triggering an alarm.

Troubleshooting:

Cause	Verification method	Solution
Pulse SIGN input voltage too high	1. Check the wiring of SIGN+ and SIGN- to confirm whether the current-limiting resistor is connected. 2. Check the 24 V power supply voltage to confirm whether the specified input range has been exceeded. 3. Measure the voltage between SIGN+ and SIGN- to confirm whether the voltage measured exceeds 24 V or near 24 V.	1. Check the wiring of SIGN+ and SIGN-. The current-limiting resistor must be connected. 2. Check the power supply voltage for SIGN+ and SIGN-. If the voltage is too high, use a power supply within 24 V.

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.

20 Maintenance

20.1 Maintenance Period

The electrical and electronic parts inside the servo drive and motor may be mechanically worn out and degraded. To keep the servo drive and servo motor in good condition, perform parts replacement based on the following table. Before replacement, contact the agent or Inovance first to check whether the components need to be replaced.

Object	Item	Standard replacement cycle	Description
Drive	Power bus capacitor	About 8 years (ambient temperature: 30°C; load rate: 80%; uptime per day: 20 hours; standard environment[1])	The standard replacement interval is for reference only. If any device or component works improperly before the replacement cycle expires, replace it immediately.
	Number of cooling fans	About 5 years (ambient temperature: 30°C; load rate: 80%; uptime per day: 20 hours; standard environment[1])	
	Control circuit aluminum electrolytic capacitor	About 10 years (ambient temperature: 30°C; load rate: 80%; uptime per day: 20 hours; standard environment[1])	
	Pre-charge relay	About 100,000 operations (depending on the operating conditions)	
	Pre-charge resistor	About 20,000 operations (depending on the operating conditions)	
	Dynamic brake relay	About 1,000 operations (rated motor speed; interval: 5 min; inertia: 20)	
	Dynamic brake resistor		
Motor	Bearing	22,000 to 40,000 hours	The standard replacement interval is for reference only. If any device or component works improperly before the replacement cycle expires, replace it immediately.
	Fan	30,000 to 40,000 hours	
	Encoder	22,000 to 40,000 hours	
	Encoder battery	22,000 to 40,000 hours	
	Insulation resistance	Check the insulation resistance at least once per year.	Use an insulation resistance gauge (set to 500 VDC) to measure the insulation resistance. Measurement method: Measure the resistance between the PE (grounding) and any phase among U/V/W. The resistance measured should be higher than 10 MΩ.
Device	Overall inspection	Perform overall inspection at least once every five years or every 20,000 hours, whichever comes first.	Perform maintenance based on the related maintenance guide of the equipment.

Note

[1]: For details on the standard environment, see *"5.2.2 Installation Environment" on page 68*.

20.2 Daily Maintenance and Inspection

20.2.1 Routine Maintenance Items

The standard environmental conditions are as follows: average ambient temperature: 30°C; average load rate: < 80%; uptime: < 20 hours per day

Routine checklist

Table 20–1 Routine checklist

No.	Routine checklist	Tick
1	The ambient temperature and humidity are normal. There is no dust or unwanted objects in the servo drive.	☐
2	There is no abnormal vibration or noise.	☐
3	The voltage of the power supply is normal.	☐
4	There is no strange smell.	☐
5	There are no fibers adhered to the air inlet.	☐
6	There is no intrusion of unwanted objects on the load end.	☐
7	The brake circuit is functioning properly. The control circuit is not loose or showing any other abnormalities, such as blackening or melting. Perform a separate brake functional test to verify that the brake operates normally.	☐

Routine cleaning list

Table 20–2 Routine cleaning list

No.	Routine cleaning list	Tick
1	Clean the dust on the equipment surface, especially the metallic dust.	☐
2	Keep the front end of the servo drive and the connectors clean.	☐

Note

- Before cleaning, switch off the power supply and clean with an air gun or a piece of dry cloth.
- Do not use gasoline, dilutes, alcohol, or acid or alkaline detergent to prevent enclosure discolor or damage.

20.2.2 Periodic Inspection Items

Table 20–3 Periodic checklist

No.	Item	Yes
1	The screws used to fix the couplings between devices are in place.	☐
2	There is no sign of overheating.	☐
3	Terminal blocks are in good condition without any sign of damage.	☐
4	The clamping units of terminal blocks are in place.	☐

20.3 Replacing Components

20.3.1 Replacing the Drive

Caution

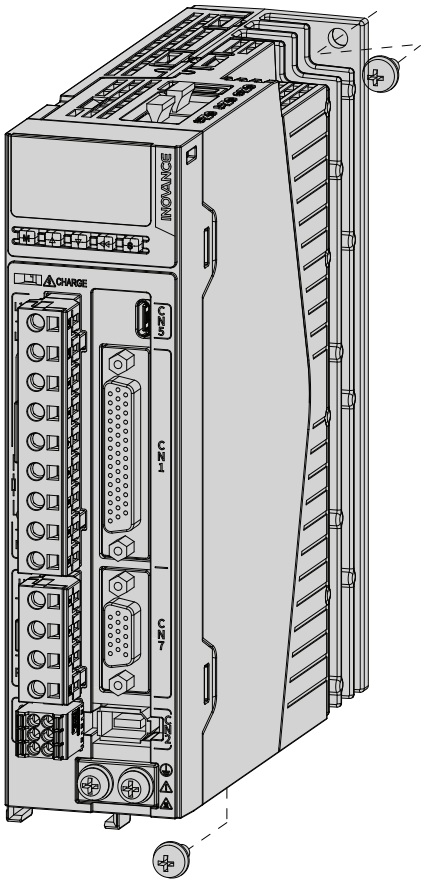
- Note that the drive is energized with high voltage. All the wiring work can be performed with power off only.
- Before maintenance, power off and wait for at least 15 minutes until the voltage of drive is lower than 36 VDC. Failure to comply may result in personal injury caused by the residual voltage in the capacitor.
- Only trained professionals are allowed to perform inspection and maintenance on the drive. Failure to comply may result in severe personal injury, death, or major property loss.
- Even if the motor is not running, the power supply and terminals may still be live due to presence of an external power supply. Be careful when you operate with the equipment.
- Take cautious when handling heavy equipment or equipment with high center of gravity. Improper lifting or handling may result in death, serious personal injury, or major property loss.

Procedure

1. Disconnect the drive power supply.
2. 15 minutes after power-off, check whether the drive voltage is lower than 36 VDC.
3. Remove all cables from the drive.
4. Remove the two M4 screws that secure the drive and take off the drive.

   Note:

   - Servo drives in sizes A and C are secured by two screws, with one screw on the top and the other one at the bottom.
   - Drives in size D are secured by three screws, with two screws on the top and another one at the bottom.
   - Drives in size E are secured by four screws, with two screws on the top and the other two at the bottom.



5. Install the drive and secure it with two M4 screws. The recommended torque is 1.2 N·m. After the drive is installed, check the items on the checklist. For details about mechanical installation and the post-installation checklist, see *" Install" on page 66*.
6. Re-connect the cables and check the items according to the post-installation checklist. For details about electrical installation and the post-wiring checklist, see *" Wiring" on page 88*.
7. Connect the power supply of the drive.
8. Perform a complete commissioning with the commissioning tool. For details about the commissioning tool and commissioning procedure, see chapters "Commissioning Tools" and "Commissioning and Operation".

20.3.2 Replacing the Motor Flat Key

Caution

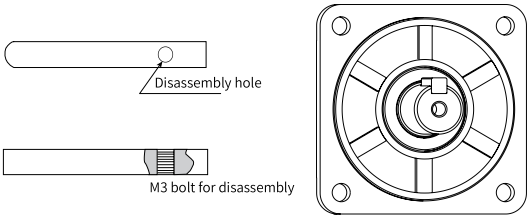
- Observe all the requirements presented in this chapter. Failure to comply may result in equipment fault or damage.
- Violent disassembly is not allowed. Take enough care during disassembly to prevent personal injury.

Standard MS1 series motors in flange sizes 60, 80, and 130 adopt the C-type flat key that carries a disassembly hole. To disassemble the flat key, select a proper disassembly bolt (inner hexagon bolt recommended) based on the following table.

Specification of the key disassembly bolt		
Motor size	Flat key size (unit: mm)	Specifications of the disassembly bolt (Inner hexagon bolt)
Size 40	Type-A/B flat key–3×3×14	-
Frame size 60	Type-C flat key–C5 × 5 × 16.5	M3 × 10 and above
Size 80	Type-C flat key–C6 × 6 × 25	M3 × 15 and above
Size 100	Type-C flat key–C8 × 7 × 35	M3 × 20 and above
Size 130	Type-C flat key–C8 × 7 × 35	M3 × 20 and above
Size 180	Type-C flat key–C10 × 8 × 64	M3 × 20 and above

- Tool needed: an Allen wrench
- Removal procedure:

  1. Select a proper disassembly bolt (inner hexagon bolt recommended) based on the motor model.
  2. Use an Allen wrench to screw down the screw until the A-A end of the flat key is detached from the keyway, as shown below.



21 Servo Technical Specifications

21.1 Electrical Specifications

- Electrical specifications of single-phase 200 V drives

Item		Size A		Size C		Size D
Drive model		S1R6	S2R8	S5R5	S7R6	S012
Servo drive power (kW)		0.2	0.4	0.75	1.0	1.5
Max. applicable motor capacity (kW)		0.2	0.4	0.75	1.0	1.5
Power supply capacity (kVA)		1.4	2.8	4.6	6.0	8.0
Continuous output current (Arms)		1.6	2.8	5.5	7.6	12.0
Max. output current (Arms)		5.8	10.1	16.9	23.0	32.0
Main circuit	Continuous input current (Arms)	2.3	4.0	7.9	9.6	12.8
	Main circuit power supply	Single-phase 200 VAC to 240 VAC, -10% to +10%, 50 Hz/60 Hz				
	Heat generation (W)[1]	12	23.8	38.2	47.32	69.84
Control circuit	Control circuit power supply	Single-phase 200 VAC to 240 VAC, -10% to +10%, 50 Hz/60 Hz				
	Heat generation (W)[2]	16				
Control circuit backup power circuit[3]	Power input range	24 VDC±15% (powered by SELV/PELV[4] power supply)				
	Power of external power supply	≥ 50 W				
Braking resistor	Resistance (Ω)	Optional	Optional	50	25	25
	Power (W)	Optional	Optional	50	80	80
	Min. allowable resistance of external braking resistor (Ω)	40	40	40	20	15
	Maximum braking energy absorbed by capacitor (J)	9.3	18.59	32.42	32.42	47.68
	Braking resistor	All models support built-in and external braking resistors. Only drives in size A do not come with a built-in braking resistor as standard.				
Cooling method		Naturally-ventilated		Air cooling		
Overvoltage category		III				
Max. input surge current at power-on (A)		18.65	18.65	9.325	9.325	12.433
3T (ms) (3 x RC time constant[5])		23.4	46.8	163.2	163.2	180

Note

- The main circuit of S1R6, S2R8, S5R5, S7R6, and S012 servo drives support single-phase 200 V power supplies without derating.
- The maximum braking energy that can be absorbed by capacitors is calculated based on the rated input of 220 VAC.

- Electrical specifications of three-phase 200 V drives

Item		Size A		Size C		Size D	Size E		
Drive model		S1R6	S2R8	S5R5	S7R6	S012	S018	S022	S027
Servo drive power (kW)		0.2	0.4	0.75	1.0	1.5	2.0	3.0	5.0
Max. applicable motor capacity (kW)		0.2	0.4	0.75	1.0	1.5	2.0	3.0	5.0
Power supply capacity (kVA)		1.21	2.42	3.84	5.05	6.68	8.33	10.42	20.08
Continuous output current (Arms)		1.6	2.8	5.5	7.6	12.0	18.0	22.0	27.0
Max. output current (Arms)		5.8	10.1	16.9	23.0	32.0	45	55	67.5
Main circuit	Continuous input current (Arms)	1.1	2.3	4.4	5.1	8.0	8.7	11.0	23.8
	Main circuit power supply	Three-phase 200 VAC to 240 VAC, -10% to +10%, 50 Hz/60 Hz							
	Heat generation (W)[1]	12	23.8	38.2	47.32	69.84	120	125	200
Control circuit	Control circuit power supply	Single-phase 200 VAC to 240 VAC, -10% to +10%, 50 Hz/60 Hz							
	Heat generation (W)[2]	16							
Control circuit backup power circuit[3]	Power input range	24 VDC±15% (powered by SELV/PELV[4] power supply)							
	Power of external power supply	≥ 50 W							
Braking resistor	Resistance (Ω)	Optional	Optional	50	25	25	20	20	20
	Power (W)	Optional	Optional	50	80	80	100	100	100
	Min. allowable resistance of external braking resistor (Ω)	40	40	40	20	15	20	20	20
	Maximum braking energy absorbed by capacitor (J)	9.3	18.59	32.42	32.42	47.68	78.19	114.43	114.43
	Braking resistor	All models support built-in and external braking resistors. Only drives in size A do not come with a built-in braking resistor as standard.							
Cooling method		Naturally-ventilated		Air cooling					
Overvoltage category		III							
Max. input surge current (A)		18.65	18.65	9.325	9.325	12.433	12.433	12.433	12.433
3T (ms) (3 x RC time constant[5])		23.4	46.8	163.2	163.2	180	295.2	432	432

Note

The maximum braking energy that can be absorbed by capacitors is calculated based on the rated input of 220 VAC.

- Three-phase 400 V drive

Item		Size B		Size C		Size D		Size E		
Drive model		T1R4	T2R3	T3R5	T5R4	T8R4	T012	T017	T021	T026
Servo drive power (kW)		0.4	0.75	1.0	1.5	2.0	3.0	5.0	6.0	7.5
Max. applicable motor capacity (kW)		0.4	0.75	1.0	1.5	2.0	3.0	5.0	6.0	7.5
Power supply capacity (kVA)		3.4	5.96	6.05	9.08	10.23	15.15	22.25	25.0	31.25
Continuous output current (Arms)		1.4	2.3	3.5	5.4	8.4	12.0	17.0	21.0	26.0
Max. output current (Arms)		6.2	9.5	11.0	14.0	20.0	30.0	42.5	52.5	65.0
Main circuit	Continuous input current (Arms)	1.0	1.8	2.4	3.6	5.6	8.0	12.0	16.0	21.0
	Main circuit power supply	Three-phase 380VAC to 480 VAC, -10% to +10%, 50 Hz/60 Hz								
	Heat generation (W)[1]	16.75	26.7	39.5	63.25	94.82	135.47	187.62	228.28	258.63
Control circuit	Control circuit power supply	Single-phase 380VAC to 480 VAC, -10% to +10%, 50 Hz/60 Hz								
	Heat generation (W)[2]	16								
Control circuit backup power circuit[3]	Power input range	24 VDC±15% (powered by SELV/PELV[4] power supply)								
	Power of external power supply	≥ 50 W								
Braking resistor	Resistance (Ω)	100	100	100	100	50	50	35	35	35
	Power (W)	50	50	80	80	80	80	100	100	100
	Min. allowable resistance of external braking resistor (Ω)	80	60	80	60	45	40	35	25	25
	Maximum braking energy absorbed by capacitor (J)	25.58		36.06	43.79	64.40	64.40	105.62	154.56	154.56
	Braking resistor	Built-in braking resistor		Built-in and external braking resistors are supported by all models.						
Cooling method		Air cooling		Air cooling						
Overvoltage category		Level 3		III						

Item	Size B		Size C		Size D		Size E		
Max. input surge current (A)	17.72	17.72	18.65	18.65	24.867	24.867	24.867	24.867	24.867
3T (ms) (3 x RC time constant[5])	23.4		33.6	40.8	45	45	73.8	108	108

Note

The maximum braking energy that can be absorbed by capacitors is calculated based on the rated input of 400 VAC.

Note

- [1] Main circuit heat generation refers to the heat generated by the drive at the rated output current.
- [2] Control circuit heat generation refers to the heat generated by the drive at the rated input current.
- [3] This power supply is only applicable to PINT models with backup power.
- [4] If you select safety functions and use a 24 V backup power supply, Safety Extra-Low Voltage (SELV) and Protective Extra-Low Voltage (PELV) power supplies must be used. SELV and PELV are voltage protection standards designed for different scenarios. SELV refers to the safety extra-low voltage of an ungrounded system, while PELV refers to the safety extra-low voltage of a protective earth system.
- [5] RC time constant = Pre-charge resistor R × Bus capacitance C, which is used to indicate the power-on time, that is, the bus voltage reaches the stable state after a time of 3τ.
- Select an external braking resistor according to the actual operating conditions. For selection of the braking resistor, see *"23.5 Braking Resistor" on page 1434*.

21.2 Technical Specifications

Item			Description
Basic specifications	Control mode		IGBT SVPWM control, sine wave current drive mode
			200 V, 400 V: Single-phase/Three-phase full bridge rectification
	Encoder feedback		Supports Inovance 23-bit and 26-bit multi-turn absolute encoders and 26-bit functional safety encoders (for drives of the functional safety type). Other supported encoders: **DDL motor:** Inovance communication encoder, sine-cosine analog encoder, ABZ incremental encoder (TTL signal), BiSS-C encoder, SSI encoder, and EnDat 2.2 encoder **DDR motor:** Inovance communication encoder, sine-cosine analog encoder, ABZ incremental encoder (TTL signal), BiSS-C encoder, SSI encoder, and EnDat 2.2 encoder **Servo motor:** Inovance communication encoder, sine-cosine analog encoder, ABZ incremental encoder (TTL signal), BiSS-C encoder, EnDat 2.2 encoder, SSI encoder, Nikon encoder, and TAMAGAWA encoder Inovance multi-turn absolute encoders can be used as incremental encoders if the battery is removed. **Note:** For details, see section "Commissioned Objects" in the User Guide.
	Conditions for use	Ambient/Storage temperature[1]	0℃ to 55℃ (average load ratio not exceeding 80% in ambient temperatures between 45℃ to 55℃) (non-frozen)/-40℃ to +70℃
		Operating/Storage humidity	Below 90% RH (no condensation)
		Vibration resistance	Operation: • Displacement amplitude: 5 Hz to 8.4 Hz: 3.5 mm • Acceleration amplitude: 1 g between 8.4 Hz and 200 Hz
			Product packaging: • 5 Hz to 100 Hz: 0.01 g^2/Hz • 200 Hz: 0.001 g^2/Hz • Grms = 1.14 g
		Shock resistance	19.6 m/s^2
		IP rating	IP20
			Note: Terminals are excluded, which have an IP rating of IP00.
		Pollution degree	PD2
		Protection class	Class I
		Altitude	The maximum altitude is 2000 m. • 1000 m and below: Derating is not needed. • Derating is needed for altitudes above 1000 m (derate 1% for every additional 100 m). • For altitudes above 2000 m, contact Inovance.

Item				Description
Speed/ Torque control mode	Per for mance	Speed control range		1 rpm to 10000 rpm (The lower speed limit must ensure that the motor can operate properly under the rated torque.)
		Torque control accuracy [2]		±1%
		Soft startup time setting		0s to 65s (Acceleration and deceleration can be set separately.)
	Input signal	Speed reference input		Analog input signal; digital input signal; DI signal combination is used to achieve selection of speed 0 to 15
		Torque reference input		Analog input signal; digital input signal
		CANopen communication mode		PV mode/PT mode
Position control mode	Input signal	Pulse reference	Pulse input form	Four forms: Direction+Pulse, positive logic; Direction + Pulse, negative logic; phase A + phase B quadrature pulse; and CW/CCW pulse
			Input forms	Differential input; open collector
			Pulse input frequency	Differential input: single: 4 Mpps, quadrature: 16 Mpps, pulse width ≥ 0.125 μs Open collector: max. single pulse frequency: 200 Kpps, pulse width must not be less than 2.5 μs
		Power supply for built-in open collector [3]		24 V (built-in 2.4 kΩ resistor)
		Multi-position reference selection		Position 0 to position 15 selectable through DI signal combination. This function can be assigned to other terminals.
		CANopen communication mode		PP mode/HM mode/IP mode
	Posi tion output	Output form		Phase A, phase B: differential output
				Phase Z: differential output or open collector output
		Frequency division ratio		Any frequency division
Input/ Output signal	DI signal	DI signal function assignment		8 DIs DI1 to DI6: regular DIs (rising edge (24 V input from low to high) input delay: 50 μs, falling edge (24 V input from high to low) input delay: 200 μs, voltage range: 20 V to 30 V) DI7 and DI8: fast DI (rising edge (24 V input from low to high) input delay: 10 μs, falling edge (24 V input from high to low) input delay: 50 μs, voltage range: 20 V to 30 V)
	DO signal	Output signal function assignment		5 DOs; with-load capacity: 50 mA; voltage range: 5 V to 30 V
	Analog input signal			AI1 of voltage type: 16-bit, -10 V to +10 V; maximum allowable voltage: ±12 V Sampling rate: 8 kHz if the gantry is disabled, 4 kHz if the gantry is enabled
				AI2 of voltage type: 12-bit, -10 V to +10 V; maximum allowable voltage: ±12 V Sampling rate: 8 kHz if the gantry is disabled, 4 kHz if the gantry is enabled
	Analog output signal			AO1 voltage output range: -10 V to +10 V Output frequency: 8 kHz if the gantry is disabled, 4 kHz if the gantry is enabled

Item			Description
Built-in functions	Overtravel (OT) prevention		The drive stops immediately when P-OT or N-OT signal is active.
	Electronic gear ratio		0.001 ≤ B/A ≤ 26843545.6
	Protective functions		Protection against overcurrent, overvoltage, undervoltage, overload, main circuit detection error, heatsink overheat, power supply phase loss, overspeed, encoder error, CPU error, parameter error, and others
	Safety function	Safety function types	STO (standard)/SS1/SBC/SOS/SS2/SLS/SDI/SSM[4]
		Applicable standard	IEC 61800-5-2:2016
	LED display		Main circuit CHARGE indicator, 5-digit LED display
	Vibration suppression		5 notches (including two adaptive notches) available, 50 Hz to 8000 Hz
	Usability functions		One-key parameter tuning, adaptive parameter tuning, intelligent parameter tuning, speed observer, and model tracking
	Communication function	Software tool commissioning	Type_C
		Multi-station communication	Modbus RTU (RS485 interface), CANopen
		Number of multi-station communication axes	Up to 32 for Modbus RTU and 127 for CANopen
		Axis address setting	No physical knob, set through the software
		Function	Including status display, user parameter setting, monitored value display, fault tracing display, JOG and auto-tuning, and communication and motion control command setting
	Other functions		Gain tuning, alarm record, and jog

Note

- [1] Install the servo drive within the allowable ambient temperature range. When it is installed inside a control cabinet, the temperature inside the cabinet must also be within this range.
- [2]: Under standard working conditions, the use of an Inovance servo motor can achieve a torque control precision of ±1%.
- [3] The internal open collector power supply is not electrically insulated from the control circuit in the servo drive.
- [4] For S models only.

21.3 Communication Specifications

Modbus RTU communication specifications

Item		Specification
Modbus Basic performance of slave	Link layer protocol	RS485
	Application layer protocol	Modbus RTU, GBT 19582.2-2008, using custom command area
	Baud rate	2400 kbps, 4800 kbps, 9600 kbps, 19200 kbps, 38400 kbps, 57600 kbps, and 115200 kbps
	Duplex mode	Half-duplex
	Data format	8-N-1 (8 data bits, no parity check, 1 stop bit), 8N1, 8N2, 801, and 8E1

CANopen communication specifications

Item		Specification
Specification	System specification	Description
Functions supported by parameters	Setting node address	The node address is set manually, with a maximum of 127. It cannot be assigned automatically
	Setting baud rate	The baud rate is set manually and cannot be assigned automatically.
State machine description	Communication layer status description/display	Initializing, Pre-Operational, Operational, and Stopped
	Emergency error code description/display	Time-Out, State-Switch-Err, PDO-Length-Err, and Manu-Err
Error frame logging	Logs error frames.	Counts the number of NMT frames with an incorrect length.
		Counts the number of NMT frames with invalid commands.
		Count the number of heartbeat frames/node protection frames with an incorrect length.
Synchronization deviation detection	Multi-phase synchronization deviation detection	Deviation of 1/4 cycles
		Deviation of 1/2 cycles
		Deviation of 3/4 cycles
		Deviation of 1 cycle
		Deviation of 2 cycles
Baud rate	20 kbps to 1 Mbps	20 kbps, 50 kbps, 100 kbps, 125 kbps, 250 kbps, 500 kbps, and 1 Mbps
SYNC	SYNC producer	The SYNC producer.
	SYNC consumer	The SYNC consumer.
SDO	Enable domain upload/ download	Transmits data smaller than or equal to 4 bytes.
	SDO abort error	The SDO error code is reported according to different conditions.
	System specification	Segmented upload/download.
	Description	Transmits data larger than 4 bytes.
PDO	Synchronous TPDO/RPDO	The synchronization number ranges from 1 to 240. The total TPDO/RPDO quantity is 4 by default, which is configurable.
	Asynchronous TPDO/RPDO	Time triggered. The total TPDO/RPDO quantity is 4 by default, which is configurable.
EMCY	Emergency message	Heartbeat timeout, PDO length error, node state switchover error, and application layer error.
NMT	Bootup service	Supports online message transmission.
NMTErrCtl	Life guard	Optional node protection (not used with heartbeat production).
	Heartbeat consumer	Supports node heartbeat consumption.
	Heartbeat producer	Supports node heartbeat production.
Expert mode	Configure the PDO communication parameters and their mappings in parameters.	Manually configure PDO communication parameters and their mappings.

21.4 Dynamic Brake Characteristic Curve

Calculating the approximate dynamic braking distance

According to the motor model, initial speed, and load inertia, the dynamic braking distance can be estimated. The approximate value of the dynamic braking distance can be calculated by the following formula.

Maximum braking distance s (turn):

$$s = \frac{V_0}{60}\left(t_e + (\tau_1 + \tau_2 V_0^2)\left(1 + \frac{J_L}{J_M}\right)\right)$$

The coefficient is as follows:

$$\tau_1 = \frac{2R_s J}{3p_n^2 \Psi_f^2} = \frac{10000\pi^2 R_s J}{9K_e^2}$$

$$\tau_2 = \frac{\pi^2 L_d^2 J}{4050 R_s \Psi_f^2} = \frac{100 L_d^2 \pi^4 P_n^2 J}{243 R_s K_e^2}$$

$$\Psi_f = \frac{\sqrt{6} K_e}{100\pi P_n}$$

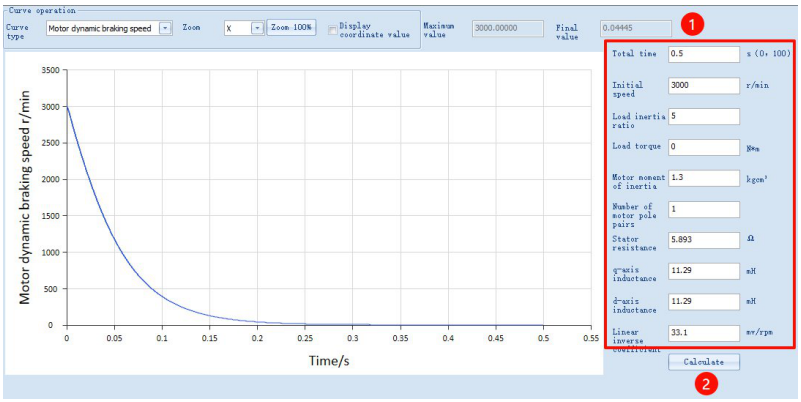
- V_0: Maximum feedback speed
- t_e: Dynamic brake program and relay delay
- $J_{L:}$ Load moment of inertia
- J_M: Motor moment of inertia
- P_n: Number of motor pole pairs
- R_s: Stator resistance (Ω)
- Ke : Kelvin, unit of thermodynamic temperature
- L_q, L_d: q-axis inductance (mH), d-axis inductance (mH)

Calculating accurate dynamic braking distance

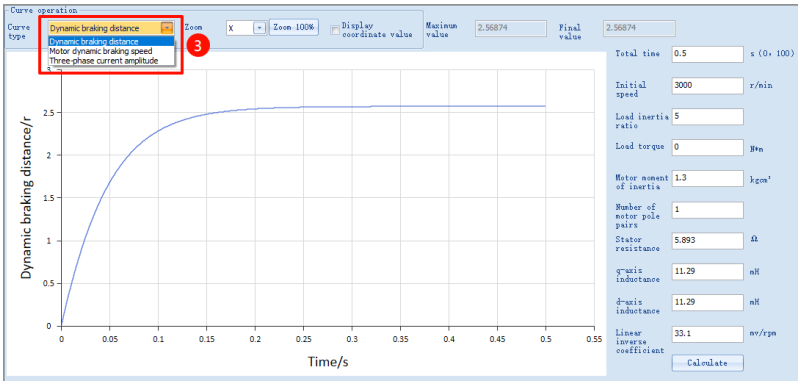
Use InoDriverShop to calculate the accurate dynamic braking distance.

Procedure:

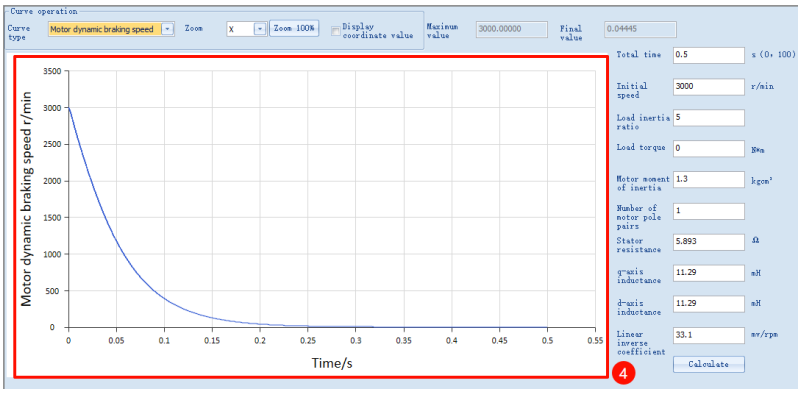
1. Set the corresponding parameters at ① according to actual motor, load, and operation parameters. The time range of the x-coordinate of the calculation chart can be adjusted by setting the total time.
2. After parameter setting is done, click "Calculate" at ② to generate dynamic braking measurement curve.



3. This function provides three dynamic braking calculation curves: dynamic braking distance-time curve (relationship between braking distance and time during dynamic braking), dynamic braking speed-time curve (relationship between motor speed and time during dynamic braking), and three-phase current amplitude-time curve (relationship between three-phase current amplitude and time during dynamic braking). You can select the curve type at ③ based on the curve needed.



4. After the curve type is selected, the curve is automatically generated at ④.



Applicable scenario:

To trigger dynamic braking at a motor speed of 3000 rpm and estimate how long can the motor stop (speed reduced to 0 rpm), perform as follows. Set parameters at ① based on actual motor parameters. After calculation at ②, select "Dynamic motor braking speed" at ③ and a "Dynamic braking speed-time curve" will be generated automatically at ④.

21.5 Load Moment of Inertia

The load moment of inertia represents the inertia of the load. The larger the load moment of inertia is, the weaker the responsiveness is. An excessively high inertia may result in unstable motion. The allowable load moment of inertia () of the motor is restricted. This value is provided strictly as a guideline and results depend on the motor driving conditions.

An overvoltage warning may occur during deceleration if the load moment of inertia exceeds the allowable value. For servo drives with a built-in regenerative resistor, an overload alarm my be present. In case of such warnings, take one of the following measures:

- Reduce the torque limit values.
- Reduce the deceleration rate.
- Reduce the maximum speed.
- Install an external braking resistor if the alarm cannot be cleared by using the above measures.

Caution

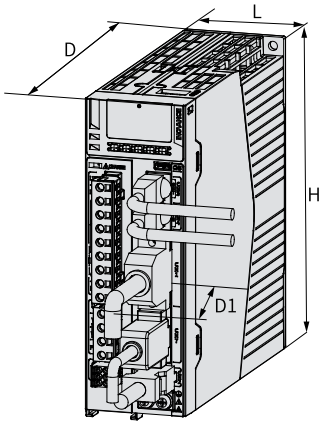
- Drives below 400 W does not provide a built-in braking resistor.
- Even if you use a built-in resistor, the energy generated in some conditions will exceed the allowable capacity loss (W) of the resistor. Therefore, an external braking resistor is required.

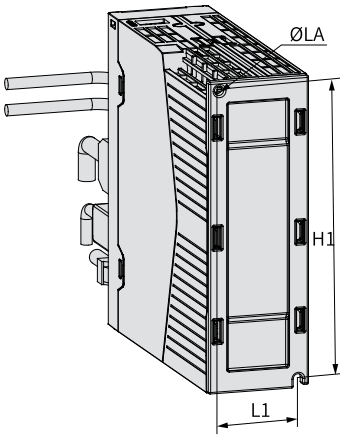
Table 21–1 Allowable load moment of inertia

Motor speed	Size A		Size B		Size C				Size D			Size E					
	S1R6	S2R8	T1R4	T2R3	S5R5	S7R6	T3R5	T5R4	S012	T8R4	T012	S018	S022	S027	T017	T021	T026
1,500 rpm	x 20																
3,000 rpm	x 20											x 10					
4,500 rpm	x 20											x 5					Not supported
6,000 rpm	x 20											x 5					Not supported
7,000 rpm	x 20		Not supported		x 20			Not supported									

Note: *Motor speed* indicates the maximum speed supported by the motor of the drive. For example, MS1H1/H4 supports 7,000 rpm, MS1H2 supports 6,000 rpm, and MS1H3 supports 4,500 rpm. When the speed exceeds 10 times of the inertia, an sufficient acceleration/deceleration time will cause drive alarms.

21.6 Product Dimensions





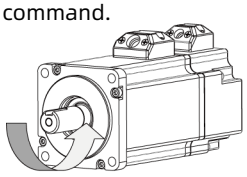
Size	L	H	D	L1	H1	D1	Φ LA	Recommended tightening torque	Weight
	Unit: mm (in.)							Unit: (N·m)	Unit: (kg)
A	45.5 (1.79)	170 (6.69)	150 (5.91)	33 (1.30)	161 (6.34)	75 (2.95)	2 × M4	1.2	0.96
B	45.5 (1.79)	170 (6.69)	180 (7.09)	34 (1.34)	160 (6.30)	75 (2.95)	2 × M4	1.2	1.2
C	55 ± 1 (2.17 ± 0.04)	170 (6.69)	173 ± 1 (6.81 ± 0.04)	44 (1.73)	160 (6.30)	75 (2.95)	2 × M4	1.2	1.3
D	80 ± 1 (3.15 ± 0.04)	170 (6.69)	183 (7.20)	71 (2.80)	160 (6.30)	75 (2.95)	3 × M4	1.2	1.8
E	90 (3.54)	250 (9.84)	230 (9.06)	78 (3.07)	240.5 (9.47)	75 (2.95)	4 × M4	1.2	3.6

22 Motor Technical Specifications

22.1 MS1-R-INT Series Servo Motor

22.1.1 General Specifications

22.1.1.1 Mechanical Characteristics

Item	Description
Duty type	S1 (Continuous duty)
Vibration class[1]	V15
Insulation resistance	500 VDC, above 10 MΩ
Excitation mode	Permanent magnet
Installation method	Flange
Thermal class	F (155℃)
Insulation voltage	1500 VAC, 1 minute (200 V class) 1800 VAC, 1 minute (400 V class)
IP rating	IP67 (excluding shaft opening and flying leads type motor connectors)
Direction of rotation	Rotates counterclockwise (CCW) when viewed from the shaft extension side with a forward run command.  CCW

Item		Description
Ambient condition	Ambient temperature	0°C to 40°C (non-freezing)
	Ambient humidity	20% RH to 80% RH (without condensation)
	Rated operating altitude	1000 m
	Altitude-based derating	• 1000 m and below: Derating is not needed. • For use above 1000 m, derate according to *"22.1.1.3 Derating Characteristics" on page 1312*. For altitudes above 2000 m, install an isolation transformer at the power input end.
	Installation location	• Free from corrosive or explosive gases • Well ventilated with minimum amount of dust, waste, and moisture • Convenient for inspection and cleaning • Away from sources that may generate strong magnetic field • Away from heating sources such as heating stoves. • Use a motor with oil seal in places with grinding fluid, oil mist, iron powders or cuttings. • Oil seal protection capability: The oil seal is only dust-proof. It cannot withstand the intrusion of oil for a long term. For direct-connected reducer applications requiring long-term oil resistance on the motor oil seal, contact Inovance technical support. • Not applicable to vacuum environments. • Not applicable to inching (not full-turn) [2] and may be stuck. • The motor with brake may generate a pattering sound. • In upstream applications of the motor, ensure the force applied on the shaft end is lower than the allowable axial force and radial force of the motor. • The system should avoid continuous operation at a natural frequency. Exceeding the allowable vibration value may damage the system.
	Storage environment	Observe the following requirements for storing a de-energized motor. • Temperature: -20°C to +60°C (non-freezing) • Storage humidity: 20% to 80% RH (without condensation)
Shock resistance [3][5]	Shock acceleration (taking flange side as standard)	490m/s^2
	Number of shocks	2
Vibration resistance [4][5]	Vibration acceleration (taking flange side as standard)	• Radial 49 m/s^2 • Axial 24.5 m/s^2

Note

- [1] Vibration class V15 indicates that the amplitude of vibration is lower than 15 μm when an individual motor rotates at rated values.
- [2] For applications that require the motor shaft to swing back and forth at a certain angle, contact Inovance.
- [3] The resistance for shock in the vertical direction when the motor is mounted with the shaft in a horizontal position is shown in the preceding table.
- [4] The vertical, side-to-side, and front-to-back resistance for vibration in three directions when the servo motor is mounted with the shaft in a horizontal position is shown in the preceding table.
- [5] The vibration intensity applied on the motor is affected by the transmission structure, alignment accuracy, mounting conditions, and external vibration. These factors may enhance the vibration applied on the motor. When the maximum allowable vibration limit is exceeded, the motor may fail. Therefore, take necessary measures to limit resonance.
- The vibration intensity applied on the motor varies with applications.

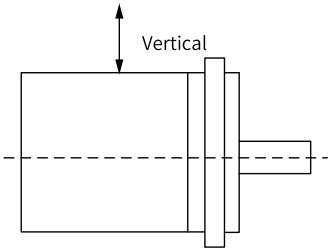


Figure 22-1 Shock applied to the servo motor

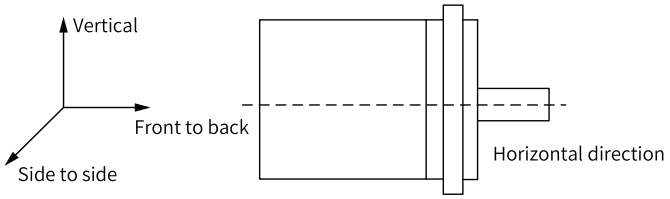


Figure 22-2 Vibration applied to the servo motor

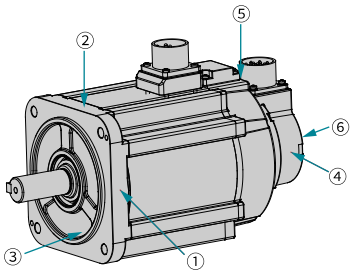


Figure 22-3 Max. allowable vibration limit of the motor

Direction	Measuring point	Limit value (10 Hz to 2000 Hz)
Radial	①②④⑤	49m/s²
Axial	③⑥	24.5m/s²

Note

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

22.1.1.2 Overload Characteristics

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

The following overload protection curve applies to hot start at an ambient temperature of 40℃, which cannot guarantee continuous duty in cases of 100% output or above. During use, keep the effective torque of the load within the continuous duty zone.

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

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

The motor overload protection curve is shown in the following figure.

- **MS1H1/H4 (frame size 40/60/80)**

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

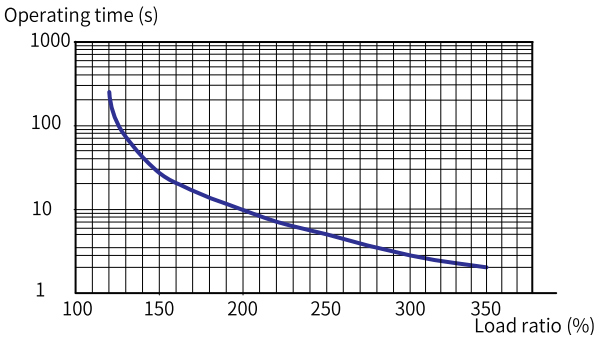


Figure 22-4 MS1H1/H4 (frame size 40/60/80) series motor overload curve

Note

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

- **MS1H2/MS1H3**

Load ratio (%)	Operating time (s)
115	6000
120	2533
125	1226
130	915
135	769
140	527
145	352
150	221
155	128
160	99
165	83
170	67
175	55
180	49
185	45
190	41
195	38
200	34
205	31
210	28
215	24
220	22
225	21
230	19
235	18
240	16
245	14
250	13
255	12
260	11
265	10
270	9
275	9
280	8
285	7
290	6
295	5
300	5

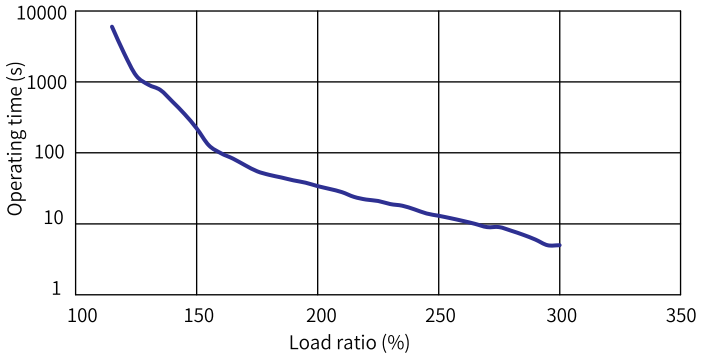


Figure 22-5 Overload curve of MS1H2 and MS1H3 series motors

Note

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

- **MS1H1-03B30CB-U210R-S**

Load ratio (%)	Operating time (s)
120	75.00
130	43.39
140	27.97
150	19.84
160	15.10
170	15.02
180	9.82
190	8.12
200	6.70
210	5.62
220	4.79
230	4.14
240	3.63
250	3.22
260	2.89
270	2.61
280	2.38
290	2.18
300	2.01
310	1.86
320	1.73
330	1.60
340	1.50
350	1.40

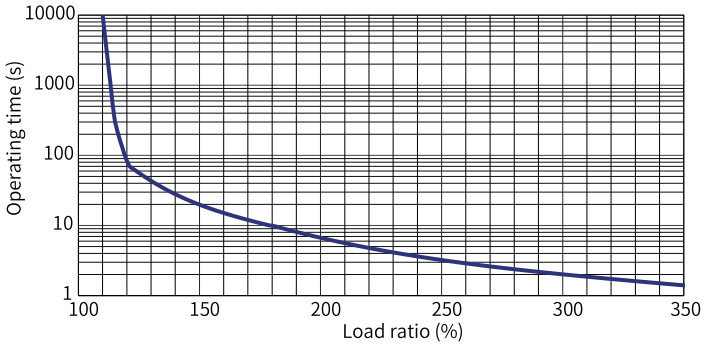


Figure 22-6 Overload curve of MS1H1-03B30CB-U210R-S series motors

22.1.1.3 Derating Characteristics

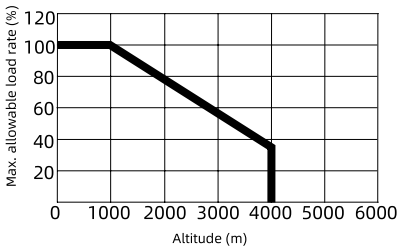
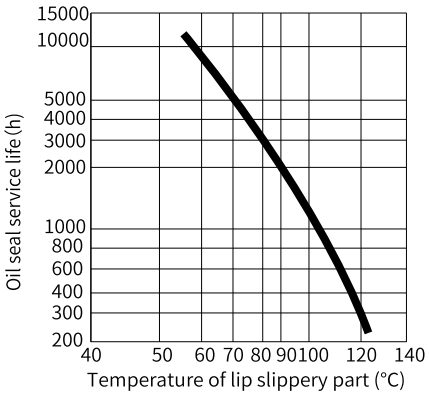


Figure 22-7 Altitude-based derating curve

22.1.1.4 Temperature Curve of the Oil Seal



22.1.1.5 Load Moment of Inertia

The load moment of inertia represents the ratio of the load inertia to the rotor inertia. The higher the load inertia ratio, the weaker the responsiveness will be. An excessively high inertia ratio can result in unstable operation. The allowable load inertia ratio of the servo motor is limited. The value is a general standard and varies according to the driving conditions of the servo motor.

An overvoltage alarm may occur during deceleration if the load moment of inertia exceeds the allowable value. For servo drives with a built-in braking resistor, an overload alarm may be reported. In cases of such alarms, take one of the following measures:

- Reduce the torque limit value.
- Reduce the deceleration rate.

- Reduce the maximum speed.
- Install an external braking resistor if the warning cannot be cleared using the above measures.

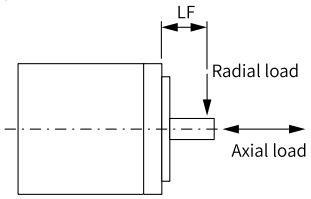
Caution

- For the built-in braking resistor of the drive, see section "Components".
- Even if you use a built-in resistor, the energy generated in some regenerative conditions may exceed the allowable capacity loss (W) of the resistor. Therefore, an external braking resistor is required.

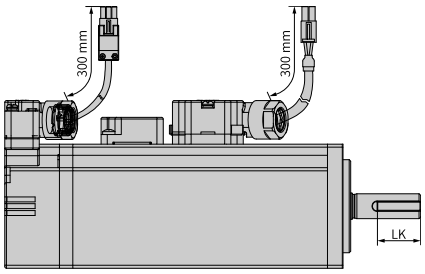
22.1.2 Model Selection (MS1-R-INT Series Servo Motor)

22.1.2.1 Selection Precautions

- Description of torque-speed characteristics curves:
  - All parameters and torque-speed characteristic values are subject to the conditions that the motor works with an Inovance servo drive and the armature coil temperature is 20°C.
  - Continuous working area: refers to a series of states in which the motor can operate safely and continuously, and the actual torque must be located in this area.
  - Intermittent duty zone: refers to a series of states in which the motor can run within a short period of time when the actual torque is greater than the rated torque.
- The characteristic values are obtained in cases where the motor is installed with the following heatsink (unit: mm):
  - MS1H1 to MS1H4: 250 × 250 × 6 (aluminum)
  - MS1H2-10C to 25C: 400 × 400 × 20 (steel)
  - MS1H2-30C to 50C: 400 × 400 × 20 (steel)
  - MS1H3-85B to 18C: 400 × 400 × 20 (steel)
  - MS1H3-29C to 55C: 550 × 550 × 30 (aluminum)
  - MS1H3-75C: 700 × 700 × 30 (aluminum)
- Radial and axial loads of the motor:



- Dimensions of flying leads type motors
  Flying leads type motors with frame size 80 and below (model ended with "-S") provide a drain wire of about 300 mm in length, as shown in the following figure.



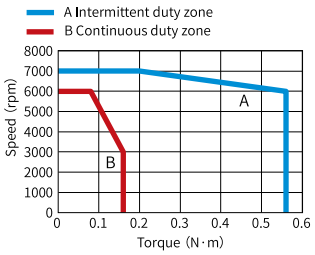
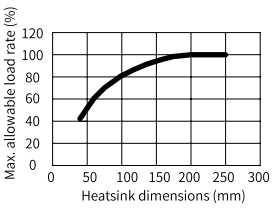
- As shown in the preceding figure, the product is marked with an LK value in the dimension diagram in the section of each model. LK indicates the length of the shaft key.
- MS1H3 (130-flange and 180-flange) comes with a key slot. When the operating speed is above 3000 rpm, the motor must run with the keyway. If you need to run the motor without the keyway at speeds higher than 3000 rpm, contact Inovance.

Note

- Values inside the parentheses in the sections corresponding to the models are parameters of the servo motor carrying a brake.
- The motor with oil seal must be derated by 10% during use.
- Use your own DC power supply as 24 V power supply of the brake. For the cable connecting the DC power supply to the motor brake, it is recommended to use cables with a diameter of 0.2 mm^2 or above for motors with low power of 750 W or below. It is recommended to use cables with a diameter of 0.8 mm^2 or above for motors with a power of 750 W or above. The brake cannot share the power supply with other appliances to prevent the voltage or current from falling due to the simultaneous operation of other electrical appliances, which may result in brake malfunction.
- Do not share a power supply with multiple brakes. Otherwise, the coil is short-circuited after one brake is dry-worn, causing failures to start the brakes that are connected to the power supply in parallel.
- The brake apply time and release time vary with the discharge circuit. Check the actual action delay of the product during use. The holding brake cannot be used for braking purpose.

22.1.2.2 Low Inertia and Small Capacity (MS1H1)

22.1.2.2.1 MS1H1-05B30CB-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	40		
Inertia, capacity	Low inertia, small capacity		
Rated power (kW)	0.05		
Rated voltage (V)	220		
Rated torque (N·m)	0.16		
Maximum torque (N·m)	0.56		
Rated frequency (Hz)	250		
Rated current (A)	1.2		Heatsink-based derating curve
Maximum current (A)	4.8		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.15		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	0.018 ± 10%	
	Motor with brake	0.0208 ± 10%	

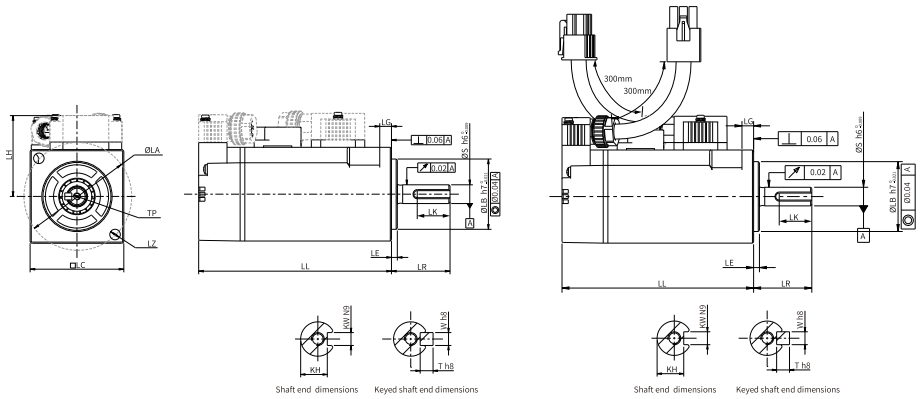
Electrical specifications of the brake

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

Allowable load

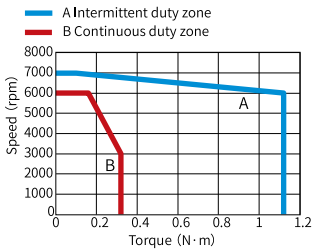
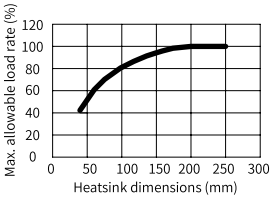
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
20	≤ 78	≤ 54

Dimensions (mm)



LL	LC	LR	LA	LZ	LH	LG	LE	
54.5 (81.8)	40	25 ± 0.5	46	2 × ϕ4.5	34.5	5	2.5 ± 0.5	
S	LB	TP	LK	KH	kW	W	T	Weight (kg)
8	30	M3 × 6	$14^{0}_{-0.36}$	$6.2^{0}_{-0.1}$	3	3	3	0.26 (0.43)

22.1.2.2.2 MS1H1-10B30CB-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	40		
Inertia, capacity	Low inertia, small capacity		
Rated power (kW)	0.1		
Rated voltage (V)	220		
Rated torque (N·m)	0.32		
Maximum torque (N·m)	1.12		
Rated frequency (Hz)	250		
Rated current (A)	1.2		Heatsink-based derating curve
Maximum current (A)	4.8		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.30		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	0.0316 ± 10%	
	Motor with brake	0.0345 ± 10%	

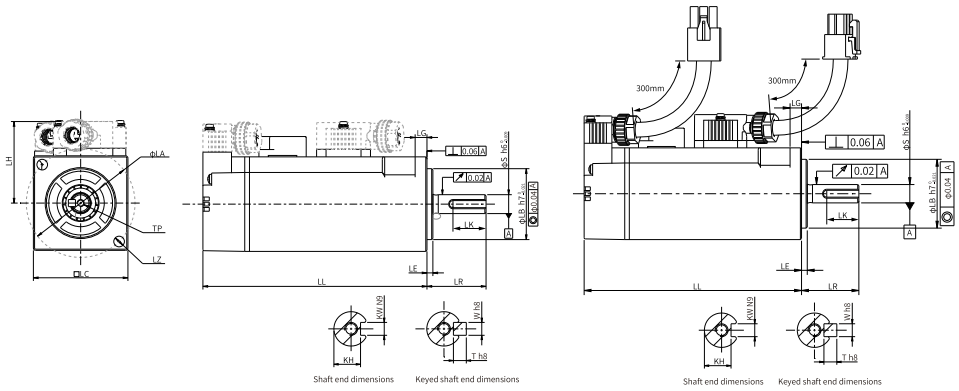
Electrical specifications of the brake

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

Allowable load

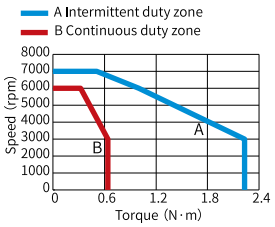
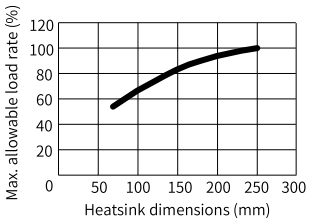
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
20	≤ 78	≤ 54

Dimensions (mm)



LL	LC	LR	LA	LZ	LH	LG	LE	
67 (94.3)	40	25 ± 0.5	46	2 × ϕ4.5	34.5	5	2.5 ± 0.5	
S	LB	TP	LK	KH	kW	W	T	Weight (kg)
8	30	M3 × 6	$14^{0}_{-0.36}$	$6.2^{0}_{-0.1}$	3	3	3	0.35 (0.52)

22.1.2.2.3 MS1H1-20B30CB-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	60		
Inertia, capacity	Low inertia, small capacity		
Rated power (kW)	0.2		
Voltage (V)	220		
Rated torque (N·m)	0.64		
Maximum torque (N·m)	2.24		
Rated frequency (Hz)	250		
Rated current (A)	1.5		Heatsink-based derating curve
Maximum current (A)	5.3		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.51		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	0.094 ± 10%	
	Motor with brake	0.106 ± 10%	

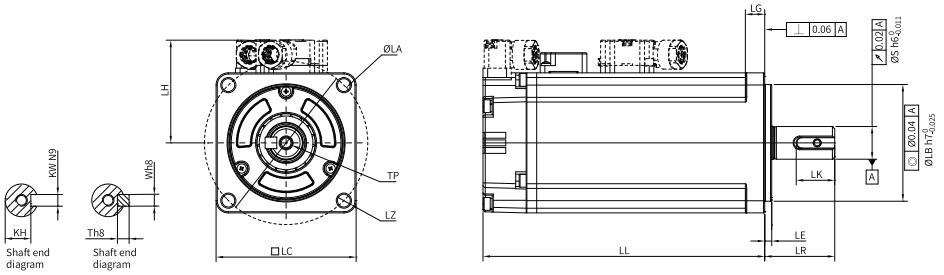
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
1.5	24	7.6	75.79	0.32	≤ 60	≤ 20	≤ 1

Allowable load

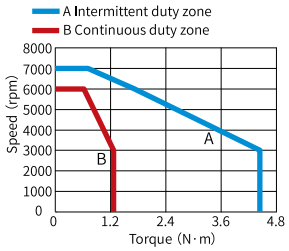
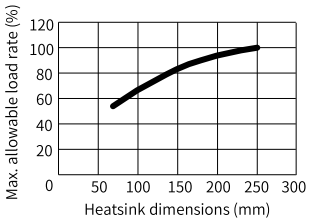
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
25	≤ 245	≤ 74

Dimensions (mm)



LC	LL	LR	LA	LZ	LH	LG	LE	
60	75.5 (103)	30 ± 0.5	70	4 × ϕ5.5	44	8.0	3 ± 0.5	
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
50	14	M5 × 12	$16^{0}_{-0.53}$	$11^{0}_{-0.1}$	5	5	5	0.80 (1.17)

22.1.2.2.4 MS1H1-40B30CB-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	60		
Inertia, capacity	Low inertia, small capacity		
Rated power (kW)	0.4		
Voltage (V)	220		
Rated torque (N·m)	1.27		
Maximum torque (N·m)	4.45		
Rated frequency (Hz)	250		
Rated current (A)	2.5		Heatsink-based derating curve
Maximum current (A)	9.8		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.57		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	0.145 ± 10%	
	Motor with brake	0.157 ± 10%	

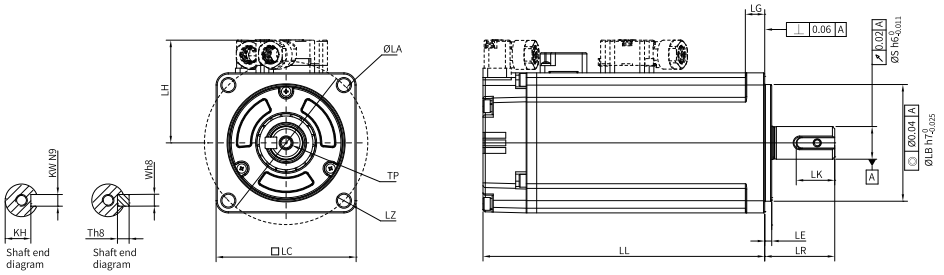
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
1.5	24	7.6	75.79	0.32	≤ 60	≤ 20	≤ 1

Allowable load

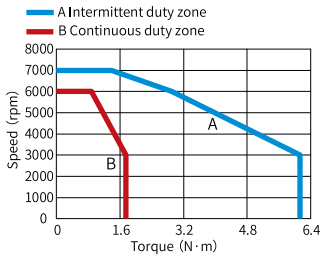
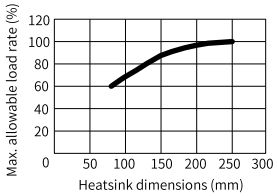
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
25	≤ 245	≤ 74

Dimensions (mm)



LC	LL	LR	LA	LZ	LH	LG	LE	
60	93 (121)	30 ± 0.5	70	4 × ϕ5.5	44	8.0	3 ± 0.5	
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
50	14	M5 × 12	$16^{0}_{-0.53}$	$11^{0}_{-0.1}$	5	5	5	1.11 (1.48)

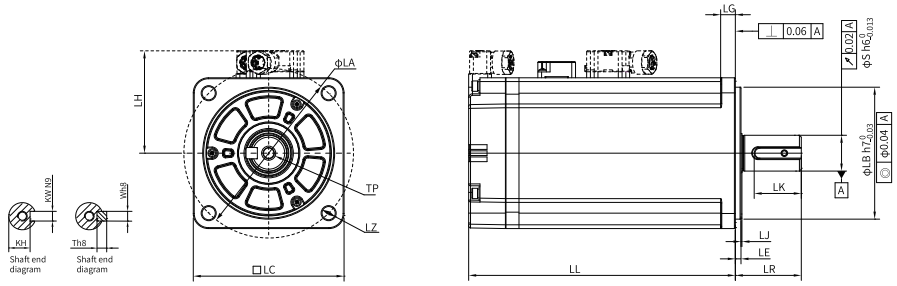
22.1.2.2.5 MS1H1-55B30CB-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	80		
Inertia, capacity	Low inertia, small capacity		
Rated power (kW)	0.55		
Voltage (V)	220		
Rated torque (N·m)	1.75		
Maximum torque (N·m)	6.13		
Rated frequency (Hz)	250		
Rated current (A)	3.9		Heatsink-based derating curve
Maximum current (A)	15		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.51		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	0.55 ± 10%	
	Motor with brake	-	

Allowable load

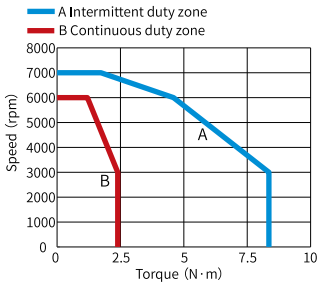
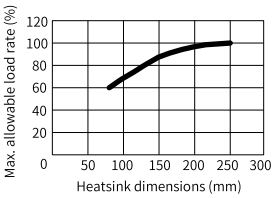
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
35	≤ 392	≤ 147

Dimensions (mm)



LC	LL	LR	LA	LZ	LH	LG	LE	LJ
80	96.7	35 ± 0.5	90	4 × φ7	54	7.5	3 ± 0.5	0.5 ± 0.35
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
70	19	M6 × 20	$25^{0}_{-0.62}$	$15.5^{0}_{-0.1}$	6	6	6	1.88

22.1.2.2.6 MS1H1-75B30CB-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	80		
Inertia, capacity	Low inertia, small capacity		
Rated power (kW)	0.75		
Voltage (V)	220		
Rated torque (N·m)	2.39		
Maximum torque (N·m)	8.36		
Rated frequency (Hz)	250		
Rated current (A)	4.4		Heatsink-based derating curve
Maximum current (A)	16.9		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.62		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	0.68 ± 10%	
	Motor with brake	0.71 ± 10%	

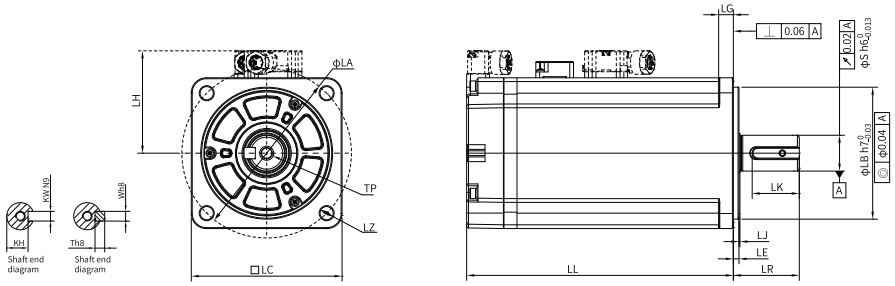
Electrical specifications of the brake

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

Allowable load

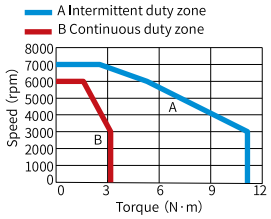
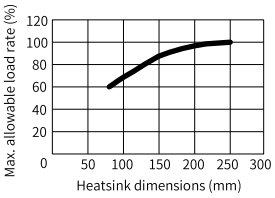
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
35	≤ 392	≤ 147

Dimensions (mm)



LC	LL	LR	LA	LZ	LH	LG	LE	LJ
80	107.3 (141.5)	35 ± 0.5	90	4 × φ7	54	7.5	3 ± 0.5	0.5 ± 0.35
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
70	19	M6 × 20	$25^{0}_{-0.62}$	$15.5^{0}_{-0.1}$	6	6	6	2.22 (2.88)

22.1.2.2.7 MS1H1-10C30CB-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	80		
Inertia, capacity	Low inertia, small capacity		
Rated power (kW)	1.0		
Voltage (V)	220		
Rated torque (N·m)	3.18		
Maximum torque (N·m)	11.1		
Rated frequency (Hz)	250		
Rated current (A)	6.2		Heatsink-based derating curve
Maximum current (A)	24		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.59		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	0.82 ± 10%	
	Motor with brake	0.87 ± 10%	

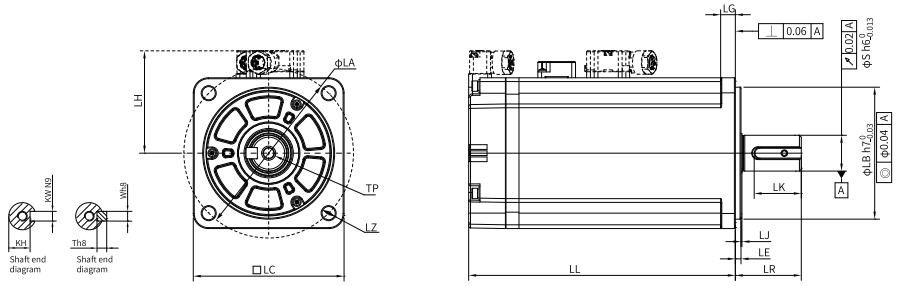
Electrical specifications of the brake

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

Allowable load

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

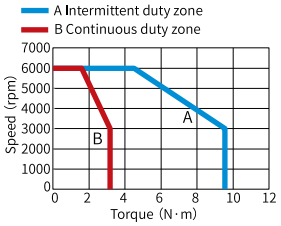
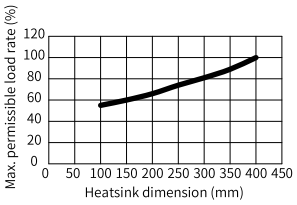
Dimensions (mm)



LC	LL	LR	LA	LZ	LH	LG	LE	LJ
80	119.2 (153.4)	35 ± 0.5	90	4 × ϕ7	54	7.5	3 ± 0.5	0.5 ± 0.35
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
70	19	M6 × 20	$25^{0}_{-0.62}$	$15.5^{0}_{-0.1}$	6	6	6	2.61 (3.27)

22.1.2.3 Low Inertia and Medium Capacity (MS1H2)

22.1.2.3.1 MS1H2-10C30CB-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	100		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	1.0		
Voltage (V)	220		
Rated torque (N·m)	3.18		
Maximum torque (N·m)	9.54		
Rated frequency (Hz)	250		
Rated current (A)	6.4		Heatsink-based derating curve
Maximum current (A)	23		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	0.54		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	1.78 ± 10%	
	Motor with brake	2.6 ± 10%	

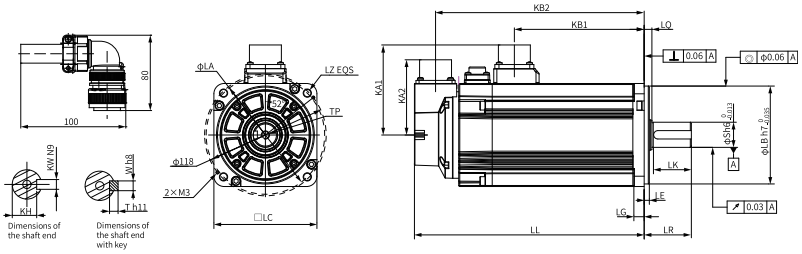
Electrical specifications of the brake

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

Allowable load

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

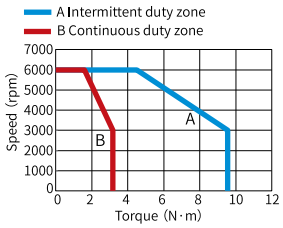
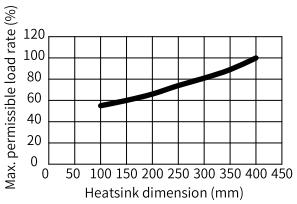
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	144 (172)	45 ± 1	115	4 × ϕ7	88	75	73	123.5 (151.5)	10	5 ± 0.3

LQ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
7.5 ± 0.75	95	24	M8 × 16	$35^{0}_{-0.62}$	$20^{0}_{-0.2}$	8	8	7	3.85 (4.9)

22.1.2.3.2 MS1H2-10C30CD-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	100		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	1.0		
Voltage (V)	380		
Rated torque (N·m)	3.18		
Maximum torque (N·m)	9.54		
Rated frequency (Hz)	250		
Rated current (A)	3.3		Heatsink-based derating curve
Maximum current (A)	11		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	1.07		
Rotor moment of inertia (kg·cm²)	Motor without brake	1.78 ± 10%	
	Motor with brake	2.6 ± 10%	

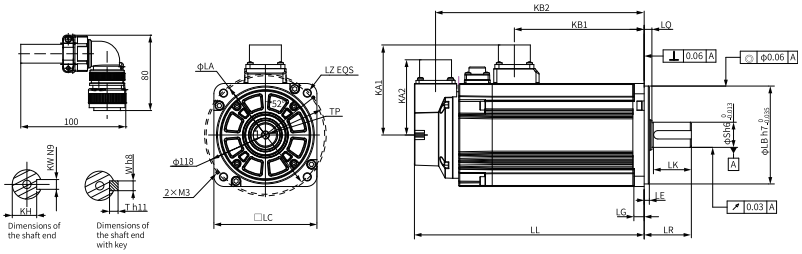
Electrical specifications of the brake

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

Allowable load

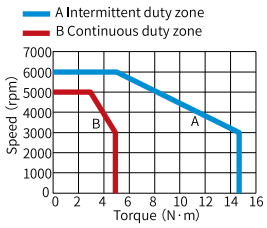
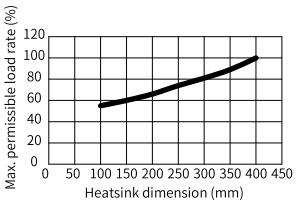
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
45	≤ 686	≤ 196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	144 (172)	45 ± 1	115	4 × ϕ7	88	75	73	123.5 (151.5)	10	5 ± 0.3
LQ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
7.5 ± 0.75	95		24	M8 × 16	$35^{0}_{-0.62}$	$20^{0}_{-0.2}$	8	8	7	3.85 (4.9)

22.1.2.3.3 MS1H2-15C30CB-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	100		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	1.5		
Voltage (V)	220		
Rated torque (N·m)	4.9		
Maximum torque (N·m)	14.7		
Rated frequency (Hz)	250		
Rated current (A)	8.6		Heatsink-based derating curve
Maximum current (A)	32		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	0.62		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	2.35 ± 10%	
	Motor with brake	3.17 ± 10%	

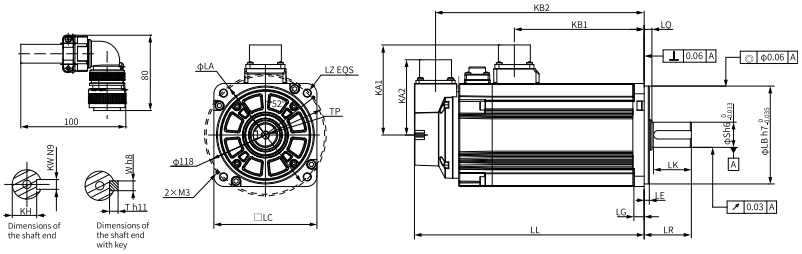
Electrical specifications of the brake

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

Allowable load

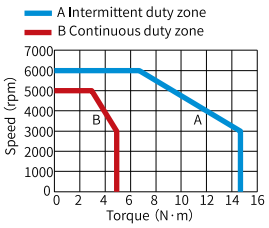
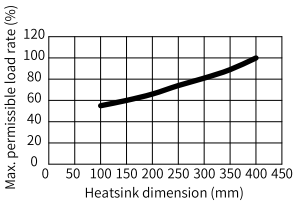
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
45	≤ 686	≤ 196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	161 (189)	45 ± 1	115	4 × ϕ7	88	92	73	140.5 (168.5)	10	5 ± 0.3
LQ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
7.5 ± 0.75	95		24	M8 × 16	$35^{0}_{-0.62}$	$20^{0}_{-0.2}$	8	8	7	4.65 (5.75)

22.1.2.3.4 MS1H2-15C30CD-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	100		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	1.5		
Voltage (V)	380		
Rated torque (N·m)	4.9		
Maximum torque (N·m)	14.7		
Rated frequency (Hz)	250		
Rated current (A)	4.2		Heatsink-based derating curve
Maximum current (A)	14		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	1.28		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	2.35 ± 10%	
	Motor with brake	3.17 ± 10%	

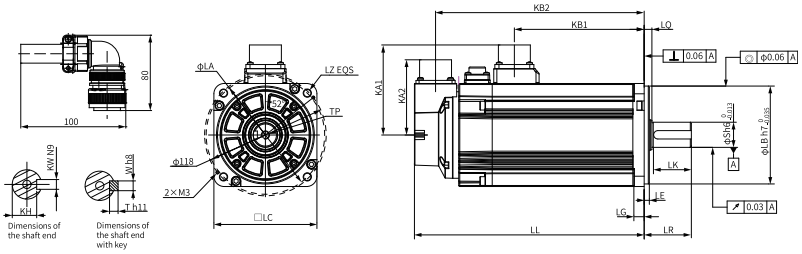
Electrical specifications of the brake

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

Allowable load

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

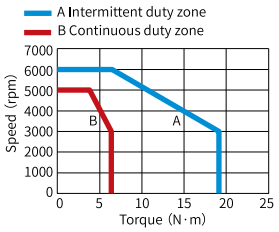
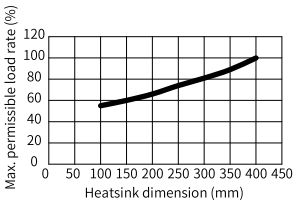
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	161 (189)	45 ± 1	115	4 × ϕ7	88	92	73	140.5 (168.5)	10	5 ± 0.3

LQ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
7.5 ± 0.75	95	24	M8 × 16	$35^{0}_{-0.62}$	$20^{0}_{-0.2}$	8	8	7	4.65 (5.75)

22.1.2.3.5 MS1H2-20C30CB-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	100		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	2.0		
Voltage (V)	220		
Rated torque (N·m)	6.36		
Maximum torque (N·m)	19.1		
Rated frequency (Hz)	250		
Rated current (A)	11.3		Heatsink-based derating curve
Maximum current (A)	42		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	0.60		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	2.92 ± 10%	
	Motor with brake	3.74 ± 10%	

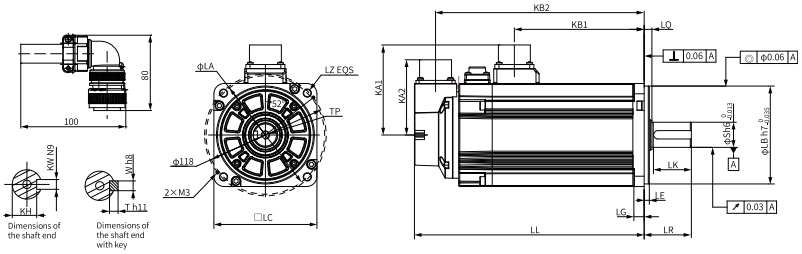
Electrical specifications of the brake

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

Allowable load

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

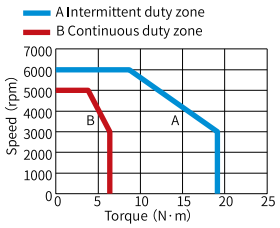
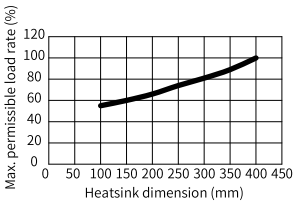
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	177 (205)	45 ± 1	115	4 × ϕ7	88	108	73	156.5 (184.5)	10	5 ± 0.3

LQ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
7.5 ± 0.75	95	24	M8 × 16	$35^{0}_{-0.62}$	$20^{0}_{-0.2}$	8	8	7	5.5 (6.55)

22.1.2.3.6 MS1H2-20C30CD-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	100		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	2.0		
Voltage (V)	380		
Rated torque (N·m)	6.36		
Maximum torque (N·m)	19.1		
Rated frequency (Hz)	250		
Rated current (A)	5.6		Heatsink-based derating curve
Maximum current (A)	20		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	1.19		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	2.92 ± 10%	
	Motor with brake	3.74 ± 10%	

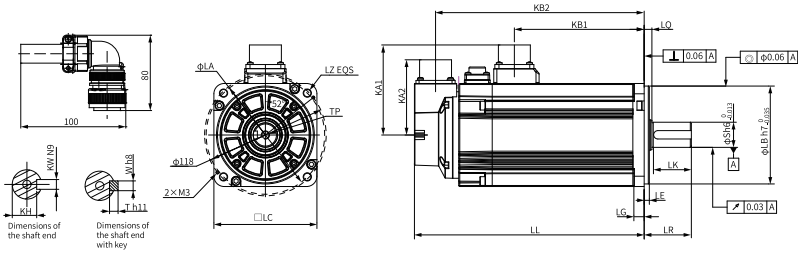
Electrical specifications of the brake

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

Allowable load

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

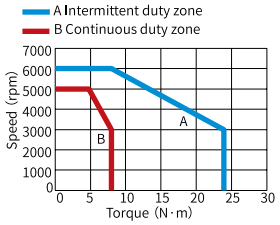
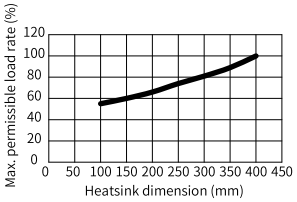
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	177 (205)	45 ± 1	115	4 × ϕ7	88	108	73	156.5 (184.5)	10	5 ± 0.3

LQ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
7.5 ± 0.75	95	24	M8 × 16	$35^{0}_{-0.62}$	$20^{0}_{-0.2}$	8	8	7	5.5 (6.55)

22.1.2.3.7 MS1H2-25C30CB-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	100		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	2.5		
Voltage (V)	220		
Rated torque (N·m)	7.96		
Maximum torque (N·m)	23.9		
Rated frequency (Hz)	250		
Rated current (A)	14.7		Heatsink-based derating curve
Maximum current (A)	53		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	0.60		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	3.49 ± 10%	
	Motor with brake	4.3 ± 10%	

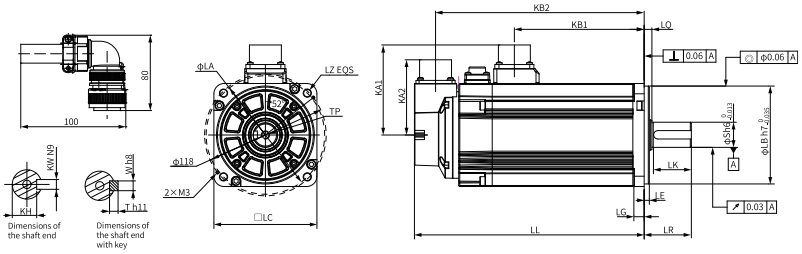
Electrical specifications of the brake

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

Allowable load

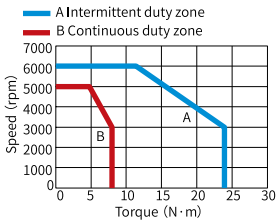
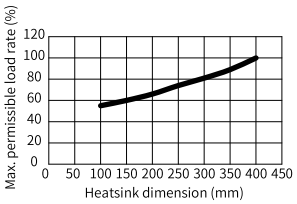
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
45	≤ 686	≤ 196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	195 (223)	45 ± 1	115	4 × ϕ7	88	126	73	174.5 (202.5)	10	5 ± 0.3
LQ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
7.5 ± 0.75	95		24	M8 × 16	$35^{0}_{-0.62}$	$20^{0}_{-0.2}$	8	8	7	6.3 (7.35)

22.1.2.3.8 MS1H2-25C30CD-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	100		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	2.5		
Voltage (V)	380		
Rated torque (N·m)	7.96		
Maximum torque (N·m)	23.9		
Rated frequency (Hz)	250		
Rated current (A)	7.2		Heatsink-based derating curve
Maximum current (A)	26		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	1.18		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	3.49 ± 10%	
	Motor with brake	4.3 ± 10%	

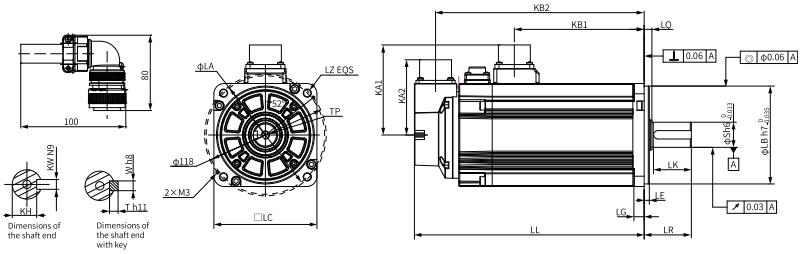
Electrical specifications of the brake

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

Allowable load

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

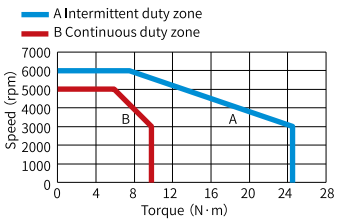
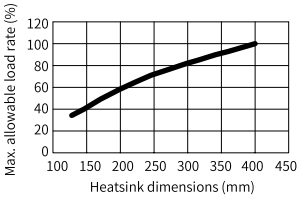
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	195 (223)	45 ± 1	115	4 × ϕ7	88	126	73	174.5 (202.5)	10	5 ± 0.3

LQ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
7.5 ± 0.75	95	24	M8 × 16	$35^{0}_{-0.62}$	$20^{0}_{-0.2}$	8	8	7	6.3 (7.35)

22.1.2.3.9 MS1H2-30C30CB-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	3.0		
Voltage (V)	220		
Rated torque (N·m)	9.8		
Maximum torque (N·m)	24.5		
Rated frequency (Hz)	150		
Rated current (A)	16.6		Heatsink-based derating curve
Maximum current (A)	55		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	0.67		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	6.4 ± 10%	
	Motor with brake	9.38 ± 10%	

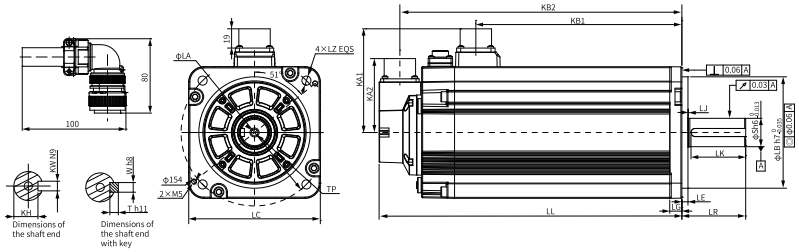
Electrical specifications of the brake

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

Allowable load

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

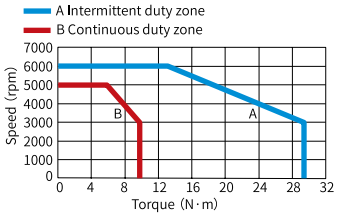
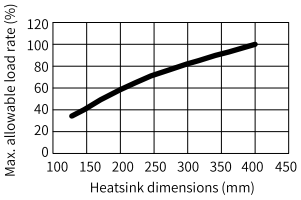
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	198 (223)	63 ± 1	145	4 × ϕ9	102.4	127.5	73	177.5 (202.5)	10.5	6 ± 0.3

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110	28	M8 × 20	$53^{0}_{-0.62}$	$24^{0}_{-0.2}$	8	8	7	10.0 (11.9)

22.1.2.3.10 MS1H2-30C30CD-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	3.0		
Voltage (V)	380		
Rated torque (N·m)	9.8		
Maximum torque (N·m)	29.4		
Rated frequency (Hz)	150		
Rated current (A)	8.9		Heatsink-based derating curve
Maximum current (A)	29		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	1.25		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	6.4 ± 10%	
	Motor with brake	9.38 ± 10%	

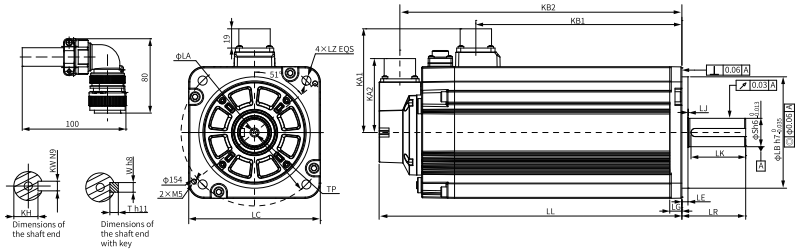
Electrical specifications of the brake

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

Allowable load

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

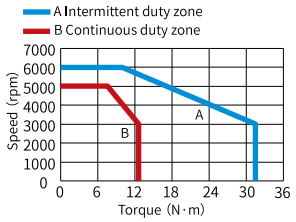
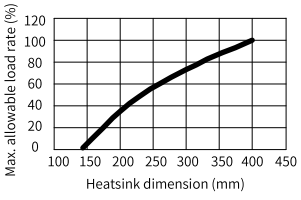
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	198 (223)	63 ± 1	145	4 × ϕ9	102.4	127.5	73	177.5 (202.5)	10.5	6 ± 0.3

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110	28	M8 × 20	$53^{0}_{-0.62}$	$24^{0}_{-0.2}$	8	8	7	10.0 (11.9)

22.1.2.3.11 MS1H2-40C30CB-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	4.0		
Voltage (V)	220		
Rated torque (N·m)	12.6		
Maximum torque (N·m)	31.5		
Rated frequency (Hz)	150		
Rated current (A)	22		Heatsink-based derating curve
Maximum current (A)	67.5		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	0.65		
Rotor moment of inertia (kg·cm^2)	Motor without brake	9 ± 10%	
	Motor with brake	11.98 ± 10%	

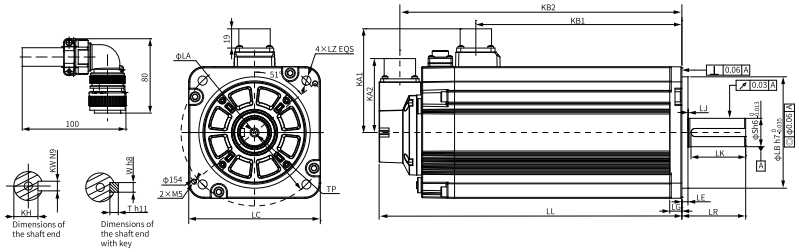
Electrical specifications of the brake

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

Allowable load

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

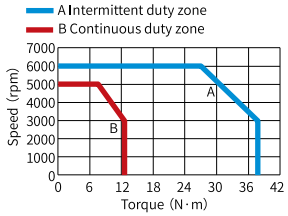
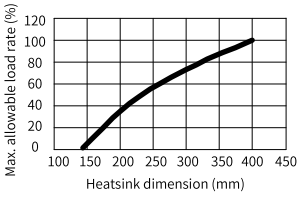
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	236 (261)	63 ± 1	145	4 × ϕ9	102.4	165.5	73	215.5 (240.5)	10.5	6 ± 0.3

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110	28	M8 × 20	$53^{0}_{-0.62}$	$24^{0}_{-0.2}$	8	8	7	13.2 (15.1)

22.1.2.3.12 MS1H2-40C30CD-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	4.0		
Voltage (V)	380		
Rated torque (N·m)	12.6		
Maximum torque (N·m)	37.8		
Rated frequency (Hz)	150		
Rated current (A)	13.5		Heatsink-based derating curve
Maximum current (A)	42.5		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	1.06		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	9 ± 10%	
	Motor with brake	11.98 ± 10%	

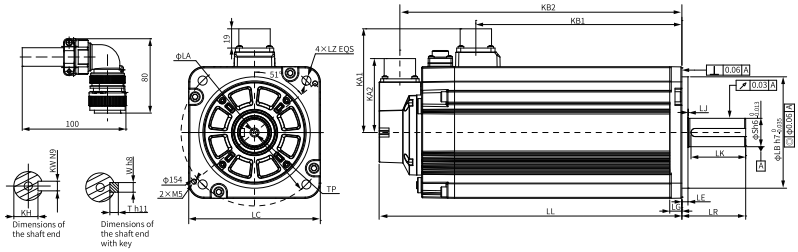
Electrical specifications of the brake

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

Allowable load

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

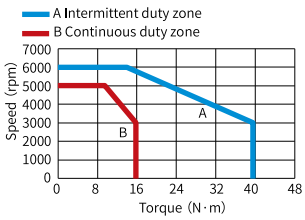
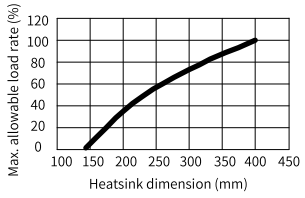
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	236 (261)	63 ± 1	145	4 × ϕ9	102.4	165.5	73	215.5 (240.5)	10.5	6 ± 0.3

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110	28	M8 × 20	$53^{0}_{-0.62}$	$24^{0}_{-0.2}$	8	8	7	13.2 (15.1)

22.1.2.3.13 MS1H2-50C30CB-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	5.0		
Voltage (V)	220		
Rated torque (N·m)	15.8		
Maximum torque (N·m)	39.5		
Rated frequency (Hz)	150		
Rated current (A)	22		Heatsink-based derating curve
Maximum current (A)	67.5		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	0.81		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	11.6 ± 10%	
	Motor with brake	14.58 ± 10%	

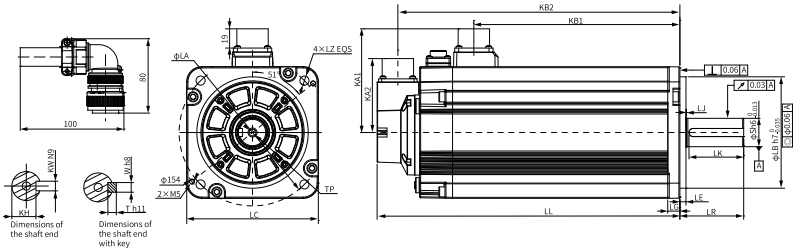
Electrical specifications of the brake

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

Allowable load

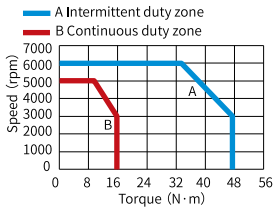
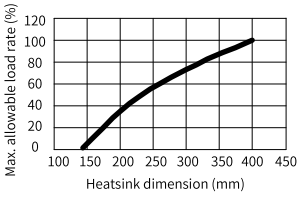
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
63	≤ 1176	≤ 392

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	274 (299)	63 ± 1	145	4 × ϕ9	102.4	203.5	73	253.5 (278.5)	10.5	6 ± 0.3
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110		28	M8 × 20	$53^{0}_{-0.62}$	$24^{0}_{-0.2}$	8	8	7	16.35 (18.25)

22.1.2.3.14 MS1H2-50C30CD-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	5.0		
Voltage (V)	380		
Rated torque (N·m)	15.8		
Maximum torque (N·m)	47.4		
Rated frequency (Hz)	150		
Rated current (A)	17		Heatsink-based derating curve
Maximum current (A)	52.5		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	1.04		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	11.6 ± 10%	
	Motor with brake	14.58 ± 10%	

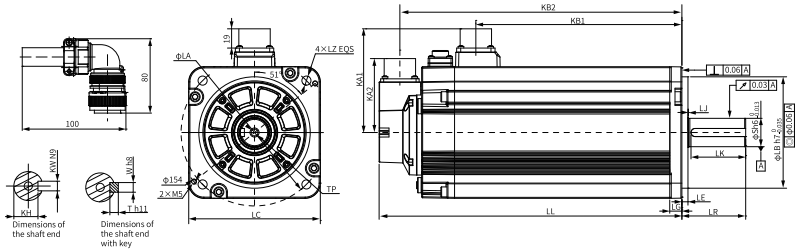
Electrical specifications of the brake

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

Allowable load

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

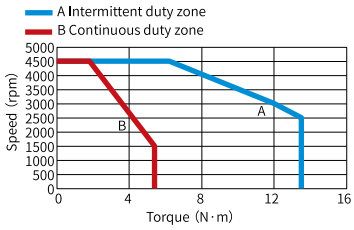
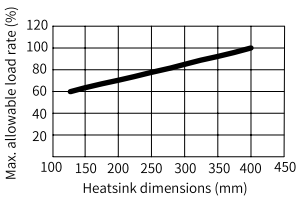
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	274 (299)	63 ± 1	145	4 × ϕ9	102.4	203.5	73	253.5 (278.5)	10.5	6 ± 0.3
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110		28	M8 × 20	$53^{0}_{-0.62}$	$24^{0}_{-0.2}$	8	8	7	16.35 (18.25)

22.1.2.4 Medium Inertia and Medium Capacity (MS1H3)

22.1.2.4.1 MS1H3-85B15CB-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	0.85		
Voltage (V)	220		
Rated torque (N·m)	5.39		
Maximum torque (N·m)	13.5		
Rated frequency (Hz)	125		
Rated current (A)	6.6		Heatsink-based derating curve
Maximum current (A)	17.2		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	0.93		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	13.56 ± 10%	
	Motor with brake	15.8 ± 10%	

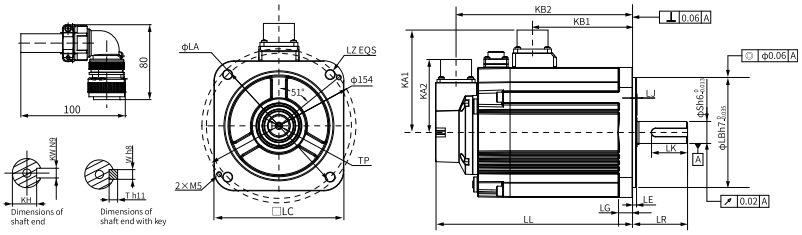
Electrical specifications of the brake

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

Allowable load

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

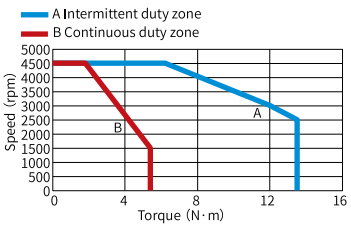
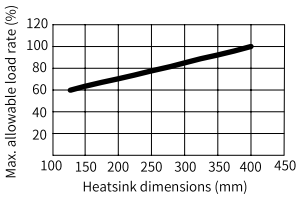
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	142 (167)	55 ± 1	145	4 × ϕ9	103	70	73	121.5 (146.5)	14	4

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110	22	M6 × 20	$35^{0}_{-0.62}$	$18^{0}_{-0.2}$	8	8	7	5.8 (7.7)

22.1.2.4.2 MS1H3-85B15CD-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	0.85		
Voltage (V)	380		
Rated torque (N·m)	5.39		
Maximum torque (N·m)	13.5		
Rated frequency (Hz)	125		
Rated current (A)	3.5		Heatsink-based derating curve
Maximum current (A)	8.5		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.84		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	13.56 ± 10%	
	Motor with brake	15.8 ± 10%	

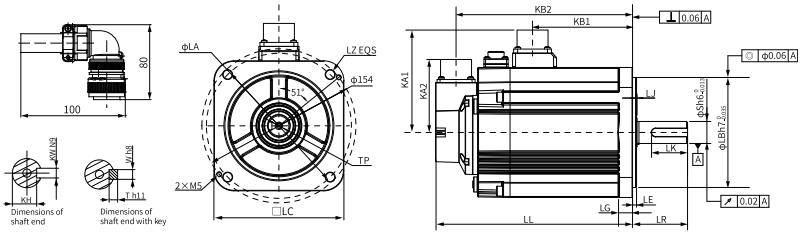
Electrical specifications of the brake

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

Allowable load

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

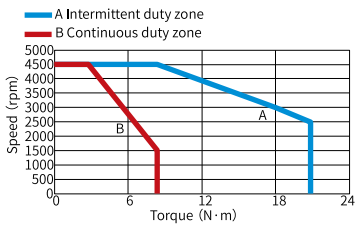
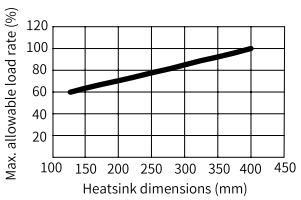
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	142 (167)	55 ± 1	145	4 × φ9	103	70	73	121.5 (146.5)	14	4

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110	22	M6 × 20	$35^{0}_{-0.62}$	$18^{0}_{-0.2}$	8	8	7	5.8 (7.7)

22.1.2.4.3 MS1H3-13C15CB-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	1.3		
Voltage (V)	220		
Rated torque (N·m)	8.34		
Maximum torque (N·m)	20.85		
Rated frequency (Hz)	125		
Rated current (A)	10.5		Heatsink-based derating curve
Maximum current (A)	27.3		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	0.89		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	19.25 ± 10%	
	Motor with brake	21.5 ± 10%	

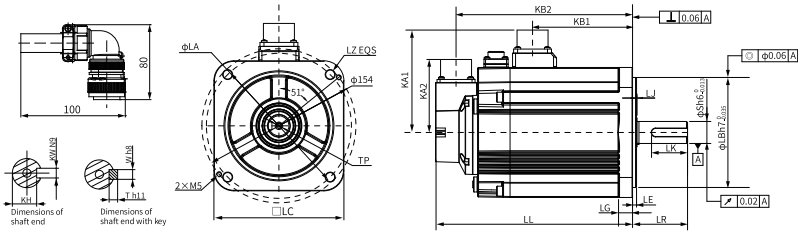
Electrical specifications of the brake

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

Allowable load

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

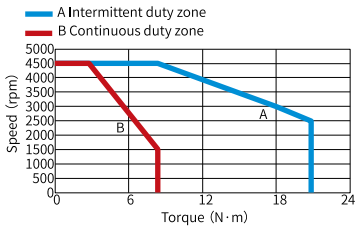
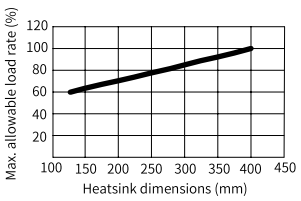
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	157 (182)	55 ± 1	145	4 × ϕ9	103	85	73	136.5 (161.5)	14	4

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110	22	M6 × 20	$35^{0}_{-0.62}$	$18^{0}_{-0.2}$	8	8	7	7.1 (8.9)

22.1.2.4.4 MS1H3-13C15CD-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	1.3		
Voltage (V)	380		
Rated torque (N·m)	8.34		
Maximum torque (N·m)	20.85		
Rated frequency (Hz)	125		
Rated current (A)	5.1		Heatsink-based derating curve
Maximum current (A)	12.6		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.85		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	19.25 ± 10%	
	Motor with brake	21.5 ± 10%	

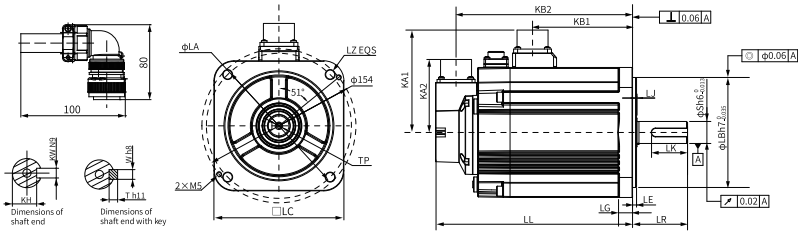
Electrical specifications of the brake

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

Allowable load

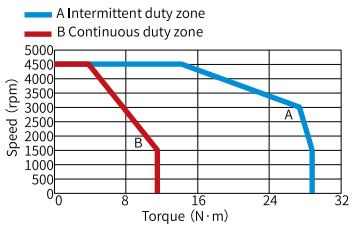
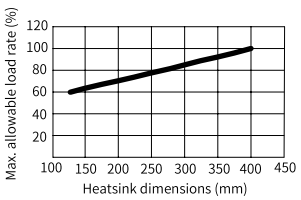
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
55	≤ 686	≤ 196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	157 (182)	55 ± 1	145	4 × ϕ9	103	85	73	136.5 (161.5)	14	4
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110		22	M6 × 20	$35^{0}_{-0.62}$	$18^{0}_{-0.2}$	8	8	7	7.1 (8.9)

22.1.2.4.5 MS1H3-18C15CB-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	1.8		
Voltage (V)	220		
Rated torque (N·m)	11.5		
Maximum torque (N·m)	28.75		
Rated frequency (Hz)	125		
Rated current (A)	11.9		Heatsink-based derating curve
Maximum current (A)	32.2		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.09		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	24.9 ± 10%	
	Motor with brake	27.2 ± 10%	

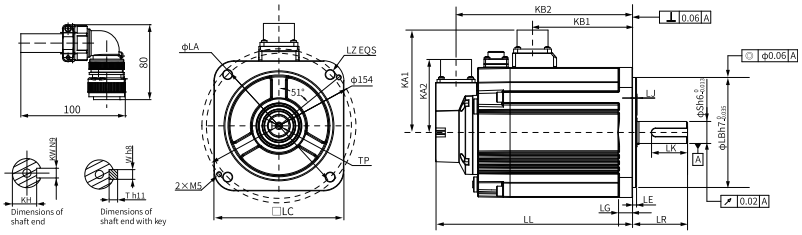
Electrical specifications of the brake

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

Allowable load

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

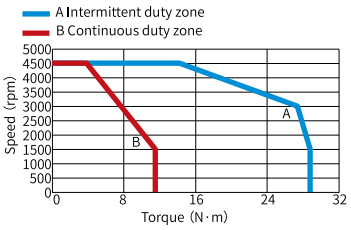
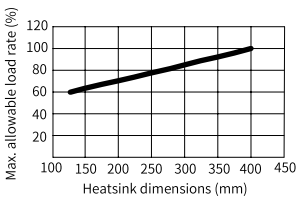
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	172 (197)	55 ± 1	145	4 × ϕ9	103	100	73	151.5 (176.5)	14	4

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110	22	M6 × 20	$35^{0}_{-0.62}$	$18^{0}_{-0.2}$	8	8	7	8.5 (10.3)

22.1.2.4.6 MS1H3-18C15CD-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	1.8		
Voltage (V)	380		
Rated torque (N·m)	11.5		
Maximum torque (N·m)	28.75		
Rated frequency (Hz)	125		
Rated current (A)	6.75		Heatsink-based derating curve
Maximum current (A)	17.7		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.87		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	24.9 ± 10%	
	Motor with brake	27.2 ± 10%	

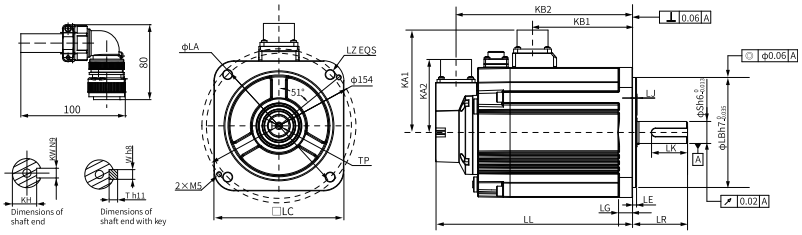
Electrical specifications of the brake

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

Allowable load

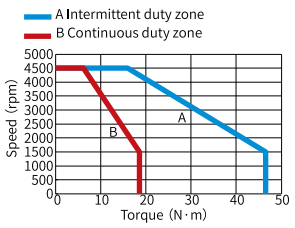
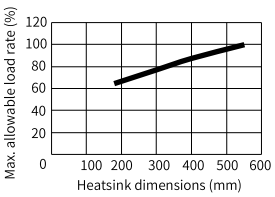
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
55	≤ 686	≤ 196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	172 (197)	55 ± 1	145	4 × ϕ9	103	100	73	151.5 (176.5)	14	4
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110		22	M6 × 20	$35^{0}_{-0.62}$	$18^{0}_{-0.2}$	8	8	7	8.5 (10.3)

22.1.2.4.7 MS1H3-29C15CB-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	180		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	2.9		
Voltage (V)	220		
Rated torque (N·m)	18.6		
Maximum torque (N·m)	46.5		
Rated frequency (Hz)	125		
Rated current (A)	18		Heatsink-based derating curve
Maximum current (A)	52.5		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.16		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	44.7 ± 10%	
	Motor with brake	52.35 ± 10%	

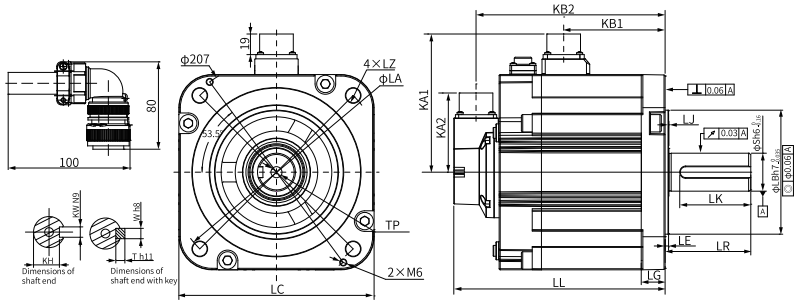
Electrical specifications of the brake

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

Allowable load

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

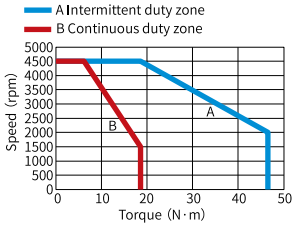
Dimensions (mm)

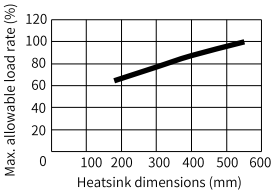


LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
180	161 (194.8)	79 ± 1	200	4 × Φ13.5	127.4	93.5	73	140.5 (174.3)	20.5	3.2 ± 0.3

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.3 ± 0.75	114.3	35	M12 × 25	$64^{0}_{-0.74}$	$30^{0}_{-0.2}$	10	10	8	13.8 (17.9)

22.1.2.4.8 MS1H3-29C15CD-A6/S63*R-INT

Motor specifications		Torque-speed characteristics
Frame size (mm)	180	
Inertia, capacity	Medium inertia, medium capacity	
Rated power (kW)	2.9	
Voltage (V)	380	
Rated torque (N·m)	18.6	
Maximum torque (N·m)	46.5	
Rated frequency (Hz)	125	
Rated current (A)	10.5	Heatsink-based derating curve

Motor specifications			Torque-speed characteristics
Maximum current (A)	29.75		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.94		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	44.7 ± 10%	
	Motor with brake	52.35 ± 10%	

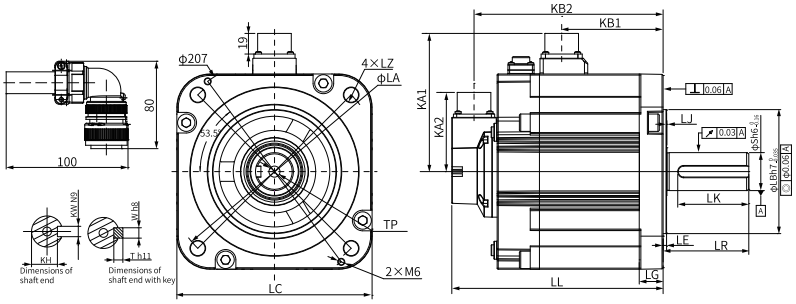
Electrical specifications of the brake

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

Allowable load

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

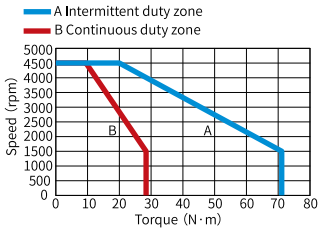
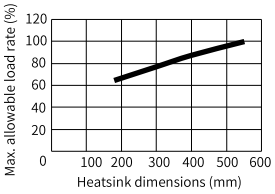
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
180	161 (194.8)	79 ± 1	200	4 × ϕ13.5	127.4	93.5	73	140.5 (174.3)	20.5	3.2 ± 0.3

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.3 ± 0.75	114.3	35	M12 × 25	$64^{0}_{-0.74}$	$30^{0}_{-0.2}$	10	10	8	13.8 (17.9)

22.1.2.4.9 MS1H3-44C15CB-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	180		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	4.4		
Voltage (V)	220		
Rated torque (N·m)	28.4		
Maximum torque (N·m)	71.1		
Rated frequency (Hz)	125		
Rated current (A)	25.5		Heatsink-based derating curve
Maximum current (A)	67		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.25		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	64.9 ± 10%	
	Motor with brake	72.55 ± 10%	

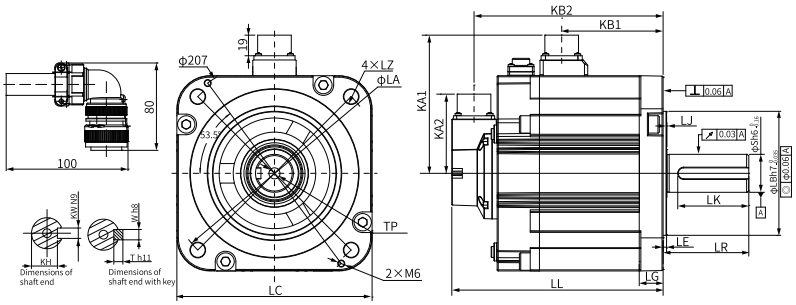
Electrical specifications of the brake

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

Allowable load

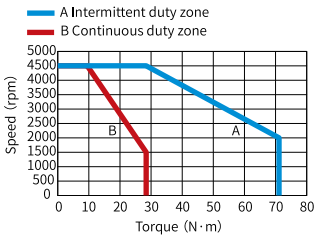
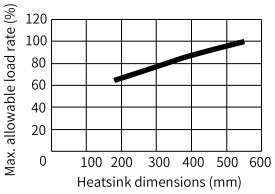
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
79	≤ 1470	≤ 490

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
180	184.5 (218.3)	79 ± 1	200	4 × ϕ13.5	127.4	117	73	164 (197.8)	20.5	3.2 ± 0.3
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.3 ± 0.75	114.3		35	M12 × 25	$64^{0}_{-0.74}$	$30^{0}_{-0.2}$	10	10	8	17.4 (21.9)

22.1.2.4.10 MS1H3-44C15CD-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	180		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	4.4		
Voltage (V)	380		
Rated torque (N·m)	28.4		
Maximum torque (N·m)	71.1		
Rated frequency (Hz)	125		
Rated current (A)	16		Heatsink-based derating curve
Maximum current (A)	42		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.96		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	64.9 ± 10%	
	Motor with brake	72.55 ± 10%	

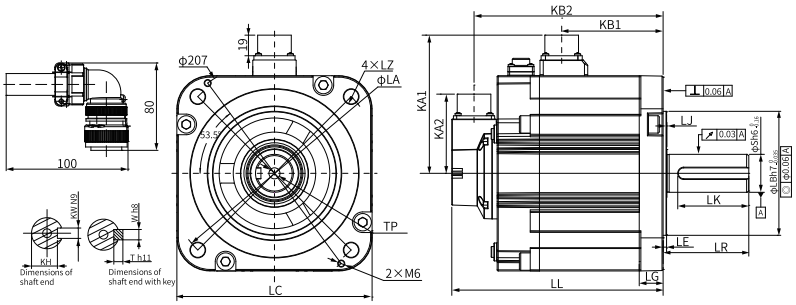
Electrical specifications of the brake

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

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
79	≤ 1470	≤ 490

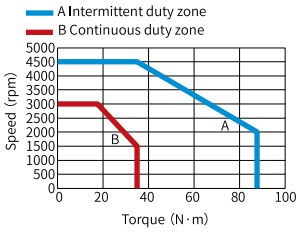
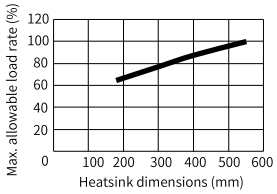
Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
180	184.5 (218.3)	79 ± 1	200	4 × ϕ13.5	127.4	117	73	164 (197.8)	20.5	3.2 ± 0.3

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.3 ± 0.75	114.3	35	M12 × 25	$64^{0}_{-0.74}$	$30^{0}_{-0.2}$	10	10	8	17.4 (21.6)

22.1.2.4.11 MS1H3-55C15CD-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	180		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	5.5		
Voltage (V)	380		
Rated torque (N·m)	35		
Maximum torque (N·m)	87.6		
Rated frequency (Hz)	125		
Rated current (A)	20.7		Heatsink-based derating curve
Maximum current (A)	52		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.92		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	86.9 ± 10%	
	Motor with brake	94.55 ± 10%	

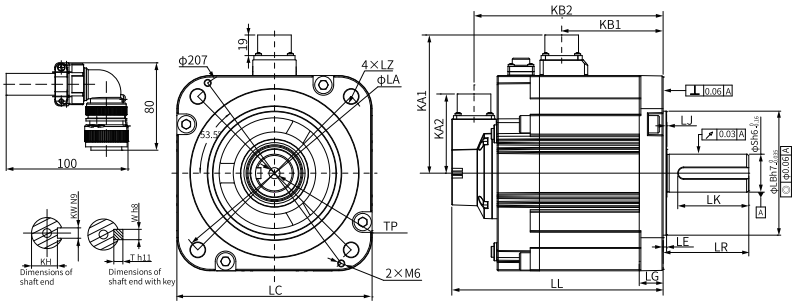
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
50	24	31	18.58	1.29	≤ 200	≤ 100	≤ 1

Allowable load

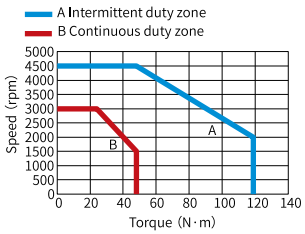
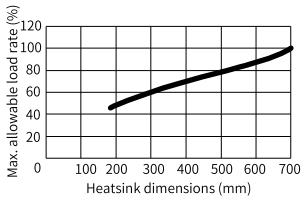
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
113	≤ 1764	≤ 588

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
180	208 (241.8)	113 ± 1	200	4 × ϕ13.5	127.4	140.5	73	187.5 (221.3)	20.5	3.2 ± 0.3
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.3 ± 0.75	114.3		42	M16 × 32	$95^{0}_{-0.87}$	$37^{0}_{-0.2}$	12	12	8	21.7 (25.9)

22.1.2.4.12 MS1H3-75C15CD-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	180		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	7.5		
Voltage (V)	380		
Rated torque (N·m)	48		
Maximum torque (N·m)	119		
Rated frequency (Hz)	125		
Rated current (A)	25		Heatsink-based derating curve
Maximum current (A)	65		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	2.13		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	127.5 ± 10%	
	Motor with brake	135.15 ± 10%	

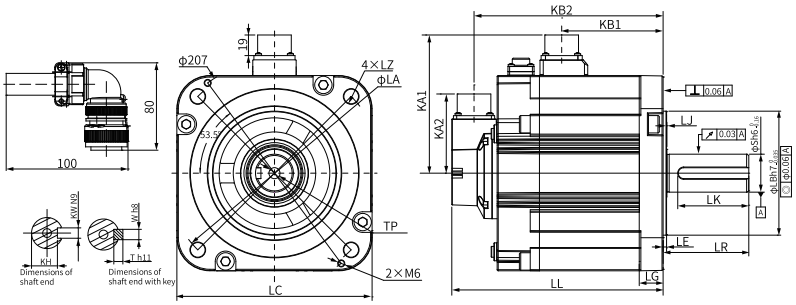
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
50	24	31	18.58	1.29	≤ 200	≤ 100	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
113	≤ 1764	≤ 588

Dimensions (mm)

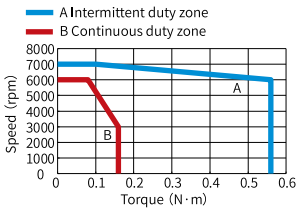
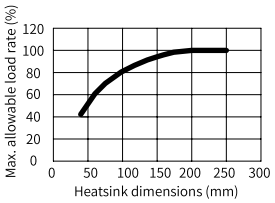


LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
180	255 (288.8)	113 ± 1	200	4 × ϕ13.5	127.4	187.5	73	234.5 (268.5)	20.5	3.2 ± 0.3

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.3 ± 0.75	114.3	42	M16 × 32	$95^{0}_{-0.87}$	$37^{0}_{-0.2}$	12	12	8	29 (33.2)

22.1.2.5 Medium Inertia and Small Capacity (MS1H4)

22.1.2.5.1 MS1H4-05B30CB-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	40		
Inertia, capacity	Medium inertia, low capacity		
Rated output (kW)	0.05		
Voltage (V)	220		
Rated torque (N·m)	0.16		
Maximum torque (N·m)	0.56		
Rated frequency (Hz)	350		
Rated current (A)	1.27		Heatsink-based derating curve
Maximum current (A)	4.78		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.15		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	0.038 ± 10%	
	Motor with brake	0.04 ± 10%	

Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
0.32	24	6.9	83.5	0.29	≤ 40	≤ 20	≤ 1.5

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
20	≤ 78	≤ 54

Dimensions (mm)

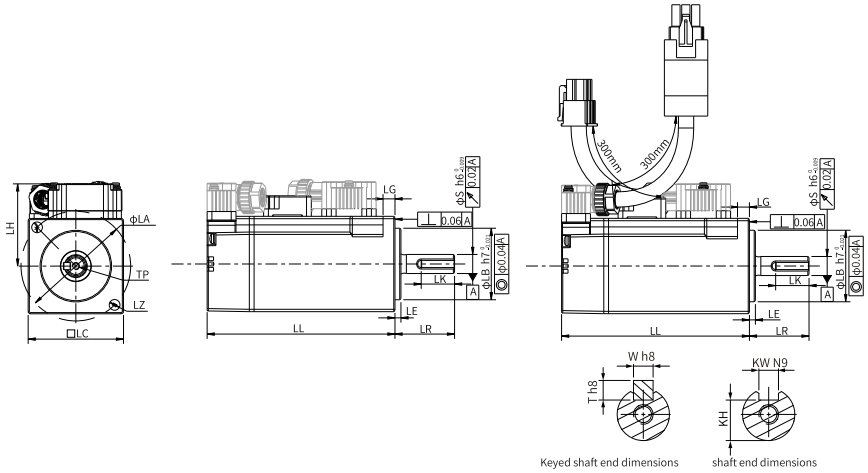


Figure 22-8 MS1H4-05B30CB-A6/S630R and MS1H4-05B30CB-A6/S632R

LL	LC	LR	LA	LZ	LH	LG	LE	
51 (78.3)	40	25 ± 0.5	46	2 × ϕ4.5	34.5	5	2.5 ± 0.5	
S	LB	TP	LK	KH	kW	W	T	Weight (kg)
8	30	M3 × 6	$14^{0}_{-0.36}$	$6.2^{0}_{-0.1}$	3	3	3	0.24 (0.40)

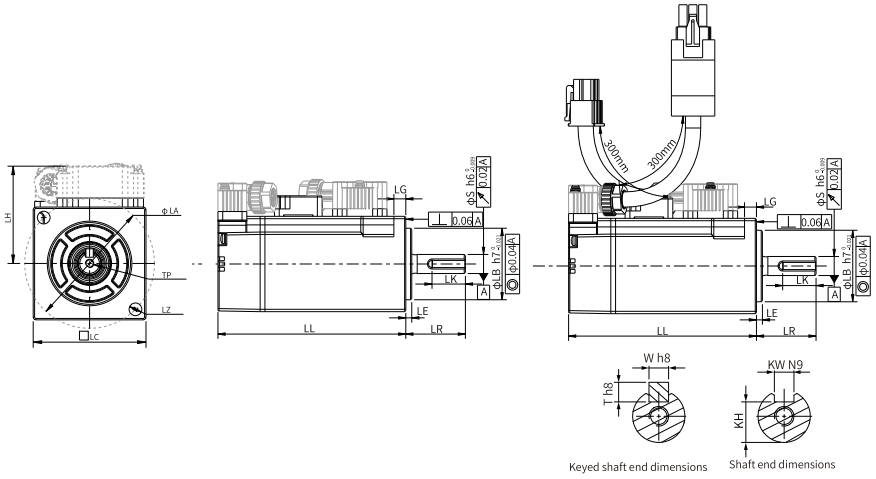
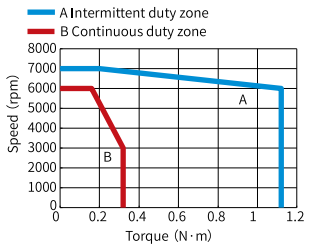
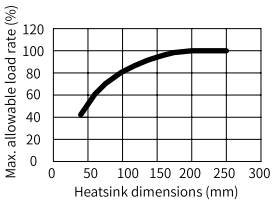


Figure 22-9 MS1H4-05B30CB-A6/S631R and MS1H4-05B30CB-A6/S634R

LL	LC	LR	LA	LZ	LH	LG	LE	
53.7 (81)	40	25 ± 0.5	46	2 × ϕ4.5	34.5	5	2.5 ± 0.5	
S	LB	TP	LK	KH	kW	W	T	Weight (kg)
8	30	M3 × 6	$14^{0}_{-0.36}$	$6.2^{0}_{-0.1}$	3	3	3	0.26 (0.42)

22.1.2.5.2 MS1H4-10B30CB-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	40		
Inertia, capacity	Medium inertia, low capacity		
Rated output (kW)	0.1		
Voltage (V)	220		
Rated torque (N·m)	0.32		
Maximum torque (N·m)	1.12		
Rated frequency (Hz)	350		
Rated current (A)	1.27		Heatsink-based derating curve
Maximum current (A)	4.78		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.29		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	0.072 ± 10%	
	Motor with brake	0.074 ± 10%	

Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
0.32	24	6.9	83.5	0.29	≤ 40	≤ 20	≤ 1.5

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
20	≤ 78	≤ 54

Dimensions (mm)

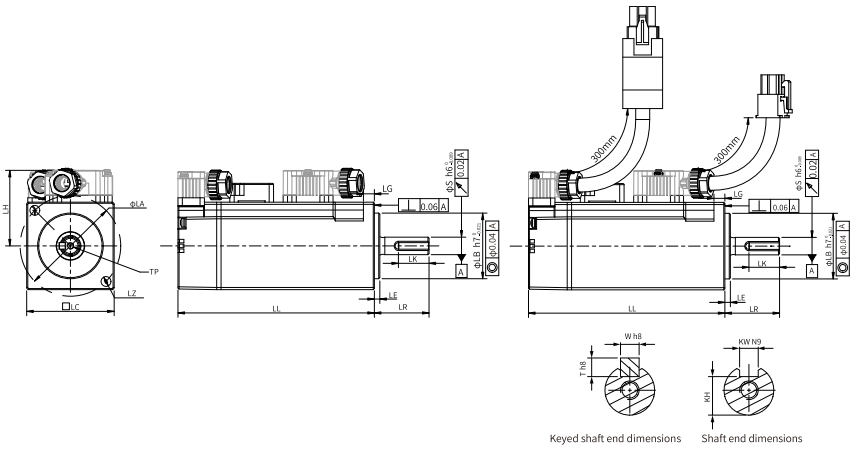


Figure 22-10 MS1H4-10B30CB-A6/S630R and MS1H4-10B30CB-A6/S632R

LL	LC	LR	LA	LZ	LH	LG	LE	
62 (89.3)	40	25 ± 0.5	46	2 × ϕ4.5	34.5	5	2.5 ± 0.5	
S	LB	TP	LK	KH	kW	W	T	Weight (kg)
8	30	M3 × 6	$14^{0}_{-0.36}$	$6.2^{0}_{-0.1}$	3	3	3	0.32 (0.48)

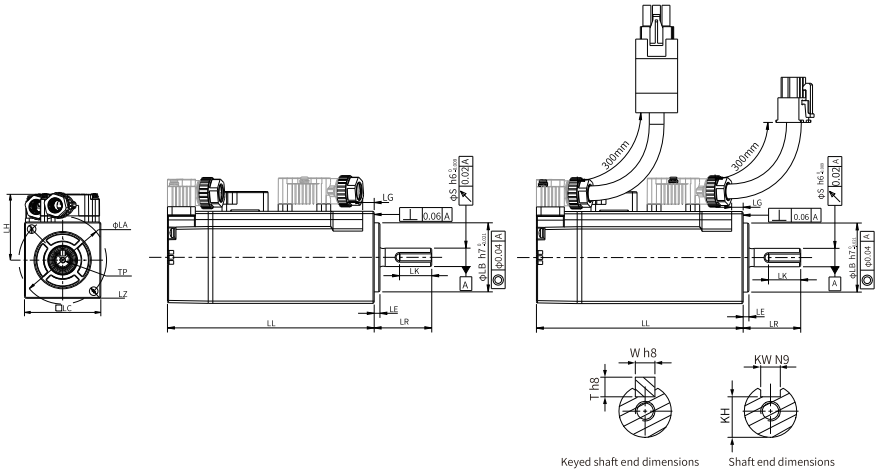
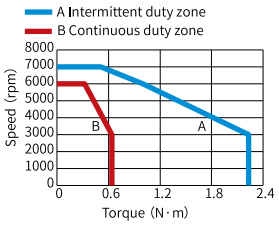
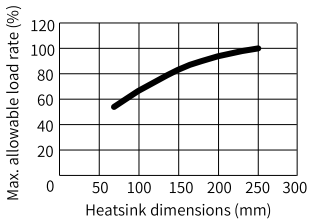


Figure 22-11 MS1H4-10B30CB-A6/S631R and MS1H4-10B30CB-A6/S634R

LL	LC	LR	LA	LZ	LH	LG	LE	
64.7 (92)	40	25 ± 0.5	46	2 × ϕ4.5	34.5	5	2.5 ± 0.5	
S	LB	TP	LK	KH	kW	W	T	Weight (kg)
8	30	M3 × 6	$14^{0}_{-0.36}$	$6.2^{0}_{-0.1}$	3	3	3	0.34 (0.50)

22.1.2.5.3 MS1H4-20B30CB-A6/S63*R-INT

Motor specifications		Torque-speed characteristics
Frame size (mm)	60	
Inertia, capacity	Medium inertia, low capacity	
Rated power (kW)	0.2	
Voltage (V)	220	
Rated torque (N·m)	0.64	
Maximum torque (N·m)	2.24	
Rated frequency (Hz)	250	
Rated current (A)	1.3	Heatsink-based derating curve

Motor specifications			Torque-speed characteristics
Maximum current (A)	5.3		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.55		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	0.22 ± 10%	
	Motor with brake	0.23 ± 10%	

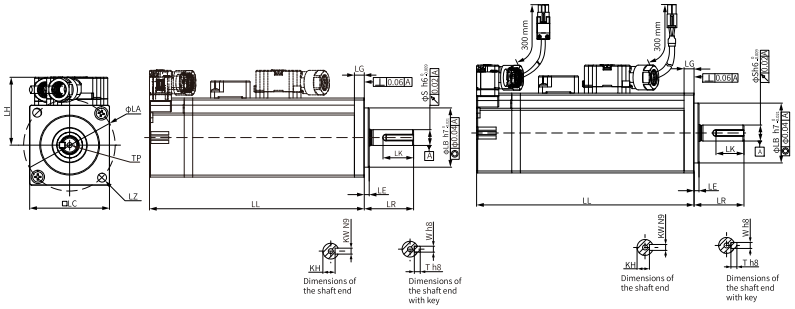
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
1.5	24	7.6	75.79	0.32	≤ 60	≤ 20	≤ 1.5

Allowable load

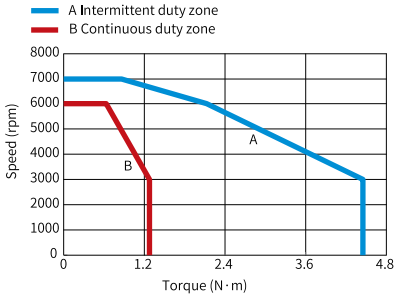
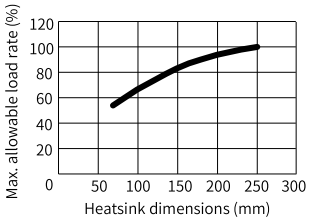
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
25	≤ 245	≤ 74

Dimensions (mm)



LC	LL	LR	LA	LZ	LH	LG	LE	
60	73.5 (101.1)	30 ± 0.5	70	4 × ϕ5.5	44	8.0	3 ± 0.5	
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
50	14	M5 × 8	$16.5^{0}_{-0.53}$	$11^{0}_{-0.1}$	5	5	5	0.78 (1.16)

22.1.2.5.4 MS1H4-40B30CB-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	60		
Inertia and capacity	Medium inertia, small capacity		
Rated power (kW)	0.4		
Voltage (V)	220		
Rated torque (N·m)	1.27		
Maximum torque (N·m)	4.45		
Rated frequency (Hz)	250		
Rated current (A)	2.4		Heatsink-based derating curve
Maximum current (A)	9.2		
Rated speed (rpm)	3000		
Maximum Speed (rpm)	7000		
Torque coefficient (N·m/A)	0.58		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	0.43±10%	
	Motor with brake	0.44±10%	

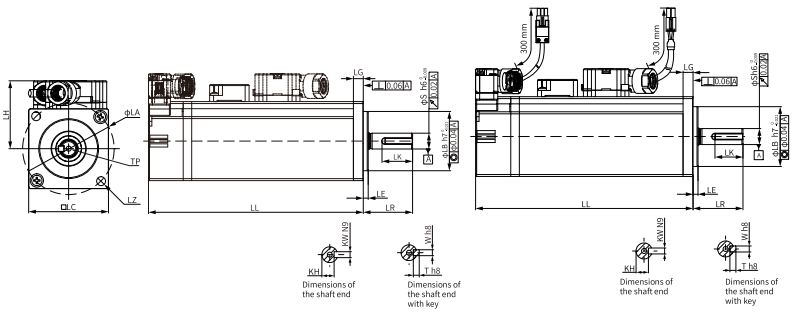
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω)±10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
1.5	24	7.6	75.79	0.32	≤ 60	≤ 20	≤ 1.5

Allowable loads

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
25	≤ 245	≤ 74

Product dimensions (in mm)

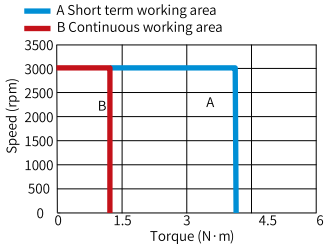


LC	LL	LR	LA	LZ	LH	LG	LE	
60	92 (119.8)	30±0.5	70	4 × ϕ5.5	44	8.0	3±0.5	
LB	S	TP	LK	KH	KW	W	T	Weight (kg)
50	14	M5 × 8	$16.5^{0}_{-0.53}$	$11^{0}_{-0.1}$	5	5	5	1.11 (1.48)

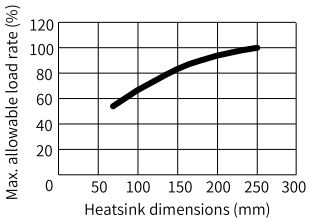
22.1.2.5.5 MS1H4-40B30CD-A6/S63*R-INT

Motor specifications		
Frame size (mm)	60	
Inertia and capacity	Medium inertia, small capacity	
Rated power (kW)	0.4	
Voltage (V)	380	
Rated torque (N·m)	1.27	
Maximum torque (N·m)	4.45	
Rated frequency (Hz)	250	
Rated current (A)	1.33	
Maximum current (A)	5.8	
Rated speed (rpm)	3000	
Maximum Speed (rpm)	3000	
Torque coefficient (N·m/A)	0.95	
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	0.43±10%
	Motor with brake	0.44±10%

Torque-speed characteristics



Heatsink-based derating curve



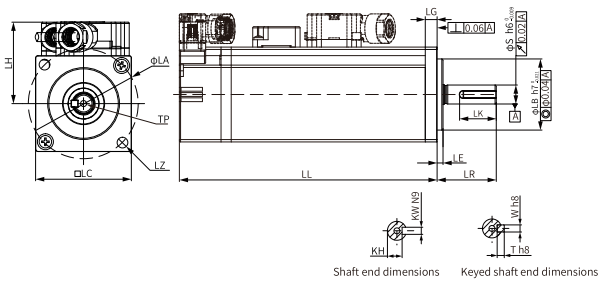
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω)±10%	Excitation current (A)	Close time (ms)	Release time (ms)	Backlash (°)
1.5	24	7.6	75.79	0.32	≤ 60	≤ 20	≤ 1.5

Allowable loads

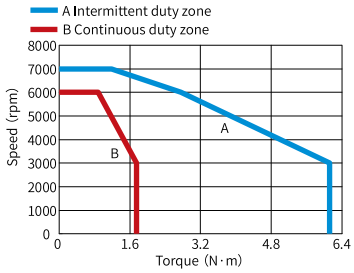
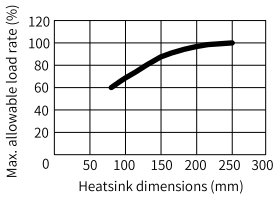
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
25	≤ 245	≤ 74

Product dimensions (in mm)



LC	LL	LR	LA	LZ	LH	LG	LE	
60	92 (119.8)	30±0.5	70	4 × ϕ5.5	44	8.0	3±0.5	
LB	S	TP	LK	KH	KW	W	T	Weight (kg)
50	14	M5 × 8	$16.5^{0}_{-0.53}$	$11^{0}_{-0.1}$	5	5	5	1.11 (1.48)

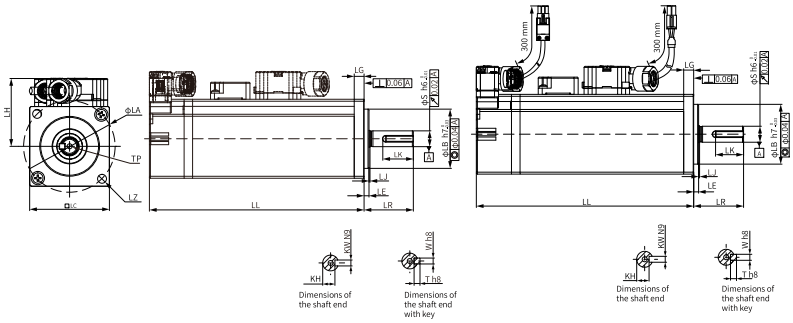
22.1.2.5.6 MS1H4-55B30CB-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	80		
Inertia, capacity	Medium inertia, low capacity		
Rated power (kW)	0.55		
Voltage (V)	220		
Rated torque (N·m)	1.75		
Maximum torque (N·m)	6.13		
Rated frequency (Hz)	250		
Rated current (A)	3.3		Heatsink-based derating curve
Maximum current (A)	13.2		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.58		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	1.12 ± 10%	
	Motor with brake	-	

Allowable load

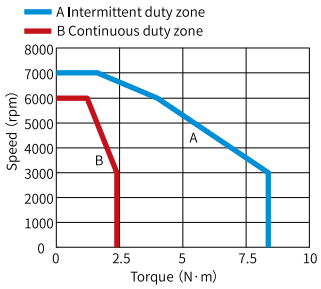
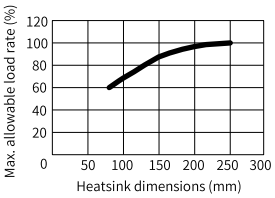
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
35	≤ 392	≤ 147

Dimensions (mm)



LC	LL	LR	LA	LZ	LH	LG	LE	LJ
80	96.7	35 ± 0.5	90	4 × ϕ7	54	7.5	3 ± 0.5	0.5 ± 0.35
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
70	19	M6 × 20	$25^{0}_{-0.62}$	$15.5^{0}_{-0.1}$	6	6	6	1.85

22.1.2.5.7 MS1H4-75B30CB-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	80		
Inertia, capacity	Medium inertia, low capacity		
Rated power (kW)	0.75		
Voltage (V)	220		
Rated torque (N·m)	2.39		
Maximum torque (N·m)	8.37		
Rated frequency (Hz)	250		
Rated current (A)	4.4		Heatsink-based derating curve
Maximum current (A)	16.9		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.63		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	1.46 ± 10%	
	Motor with brake	1.51 to 10 %	

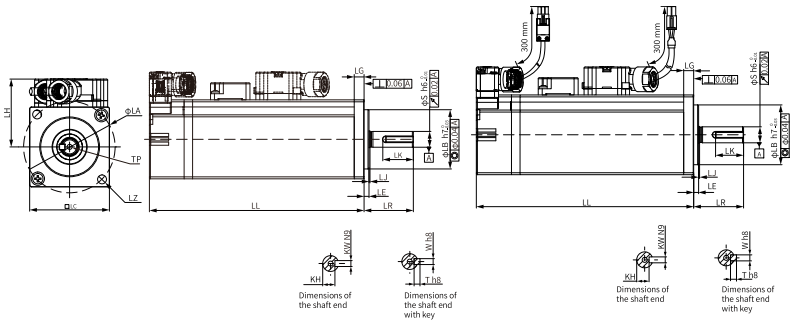
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
3.2	24	10	57.6	0.42	≤ 60	≤ 40	≤ 1

Allowable load

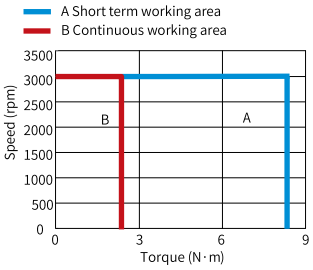
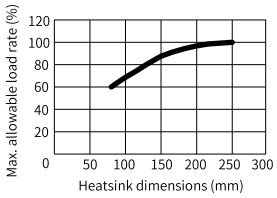
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
35	≤ 392	≤ 147

Dimensions (mm)



LC	LL	LR	LA	LZ	LH	LG	LE	LJ
80	107.3 (140.5)	35 ± 0.5	90	4 × ϕ7	54	7.5	3 ± 0.5	0.5 ± 0.35
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
70	19	M6 × 20	$250_{-}^{0.62}$	$15.50_{-0.1}$	6	6	6	2.18 (2.82)

22.1.2.5.8 MS1H4-75B30CD-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	80		
Inertia and capacity	Medium inertia, small capacity		
Rated power (kW)	0.75		
Voltage (V)	380		
Rated torque (N·m)	2.39		
Maximum torque (N·m)	8.37		
Rated frequency (Hz)	250		
Rated current (A)	2.23		Heatsink-based derating curve
Maximum current (A)	9.1		
Rated speed (rpm)	3000		
Maximum Speed (rpm)	3000		
Torque coefficient (N·m/A)	1.07		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	1.46±10%	
	Motor with brake	1.51±10%	

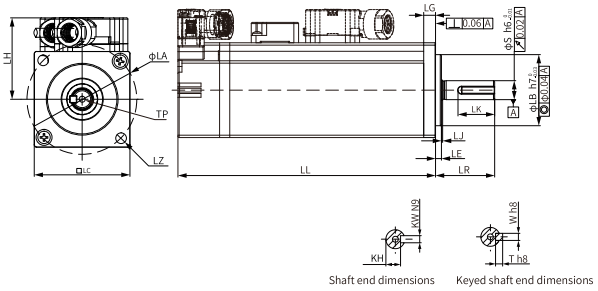
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω)±10%	Excitation current (A)	Close time (ms)	Release time (ms)	Backlash (°)
3.2	24	10	57.6	0.42	≤ 60	≤ 40	≤ 1

Allowable loads

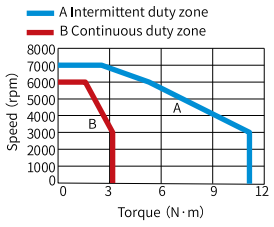
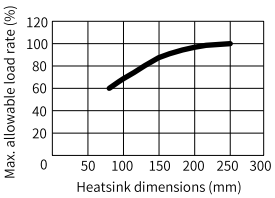
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
35	≤ 392	≤ 147

Product dimensions (in mm)



LC	LL	LR	LA	LZ	LH	LG	LE	LJ
80	107.3 (140.5)	35±0.5	90	4 × ϕ7	54	7.5	3±0.5	0.5±0.35
LB	S	TP	LK	KH	KW	W	T	Weight (kg)
70	19	M6 × 20	$25^{0}_{-0.62}$	$15.5^{0}_{-0.1}$	6	6	6	2.18 (2.82)

22.1.2.5.9 MS1H4-10C30CB-A6/S63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	80		
Inertia, capacity	Medium inertia, low capacity		
Rated power (kW)	1.0		
Voltage (V)	220		
Rated torque (N·m)	3.18		
Maximum torque (N·m)	11.13		
Rated frequency (Hz)	250		
Rated current (A)	6.5		Heatsink-based derating curve
Maximum current (A)	24		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.53		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	1.87 ± 10%	
	Motor with brake	1.97 ± 10%	

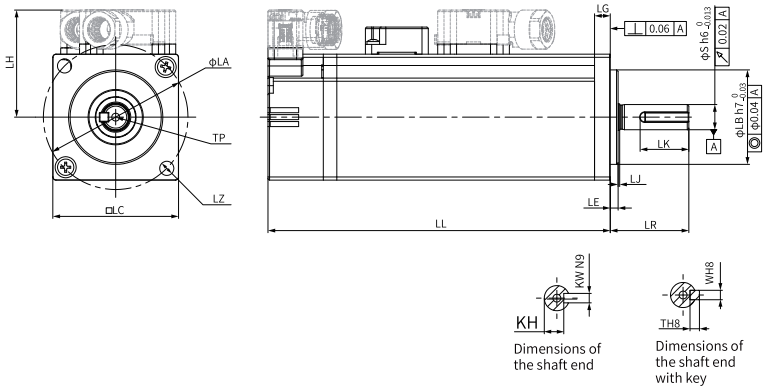
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
3.2	24	10	57.6	0.42	≤ 60	≤ 40	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
35	≤ 392	≤ 147

Dimensions (mm)

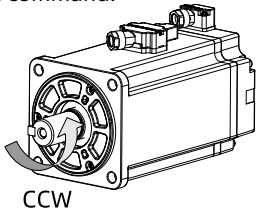


LC	LL	LR	LA	LZ	LH	LG	LE	LJ
80	118.7 (153.2)	35 ± 0.5	90	4 × ϕ7	54	7.5	3 ± 0.5	0.5 ± 0.35
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
70	19	M6 × 20	$25^{0}_{-0.62}$	$15.5^{0}_{-0.1}$	6	6	6	2.55 (2.9)

22.2 MS1-R Series Servo Motor with Battery-free Encoder

22.2.1 General Specifications

22.2.1.1 Mechanical Characteristics

Item	Description
Duty type	S1 (Continuous duty)
Vibration grade[1]	V15
Insulation resistance	500 VDC, above 10 MΩ
Excitation mode	Permanent magnet
Installation method	Flange
Thermal class	F
Insulation voltage	1500 VAC, 1 min (200 V class) 1800 VAC, 1 min (400 V class)
IP rating	IP67 (except the shaft opening)
Direction of rotation	Rotates counterclockwise (CCW) when viewed from the shaft extension side with a forward run command.  CCW

Item		Description
Ambient condition	Ambient temperature	0°C to 40°C (non-freezing)
	Ambient humidity	20% RH to 80% RH (without condensation)
	Rated operating altitude	1000 m
	Altitude-based derating	• 1000 m and below: Derating is not needed. • For use above 1000 m, derate according to *"22.2.1.3 Derating Characteristics" on page 1364*. For altitudes above 2000 m, install an isolation transformer at the power input end.
	Installation location	• Free from corrosive or explosive gases • Well ventilated with minimum amount of dust, waste, and moisture • Convenient for inspection and cleaning • Away from sources that may generate strong magnetic field • Away from heating sources such as heating stoves. • Use a motor with oil seal in places with grinding fluid, oil mist, iron powders or cuttings. • Oil seal protection capability: The oil seal is only dust-proof. It cannot withstand the intrusion of oil for a long term. For direct-connected reducer applications requiring long-term oil resistance on the motor oil seal, contact Inovance technical support. • Not applicable to vacuum environments. • Not applicable to inching conditions (not full-turn) [2], which may stuck the motor • The motor with brake may generate a pattering sound. • In upstream applications of the motor, ensure the force applied on the shaft end is lower than the allowable axial force and radial force of the motor. • The system should avoid continuous operation at a natural frequency. Exceeding the allowable vibration value may damage the system.
	Storage environment	Observe the following requirements for storing a de-energized motor. • Temperature: -20°C to +60°C (non-freezing) • Storage humidity: 20% to 80% RH (without condensation)
Shock resistance [3][5]	Shock acceleration (flange side as standard)	490 m/s^2
	Number of shocks	2
Vibration resistance [4][5]	Vibration acceleration (flange side as standard)	Radial 49 m/s^2 Axial 24.5 m/s^2

Note

- [1] Vibration class V15 indicates that the amplitude of vibration is lower than 15 μm when an individual motor rotates at rated values.
- [2] For applications that require the motor shaft to swing back and forth at a certain angle, contact Inovance.
- [3] The resistance for shock in the vertical direction when the motor is mounted with the shaft in a horizontal position is shown in the preceding table.
- [4] The vertical, side-to-side, and front-to-back resistance for vibration in three directions when the servo motor is mounted with the shaft in a horizontal position is shown in the preceding table.
- [5] The vibration intensity applied on the motor is affected by the transmission structure, alignment accuracy, mounting conditions, and external vibration. These factors may enhance the vibration applied on the motor. When the maximum allowable vibration limit is exceeded, the motor may fail. Therefore, take necessary measures to limit resonance.
- The vibration intensity applied on the motor varies with applications.

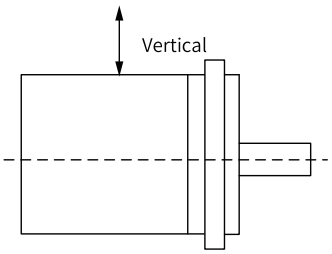


Figure 22-12 Shock applied to the servo motor

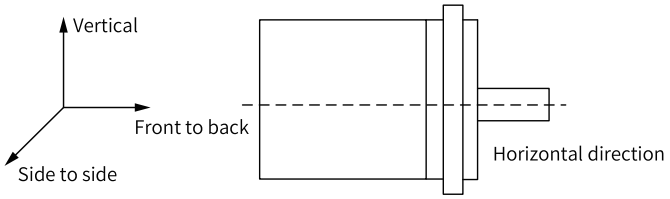


Figure 22-13 Vibration applied to the servo motor

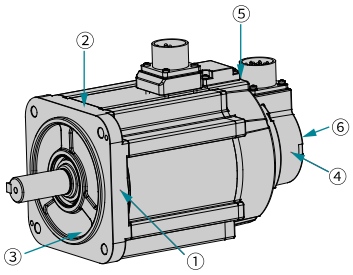


Figure 22-14 Max. allowable vibration limit of the motor

Direction	Measuring point	Limit value (10 Hz to 2000 Hz)
Radial	①②	49 m/s^2
	④⑤	49 m/s^2
Axial	③	24.5 m/s^2
	⑥	24.5 m/s^2

Note

The preceding vibration/shock standards cannot be applied for a long term. For long-term application, contact Inovance.

22.2.1.2 Overload Characteristics

The drive is compliant with NEC and CEC requirements and equipped with protective functions against overload and overtemperature.

The following overload protection curve applies to hot start at an ambient temperature of 40℃, which cannot guarantee continuous duty in cases of 100% output or above. During use, keep the effective torque of the load within the continuous duty zone.

To protect different load motors, set the motor overload protection gain based on the overload capacity of the motor. Use the default gain in general conditions. However, when one of the following conditions occurs, change the gain based on actual motor temperature:

- The motor operates in environments with high temperature.
- The motor is in cyclic motion featuring a short motion cycle and frequent acceleration/deceleration.
- Overload thermal protection only occurs during continuous energized operation. You need to check the motor temperature when the drive is powered off.

The motor overload protection curve is as follows:

- **MS1H1/H4 (frame size 40/60/80)**

Load ratio (%)	Operating time (s)
120	230
130	80
140	40
150	30
160	20
170	17
180	15
190	12
200	10
210	8.5
220	7
230	6
240	5.5
250	5
300	3
350	2

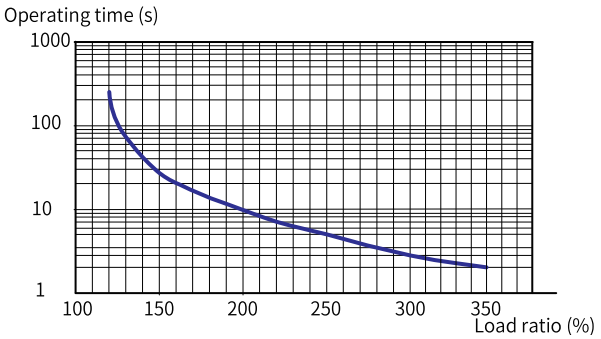


Figure 22-15 MS1H1/H4 (frame size 40/60/80) series motor overload curve

Note

The maximum torque of H1 and H4 models is the rated torque x 3.5.

- **MS1H2/MS1H3**

Load ratio (%)	Operating time (s)
115	6000
120	2533
125	1226
130	915
135	769
140	527
145	352
150	221
155	128
160	99
165	83
170	67
175	55
180	49
185	45
190	41
195	38
200	34
205	31
210	28
215	24
220	22
225	21
230	19
235	18
240	16
245	14
250	13
255	12
260	11
265	10
270	9
275	9
280	8
285	7
290	6
295	5
300	5

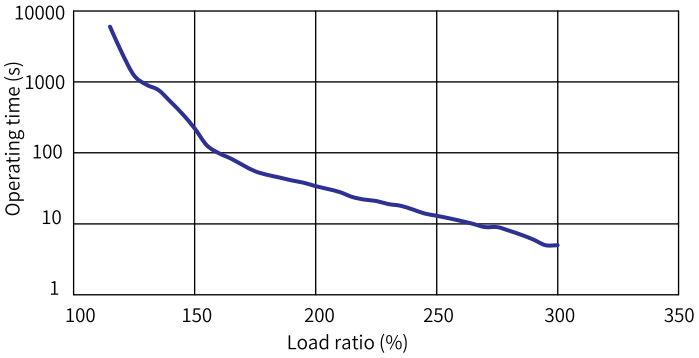


Figure 22-16 Overload curve of MS1H2 and MS1H3 series motors

Note

- The maximum torque of H2 models is the rated torque x 3.
- The maximum torque of H3 models is the rated torque x 2.5.

22.2.1.3 Derating Characteristics

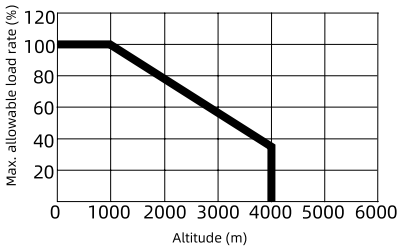
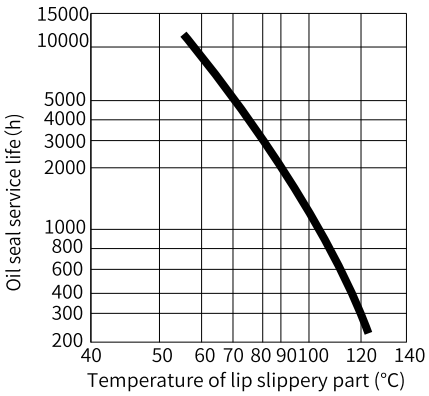


Figure 22-17 Altitude-based derating curve

22.2.1.4 Temperature Curve of the Oil Seal



22.2.1.5 Load Moment of Inertia

The load moment of inertia represents the ratio of the load inertia to the rotor inertia. The higher the load inertia ratio, the weaker the responsiveness will be. An excessively high inertia ratio can result in unstable operation. The allowable load inertia ratio of the servo motor is limited. The value is a general standard and varies according to the driving conditions of the servo motor.

An overvoltage alarm may occur during deceleration if the load moment of inertia exceeds the allowable value. For servo drives with a built-in braking resistor, an overload alarm my be reported. In cases of such alarms, take one of the following measures:

- Reduce the torque limit values.
- Reduce the deceleration rate.
- Reduce the maximum speed.
- Install an external braking resistor if the alarm cannot be cleared by using the above measures.

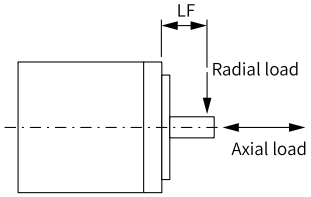
Caution

- For the built-in braking resistor of the drive, see Components.
- Even you use a built-in resistor, the energy generated in some regenerative conditions may exceed the allowable capacity loss (W) of the resistor. In this case, an external braking resistor is required.

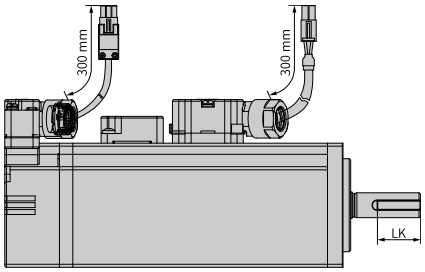
22.2.2 Model Selection (MS1-R-INT Series Servo Motor with Battery-free Encoder)

22.2.2.1 Selection Instructions

- Description of torque-speed characteristics curves:
  - All parameters and torque-speed characteristic values are subject to the conditions that the motor works with an Inovance servo drive and the armature coil temperature is 20°C.
  - Continuous duty zone: refers to a series of states in which the motor can operate safely and continuously, and the actual torque must be located in this area.
  - Intermittent duty zone: refers to a series of states in which the motor can run within a short period of time when the actual torque is greater than the rated torque.
- The characteristic values are obtained in cases where the motor is installed with the following heatsink (unit: mm):
  - MS1H1/MS1H4: 250 x 250 x 6 (aluminum)
  - MS1H2-10C to 25C: 400 x 400 x 20 (steel)
  - MS1H2-30C to 50C: 400 x 400 x 20 (steel)
  - MS1H3-85B to 18C: 400 x 400 x 20 (steel)
  - MS1H3-29C to 55C: 550 x 550 x 30 (aluminum)
  - MS1H3-75C: 700 x 700 x 30 (aluminum)
- Radial and axial loads of the motor:



- Dimensions of flying leads type motors
  Flying leads type motors with frame sizes 60/80 (model ended with "-S") provide a drain wire of about 300 mm in length, as shown in the following figure.



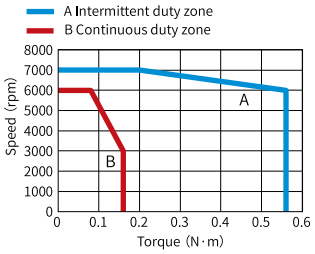
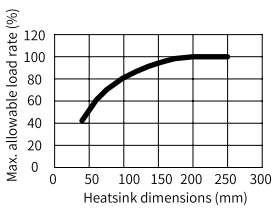
- As shown in the preceding figure, the product is marked with an LK value in the dimension diagram. LK indicates the length of the shaft key.
- MS1H3 (130-flange and 180-flange) comes with a key slot. When the operating speed is above 3000 rpm, the motor must run with the keyway. If you need to run the motor without the keyway at speeds higher than 3000 rpm, contact Inovance.

Note

- Values inside the parentheses in the following sections are parameters of the servo motor with a brake.
- The motor with oil seal must be derated by 10% during use.
- Use your own DC power supply as 24 V power supply of the brake. For the cable connecting the DC power supply to the motor brake, it is recommended to use cables with a cross-sectional area of 0.2 mm^2 or above for motors with rated 750 W or below. It is recommended to use cables with a cross-sectional area of 0.8 mm^2 or above for motors rated 750 W or above. The brake cannot share the same power supply with other appliances to prevent the voltage or current from falling due to the simultaneous operation of other electrical appliances, which may result in brake malfunction.
- Do not share a power supply among multiple brakes. Otherwise, a short-circuited coil caused by dry friction will lock other brakes that are connected to the power supply in parallel, resulting in dry friction on these brakes.
- The brake apply time and release time vary with the discharge circuit. Check the actual action delay of the product during use. The holding brake cannot be used for braking purpose.

22.2.2.2 Low Inertia and Small Capacity (MS1H1)

22.2.2.2.1 MS1H1-05B30CB-V63*R-INT

<table>
<tr><th colspan="3">Motor specifications</th><th>Torque-speed characteristics</th></tr>
<tr><td>Frame size (mm)</td><td colspan="2">40</td><td rowspan="7">
</td></tr>
<tr><td>Inertia and capacity</td><td colspan="2">Low inertia, small capacity</td></tr>
<tr><td>Rated power (kW)</td><td colspan="2">0.05</td></tr>
<tr><td>Rated voltage (V)</td><td colspan="2">220</td></tr>
<tr><td>Rated torque (N·m)</td><td colspan="2">0.16</td></tr>
<tr><td>Maximum torque (N·m)</td><td colspan="2">0.56</td></tr>
<tr><td>Rated frequency (Hz)</td><td colspan="2">250</td></tr>
<tr><td>Rated current (A)</td><td colspan="2">1.2</td><td>Heatsink-based derating curve</td></tr>
<tr><td>Maximum current (A)</td><td colspan="2">4.8</td><td rowspan="6">
</td></tr>
<tr><td>Rated speed (rpm)</td><td colspan="2">3000</td></tr>
<tr><td>Maximum speed (rpm)</td><td colspan="2">7000</td></tr>
<tr><td>Torque coefficient (N·m/A)</td><td colspan="2">0.15</td></tr>
<tr><td rowspan="2">Rotor moment of inertia ($kg·cm^2$)</td><td>Motor without brake</td><td>0.018±10%</td></tr>
<tr><td>Motor with brake</td><td>0.0208±10%</td></tr>
</table>

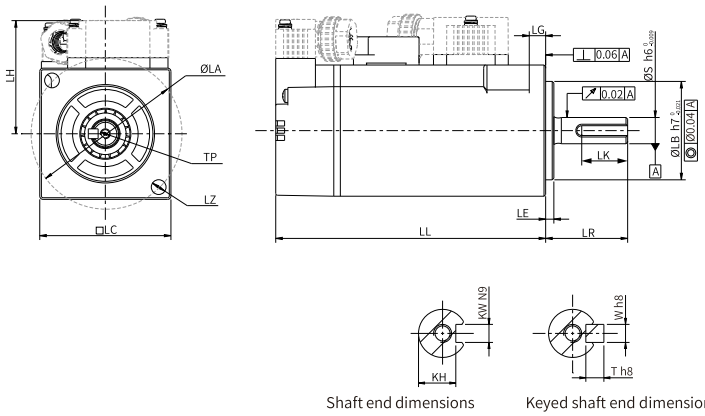
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω)±10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
0.32	24	6.9	83.5	0.29	≤ 40	≤ 20	≤ 1.5

Allowable loads

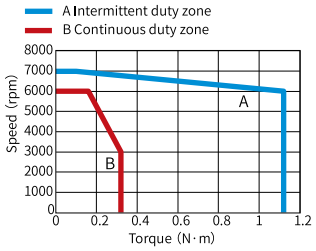
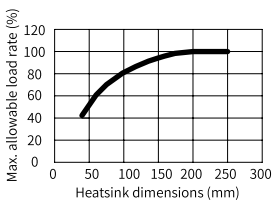
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
20	≤ 78	≤ 54

Product dimensions (in mm)



LL	LC	LR	LA	LZ	LH	LG	LE	
57 (84.3)	40	25±0.5	46	2 × ϕ4.5	34.5	5	2.5±0.5	
S	LB	TP	LK	KH	KW	W	T	Weight (kg)
8	30	M3 × 7	$14^{0}_{-0.36}$	$6.2^{0}_{-0.1}$	3	3	3	0.26 (0.43)

22.2.2.2.2 MS1H1-10B30CB-V63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	40		
Inertia and capacity	Low inertia, small capacity		
Rated power (kW)	0.1		
Rated voltage (V)	220		
Rated torque (N·m)	0.32		
Maximum torque (N·m)	1.12		
Rated frequency (Hz)	250		
Rated current (A)	1.2		Heatsink-based derating curve
Maximum current (A)	4.8		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.30		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	0.0316±10%	
	Motor with brake	0.0345±10%	

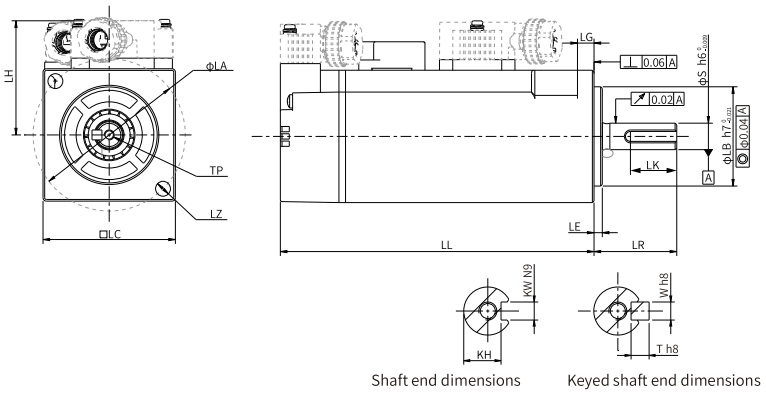
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω)±10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
0.32	24	6.9	83.5	0.29	≤ 40	≤ 20	≤ 1.5

Allowable loads

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
20	≤ 78	≤ 54

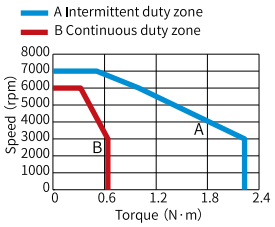
Product dimensions (in mm)

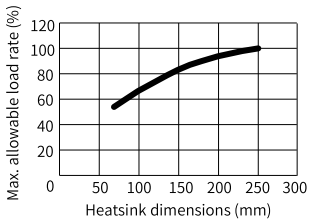


Shaft end dimensions　　Keyed shaft end dimensions

LL	LC	LR	LA	LZ	LH	LG	LE	
69.5 (96.8)	40	25±0.5	46	2 × ϕ4.5	34.5	5	2.5±0.5	
S	LB	TP	LK	KH	KW	W	T	Weight (kg)
8	30	M3 × 7	$14^{0}_{-0.36}$	$6.2^{0}_{-0.1}$	3	3	3	0.35 (0.52)

22.2.2.2.3 MS1H1-20B30CB-V63*R-INT

Motor specifications		Torque-speed characteristics
Frame size (mm)	60	
Inertia, capacity	Low inertia, small capacity	
Rated power (kW)	0.2	
Voltage (V)	220	
Rated torque (N·m)	0.64	
Maximum torque (N·m)	2.24	
Rated frequency (Hz)	250	
Rated current (A)	1.5	Heatsink-based derating curve

Motor specifications			Torque-speed characteristics
Maximum current (A)	5.3		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.51		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	0.094 ± 10%	
	Motor with brake	0.106 ± 10%	

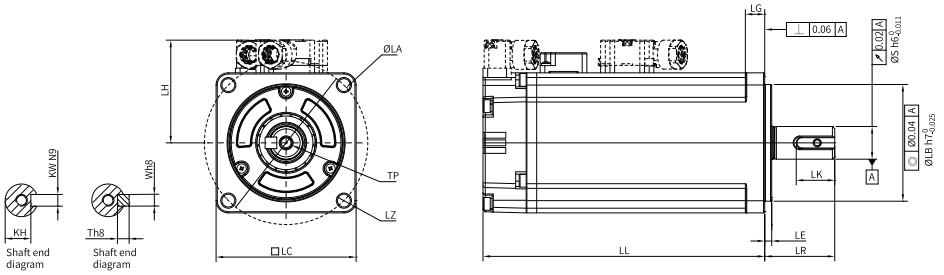
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
1.5	24	7.6	75.79	0.32	≤ 60	≤ 20	≤ 1

Allowable load

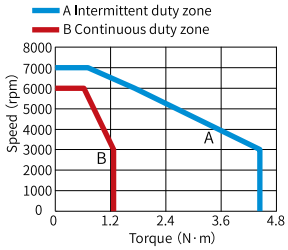
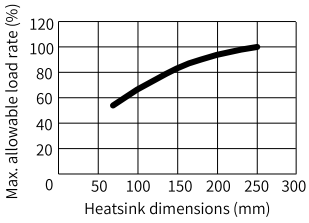
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
25	≤ 245	≤ 74

Dimensions (mm)



LC	LL	LR	LA	LZ	LH	LG	LE	
60	75.5 (103)	30 ± 0.5	70	4 × ϕ5.5	44	8.0	3 ± 0.5	
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
50	14	M5 × 12	$16^{0}_{-0.53}$	$11^{0}_{-0.1}$	5	5	5	0.80 (1.17)

22.2.2.2.4 MS1H1-40B30CB-V63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	60		
Inertia, capacity	Low inertia, small capacity		
Rated power (kW)	0.4		
Voltage (V)	220		
Rated torque (N·m)	1.27		
Maximum torque (N·m)	4.45		
Rated frequency (Hz)	250		
Rated current (A)	2.5		Heatsink-based derating curve
Maximum current (A)	9.8		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.57		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	0.145 ± 10%	
	Motor with brake	0.157 ± 10%	

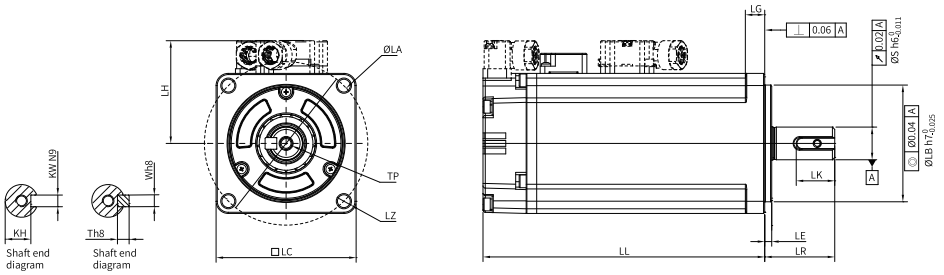
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
1.5	24	7.6	75.79	0.32	≤ 60	≤ 20	≤ 1

Allowable load

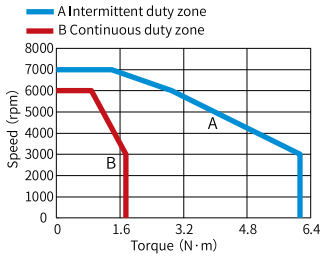
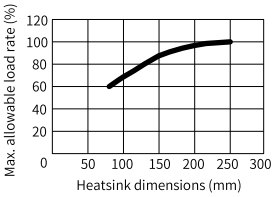
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
25	≤ 245	≤ 74

Dimensions (mm)



LC	LL	LR	LA	LZ	LH	LG	LE	
60	93 (121)	30 ± 0.5	70	4 × ϕ5.5	44	8.0	3 ± 0.5	
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
50	14	M5 × 12	$16^{0}_{-0.53}$	$11^{0}_{-0.1}$	5	5	5	1.11 (1.48)

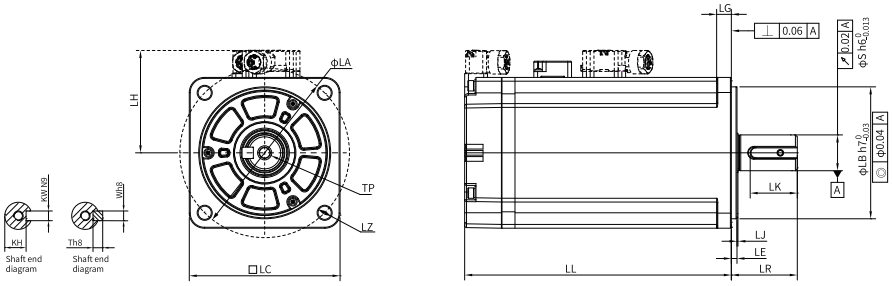
22.2.2.2.5 MS1H1-55B30CB-V631R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	80		
Inertia, capacity	Low inertia, small capacity		
Rated power (kW)	0.55		
Voltage (V)	220		
Rated torque (N·m)	1.75		
Maximum torque (N·m)	6.13		
Rated frequency (Hz)	250		
Rated current (A)	3.9		Heatsink-based derating curve
Maximum current (A)	15		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.51		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	0.55 ± 10%	
	Motor with brake	-	

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
35	≤ 392	≤ 147

Dimensions (mm)

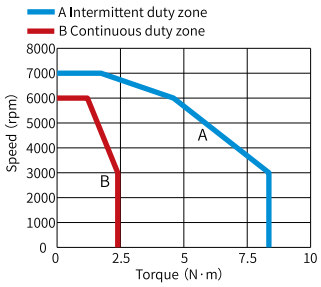


LC	LL	LR	LA	LZ	LH	LG	LE	LJ
80	96.7	35 ± 0.5	90	4 × ϕ7	54	7.5	3 ± 0.5	0.5 ± 0.35
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
70	19	M6 × 20	$25^{0}_{-0.62}$	$15.5^{0}_{-0.1}$	6	6	6	1.88

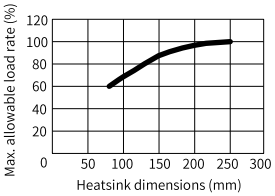
22.2.2.2.6 MS1H1-75B30CB-V63*R-INT

Motor specifications		
Frame size (mm)	80	
Inertia, capacity	Low inertia, small capacity	
Rated power (kW)	0.75	
Voltage (V)	220	
Rated torque (N·m)	2.39	
Maximum torque (N·m)	8.36	
Rated frequency (Hz)	250	
Rated current (A)	4.4	
Maximum current (A)	16.9	
Rated speed (rpm)	3000	
Maximum speed (rpm)	7000	
Torque coefficient (N·m/A)	0.62	
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	0.68 ± 10%
	Motor with brake	0.71 ± 10%

Torque-speed characteristics



Heatsink-based derating curve



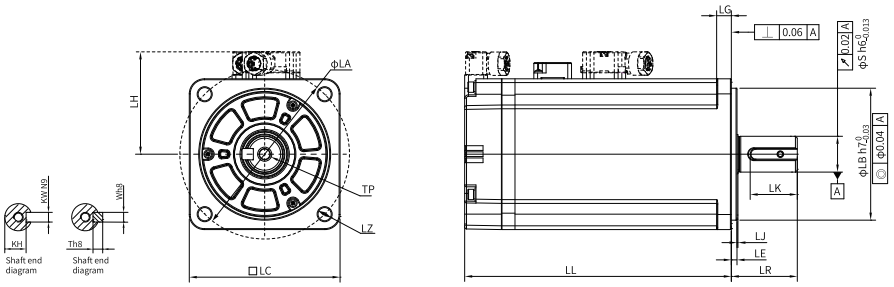
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
3.2	24	10	57.6	0.42	≤ 60	≤ 40	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
35	≤ 392	≤ 147

Dimensions (mm)

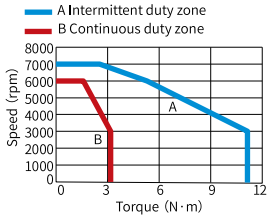


LC	LL	LR	LA	LZ	LH	LG	LE	LJ
80	107.3 (141.5)	35 ± 0.5	90	4 × ϕ7	54	7.5	3 ± 0.5	0.5 ± 0.35
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
70	19	M6 × 20	$25^{0}_{-0.62}$	$15.5^{0}_{-0.1}$	6	6	6	2.22 (2.88)

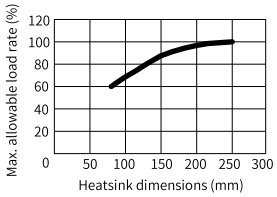
22.2.2.2.7 MS1H1-10C30CB-V63*R-INT

Motor specifications		
Frame size (mm)	80	
Inertia, capacity	Low inertia, small capacity	
Rated power (kW)	1.0	
Voltage (V)	220	
Rated torque (N·m)	3.18	
Maximum torque (N·m)	11.1	
Rated frequency (Hz)	250	
Rated current (A)	6.2	
Maximum current (A)	24	
Rated speed (rpm)	3000	
Maximum speed (rpm)	7000	
Torque coefficient (N·m/A)	0.59	
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	0.82 ± 10%
	Motor with brake	0.87 ± 10%

Torque-speed characteristics



Heatsink-based derating curve



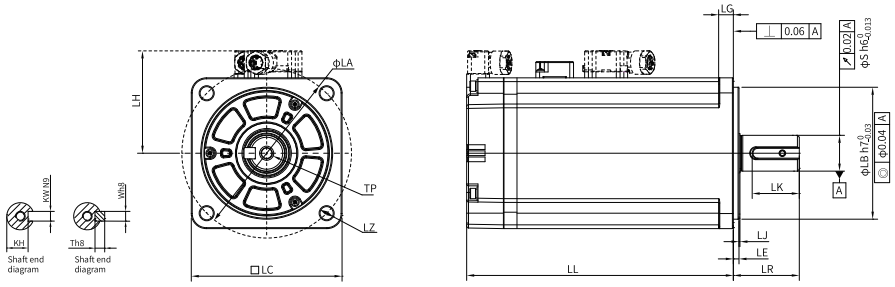
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
3.2	24	10	57.6	0.42	≤ 60	≤ 40	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
35	≤ 392	≤ 147

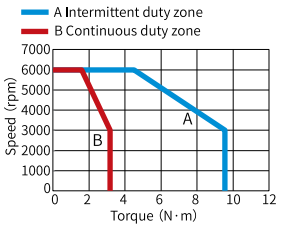
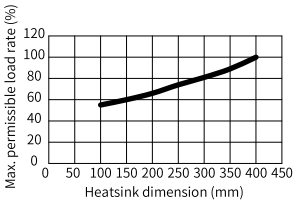
Dimensions (mm)



LC	LL	LR	LA	LZ	LH	LG	LE	LJ
80	119.2 (153.4)	35 ± 0.5	90	4 × ϕ7	54	7.5	3 ± 0.5	0.5 ± 0.35
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
70	19	M6 × 20	$25^{0}_{-0.62}$	$15.5^{0}_{-0.1}$	6	6	6	2.61 (3.27)

22.2.2.3 Low Inertia and Medium Capacity (MS1H2)

22.2.2.3.1 MS1H2-10C30CB-V63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	100		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	1.0		
Voltage (V)	220		
Rated torque (N·m)	3.18		
Maximum torque (N·m)	9.54		
Rated frequency (Hz)	250		
Rated current (A)	6.4		Heatsink-based derating curve
Maximum current (A)	23		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	0.54		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	1.78 ± 10%	
	Motor with brake	2.6 ± 10%	

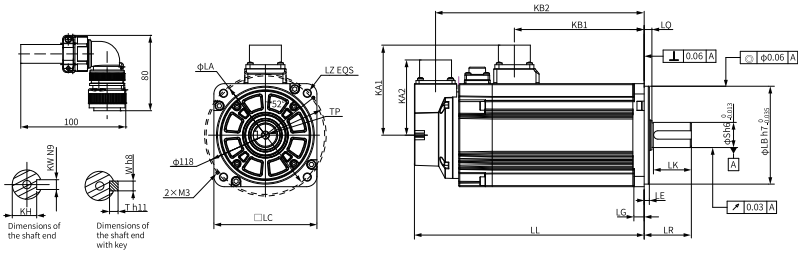
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
8	24	17.6	32.73	0.73	≤ 100	≤ 40	≤ 1

Allowable load

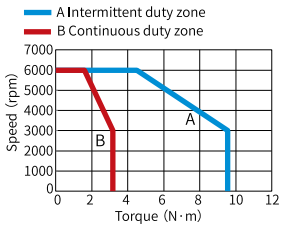
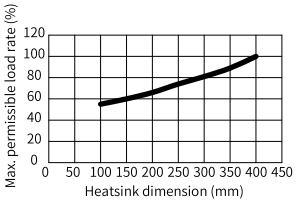
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
45	≤ 686	≤ 196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	144 (172)	45 ± 1	115	4 × ϕ7	88	75	73	123.5 (151.5)	10	5 ± 0.3
LQ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
7.5 ± 0.75	95		24	M8 × 16	$35^{0}_{-0.62}$	$20^{0}_{-0.2}$	8	8	7	3.85 (4.9)

22.2.2.3.2 MS1H2-10C30CD-V63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	100		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	1.0		
Voltage (V)	380		
Rated torque (N·m)	3.18		
Maximum torque (N·m)	9.54		
Rated frequency (Hz)	250		
Rated current (A)	3.3		Heatsink-based derating curve
Maximum current (A)	11		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	1.07		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	1.78 ± 10%	
	Motor with brake	2.6 ± 10%	

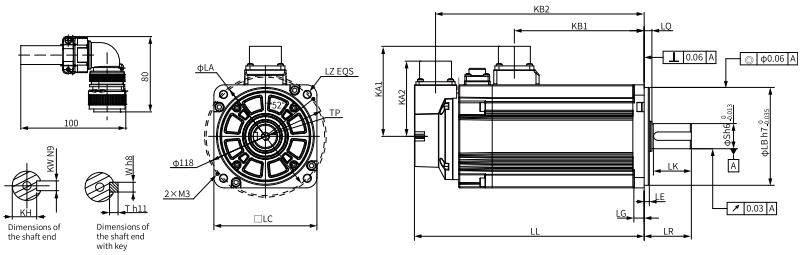
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
8	24	17.6	32.73	0.73	≤ 100	≤ 40	≤ 1

Allowable load

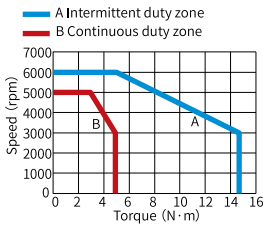
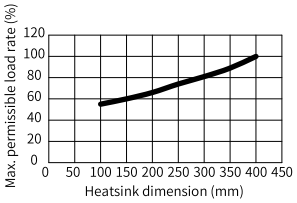
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
45	≤ 686	≤ 196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	144 (172)	45 ± 1	115	4 × ϕ7	88	75	73	123.5 (151.5)	10	5 ± 0.3
LQ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
7.5 ± 0.75	95		24	M8 × 16	$35^{0}_{-0.62}$	$20^{0}_{-0.2}$	8	8	7	3.85 (4.9)

22.2.2.3.3 MS1H2-15C30CB-V63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	100		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	1.5		
Voltage (V)	220		
Rated torque (N·m)	4.9		
Maximum torque (N·m)	14.7		
Rated frequency (Hz)	250		
Rated current (A)	8.6		Heatsink-based derating curve
Maximum current (A)	32		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	0.62		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	2.35 ± 10%	
	Motor with brake	3.17 ± 10%	

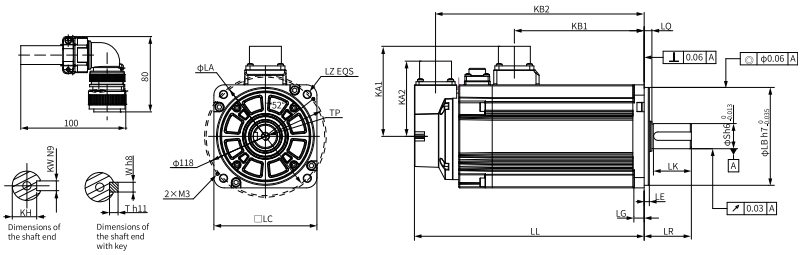
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
8	24	17.6	32.73	0.73	≤ 100	≤ 40	≤ 1

Allowable load

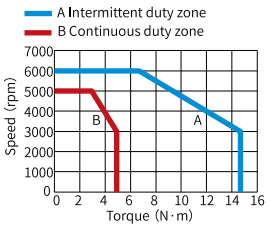
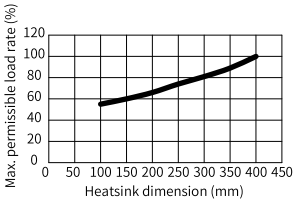
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
45	≤ 686	≤ 196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	161 (189)	45 ± 1	115	4 × ϕ7	88	92	73	140.5 (168.5)	10	5 ± 0.3
LQ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
7.5 ± 0.75	95		24	M8 × 16	$35^{0}_{-0.62}$	$20^{0}_{-0.2}$	8	8	7	4.65 (5.75)

22.2.2.3.4 MS1H2-15C30CD-V63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	100		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	1.5		
Voltage (V)	380		
Rated torque (N·m)	4.9		
Maximum torque (N·m)	14.7		
Rated frequency (Hz)	250		
Rated current (A)	4.2		Heatsink-based derating curve
Maximum current (A)	14		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	1.28		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	2.35 ± 10%	
	Motor with brake	3.17 ± 10%	

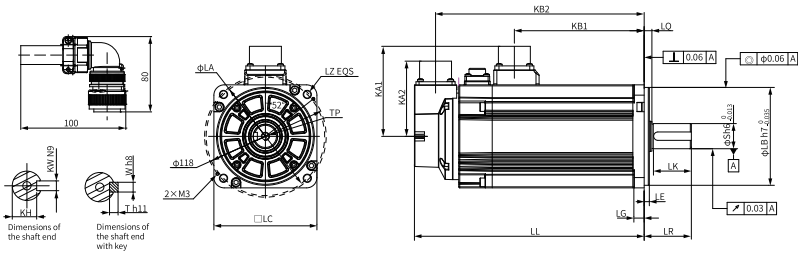
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
8	24	17.6	32.73	0.73	≤ 100	≤ 40	≤ 1

Allowable load

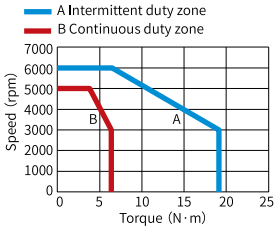
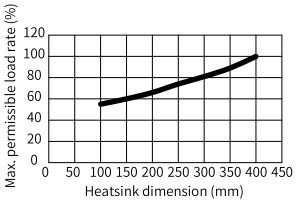
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
45	≤ 686	≤ 196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	161 (189)	45 ± 1	115	4 × ϕ7	88	92	73	140.5 (168.5)	10	5 ± 0.3
LQ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
7.5 ± 0.75	95		24	M8 × 16	$35^{0}_{-0.62}$	$20^{0}_{-0.2}$	8	8	7	4.65 (5.75)

22.2.2.3.5 MS1H2-20C30CB-V63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	100		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	2.0		
Voltage (V)	220		
Rated torque (N·m)	6.36		
Maximum torque (N·m)	19.1		
Rated frequency (Hz)	250		
Rated current (A)	11.3		Heatsink-based derating curve
Maximum current (A)	42		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	0.60		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	2.92 ± 10%	
	Motor with brake	3.74 ± 10%	

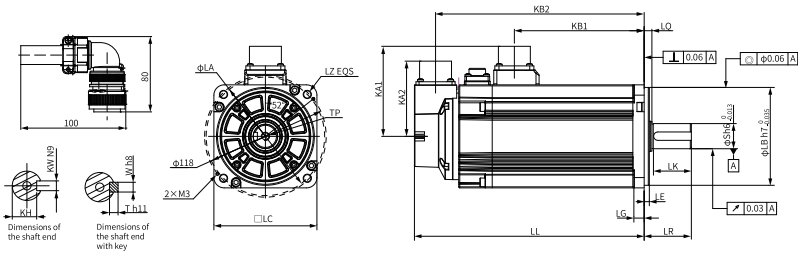
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
8	24	17.6	32.73	0.73	≤ 100	≤ 40	≤ 1

Allowable load

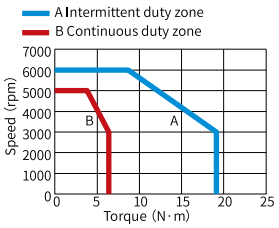
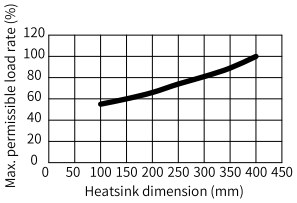
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
45	≤ 686	≤ 196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	177 (205)	45 ± 1	115	4 × ϕ7	88	108	73	156.5 (184.5)	10	5 ± 0.3
LQ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
7.5 ± 0.75	95		24	M8 × 16	$35^{0}_{-0.62}$	$20^{0}_{-0.2}$	8	8	7	5.5 (6.55)

22.2.2.3.6 MS1H2-20C30CD-V63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	100		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	2.0		
Voltage (V)	380		
Rated torque (N·m)	6.36		
Maximum torque (N·m)	19.1		
Rated frequency (Hz)	250		
Rated current (A)	5.6		Heatsink-based derating curve
Maximum current (A)	20		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	1.19		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	2.92 ± 10%	
	Motor with brake	3.74 ± 10%	

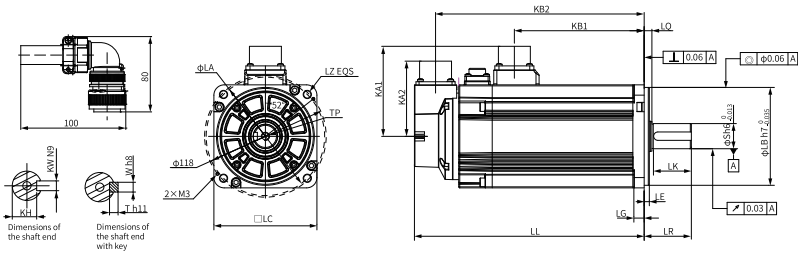
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
8	24	17.6	32.73	0.73	≤ 100	≤ 40	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
45	≤ 686	≤ 196

Dimensions (mm)

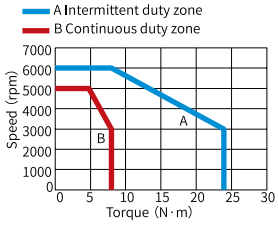


LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	177 (205)	45 ± 1	115	4 × ϕ7	88	108	73	156.5 (184.5)	10	5 ± 0.3
LQ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
7.5 ± 0.75	95		24	M8 × 16	$35^{0}_{-0.62}$	$20^{0}_{-0.2}$	8	8	7	5.5 (6.55)

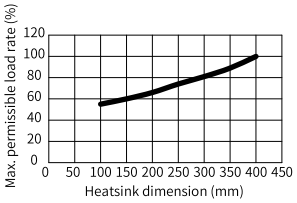
22.2.2.3.7 MS1H2-25C30CB-V63*R-INT

Motor specifications		
Frame size (mm)	100	
Inertia, capacity	Low inertia, medium capacity	
Rated power (kW)	2.5	
Voltage (V)	220	
Rated torque (N·m)	7.96	
Maximum torque (N·m)	23.9	
Rated frequency (Hz)	250	
Rated current (A)	14.7	
Maximum current (A)	53	
Rated speed (rpm)	3000	
Maximum speed (rpm)	6000	
Torque coefficient (N·m/A)	0.60	
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	3.49 ± 10%
	Motor with brake	4.3 ± 10%

Torque-speed characteristics



Heatsink-based derating curve



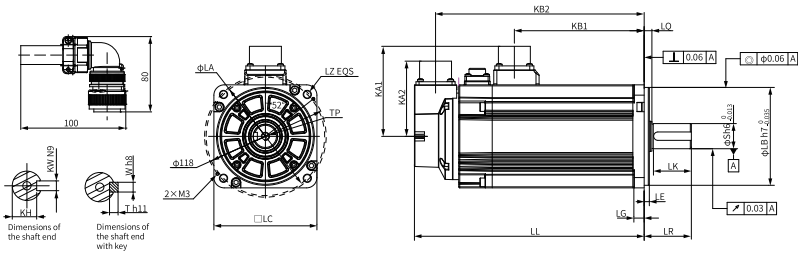
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
8	24	17.6	32.73	0.73	≤ 100	≤ 40	≤ 1

Allowable load

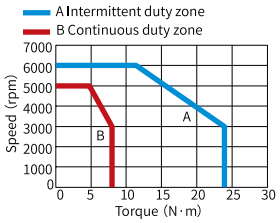
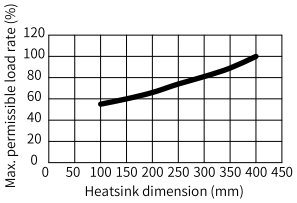
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
45	≤ 686	≤ 196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	195 (223)	45 ± 1	115	4 × ϕ7	88	126	73	174.5 (202.5)	10	5 ± 0.3
LQ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
7.5 ± 0.75	95		24	M8 × 16	$35^{0}_{-0.62}$	$20^{0}_{-0.2}$	8	8	7	6.3 (7.35)

22.2.2.3.8 MS1H2-25C30CD-V63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	100		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	2.5		
Voltage (V)	380		
Rated torque (N·m)	7.96		
Maximum torque (N·m)	23.9		
Rated frequency (Hz)	250		
Rated current (A)	7.2		Heatsink-based derating curve
Maximum current (A)	26		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	1.18		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	3.49 ± 10%	
	Motor with brake	4.3 ± 10%	

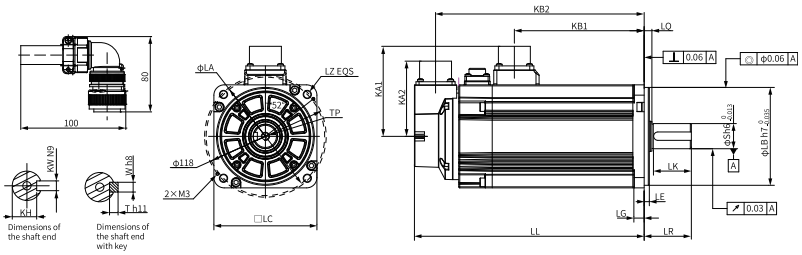
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
8	24	17.6	32.73	0.73	≤ 100	≤ 40	≤ 1

Allowable load

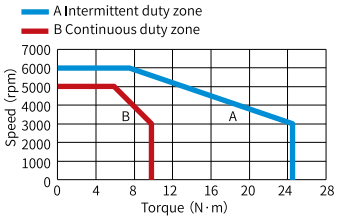
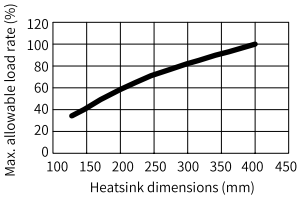
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
45	≤ 686	≤ 196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
100	195 (223)	45 ± 1	115	4 × ϕ7	88	126	73	174.5 (202.5)	10	5 ± 0.3
LQ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
7.5 ± 0.75	95		24	M8 × 16	$35^{0}_{-0.62}$	$20^{0}_{-0.2}$	8	8	7	6.3 (7.35)

22.2.2.3.9 MS1H2-30C30CB-V63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	3.0		
Voltage (V)	220		
Rated torque (N·m)	9.8		
Maximum torque (N·m)	24.5		
Rated frequency (Hz)	150		
Rated current (A)	16.6		Heatsink-based derating curve
Maximum current (A)	55		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	0.67		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	6.4 ± 10%	
	Motor with brake	9.38 ± 10%	

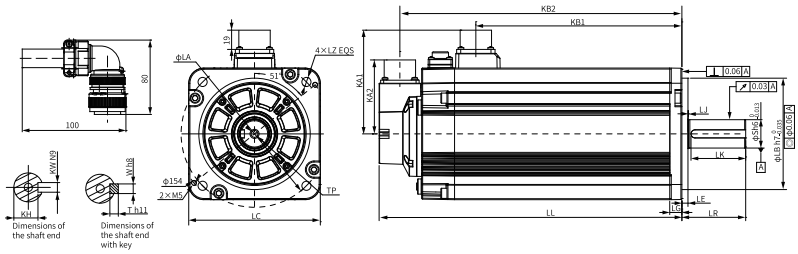
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

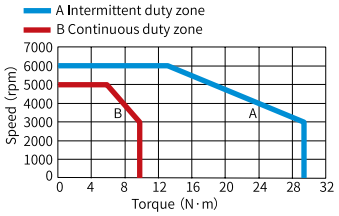
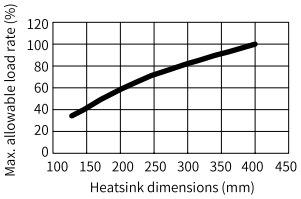
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
63	≤ 1176	≤ 392

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	198 (223)	63 ± 1	145	4 × ϕ9	102.4	127.5	73	177.5 (202.5)	10.5	6 ± 0.3
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110		28	M8 × 20	$53^{0}_{-0.62}$	$24^{0}_{-0.2}$	8	8	7	10.0 (11.9)

22.2.2.3.10 MS1H2-30C30CD-V63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	3.0		
Voltage (V)	380		
Rated torque (N·m)	9.8		
Maximum torque (N·m)	29.4		
Rated frequency (Hz)	150		
Rated current (A)	8.9		Heatsink-based derating curve
Maximum current (A)	29		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	1.25		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	6.4 ± 10%	
	Motor with brake	9.38 ± 10%	

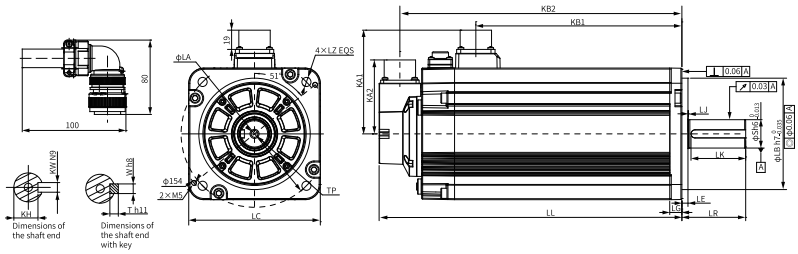
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

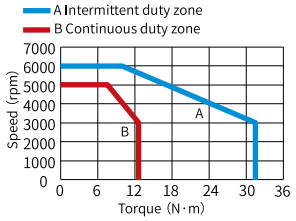
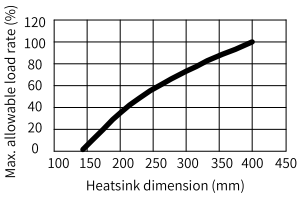
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
63	≤ 1176	≤ 392

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	198 (223)	63 ± 1	145	4 × ϕ9	102.4	127.5	73	177.5 (202.5)	10.5	6 ± 0.3
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110		28	M8 × 20	$53^{0}_{-0.62}$	$24^{0}_{-0.2}$	8	8	7	10.0 (11.9)

22.2.2.3.11 MS1H2-40C30CB-V63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	4.0		
Voltage (V)	220		
Rated torque (N·m)	12.6		
Maximum torque (N·m)	31.5		
Rated frequency (Hz)	150		
Rated current (A)	22		Heatsink-based derating curve
Maximum current (A)	67.5		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	0.65		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	9 ± 10%	
	Motor with brake	11.98 ± 10%	

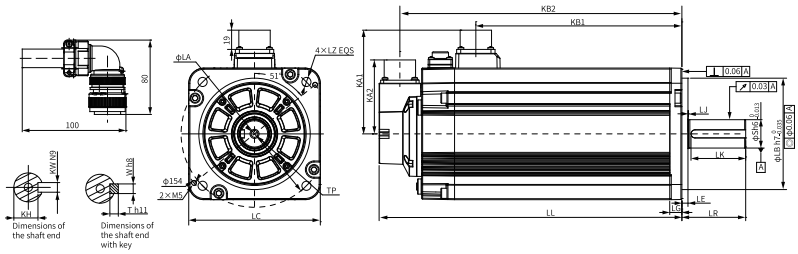
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

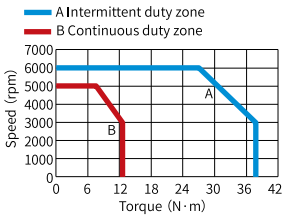
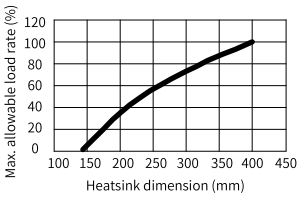
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
63	≤ 1176	≤ 392

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	236 (261)	63 ± 1	145	4 × ϕ9	102.4	165.5	73	215.5 (240.5)	10.5	6 ± 0.3
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110		28	M8 × 20	$53^{0}_{-0.62}$	$24^{0}_{-0.2}$	8	8	7	13.2 (15.1)

22.2.2.3.12 MS1H2-40C30CD-V63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	4.0		
Voltage (V)	380		
Rated torque (N·m)	12.6		
Maximum torque (N·m)	37.8		
Rated frequency (Hz)	150		
Rated current (A)	13.5		Heatsink-based derating curve
Maximum current (A)	42.5		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	1.06		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	9 ± 10%	
	Motor with brake	11.98 ± 10%	

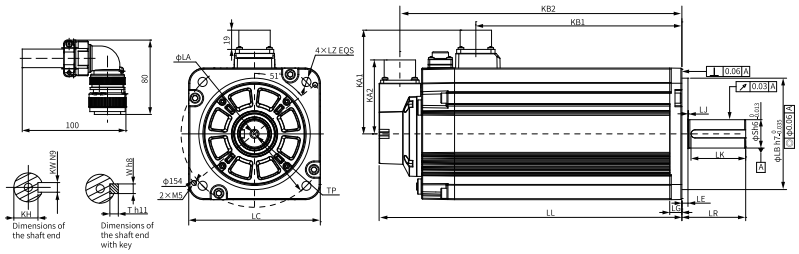
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

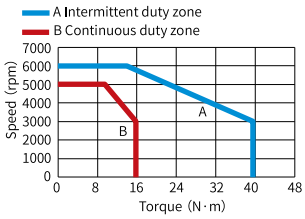
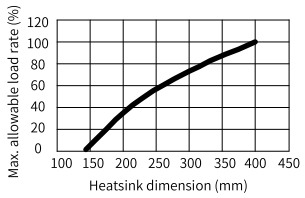
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
63	≤ 1176	≤ 392

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	236 (261)	63 ± 1	145	4 × ϕ9	102.4	165.5	73	215.5 (240.5)	10.5	6 ± 0.3
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110		28	M8 × 20	$53^{0}_{-0.62}$	$24^{0}_{-0.2}$	8	8	7	13.2 (15.1)

22.2.2.3.13 MS1H2-50C30CB-V63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	5.0		
Voltage (V)	220		
Rated torque (N·m)	15.8		
Maximum torque (N·m)	39.5		
Rated frequency (Hz)	150		
Rated current (A)	22		Heatsink-based derating curve
Maximum current (A)	67.5		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	0.81		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	11.6 ± 10%	
	Motor with brake	14.58 ± 10%	

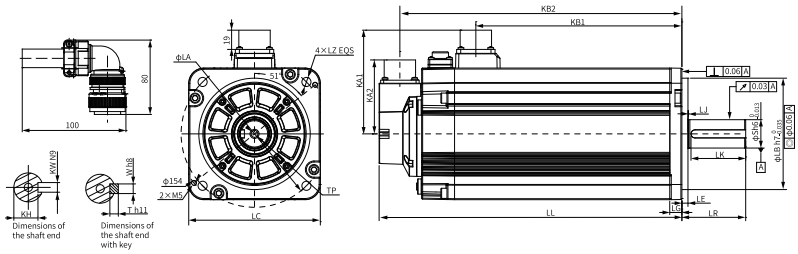
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

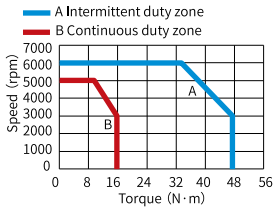
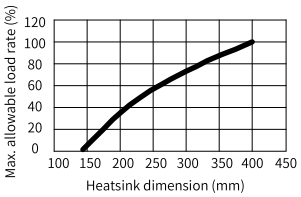
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
63	≤ 1176	≤ 392

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	274 (299)	63 ± 1	145	4 × ϕ9	102.4	203.5	73	253.5 (278.5)	10.5	6 ± 0.3
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110		28	M8 × 20	$53^{0}_{-0.62}$	$24^{0}_{-0.2}$	8	8	7	16.35 (18.25)

22.2.2.3.14 MS1H2-50C30CD-V63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Low inertia, medium capacity		
Rated power (kW)	5.0		
Voltage (V)	380		
Rated torque (N·m)	15.8		
Maximum torque (N·m)	47.4		
Rated frequency (Hz)	150		
Rated current (A)	17		Heatsink-based derating curve
Maximum current (A)	52.5		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6000		
Torque coefficient (N·m/A)	1.04		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	11.6 ± 10%	
	Motor with brake	14.58 ± 10%	

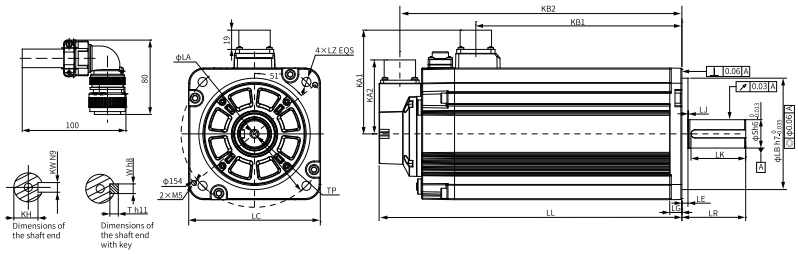
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
63	≤ 1176	≤ 392

Dimensions (mm)



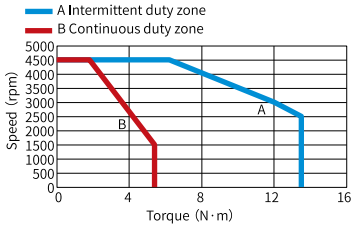
LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	274 (299)	63 ± 1	145	4 × ϕ9	102.4	203.5	73	253.5 (278.5)	10.5	6 ± 0.3
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110		28	M8 × 20	$53^{0}_{-0.62}$	$24^{0}_{-0.2}$	8	8	7	16.35 (18.25)

22.2.2.4 Medium Inertia and Medium Capacity (MS1H3)

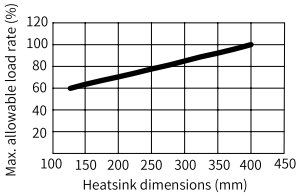
22.2.2.4.1 MS1H3-85B15CB-V63*R-INT

Motor specifications		
Frame size (mm)	130	
Inertia, capacity	Medium inertia, medium capacity	
Rated power (kW)	0.85	
Voltage (V)	220	
Rated torque (N·m)	5.39	
Maximum torque (N·m)	13.5	
Rated frequency (Hz)	125	
Rated current (A)	6.6	
Maximum current (A)	17.2	
Rated speed (rpm)	1500	
Maximum speed (rpm)	4500	
Torque coefficient (N·m/A)	0.93	
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	13.56 ± 10%
	Motor with brake	15.8 ± 10%

Torque-speed characteristics



Heatsink-based derating curve



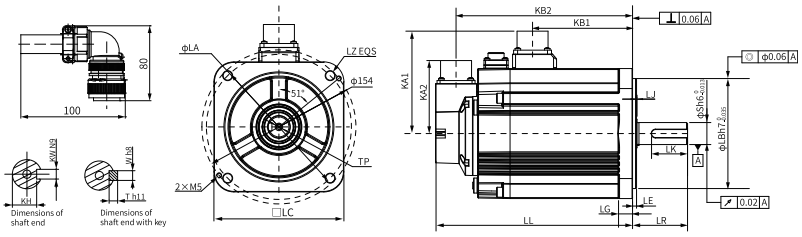
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

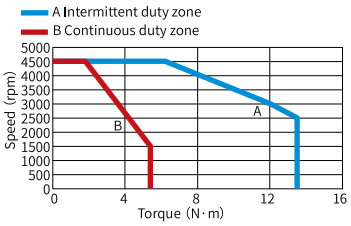
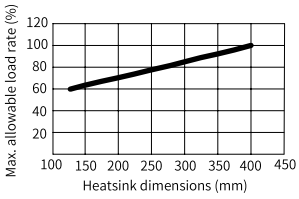
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
55	≤ 686	≤ 196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	142 (167)	55 ± 1	145	4 × ϕ9	103	70	73	121.5 (146.5)	14	4
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110		22	M6 × 20	$35^{0}_{-0.62}$	$18^{0}_{-0.2}$	8	8	7	5.8 (7.7)

22.2.2.4.2 MS1H3-85B15CD-V63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	0.85		
Voltage (V)	380		
Rated torque (N·m)	5.39		
Maximum torque (N·m)	13.5		
Rated frequency (Hz)	125		
Rated current (A)	3.5		Heatsink-based derating curve
Maximum current (A)	8.5		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.84		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	13.56 ± 10%	
	Motor with brake	15.8 ± 10%	

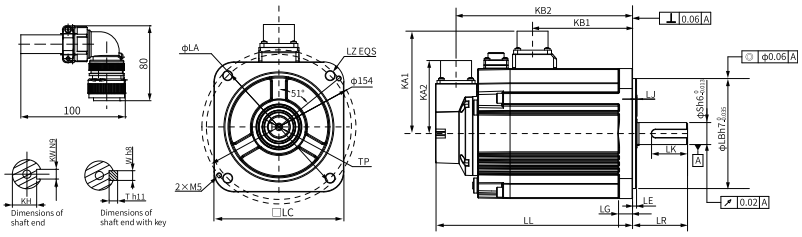
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

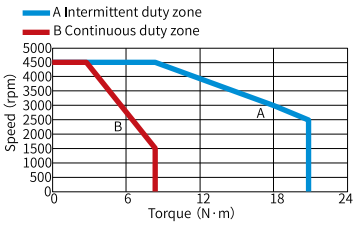
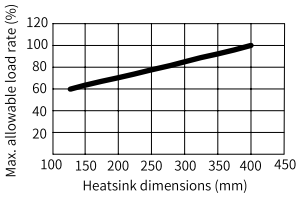
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
55	≤ 686	≤ 196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	142 (167)	55 ± 1	145	4 × ϕ9	103	70	73	121.5 (146.5)	14	4
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110		22	M6 × 20	$35^{0}_{-0.62}$	$18^{0}_{-0.2}$	8	8	7	5.8 (7.7)

22.2.2.4.3 MS1H3-13C15CB-V63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	1.3		
Voltage (V)	220		
Rated torque (N·m)	8.34		
Maximum torque (N·m)	20.85		
Rated frequency (Hz)	125		
Rated current (A)	10.5		Heatsink-based derating curve
Maximum current (A)	27.3		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	0.89		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	19.25 ± 10%	
	Motor with brake	21.5 ± 10%	

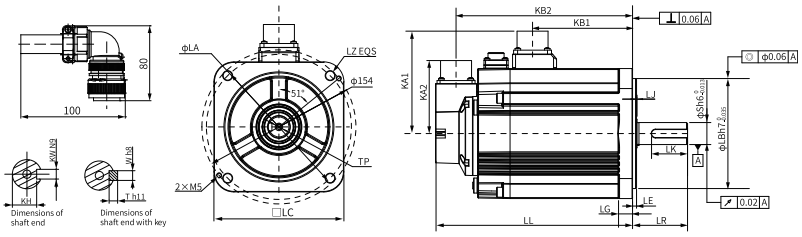
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

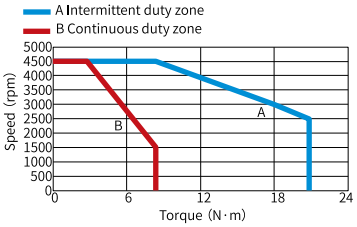
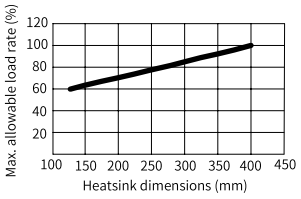
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
55	≤ 686	≤ 196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	157 (182)	55 ± 1	145	4 × ϕ9	103	85	73	136.5 (161.5)	14	4
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110		22	M6 × 20	$35^{0}_{-0.62}$	$18^{0}_{-0.2}$	8	8	7	7.1 (8.9)

22.2.2.4.4 MS1H3-13C15CD-V63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	1.3		
Voltage (V)	380		
Rated torque (N·m)	8.34		
Maximum torque (N·m)	20.85		
Rated frequency (Hz)	125		
Rated current (A)	5.1		Heatsink-based derating curve
Maximum current (A)	12.6		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.85		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	19.25 ± 10%	
	Motor with brake	21.5 ± 10%	

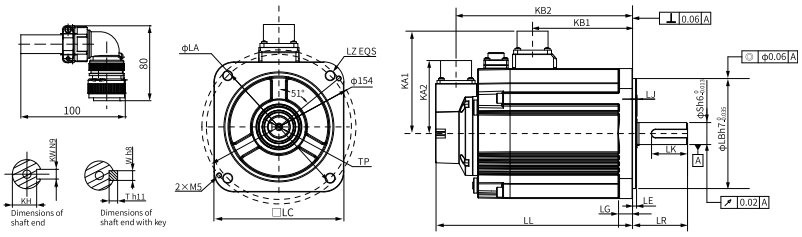
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

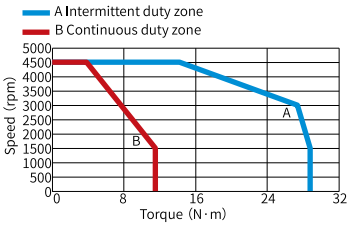
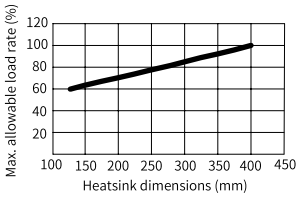
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
55	≤ 686	≤ 196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	157 (182)	55 ± 1	145	4 × ϕ9	103	85	73	136.5 (161.5)	14	4
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110		22	M6 × 20	$35^{0}_{-0.62}$	$18^{0}_{-0.2}$	8	8	7	7.1 (8.9)

22.2.2.4.5 MS1H3-18C15CB-V63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	1.8		
Voltage (V)	220		
Rated torque (N·m)	11.5		
Maximum torque (N·m)	28.75		
Rated frequency (Hz)	125		
Rated current (A)	11.9		Heatsink-based derating curve
Maximum current (A)	32.2		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.09		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	24.9 ± 10%	
	Motor with brake	27.2 ± 10%	

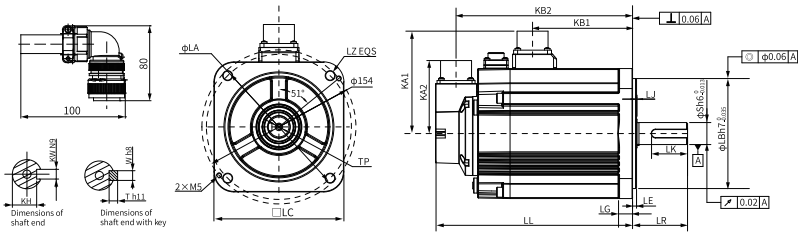
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

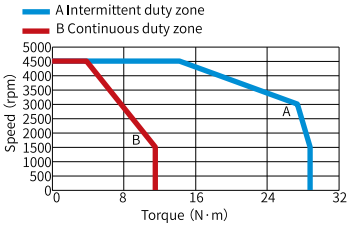
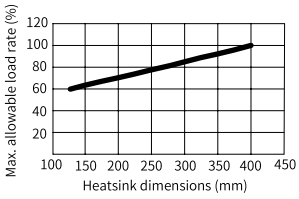
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
55	≤ 686	≤ 196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	172 (197)	55 ± 1	145	4 × ϕ9	103	100	73	151.5 (176.5)	14	4
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110		22	M6 × 20	$35^{0}_{-0.62}$	$18^{0}_{-0.2}$	8	8	7	8.5 (10.3)

22.2.2.4.6 MS1H3-18C15CD-V63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	130		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	1.8		
Voltage (V)	380		
Rated torque (N·m)	11.5		
Maximum torque (N·m)	28.75		
Rated frequency (Hz)	125		
Rated current (A)	6.75		Heatsink-based derating curve
Maximum current (A)	17.7		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.87		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	24.9 ± 10%	
	Motor with brake	27.2 ± 10%	

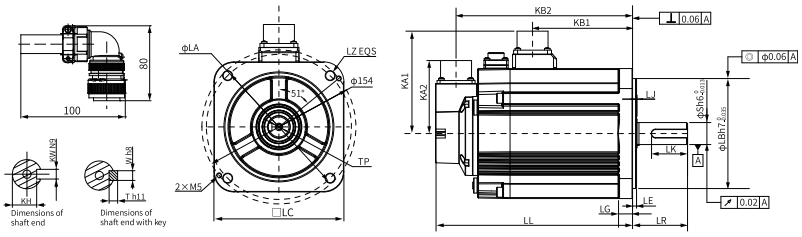
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
16	24	24	24	1	≤ 120	≤ 60	≤ 1

Allowable load

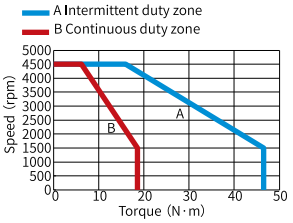
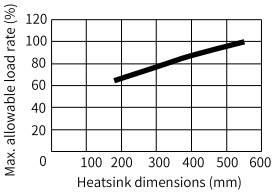
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
55	≤ 686	≤ 196

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
130	172 (197)	55 ± 1	145	4 × ϕ9	103	100	73	151.5 (176.5)	14	4
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.5 ± 0.75	110		22	M6 × 20	$35^{0}_{-0.62}$	$18^{0}_{-0.2}$	8	8	7	8.5 (10.3)

22.2.2.4.7 MS1H3-29C15CB-V63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	180		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	2.9		
Voltage (V)	220		
Rated torque (N·m)	18.6		
Maximum torque (N·m)	46.5		
Rated frequency (Hz)	125		
Rated current (A)	18		Heatsink-based derating curve
Maximum current (A)	52.5		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.16		
Rotor moment of inertia (kg·cm²)	Motor without brake	44.7 ± 10%	
	Motor with brake	52.35 ± 10%	

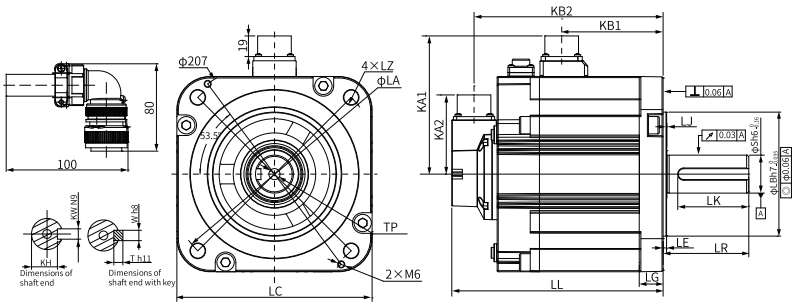
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
50	24	31	18.58	1.29	≤ 200	≤ 100	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
79	≤ 1470	≤ 490

Dimensions (mm)



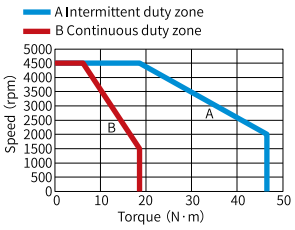
LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
180	161 (194.8)	79 ± 1	200	4 × ϕ13.5	127.4	93.5	73	140.5 (174.3)	20.5	3.2 ± 0.3

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.3 ± 0.75	114.3	35	M12 × 25	$64^{0}_{-0.74}$	$30^{0}_{-0.2}$	10	10	8	13.8 (17.9)

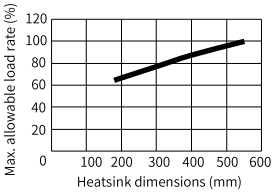
22.2.2.4.8 MS1H3-29C15CD-V63*R-INT

Motor specifications		
Frame size (mm)	180	
Inertia, capacity	Medium inertia, medium capacity	
Rated power (kW)	2.9	
Voltage (V)	380	
Rated torque (N·m)	18.6	
Maximum torque (N·m)	46.5	
Rated frequency (Hz)	125	
Rated current (A)	10.5	
Maximum current (A)	29.75	
Rated speed (rpm)	1500	
Maximum speed (rpm)	4500	
Torque coefficient (N·m/A)	1.94	
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	44.7 ± 10%
	Motor with brake	52.35 ± 10%

Torque-speed characteristics



Heatsink-based derating curve



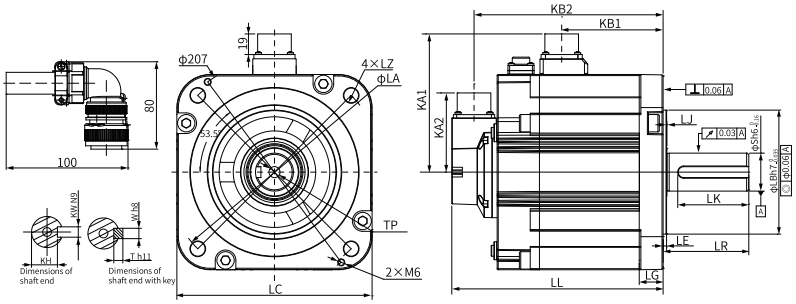
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
50	24	31	18.58	1.29	≤ 200	≤ 100	≤ 1

Allowable load

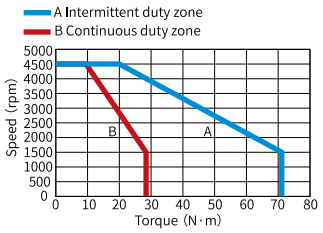
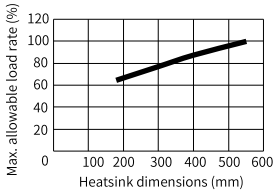
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
79	≤ 1470	≤ 490

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
180	161 (194.8)	79 ± 1	200	4 × ϕ13.5	127.4	93.5	73	140.5 (174.3)	20.5	3.2 ± 0.3
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.3 ± 0.75	114.3		35	M12 × 25	$64^{0}_{-0.74}$	$30^{0}_{-0.2}$	10	10	8	13.8 (17.9)

22.2.2.4.9 MS1H3-44C15CB-V63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	180		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	4.4		
Voltage (V)	220		
Rated torque (N·m)	28.4		
Maximum torque (N·m)	71.1		
Rated frequency (Hz)	125		
Rated current (A)	25.5		Heatsink-based derating curve
Maximum current (A)	67		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.25		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	64.9 ± 10%	
	Motor with brake	72.55 ± 10%	

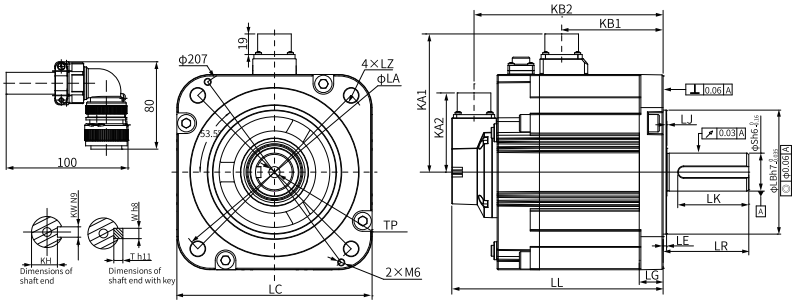
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
50	24	31	18.58	1.29	≤ 200	≤ 100	≤ 1

Allowable load

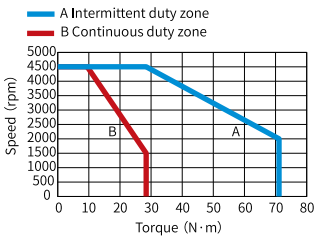
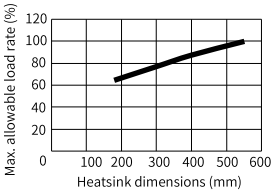
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
79	≤ 1470	≤ 490

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
180	184.5 (218.3)	79 ± 1	200	4 × ϕ13.5	127.4	117	73	164 (197.8)	20.5	3.2 ± 0.3
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.3 ± 0.75	114.3		35	M12 × 25	$64^{0}_{-0.74}$	$30^{0}_{-0.2}$	10	10	8	17.4 (21.9)

22.2.2.4.10 MS1H3-44C15CD-V63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	180		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	4.4		
Voltage (V)	380		
Rated torque (N·m)	28.4		
Maximum torque (N·m)	71.1		
Rated frequency (Hz)	125		
Rated current (A)	16		Heatsink-based derating curve
Maximum current (A)	42		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.96		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	64.9 ± 10%	
	Motor with brake	72.55 ± 10%	

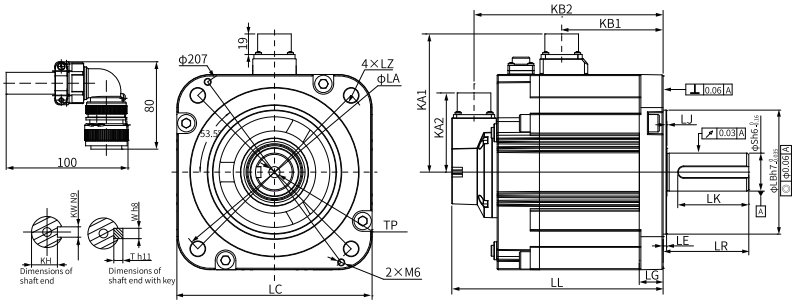
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
50	24	31	18.58	1.29	≤ 200	≤ 100	≤ 1

Allowable load

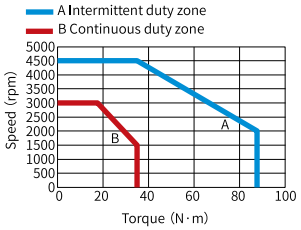
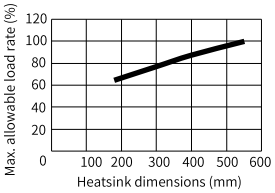
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
79	≤ 1470	≤ 490

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
180	184.5 (218.3)	79 ± 1	200	4 × ϕ13.5	127.4	117	73	164 (197.8)	20.5	3.2 ± 0.3
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.3 ± 0.75	114.3		35	M12 × 25	$64^{0}_{-0.74}$	$30^{0}_{-0.2}$	10	10	8	17.4 (21.6)

22.2.2.4.11 MS1H3-55C15CD-V63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	180		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	5.5		
Voltage (V)	380		
Rated torque (N·m)	35		
Maximum torque (N·m)	87.6		
Rated frequency (Hz)	125		
Rated current (A)	20.7		Heatsink-based derating curve
Maximum current (A)	52		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	1.92		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	86.9 ± 10%	
	Motor with brake	94.55 ± 10%	

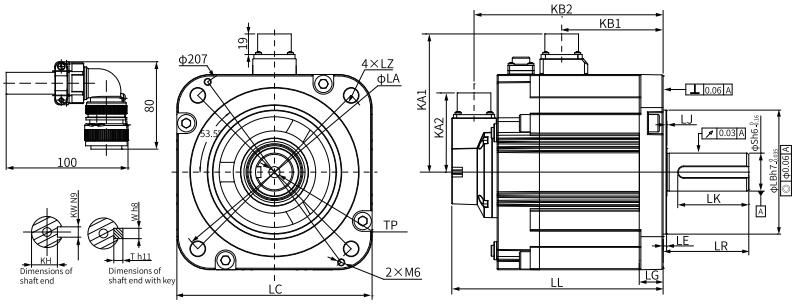
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
50	24	31	18.58	1.29	≤ 200	≤ 100	≤ 1

Allowable load

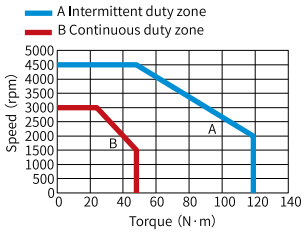
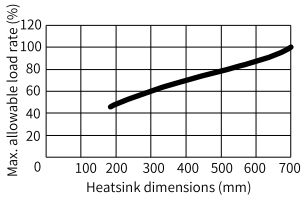
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
113	≤ 1764	≤ 588

Dimensions (mm)



LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
180	208 (241.8)	113 ± 1	200	4 × ϕ13.5	127.4	140.5	73	187.5 (221.3)	20.5	3.2 ± 0.3
LJ	LB		S	TP	LK	KH	kW	W	T	Weight (kg)
0.3 ± 0.75	114.3		42	M16 × 32	$95^{0}_{-0.87}$	$37^{0}_{-0.2}$	12	12	8	21.7 (25.9)

22.2.2.4.12 MS1H3-75C15CD-V63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	180		
Inertia, capacity	Medium inertia, medium capacity		
Rated power (kW)	7.5		
Voltage (V)	380		
Rated torque (N·m)	48		
Maximum torque (N·m)	119		
Rated frequency (Hz)	125		
Rated current (A)	25		Heatsink-based derating curve
Maximum current (A)	65		
Rated speed (rpm)	1500		
Maximum speed (rpm)	4500		
Torque coefficient (N·m/A)	2.13		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	127.5 ± 10%	
	Motor with brake	135.15 ± 10%	

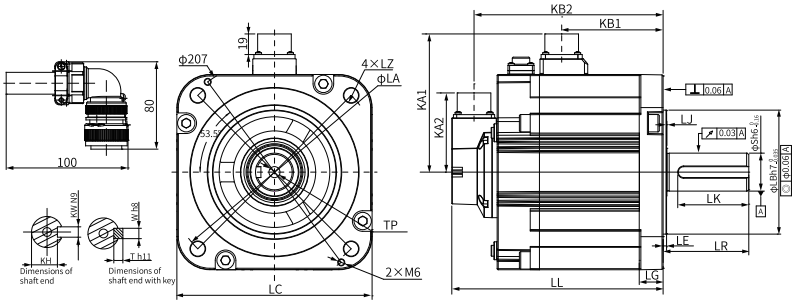
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
50	24	31	18.58	1.29	≤ 200	≤ 100	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
113	≤ 1764	≤ 588

Dimensions (mm)

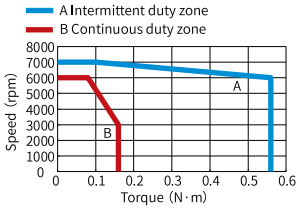
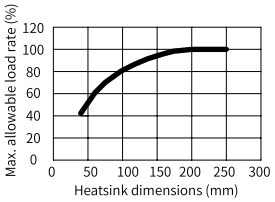


LC	LL	LR	LA	LZ	KA1	KB1	KA2	KB2	LG	LE
180	255 (288.8)	113 ± 1	200	4 × ϕ13.5	127.4	187.5	73	234.5 (268.5)	20.5	3.2 ± 0.3

LJ	LB	S	TP	LK	KH	kW	W	T	Weight (kg)
0.3 ± 0.75	114.3	42	M16 × 32	$95^{0}_{-0.87}$	$37^{0}_{-0.2}$	12	12	8	29 (33.2)

22.2.2.5 Medium Inertia and Small Capacity (MS1H4)

22.2.2.5.1 MS1H4-05B30CB-V63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	40		
Inertia and capacity	Medium inertia, small capacity		
Rated output (kW)	0.05		
Rated voltage (V)	220		
Rated torque (N·m)	0.16		
Maximum torque (N·m)	0.56		
Rated frequency (Hz)	350		
Rated current (A)	1.27		Heatsink-based derating curve
Maximum current (A)	4.78		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.15		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	0.038±10%	
	Motor with brake	0.04±10%	

Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω)±10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
0.32	24	6.9	83.5	0.29	≤ 40	≤ 20	≤ 1.5

Allowable loads

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
20	≤ 78	≤ 54

Product dimensions (in mm)

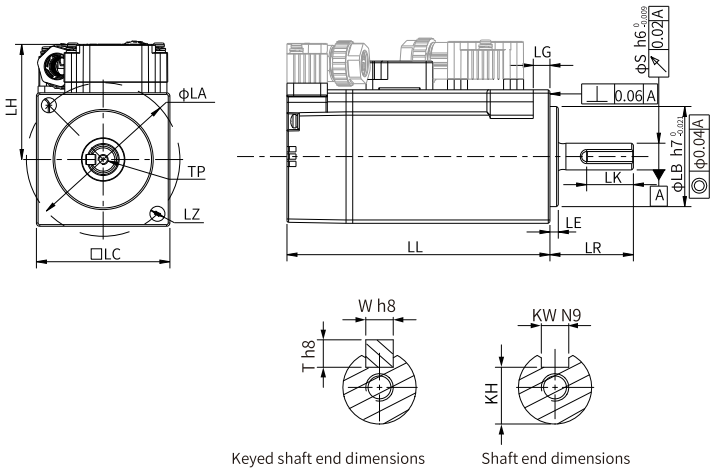


Figure 22-18 MS1H4-05B30CB-V630R-INT and MS1H4-05B30CB-V632R-INT

LL	LC	LR	LA	LZ	LH	LG	LE	
53.5 (80.8)	40	25±0.5	46	2 × ϕ4.5	34.5	5	2.5±0.5	
S	LB	TP	LK	KH	kW	W	T	Weight (kg)
8	30	M3 × 7	$14^{0}_{-0.36}$	$6.2^{0}_{-0.1}$	3	3	3	0.24 (0.40)

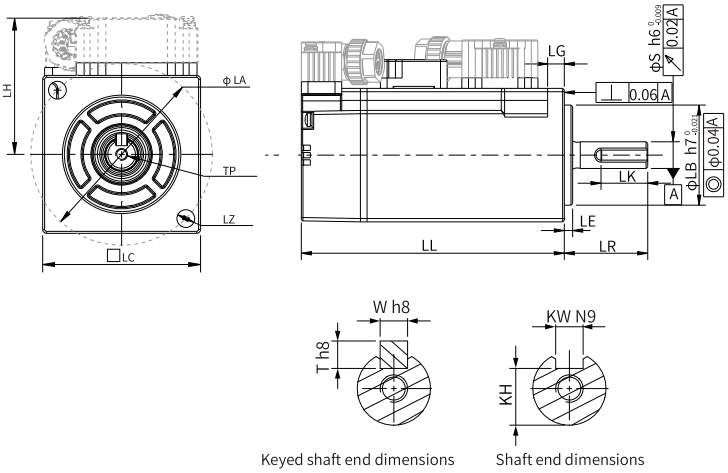
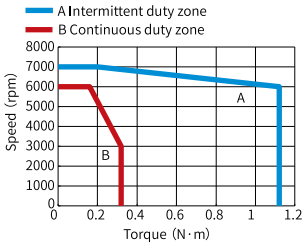
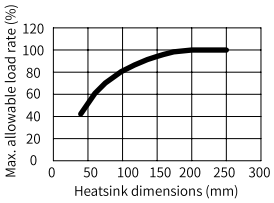


Figure 22-19 MS1H4-05B30CB-V631R-INT and MS1H4-05B30CB-V634R-INT

LL	LC	LR	LA	LZ	LH	LG	LE	
56.15 (83.45)	40	25±0.5	46	2 × ϕ4.5	34.5	5	2.5±0.5	
S	LB	TP	LK	KH	kW	W	T	Weight (kg)
8	30	M3 × 7	$14^{0}_{-0.36}$	$6.2^{0}_{-0.1}$	3	3	3	0.26 (0.42)

22.2.2.5.2 MS1H4-10B30CB-V63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	40		
Inertia and capacity	Medium inertia, small capacity		
Rated output (kW)	0.1		
Rated voltage (V)	220		
Rated torque (N·m)	0.32		
Maximum torque (N·m)	1.12		
Rated frequency (Hz)	350		
Rated current (A)	1.27		Heatsink-based derating curve
Maximum current (A)	4.78		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.29		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	0.072±10%	
	Motor with brake	0.074±10%	

Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω)±10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
0.32	24	6.9	83.5	0.29	≤ 40	≤ 20	≤ 1.5

Allowable loads

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
20	≤ 78	≤ 54

Product dimensions (in mm)

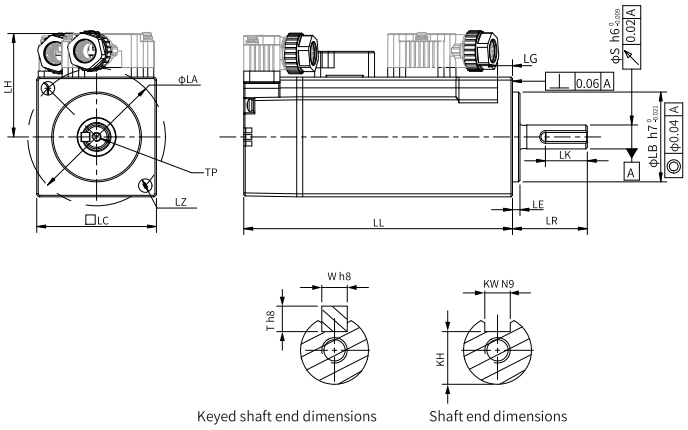


Figure 22-20 MS1H4-10B30CB-V630R-INT and MS1H4-10B30CB-V632R-INT

LL	LC	LR	LA	LZ	LH	LG	LE	
64.5 (91.8)	40	25±0.5	46	2 × ϕ4.5	34.5	5	2.5±0.5	
S	LB	TP	LK	KH	kW	W	T	Weight (kg)
8	30	M3 × 7	$14^{0}_{-0.36}$	$6.2^{0}_{-0.1}$	3	3	3	0.32 (0.48)

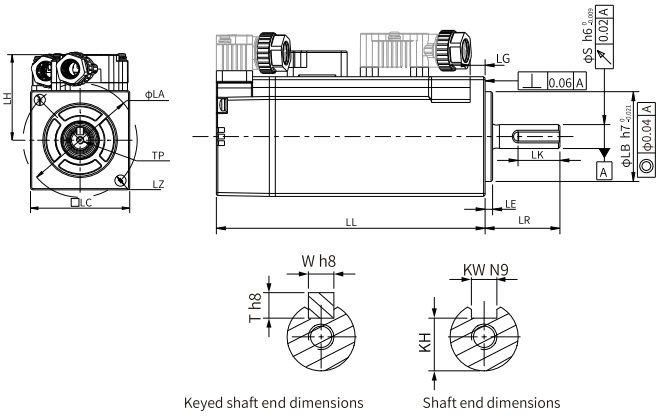
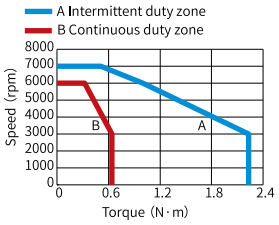
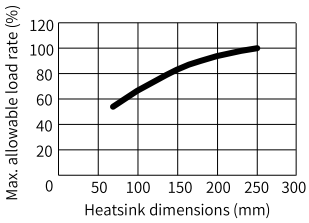


Figure 22-21 MS1H4-10B30CB-V631R-INT and MS1H4-10B30CB-V634R-INT

LL	LC	LR	LA	LZ	LH	LG	LE	
67.15 (94.45)	40	25±0.5	46	2 × ϕ4.5	34.5	5	2.5±0.5	
S	LB	TP	LK	KH	kW	W	T	Weight (kg)
8	30	M3 × 7	$14^{0}_{-0.36}$	$6.2^{0}_{-0.1}$	3	3	3	0.34 (0.50)

22.2.2.5.3 MS1H4-20B30CB-V63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	60		
Inertia, capacity	Medium inertia, low capacity		
Rated power (kW)	0.2		
Voltage (V)	220		
Rated torque (N·m)	0.64		
Maximum torque (N·m)	2.24		
Rated frequency (Hz)	250		
Rated current (A)	1.3		Heatsink-based derating curve
Maximum current (A)	5.3		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.55		
Rotor moment of inertia ($kg \cdot cm^2$)	Motor without brake	0.22 ± 10%	
	Motor with brake	0.23 ± 10%	

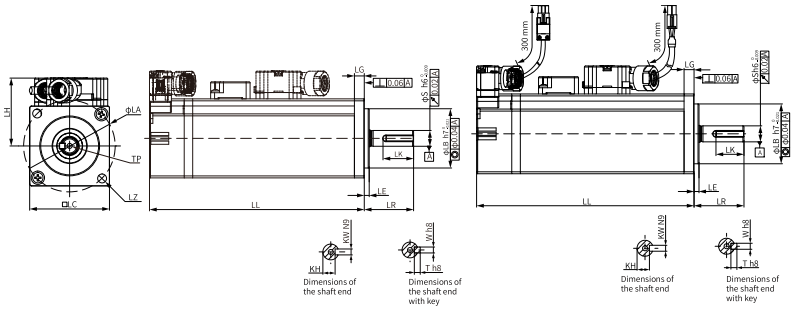
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
1.5	24	7.6	75.79	0.32	≤ 60	≤ 20	≤ 1.5

Allowable load

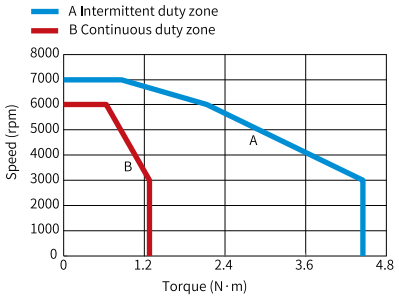
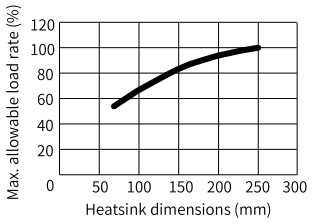
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
25	≤ 245	≤ 74

Dimensions (mm)



LC	LL	LR	LA	LZ	LH	LG	LE	
60	73.5 (101.1)	30 ± 0.5	70	4 × ϕ5.5	44	8.0	3 ± 0.5	
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
50	14	M5 × 8	$16.5^{0}_{-0.53}$	$11^{0}_{-0.1}$	5	5	5	0.78 (1.16)

22.2.2.5.4 MS1H4-40B30CB-V63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	60		
Inertia and capacity	Medium inertia, small capacity		
Rated power (kW)	0.4		
Voltage (V)	220		
Rated torque (N·m)	1.27		
Maximum torque (N·m)	4.45		
Rated frequency (Hz)	250		
Rated current (A)	2.4		Heatsink-based derating curve
Maximum current (A)	9.2		
Rated speed (rpm)	3000		
Maximum Speed (rpm)	7000		
Torque coefficient (N·m/A)	0.58		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	0.43±10%	
	Motor with brake	0.44±10%	

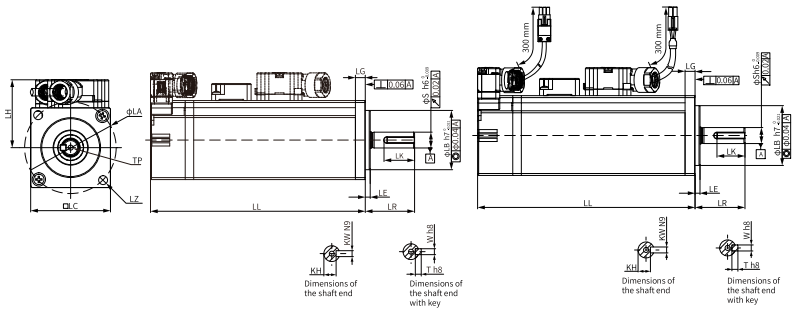
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC)±10%	Rated power (W)	Coil resistance (Ω)±10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
1.5	24	7.6	75.79	0.32	≤ 60	≤ 20	≤ 1.5

Allowable loads

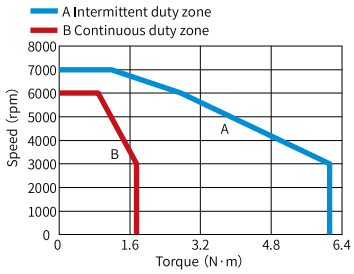
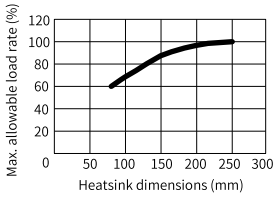
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
25	≤ 245	≤ 74

Product dimensions (in mm)



LC	LL	LR	LA	LZ	LH	LG	LE	
60	92 (119.8)	30±0.5	70	4 × ϕ5.5	44	8.0	3±0.5	
LB	S	TP	LK	KH	KW	W	T	Weight (kg)
50	14	M5 × 8	$16.5^{0}_{-0.53}$	$11^{0}_{-0.1}$	5	5	5	1.11 (1.48)

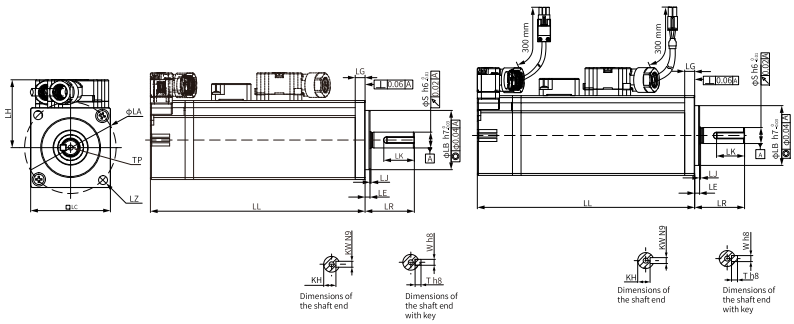
22.2.2.5.5 MS1H4-55B30CB-V631R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	80		
Inertia, capacity	Medium inertia, low capacity		
Rated power (kW)	0.55		
Voltage (V)	220		
Rated torque (N·m)	1.75		
Maximum torque (N·m)	6.13		
Rated frequency (Hz)	250		
Rated current (A)	3.3		Heatsink-based derating curve
Maximum current (A)	13.2		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.58		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	1.12 ± 10%	
	Motor with brake	-	

Allowable load

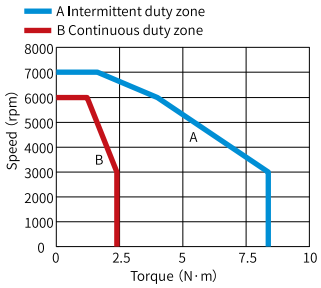
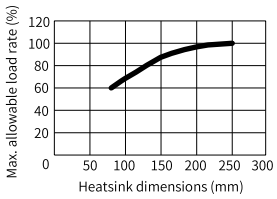
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
35	≤ 392	≤ 147

Dimensions (mm)



LC	LL	LR	LA	LZ	LH	LG	LE	LJ
80	96.7	35 ± 0.5	90	4 × ϕ7	54	7.5	3 ± 0.5	0.5 ± 0.35
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
70	19	M6 × 20	$25^{0}_{-0.62}$	$15.5^{0}_{-0.1}$	6	6	6	1.85

22.2.2.5.6 MS1H4-75B30CB-V63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	80		
Inertia, capacity	Medium inertia, low capacity		
Rated power (kW)	0.75		
Voltage (V)	220		
Rated torque (N·m)	2.39		
Maximum torque (N·m)	8.37		
Rated frequency (Hz)	250		
Rated current (A)	4.4		Heatsink-based derating curve
Maximum current (A)	16.9		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.63		
Rotor moment of inertia ($kg·cm^2$)	Motor without brake	1.46 ± 10%	
	Motor with brake	1.51 to 10 %	

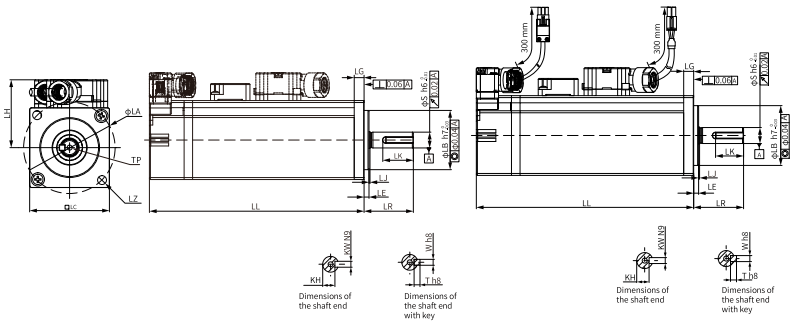
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
3.2	24	10	57.6	0.42	≤ 60	≤ 40	≤ 1

Allowable load

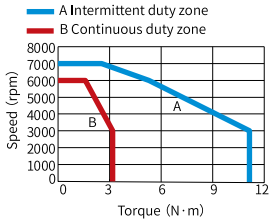
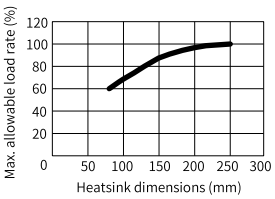
LF (mm)	Allowable radial load (N)	Allowable axial load (N)
35	≤ 392	≤ 147

Dimensions (mm)



LC	LL	LR	LA	LZ	LH	LG	LE	LJ
80	107.3 (140.5)	35 ± 0.5	90	4 × ϕ7	54	7.5	3 ± 0.5	0.5 ± 0.35
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
70	19	M6 × 20	250 $^{-0.62}$	15.50 $^{-0.1}$	6	6	6	2.18 (2.82)

22.2.2.5.7 MS1H4-10C30CB-V63*R-INT

Motor specifications			Torque-speed characteristics
Frame size (mm)	80		
Inertia, capacity	Medium inertia, low capacity		
Rated power (kW)	1.0		
Voltage (V)	220		
Rated torque (N·m)	3.18		
Maximum torque (N·m)	11.13		
Rated frequency (Hz)	250		
Rated current (A)	6.5		Heatsink-based derating curve
Maximum current (A)	24		
Rated speed (rpm)	3000		
Maximum speed (rpm)	7000		
Torque coefficient (N·m/A)	0.53		
Rotor moment of inertia (kg·cm^2)	Motor without brake	1.87 ± 10%	
	Motor with brake	1.97 ± 10%	

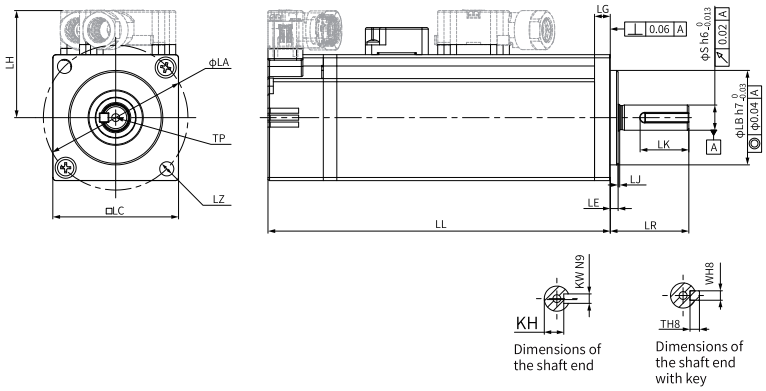
Electrical specifications of the brake

Holding torque (N·m)	Power supply voltage (VDC) ± 10%	Rated power (W)	Coil resistance (Ω) ± 10%	Excitation current (A)	Apply time (ms)	Release time (ms)	Backlash (°)
3.2	24	10	57.6	0.42	≤ 60	≤ 40	≤ 1

Allowable load

LF (mm)	Allowable radial load (N)	Allowable axial load (N)
35	≤ 392	≤ 147

Dimensions (mm)



LC	LL	LR	LA	LZ	LH	LG	LE	LJ
80	118.7 (153.2)	35 ± 0.5	90	4 × ϕ7	54	7.5	3 ± 0.5	0.5 ± 0.35
LB	S	TP	LK	KH	kW	W	T	Weight (kg)
70	19	M6 × 20	$25^{0}_{-0.62}$	$15.5^{0}_{-0.1}$	6	6	6	2.55 (2.9)

23 Options

23.1 Cables

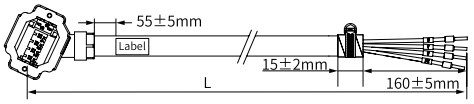
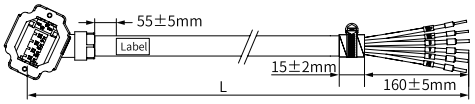
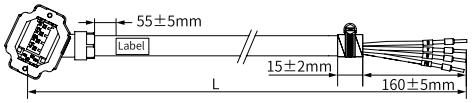
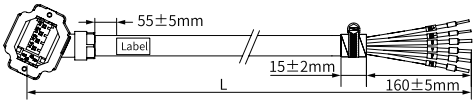
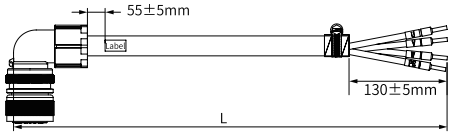
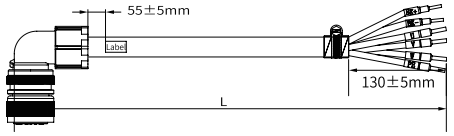
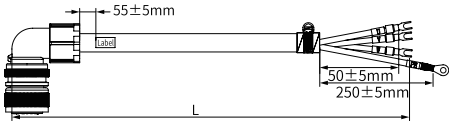
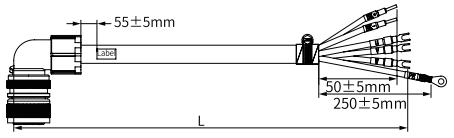
23.1.1 Power Cable

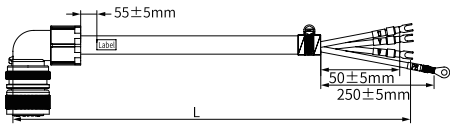
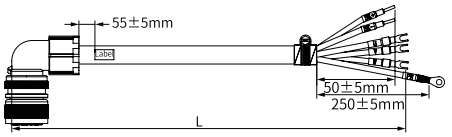
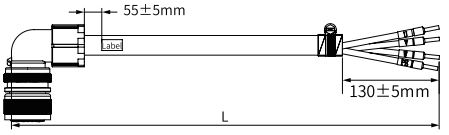
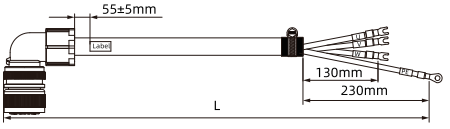
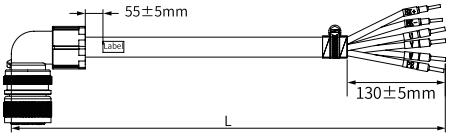
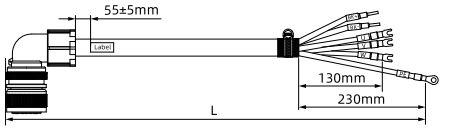
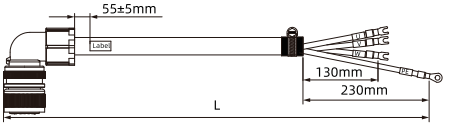
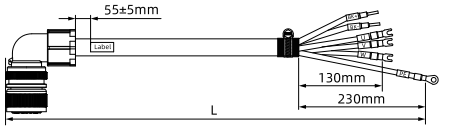
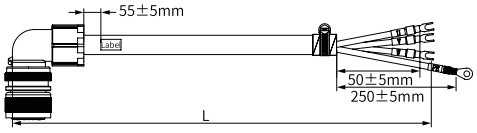
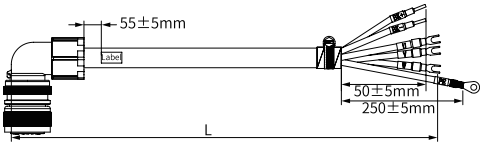
Power cable model

S6-L-M ① 0 ② 0 ③ 1 ④ - 3.0 ⑤ - T ⑥ - X ⑦ - INT ⑧

① **Cable type** S6-L-B/M: Motion control power cable B: With brake M: Without brake	③ **Cross-sectional area** 0: Flange sizes 25/40/60/80 mm 1: Frame sizes 100/130/180 mm with drive rated current lower than 13 A 2: Frame sizes 180 mm with drive rated power higher than 13 A 4: 4 × 2.5 mm^2 5: 4 × 1.5 mm^2 6: 4 × 0.75mm^2 B: 4 × 12 AWG	⑤ **Cable length (m)** 3.0: 3 5.0: 5 8.0: 8 10.0: 10 12.0: 12 15.0: 15 20.0: 20
② **Connector type at drive side** 0: U-shaped terminal 1: Pin terminal	④ **Connector type on the motor end** 0: 6-core plastic connector 1: 9-core aviation connector 2: 6-core aviation connector 7: MS1 custom connector (front outlet) 8: MS1 custom connector (rear outlet) D: AVIC JY27P14-4TK2 aviation plug	⑥ **Special requirements** Blank: Fixed cables T: Cable in the drag chain ≥ 10 million times TTS: Drag chain shielding ≥ 20 million times
		⑦ **Customized or branded** Blank: Default 2: Brand xx
		⑧ **Version** INT: International version

List of Power Cables (Compatible with MS1-R-INT Series Motor)

Motor model	Cable		Cable model	Cable length (mm)	Appearance
MS1H1/ MS1H4 motor	Front outlet	Without brake	S6-L-M107-3.0 (-T) -INT	3000	
			S6-L-M107-5.0 (-T) -INT	5000	
			S6-L-M107-10.0 (-T) -INT	10000	
		With brake	S6-L-B107-3.0 (-T) -INT	3000	
			S6-L-B107-5.0 (-T) -INT	5000	
			S6-L-B107-10.0 (-T) -INT	10000	
	Rear outlet	Without brake	S6-L-M108-3.0 (-T) -INT	3000	
			S6-L-M108-5.0 (-T) -INT	5000	
			S6-L-M108-10.0 (-T) -INT	10000	
		With brake	S6-L-B108-3.0 (-T) -INT	3000	
			S6-L-B108-5.0 (-T) -INT	5000	
			S6-L-B108-10.0 (-T) -INT	10000	
MS1H2 motors rated 3 kW or below/ MS1H3 motors rated 1.8 kW or below (400 V voltage class)	Without brake		S6-L-M111-3.0 (-T) -INT	3000	
			S6-L-M111-5.0 (-T) -INT	5000	
			S6-L-M111-10.0 (-T) -INT	10000	
	With brake		S6-L-B111-3.0 (-T) -INT	3000	
			S6-L-B111-5.0 (-T) -INT	5000	
			S6-L-B111-10.0 (-T) -INT	10000	
MS1H2 motors rated 3 kW or below/ MS1H3 motors rated 1.8 kW or below (200 V voltage class)	Without brake		S6-L-M011-3.0 (-T) -INT	3000	
			S6-L-M011-5.0 (-T) -INT	5000	
			S6-L-M011-10.0 (-T) -INT	10000	
	With brake		S6-L-B011-3.0 (-T) -INT	3000	
			S6-L-B011-5.0 (-T) -INT	5000	
			S6-L-B011-10.0 (-T) -INT	10000	

Motor model	Cable	Cable model	Cable length (mm)	Appearance
MS1H2 motors rated 4 kW/5 kW	Without brake	S6-L-M011-3.0 (-T) -INT	3000	
		S6-L-M011-5.0 (-T) -INT	5000	
		S6-L-M011-10.0 (-T) -INT	10000	
	With brake	S6-L-B011-3.0 (-T) -INT	3000	
		S6-L-B011-5.0 (-T) -INT	5000	
		S6-L-B011-10.0 (-T) -INT	10000	
MS1H3 motors (2.9 kW) (400 V voltage class)	Without brake	S6-L-M112-3.0 (-T) -INT	3000	
		S6-L-M112-5.0 (-T) -INT	5000	
		S6-L-M112-10.0 (-T) -INT	10000	
		S6-L-M012-3.0 (-T) -INT	3000	
		S6-L-M012-5.0 (-T) -INT	5000	
		S6-L-M012-10.0 (-T) -INT	10000	
	With brake	S6-L-B112-3.0 (-T) -INT	3000	
		S6-L-B112-5.0 (-T) -INT	5000	
		S6-L-B112-10.0 (-T) -INT	10000	
		S6-L-B012-3.0 (-T) -INT	3000	
		S6-L-B012-5.0 (-T) -INT	5000	
		S6-L-B012-10.0 (-T) -INT	10000	
MS1H3 motors (2.9 kW) (200 V voltage class)	Without brake	S6-L-M012-3.0 (-T) -INT	3000	
		S6-L-M012-5.0 (-T) -INT	5000	
		S6-L-M012-10.0 (-T) -INT	10000	
	With brake	S6-L-B012-3.0 (-T) -INT	3000	
		S6-L-B012-5.0 (-T) -INT	5000	
		S6-L-B012-10.0 (-T) -INT	10000	
MS1H3 (4.4 kW and above)	Without brake	S6-L-M022-3.0 (-T) -INT	3000	
		S6-L-M022-5.0 (-T) -INT	5000	
		S6-L-M022-10.0 (-T) -INT	10000	
	With brake	S6-L-B022-3.0 (-T) -INT	3000	
		S6-L-B022-5.0 (-T) -INT	5000	
		S6-L-B022-10.0 (-T) -INT	10000	

Note

If the brake cable exceeds 10 m, it is recommended to use a shielded cable.

List of Motor Model Selection (Compatible with LMC Linear Module)

For details about power cable models, see *"2.1.3 List of Motor Model Selection (Compatible with LMC Linear Module)" on page 37*.

List of Power Cables (Compatible with ISM Series Torque Motor)

For details about power cable models, see *"2.1.5 List of Motor Model Selection (Compatible with ISM Series Torque Motor)" on page 38*.

List of Power Cables (Compatible with MP Series Torque Motor)

For details about power cable models, see *"2.1.4 List of Motor Model Selection (Compatible with MP Series Torque Motor)" on page 38*.

23.1.2 Encoder cable

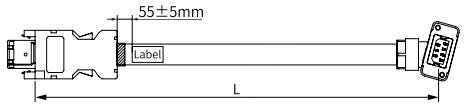
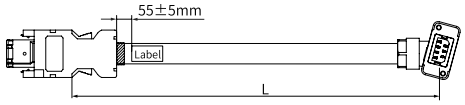
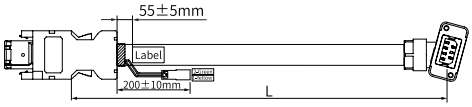
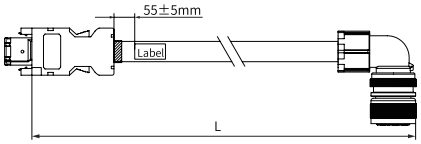
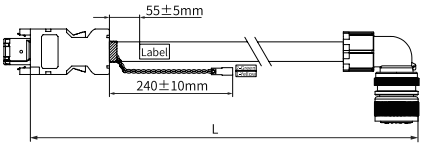
Encoder cable model

S6-L-P ① 1 ② 2 ③ 1 ④ - 3.0 ⑤ - T ⑥ - X ⑦ - X ⑧ - X ⑨ - INT ⑩

① **Cable type** S6-L-P: Encoder cable	④ **Connector type at motor side** 1: 17-conductor aviation connector 4: MS1 custom connector (front outlet) 5: MS1 custom connector (rear outlet)	⑥ **Special requirements** Blank: Fixed cables T: Cable in the drag chain ≥ 10 million times TTS: Drag chain shielding ≥ 20 million times
② **Connector type at drive side** 1: USB plug 2: DB15 plug	A: RSF (MS15 series) and Inovance (EL0I) pulse-type grating C: DB15 with 2 rows of LAMOTION (RU2 series) grating D: Inovance communication-type incremental grating/magnetic grating G: DB9 plug H: USB plug N: TSUN absolute magnetic grating (2 rows of DB9 females) P: LAMOTION absolute magnetic grating (2 rows of DB9 females)	⑦ **Manufacturer** Blank: Default 2: Brand xx ⑧ **Hall sensor** Empty: Without Hall H: With Hall

③ **Encoder application mode**	⑤ **Cable length (m)**	⑨ **Limit**
1: Communication-type incremental encoder	0.5: 0.5	Blank: No limit
2: Communication-type multi-turn absolute encoder	3.0: 3	L: With limit
3: Grating	5.0: 5	⑩ **Version**
4: Magnetic grating	8.0: 8	INT: Global version
5: 23-bit single-turn absolute encoder	10.0: 10	
	12.0: 12	
	15.0: 15	
	20.0: 20	

List of encoder cables (applicable to MS1-R-INT series motors)

Motor model	Cable name		Cable model	L cable length (mm)	Drawing
MS1H1/ MS1H4 terminal-type motor	Front outlet	Single-turn absolute encoder	S6-L-P114-3.0 (-T) -INT	3000	
			S6-L-P114-5.0 (-T) -INT	5000	
			S6-L-P114-10.0 (-T) -INT	10000	
		Multi-turn absolute encoder[1]	S6-L-P124-3.0 (-T) -INT	3000	
			S6-L-P124-5.0 (-T) -INT	5000	
			S6-L-P124-10.0 (-T) -INT	10000	
	Rear outlet	Single-turn absolute encoder	S6-L-P115-3.0 (-T) -INT	3000	
			S6-L-P115-5.0 (-T) -INT	5000	
			S6-L-P115-10.0 (-T) -INT	10000	
		Multi-turn absolute encoder[1]	S6-L-P125-3.0 (-T) -INT	3000	
			S6-L-P125-5.0 (-T) -INT	5000	
			S6-L-P125-10.0 (-T) -INT	10000	
MS1H2/MS1H3 motor		Single-turn absolute encoder	S6-L-P111-3.0 (-T) -INT	3000	
			S6-L-P111-5.0 (-T) -INT	5000	
			S6-L-P111-10.0 (-T) -INT	10000	
		Multi-turn absolute encoder[1]	S6-L-P121-3.0 (-T) -INT	3000	
			S6-L-P121-5.0 (-T) -INT	5000	
			S6-L-P121-10.0 (-T) -INT	10000	

Note

- The encoder cable is equipped with a shield as standard.
- [1]: The 6-conductor cable can be used in normal cases. The cable is reserved for compatibility with the original battery model. It is not required to be connected to the battery box during actual use.

List of encoder cables (applicable to LMC linear modules)

Readhead type	Cable length (m)				
	3	5	8	10	12
RSF-MS15 series, RU2 series, Inovance pulse-type grating (DB15, two rows), Renishaw grating, and LAMOTION RU2 grating without limits (No Hall or limit)	S6-L-P23A-3.0-TTS-2-INT	S6-L-P23A-5.0-TTS-2-INT	S6-L-P23A-8.0-TTS-2-INT	S6-L-P23A-10.0-TTS-2-INT	S6-L-P23A-12.0-TTS-2-INT
RSF-MS15 series, RU2 series, Inovance pulse-type grating (DB15, two rows), Renishaw grating, and LAMOTION RU2 grating without limits (No Hall or limit)	S6-L-P23A-3.0-TTS-2-H-INT	S6-L-P23A-5.0-TTS-2-H-INT	S6-L-P23A-8.0-TTS-2-H-INT	S6-L-P23A-10.0-TTS-2-H-INT	S6-L-P23A-12.0-TTS-2-H-INT
Inovance communication-type ELMI magnetic grating/ELOI grating (No Hall or limit)	S6-L-P24D-3.0-TTS-2-INT	S6-L-P24D-5.0-TTS-2-INT	S6-L-P24D-8.0-TTS-2-INT	S6-L-P24D-10.0-TTS-2-INT	S6-L-P24D-12.0-TTS-2-INT
Inovance communication-type ELMI magnetic grating/ELOI grating (No Hall or limit)	S6-L-P24D-3.0-TTS-2-H-INT	S6-L-P24D-5.0-TTS-2-H-INT	S6-L-P24D-8.0-TTS-2-H-INT	S6-L-P24D-10.0-TTS-2-H-INT	S6-L-P24D-12.0-TTS-2-H-INT
LAMOTION grating (RU2 series) with limit (No Hall or limit)	S6-L-P23C-3.0-TTS-2-L-INT	S6-L-P23C-5.0-TTS-2-L-INT	S6-L-P23C-8.0-TTS-2-L-INT	S6-L-P23C-10.0-TTS-2-L-INT	S6-L-P23C-12.0-TTS-2-L-INT
LAMOTION grating (RU2 series) with limit (With Hall and limit)	S6-L-P23C-3.0-TTS-2-H-L-INT	S6-L-P23C-5.0-TTS-2-H-L-INT	S6-L-P23C-8.0-TTS-2-H-L-INT	S6-L-P23C-10.0-TTS-2-H-L-INT	S6-L-P23C-12.0-TTS-2-H-L-INT
LAMOTION absolute readhead encoder (No Hall or limit)	S6-L-P24P-3.0-TTS-INT	S6-L-P24P-5.0-TTS-INT	S6-L-P24P-8.0-TTS-INT	S6-L-P24P-10.0-TTS-INT	S6-L-P24P-12.0-TTS-INT
TSUN absolute readhead encoder (No Hall or limit)	S6-L-P24N-3.0-TTS-INT	S6-L-P24N-5.0-TTS-INT	S6-L-P24N-8.0-TTS-INT	S6-L-P24N-10.0-TTS-INT	S6-L-P24N-12.0-TTS-INT

List of encoder cables (applicable to ISM series torque motors)

Motor model	Servo drive SV680-INT	Encoder extension cable length (3 m)	Encoder extension cable length (5 m)	Encoder extension cable length (10 m)
ISMT1-160F12AB-A113X-INT ISMT1-160F12AB-A133X-INT	S2R8	S6-L-P22D-3.0-TTS-INT	S6-L-P22D-5.0-TTS-INT	S6-L-P22D-10.0-TTS-INT
ISMT1-160F45AB-A133X-INT				

List of encoder cables (applicable to MP series precision torque motors)

Motor model	Servo drive SV680-INT	Extension cable length of 3 m	Extension cable length of 5 m	Extension cable length of 10 m
MP1-112F10AB-U313X-INT	S2R8	S6-L-P22D-3.0-TTS-INT	S6-L-P22D-5.0-TTS-INT	S6-L-P22D-10.0-TTS-INT
MP1-140S10BB-U323X-INT	S012	S6-L-P22D-3.0-TTS-INT	S6-L-P22D-5.0-TTS-INT	S6-L-P22D-10.0-TTS-INT
MP1-175S11BB-U333X-INT	S012	S6-L-P22D-3.0-TTS-INT	S6-L-P22D-5.0-TTS-INT	S6-L-P22D-10.0-TTS-INT
MP1-220S15BB-U323X-INT	S012	S6-L-P25G-3.0-INT	S6-L-P25G-5.0-INT	S6-L-P25G-10.0-INT
MP1-220S30BD-U323X-INT	T021	S6-L-P25G-3.0-INT	S6-L-P25G-5.0-INT	S6-L-P25G-10.0-INT
MP1-220S30BD-U323L-C-INT	T026	S6-L-P25G-3.0-INT	S6-L-P25G-5.0-INT	S6-L-P25G-10.0-INT

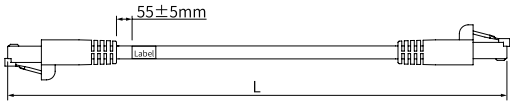
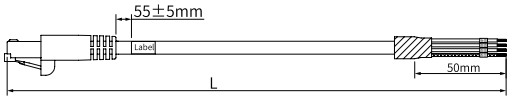
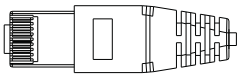
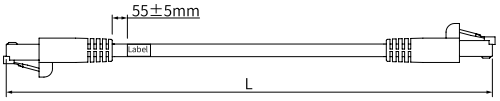
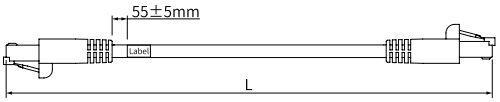
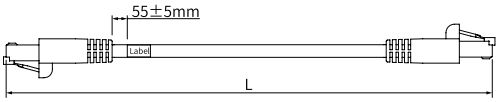
23.1.3 Communication cable

Communication cable model

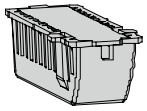
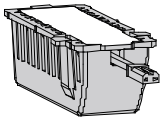
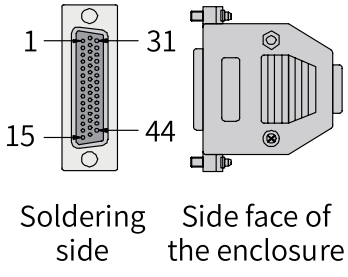
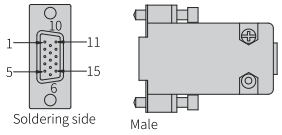
$$\underset{①}{\text{S6-L-T}} - \underset{②}{02} - \underset{③}{0.3}$$

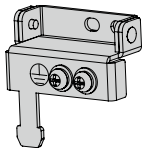
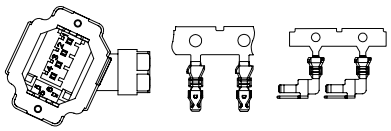
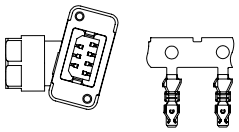
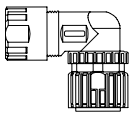
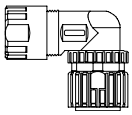
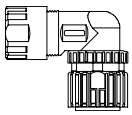
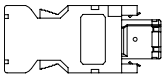
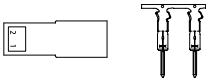
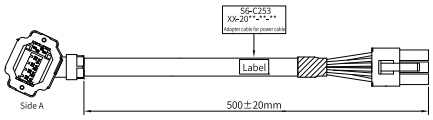
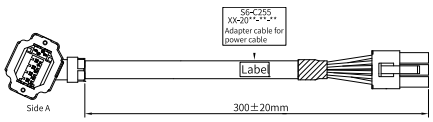
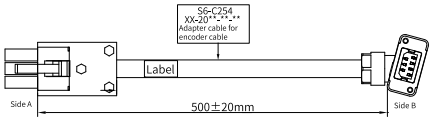
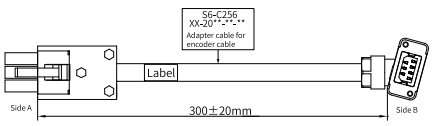
① **Cable type**	② **Cable connection type**	③ **Cable length (m)**
S6-L-T: Motion control communication cable	01: Multi-drive communication cable (CAN and RS485) 02: Servo drive to PLC communication cable 03: Drive communication termination resistor cable (CAN and RS485) 04: Drive network communication cable (CaT.5 and PROFINET) 07: Drive network communication cable (CaT.6 and PROFINET) 08: Drive network communication cable (CaT.7 and PROFINET)	0.3: 0.3 2.0: 2 ...

List of communication cables

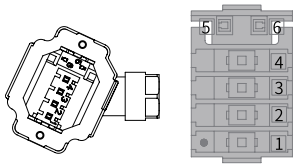
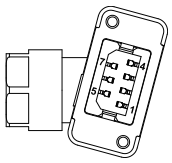
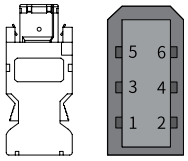
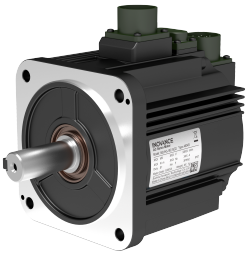
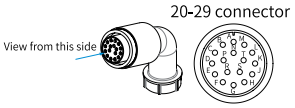
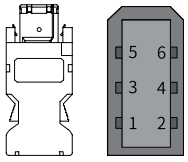
Cable	Cable model	Cable length (mm)	Appearance
Communication cable for multi-drive parallel connection	S6-L-T01-0.3	300	
Servo drive to PLC communication cable	S6-L-T02-2.0	2000	
plug for terminal matching resistor for servo drive communication	S6-L-T03-0.0	-	
Servo drive communication cables (CAT.5E and PROFINET)	S6-L-T04-0.3	300	
Servo drive communication cables (CAT.T6A and PROFINET)	S6-L-T07-0.3	300	
Servo drive communication cables (CAT.7 and PROFINET)	S6-L-T08-0.3	300	

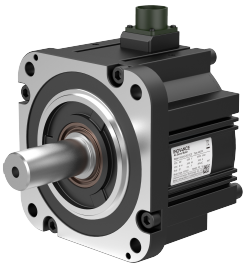
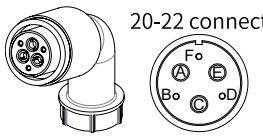
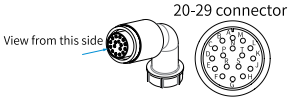
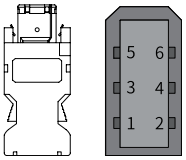
23.1.4 Connector Kits

Connector kit	Model	Drawing
Battery box kit (without battery)	S6-C4A-NB	
Battery kit	S6-C4A	
CN1 terminal (DB44)	S6-C8	
CN7 terminal (DB15)	S6-C6	

Connector kit	Model	Drawing
Shield bracket	S6-C25 (Optional for size A to size C)	
	S6-C27 (Optional for size D to size E)	
Power plug (< 750 W) on the motor side	S6-C246	
Encoder plug (< 750 W) on the motor side	S6-C247	
Power connector for frame sizes 100 to 130 at motor side with power above 1000 W	S6-C248	
Power connector for frame size 180 at motor side with power above 1000 W	S6-C249	
Encoder connector at motor side with power above 1000 W	S6-C250	
CN2(1394)	S6-C251	
Battery box connector	S6-C252	
Power flying leads at motor side with power below 750 W - 500 mm	S6-C253	
Power flying leads at motor side with power below 750 W - 300 mm	S6-C255	
Encoder flying leads at motor side with power below 750 W - 500 mm	S6-C254	
Encoder flying leads at motor side with power below 750 W - 300 mm	S6-C256	

23.1.5 Description of Cable Terminals

<table>
<tr><th>Name</th><th>Diagram</th><th colspan="3">Power cable 6-pin connector</th><th colspan="3">Motor-side encoder 7-pin connector</th><th colspan="3">Drive-side 6-pin male connector</th></tr>
<tr><td rowspan="10">Terminal-type motor with frame sizes 40/60/80</td><td rowspan="10"></td><td colspan="3"></td><td colspan="3"></td><td colspan="3"></td></tr>
<tr><td>Pin No.</td><td>Signal Name</td><td>Color</td><td>Pin No.</td><td>Signal Name</td><td>Color</td><td>Pin No.</td><td>Signal Name</td><td>Color</td></tr>
<tr><td>1</td><td>PE</td><td>Yellow/ Green</td><td>1</td><td>PS+</td><td>Gray</td><td>1</td><td>+5 V</td><td>White</td></tr>
<tr><td>2</td><td>W</td><td>Black 3</td><td>2</td><td>PS-</td><td>Pink</td><td>2</td><td>GND</td><td>Brown</td></tr>
<tr><td>3</td><td>V</td><td>Black 2</td><td>3</td><td>DC+</td><td>Yellow</td><td>5</td><td>PS+</td><td>Gray</td></tr>
<tr><td>4</td><td>U</td><td>Black 1</td><td>4</td><td>DC-</td><td>Green</td><td>6</td><td>PS-</td><td>Pink</td></tr>
<tr><td>5</td><td rowspan="2">Brake (polarity insensitive)</td><td>White</td><td>5</td><td>+5 V</td><td>White</td><td rowspan="3">Enclosure</td><td rowspan="3">PE</td><td rowspan="3">-</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Brown</td><td>6</td><td>GND</td><td>Brown</td></tr>
<tr><td>7</td><td>PE</td><td>-</td></tr>
<tr><td rowspan="10">Motors with frame sizes 100/130</td><td rowspan="10"></td><td colspan="3">Power cable connector</td><td colspan="3">Encoder cable connector of motors</td><td colspan="3">Drive-side 6-pin male connector</td></tr>
<tr><td colspan="3"></td><td colspan="3"></td><td colspan="3"></td></tr>
<tr><td>Pin No.</td><td>Pin No.</td><td>Color</td><td>Pin No.</td><td>Signal Name</td><td>Color</td><td>Pin No.</td><td>Signal Name</td><td>Color</td></tr>
<tr><td>B</td><td>U</td><td>Black 1</td><td>A</td><td>PS+</td><td>Gray</td><td>1</td><td>+5 V</td><td>White</td></tr>
<tr><td>I</td><td>V</td><td>Black 2</td><td>B</td><td>PS-</td><td>Pink</td><td>2</td><td>GND</td><td>Brown</td></tr>
<tr><td>F</td><td>W</td><td>Black 3</td><td>E</td><td>DC+</td><td>Yellow</td><td>5</td><td>PS+</td><td>Gray</td></tr>
<tr><td>G</td><td>PE</td><td>Yellow/ Green</td><td>F</td><td>DC-</td><td>Green</td><td>6</td><td>PS-</td><td>Pink</td></tr>
<tr><td>C</td><td rowspan="2">Brake (polarity insensitive)</td><td>Black 4</td><td>G</td><td>+5 V</td><td>White</td><td rowspan="3">Enclosure</td><td rowspan="3">PE</td><td rowspan="3">-</td></tr>
<tr><td rowspan="2">E</td><td rowspan="2">Black 5</td><td>H</td><td>GND</td><td>Brown</td></tr>
<tr><td>J</td><td>Shield</td><td>-</td></tr>
</table>

<table>
<tr><td rowspan="10">Motors with frame size 180</td><td rowspan="10"></td><td colspan="3">Power cable connector</td><td colspan="3">Encoder cable connector of motors</td><td colspan="3">Drive-side 6-pin male connector</td></tr>
<tr><td colspan="3">
</td><td colspan="3">
</td><td colspan="3">
</td></tr>
<tr><td>Pin No.</td><td>Pin No.</td><td>Color</td><td>Pin No.</td><td>Signal Name</td><td>Color</td><td>Pin No.</td><td>Signal Name</td><td>Color</td></tr>
<tr><td>A</td><td>U</td><td>Black 1</td><td>A</td><td>PS+</td><td>Gray</td><td>1</td><td>+5 V</td><td>White</td></tr>
<tr><td>C</td><td>V</td><td>Black 2</td><td>B</td><td>PS-</td><td>Pink</td><td>2</td><td>GND</td><td>Brown</td></tr>
<tr><td>E</td><td>W</td><td>Black 3</td><td>E</td><td>DC+</td><td>Yellow</td><td>5</td><td>PS+</td><td>Gray</td></tr>
<tr><td>F</td><td>PE</td><td>Yellow/ Green</td><td>F</td><td>DC-</td><td>Green</td><td>6</td><td>PS-</td><td>Pink</td></tr>
<tr><td>B</td><td rowspan="3">Brake (polarity insensitive)</td><td rowspan="3">Black 4</td><td>G</td><td>+5 V</td><td>White</td><td rowspan="3">Enclosure</td><td rowspan="3">PE</td><td rowspan="3">-</td></tr>
<tr><td rowspan="2">D</td><td>H</td><td>GND</td><td>Brown</td></tr>
<tr><td rowspan="2">Black 5</td><td>J</td><td>Shield</td><td>-</td></tr>
</table>

23.2 Peripheral Electrical Components

23.2.1 List of Peripheral Electrical Components

Name	Installation position	Applicable drive model	Function
Fuse and circuit breaker	Input side of the servo drive	All	To comply with EN 61800-5-1 and UL61800-5-1 standards, install a fuse/circuit breaker on the input side of the servo drive to prevent accidents caused by short circuit in the internal circuit.
Electromagnetic contactor	Input side of the servo drive		Used to connect or disconnect the circuit.
AC input reactor	Input side of the servo drive		Used to eliminate the higher harmonics of the input side effectively and improve the power factor of the input side.
EMC filter	Input side of the servo drive		Used to reduce external conduction and radiation interference of the drive.
Magnetic ring and ferrite clamp	Output side of the drive		Reduces interferences to the outside and the bearing current.
	Signal cable		Improves the anti-interference performance of signals.

23.2.2 Fuse (CE)

To prevent accidents caused by short circuit, install a fuse on the input side of the drive.

Table 23–1 Recommended fuse

Drive model SV680-INT series			Recommended fuse Rated current (A)
Size	Model	Continuous input current of main circuit (A)	
Single-phase 200 V			
A	S1R6	2.3	5
	S2R8	4.0	12
C	S5R5	7.9	12
	S7R6	9.6	15
D	S012	12.8	20
Three-phase 200 V			
A	S1R6	1.1	5
	S2R8	2.3	5
C	S5R5	4.4	12
	S7R6	5.1	12
D	S012	8.0	15
E	S018	8.7	20
	S022	11.0	20
	S027	23.8	32
Three-phase 400 V			
B	T1R4	1.0	5
	T2R3	2.1	5
C	T3R5	2.4	5
	T5R4	3.6	10
D	T8R4	5.6	15
	T012	8.0	15
E	T017	12.0	20
	T021	16.0	25
	T026	21.0	30

The recommended values in the preceding table are based on the following conditions. If the conditions vary from the prerequisites described in the table, select a model according to the actual conditions.

- The ambient temperature of the device is 35°C without forced air cooling.
- The altitude is 2000 m.
- Only a single drive is installed.
- The current-carrying density of the conductor is 1.3 A/mm².

When you select a fuse, take into account the maximum input surge current parameter in the "Electrical Specifications" section of the User Guide to ensure that the fuse pre-arcing (I^2t) can withstand surge current conditions multiple times over its expected service life.

23.2.3 Fuse (UL)

Table 23–2 Recommended protective device for the drive

Drive model SV680-INT series			Recommended non-semiconductor fuse
Size	Model	Continuous input current of main circuit (A)	Rated current (A)
Single-phase 200 V			
A	S1R6	2.3	6
	S2R8	4	10
C	S5R5	7.9	15
	S7R6	9.6	20
D	S012	12.8	20
Three-phase 200 V			
A	S1R6	1.1	6
	S2R8	2.3	6
C	S5R5	4.4	10
	S7R6	5.1	10
D	S012	8.0	15 to 20
E	S018	8.7	15 to 40
	S022	11.0	20 to 40
	S027	23.8	40
Three-phase 400 V			
B	T1R4	1.1	6 to 10
	T2R3	2.1	6 to 10
C	T3R5	2.4	6 to 10
	T5R4	3.6	6 to 10
D	T8R4	5.6	10 to 20
	T012	8.0	15 to 20
E	T017	12.0	20 to 40
	T021	16.0	30 to 40
	T026	21.0	35 to 40

The recommended values in the preceding table are based on the following conditions. If the conditions vary from the prerequisites described in the table, select a model according to the actual conditions.

- The ambient temperature of the device is 35°C without forced air cooling.
- The altitude is 2000 m.
- Only a single drive is installed.
- The current-carrying density of the conductor is 1.3 A/mm^2.

When you select a fuse, take into account the maximum input surge current parameter in the "Electrical Specifications" section of the User Guide to ensure that the fuse pre-arcing (I^2t) can withstand surge current conditions multiple times over its expected service life.

Fuse selection requirements:

- If the short-circuit current rating is 5 kA/65 kA and the drive size is A/C/D/E, it is recommended to use a class J or class CC fuse that complies with the UL 248 standard. If you use a class CC fuse, the maximum allowable rating of the circuit breaker is 30 A.
- If the short-circuit current rating is 5 kA/65 kA and the drive size is B, it is recommended to use a class J fuse that complies with the UL 248 standard.

23.2.4 Electromagnetic Contactor

Table 23–3 Recommended electromagnetic contactor model

Servo drive SV680-INT series			Recommended contactor		
Size	Model	Continuous input current of main circuit (A)	Manufacturer	Current (A)	Model
Single-phase 200 V					
A	S1R6	2.3	Schneider	9	LC1 D09
	S2R8	4.0		9	LC1 D09
C	S5R5	7.9		9	LC1 D09
	S7R6	9.6		12	LC1 D12
D	S012	12.8		18	LC1 D18
Three-phase 200 V					
A	S1R6	1.1	Schneider	9	LC1 D09
	S2R8	2.3			
C	S5R5	4.4			
	S7R6	5.1			
D	S012	8.0		9	LC1 D09
E	S018	8.7		12	LC1 D12
	S022	11.0			
	S027	23.8		25	LC1 D25
Three-phase 400 V					
B	T1R4	1.0	Schneider	9	LC1 D09
	T2R3	1.8		9	LC1 D09
C	T3R5	2.4		9	LC1 D09
	T5R4	3.6		9	LC1 D09
D	T8R4	5.6		9	LC1 D09
	T012	8.0		9	LC1 D09
E	T017	12.0		18	LC1 D18
	T021	16.0		18	LC1 D18
	T026	21.0		25	LC1 D25

23.2.5 Circuit Breaker (CE)

Table 23–4 Recommended circuit breaker models

Drive model SV680PS-INT series			Recommended circuit breaker Rated current (A)
Size	Model	Continuous input current of main circuit (A)	
Single-phase 200 V			
A	S1R6	2.3	4
	S2R8	4.0	6
C	S5R5	7.9	16
	S7R6	9.6	16
D	S012	12.8	20
Three-phase 200 V			
A	S1R6	1.1	4
	S2R8	2.3	4
C	S5R5	4.4	6
	S7R6	5.1	10
D	S012	8.0	16

Drive model SV680PS-INT series			Recommended circuit breaker Rated current (A)
Size	Model	Continuous input current of main circuit (A)	
E	S018	8.7	16
	S022	11.0	16
	S027	23.8	32
Three-phase 400 V			
B	T1R4	1.1	4
	T2R3	2.1	4
C	T3R5	2.4	4
	T5R4	3.6	6
D	T8R4	5.6	10
	T012	8.0	16
E	T017	12.0	16
	T021	16.0	25
	T026	21.0	32

The recommended values in the preceding table are based on the following conditions. If the conditions vary from the prerequisites described in the table, select a model according to the actual conditions.

- The ambient temperature of the device is 35°C without forced air cooling.
- The altitude is 2000 m.
- Only a single drive is installed.
- The current-carrying density of the conductor is 1.3 A/mm².

When you select a circuit breaker, take into account parameter "Max. input surge current (A)" in section "Electrical Specifications" in the User Guide. Make sure that the trip characteristics curve of the circuit breaker can support the surge current working conditions.

If a residual current device (RCD) is needed, select the RCD according to the following requirements:

- Use a B-type residual current device (RCD) because the drive may generate DC leakage current in the protective conductor.
- For each drive, use an RCD with tripping current not lower than 100 mA to prevent RCD malfunction due to high-frequency leakage current generated by the drive.
- When multiple drives are connected in parallel and one RCD is used, select an RCD whose tripping current is not lower than 300 mA.
- It is recommended to use Chint or Schneider RCDs.

23.2.6 Circuit Breaker (UL)

Table 23–5 Recommended protective device for the drive

Drive model SV680-INT series			Recommended inverse time circuit breaker (Breaking capacity 5 kA, compliant with UL 489)	Recommended inverse time circuit breaker (Breaking capacity 65 kA, compliant with UL 489)	Recommended inverse time circuit breaker[1] (Breaking capacity 5 kA or 65 kA, compliant with UL 489)
Size	Model	Continuous input current of main circuit (A)	Rated current (A)	Rated current (A)	Rated current (A)
Single-phase 200 V					
A	S1R6	2.3	5 to 15	-	≤ 40
	S2R8	4.0	8 to 15	-	≤ 40
C	S5R5	7.9	15	15	≤ 40
	S7R6	9.6	15	15	≤ 100
D	S012	12.8	20	20	≤ 100
Three-phase 200 V					
A	S1R6	1.1	5 to 15	-	≤ 40
	S2R8	2.3	5 to 15	-	≤ 40
C	S5R5	4.4	8 to 15	-	≤ 40
	S7R6	5.1	10 to 15	-	≤ 100
D	S012	8.0	15 to 20	15	≤ 100
E	S018	8.7	16 to 40	20	≤ 100
	S022	11.0	20 to 40	20	≤ 100
	S027	23.8	40	40	≤ 100
Three-phase 400 V					
B	T1R4	1.1	4 to 15	-	≤ 100
	T2R3	2.1	4 to 15	-	≤ 100
C	T3R5	2.4	5 to 15	-	≤ 100
	T5R4	3.6	7 to 15	-	≤ 100
D	T8R4	5.6	12 to 20	-[2]	≤ 100
	T012	8.0	15 to 20	15	≤ 100
E	T017	12.0	25 to 40	25	≤ 100
	T021	16.0	30 to 40	30	≤ 100
	T026	21.0	40	40	≤ 100

The recommended values in the preceding table are based on the following conditions. If the conditions vary from the prerequisites described in the table, select a model according to the actual conditions.

- The ambient temperature of the device is 35°C without forced air cooling.
- The altitude is 2000 m.
- Only a single drive is installed.
- The current-carrying density of the conductor is 1.3 A/mm².

Circuit breaker selection requirements:

- When you select a circuit breaker, take into account parameter "Max. input surge current (A)" in section "Electrical Specifications" in the User Guide. Make sure that the trip characteristics curve of the circuit breaker can support the surge current working conditions.
- If the short-circuit current rating is 5 kA/65 kA and the drive size is A/B/C/D/E, it is recommended to use an inverse-time circuit breaker that complies with the UL 489 standard.
- [1]: It is recommended to refer to this column when you select circuit breakers for multi-drive parallel systems.
- [2]: For this drive model, when used with a circuit breaker having a breaking capacity of 65 kA, no recommended current value is provided. However, the rated current of this circuit breaker must not exceed the maximum rated current of the selected circuit breaker with a breaking capacity of 5 kA.

23.2.7 AC Input Reactor

Model selection

The optional AC input reactor is mainly used to reduce harmonics in the input current. In applications where harmonics need to be suppressed, install an external reactor. The following table lists the recommended manufacturers and models of input reactors.

Table 23–6 AC input reactor model selection

Servo drive SV680-INT series			Applicable reactor	Inductance (mH)
Size	Model	Continuous input current of main circuit (A)		
Three-phase 200 V				
A	S1R6	1.1	MD-ACL-10-5-4T	5
	S2R8	2.3	MD-ACL-10-5-4T	5
C	S5R5	4.4	MD-ACL-10-5-4T	5
	S7R6	5.1	MD-ACL-10-5-4T	5
D	S012	8.0	MD-ACL-10-5-4T	5
E	S018	8.7	MD-ACL-15-3-4T	3
	S022	11.0	MD-ACL-15-3-4T	3
	S027	23.8	MD-ACL-40-1.45-4T	1.45
Three-phase 400 V				
B	T1R4	1.0	MD-ACL-10-5-4T	5
	T2R3	1.8	MD-ACL-10-5-4T	5
C	T3R5	2.4	MD-ACL-10-5-4T	5
	T5R4	3.6	MD-ACL-10-5-4T	5
D	T8R4	5.6	MD-ACL-10-5-4T	5
	T012	8.0	MD-ACL-10-5-4T	5
E	T017	12.0	MD-ACL-15-3-4T	3
	T021	16.0	MD-ACL-40-1.45-4T	1.45
	T026	21.0	MD-ACL-40-1.45-4T	1.45

Dimensions

Inovance input reactor:

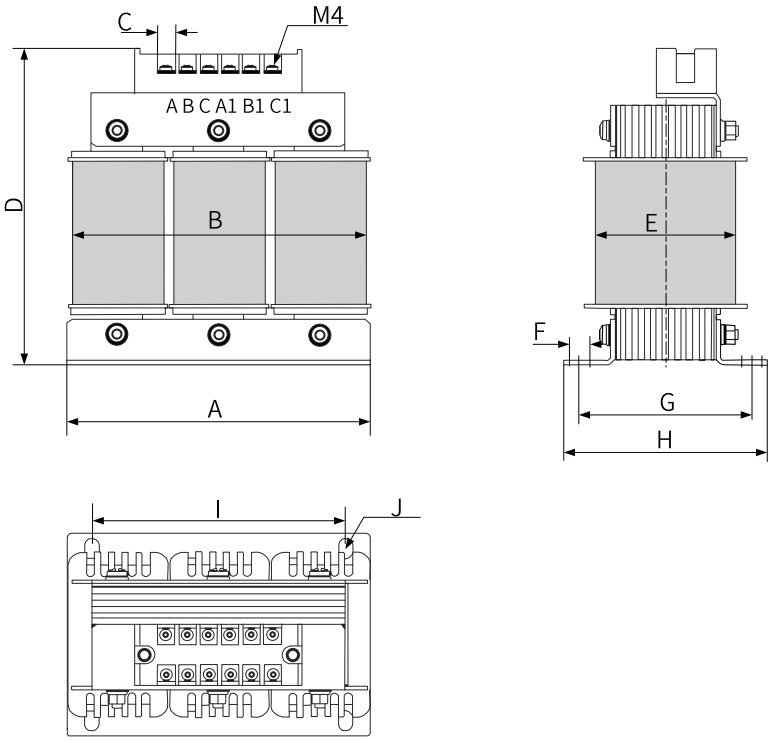


Figure 23-1 Dimensions of 10 A to 15 A AC input reactors

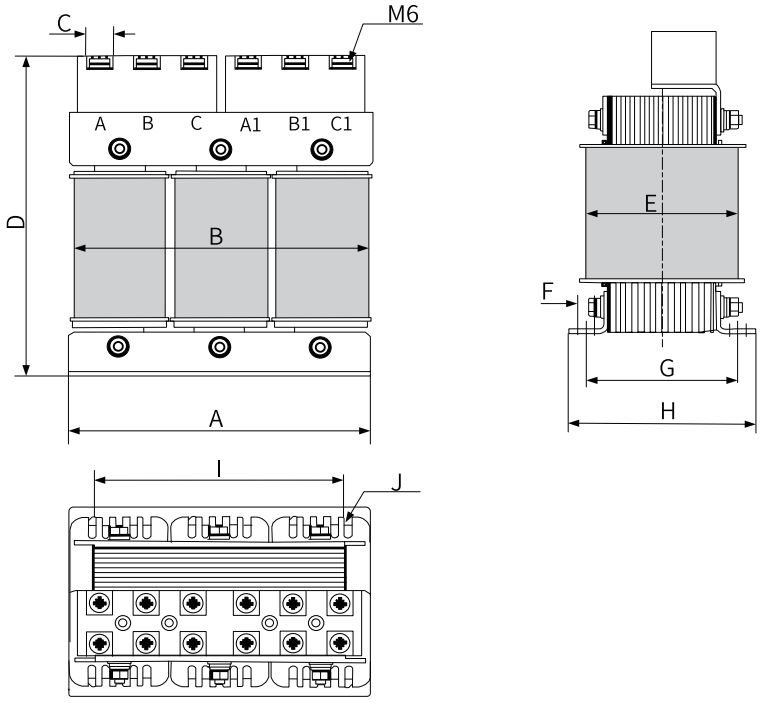


Figure 23-2 Dimensions of 40 A (1.45 mH) AC input reactors

Table 23–7 Dimensions of Inovance AC input reactors (unit: mm)

Model	A	B	C	D	E	F	G	H	I	J
MD-ACL-10-5-4T	150±2	155	8	160	80	10	85±2	100±2	125±1	Ø7x10
MD-ACL-15-3-4T	150±2	155	8	160	80	10	85±2	100±2	125±1	Ø7x10
MD-ACL-40-1.45-4T	180±2	185	16	200	105	10	95±2	117±2	150±1	Ø7x10

23.2.8 EMC Filter

Model selection

To comply with the radiated and conducted emission requirements of EN IEC 61800-3, install an external EMC filter. The recommended EMC filters for this drive are Schaffner FN2090 and FN3287 filters. Filters of equivalent specifications and performance from other brands are also acceptable. The specifications of Schaffner FN2090 and FN3287 filters are as follows.

Table 23–8 Standard EMC filter model and appearance

Filter model (recommended)		Appearance
Schaffner	FN2090	
	FN3287	

Table 23–9 Filter model selection (Schaffner)

Servo drive SV680-INT series			Applicable filter (recommended)
Size	Model	Continuous input current of main circuit (A)	
Single-phase 200 V			
A	S1R6	2.3	FN2090-3-06
	S2R8	4.0	FN2090-4-06
C	S5R5	7.9	FN2090-8-06
	S7R6	9.6	FN2090-10-06
D	S012	12.8	FN2090-16-06
Three-phase 200 V			
A	S1R6	1.1	FN3287-10-44-C28-R65
	S2R8	2.3	FN3287-10-44-C28-R65

Servo drive SV680-INT series			Applicable filter (recommended)
Size	Model	Continuous input current of main circuit (A)	
C	S5R5	4.4	FN3287-10-44-C28-R65
	S7R6	5.1	FN3287-10-44-C28-R65
D	S012	8.0	FN3287-10-44-C28-R65
E	S018	8.7	FN3287-10-44-C28-R65
	S022	11.0	FN3287-16-44-C33-R65
	S027	23.8	FN3287-25-33-C33-R65
Three-phase 400 V			
B	T1R4	1.0	FN3287-10-44-C28-R65
	T2R3	1.8	FN3287-10-44-C28-R65
C	T3R5	2.4	FN3287-10-44-C28-R65
	T5R4	3.6	FN3287-10-44-C28-R65
D	T8R4	5.6	FN3287-10-44-C28-R65
	T012	8.0	FN3287-10-44-C28-R65
E	T017	12.0	FN3287-16-44-C33-R65
	T021	16.0	FN3287-16-44-C33-R65
	T026	21.0	FN3287-25-33-C33-R65

Dimensions

- Dimensions of Schaffner FN2090 filters:

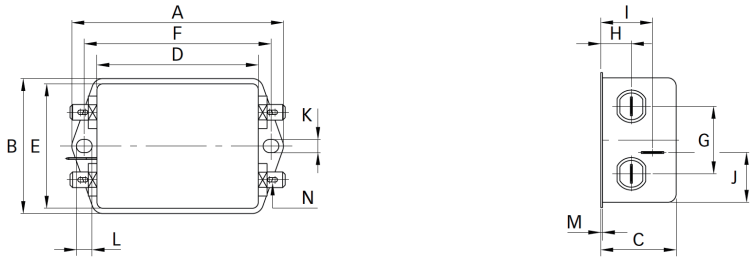


Figure 23-3 Dimensions of FN2090 filters (unit: mm)

Table 23–10 Dimensions of FN2090 filters (unit: mm)

Rated current (A)	A	B	C	D	E	F	G	H	I	J	K	L	M	N
3	85	54	30.3	64.8	49.8	75	27	12.3	20.8	19.9	5.3	6.3	0.7	6.3 × 0.8
4														
6														
8	113.5±1	57.5±1	45.4±1	94±1	56	103	25	12.4	32.4	15.5	4.4	6	1	6.3 × 0.8

- Dimensions of Schaffner FN3287 filters:

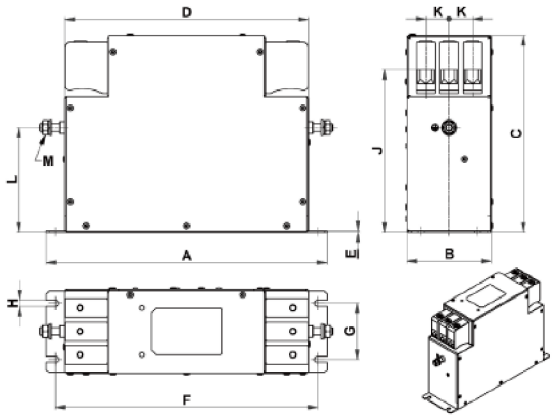


Figure 23-4 Dimensions of FN3287 filters (unit: mm)

Table 23–11 Dimensions of FN3287 filters (unit: mm)

Rated current (A)	A	B	C	D	E	F	G	H	J±2	K	L±1	M
10	180	40	112	153	0.8	170	20	4.5	94	11	68	M5
16	200	45	112	170	0.8	185	25	5.4	102	11	76	M5
25	205	45	132	173	0.8	190	25	5.4	113	13	83	M5

23.2.9 Magnetic Ring and Magnetic Buckle

The magnetic ring can be installed on the input or output side of the drive. Install the magnetic ring as close to the drive as possible. Installing the magnetic ring on the input side can suppress the noise in the input power supply system of the drive. A magnetic ring on the output side is mainly used to reduce the external interference of the drive and reduce the bearing current.

In applications with leakage current and signal cable interference, install a magnetic ring or a ferrite clamp.

Model selection

- Amorphous magnetic ring: supports high permeability when the frequency is within 1 MHz and excellent anti-interference performance, but is not as low-cost as the ferrite clamp. See *“ Dimensions” on page 1432* for details.
- Ferrite clamp: supports good interference suppression performance within a frequency band above 1 MHz, and is applicable to low-power servo drives and signal cables. It is low-cost and easy to install

Magnetic ring and magnetic buckle (recommended)			Appearance
Type	Model	Manufacturer	
Magnetic ring	DY644020H	DAYOU-TECH	
	DY805020H	DAYOU-TECH	
Magnetic buckle	DYR-130-B	Dongyang Ferrite Material Co., Ltd	

Dimensions

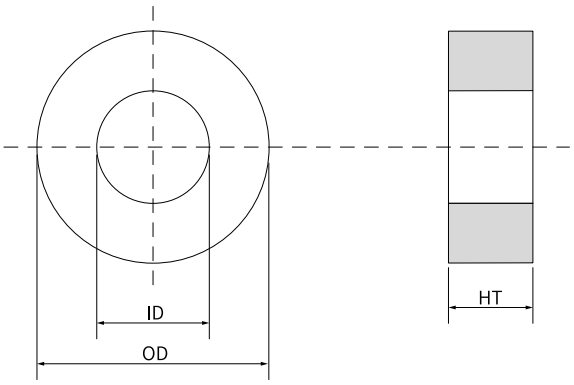


Figure 23-5 Dimensions of the magnetic ring

Table 23–12 Dimensions of the magnetic ring

Model	Dimension (OD × ID × HT) (mm)
DY644020H	64 × 40 × 20
DY805020H	80 × 50 × 20

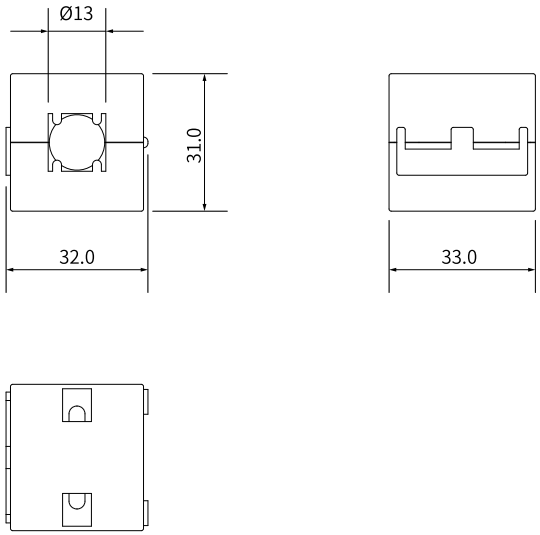


Figure 23-6 Dimensions of the magnetic buckle

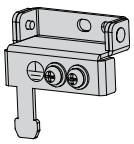
Table 23–13 Dimensions of the magnetic buckle

Model	Dimension (width × outer diameter × inner diameter) (mm)
DYR-130-B	32.0 × 31 × 13

23.3 Shield Bracket

To reduce electromagnetic interference, shield brackets and clamps are used with the drive cables.

Table 23–14 Shield bracket

Model	Outline drawing
S6-C25 (optional for size A to size C)	
S6-C27 (optional for size D to size E)	

23.4 Absolute Encoder Batteries

Selection

Select an appropriate battery according to the following table.

Table 23–15 Description of the absolute encoder battery

Specification	Item	Rating			Condition
		Min.	Typical Value	Max.	
Output: 3.6 V, 2700 mAh	External battery voltage (V)	3.2	3.6	3.8	In standby state[1]
	Circuit fault voltage (V)	-	2.6	-	In standby state
	Battery alarm voltage (V)	2.85	3	3.15	-
	Current consumed by the circuit (uA)	-	2	-	In normal operation[2]
		-	10	-	In standby state, shaft at standstill
		-	300	-	In standby state, shaft rotating
	Ambient temperature (℃)	0	-	40	Same as the motor.
	Storage temperature (℃)	0	-	30	

The preceding values are obtained under an ambient temperature of 20℃.

Note

- [1]: The "standby state" means the encoder counts the multi-turn data by using the power from the external battery when the servo drive power supply is not switched on. In this case, data transceiving stops.
- [2]: During normal operation, the absolute encoder supports one-turn or multi-turn data counting and transceiving. Power on the servo drive after connecting the absolute encoder properly. The encoder starts data transceiving after a short delay of about 5s upon power-on. The motor speed must be lower than or equal to 10 rpm during transition from the standby state to the normal operation state (upon power-on). Otherwise, Er.740 (Encoder fault) may occur. In this case, you need to power off and on the servo drive again.

23.5 Braking Resistor

When the motor torque direction is opposite to the speed direction, the energy is transmitted from the motor back to the servo drive, causing rise of the bus voltage. When the bus voltage rises to the braking threshold, the energy is consumed by the braking resistor according to the braking requirements. Otherwise, the drive will be damaged. You can use either a built-in or external braking resistor. Do not use a built-in braking resistor and an external braking resistor at the same time. Specifications of the braking resistor are as follows.

Table 23–16 Braking resistor specifications

Drive model (SV680P*****-*INT)	Specifications of built-in braking resistors			Min. allowable resistance of external braking resistor (Ω) (H02.21)
	Resistance (Ω)	Power (Pr) (W)	Processing power Pa (W)	
S1R6	-	-	-	40
S2R8	-	-	-	
S5R5	50	50	40	
S7R6	25	80	64	20
S012				15

Drive model (SV680P*****-*INT)	Specifications of built-in braking resistors			Min. allowable resistance of external braking resistor (Ω) (H02.21)
	Resistance (Ω)	Power (Pr) (W)	Processing power Pa (W)	
S018	20	100	80	20
S022				
S027				
T1R4	100	50	40	80
T2R3	100	50	40	60
T3R5	100	80	64	80
T5R4	100			60
T8R4	50			45
T012				40
T017	35	100	80	35
T021				25
T026				

Note

- The drive model (SV680P*****-*INT) includes all model types, for example, S1R6 includes SV680PS1R6I-PINT, SV680PS1R6I-GINT, SV680PS1R6S-PINT, and SV680PS1R6S-GINT.
- The built-in braking resistor is not available in standard S1R6 and S2R8 models. You can install an external braking resistor as needed or contact Inovance to order customized S1R6 and S2R8 models that carry the built-in braking resistor.
- The processing power (P_a) of the built-in braking resistor is affected by the ambient temperature and actual load rate of the drive.

The kinetic energy generated upon braking of a reciprocating motor is converted into electric energy that is fed back to the bus capacitor. When the bus voltage rises above the braking voltage threshold, the braking resistor starts consuming the excessive energy fed back by the motor. Figure *"Figure 23-7" on page 1435* shows the motor speed curve.

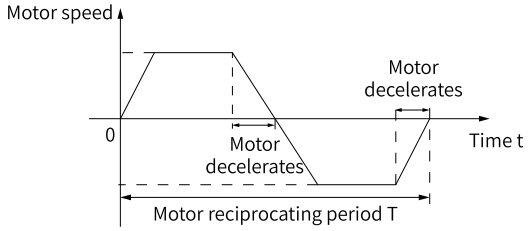


Figure 23-7 Motor speed curve

Energy calculation

The drive model S1R6 or S2R8 does not have a built-in braking resistor. They can be charged through a capacitor. An external braking resistor is needed when the rotational energy of the motor and the load exceeds the values listed in the following table.

Drive model (SV680P*****-*INT)	Absorbable braking energy (W)	Remarks
S1R6	13.15	The input voltage of the main circuit power supply is 200 VAC.
S2R8	26.29	

- The following table shows the energy generated by a 200 V motor in decelerating from the rated speed to a standstill during no-load operation.

Table 23–17 200 V motor energy data

Capacity (kW)	Servo motor model MS1H*-*******-*****	Rotor inertia (J) (kg·cm^2)	Braking energy generated from rated speed to standstill: E_O (J)	Max. absorbable braking energy by the capacitor E_C (J)
0.05	MS1H1-05B30CB-**30R-INT	0.018±10%	0.13	9.3
	MS1H1-05B30CB-**32R-INT	0.0208±10%	0.14	
0.1	MS1H1-10B30CB-**30R-INT	0.0316±10%	0.20	9.3
	MS1H1-10B30CB-**32R-INT	0.0345±10%	0.21	
0.2	MS1H1-20B30CB-**31R-INT	0.094±10 %	0.46	9.3
	MS1H1-20B30CB-**34R-INT	0.106±10 %	0.52	
0.4	MS1H1-40B30CB-**31R-INT	0.145±10 %	0.72	18.59
	MS1H1-40B30CB-**34R-INT	0.157±10 %	0.78	
0.55	MS1H1-55B30CB-**31R-INT	0.55±10 %	2.72	32.42
0.75	MS1H1-75B30CB-**31R-INT	0.68±10 %	3.36	32.42
	MS1H1-75B30CB-**34R-INT	0.71±10 %	3.51	
1.0	MS1H1-10C30CB-**31R-INT	0.82±10 %	4.05	32.42
	MS1H1-10C30CB-**34R-INT	0.87±10 %	4.30	
1.0	MS1H2-10C30CB-**31R-INT	1.78±10%	8.80	32.42
	MS1H2-10C30CB-**34R-INT	2.6±10%	12.86	
1.5	MS1H2-15C30CB-**31R-INT	2.35±10%	11.6	47.68
	MS1H2-15C30CB-**34R-INT	3.17±10%	15.68	
2.0	MS1H2-20C30CB-**31R-INT	2.92±10%	14.44	78.19
	MS1H2-20C30CB-**34R-INT	3.74±10%	18.49	
2.5	MS1H2-25C30CB-**31R-INT	3.49±10%	17.26	114.43
	MS1H2-25C30CB-**34R-INT	4.3±10%	21.26	
3.0	MS1H2-30C30CB-**31R-INT	6.4±10%	31.65	114.43
	MS1H2-30C30CB-**34R-INT	9.38±10%	46.38	
4.0	MS1H2-40C30CB-**31R-INT	9±10%	44.51	114.43
	MS1H2-40C30CB-**34R-INT	11.98±10%	59.24	
5.0	MS1H2-50C30CB-**31R-INT	11.6±10%	57.36	114.43
	MS1H2-50C30CB-**34R-INT	14.58±10%	72.10	
0.85	MS1H3-85B15CB-**31R-INT	13.56±10%	16.45	32.42
	MS1H3-85B15CB-**34R-INT	15.8±10%	17.3	
1.3	MS1H3-13C15CB-**31R-INT	19.25±10%	22	47.68
	MS1H3-13C15CB-**34R-INT	21.5±10%	22.86	
1.8	MS1H3-18C15CB-**31R-INT	24.9±10%	30.78	78.19
	MS1H3-18C15CB-**34R-INT	27.2±10%	33.63	
2.9	MS1H3-29C15CB-**31R-INT	44.7±10%	55.26	114.43
	MS1H3-29C15CB-**34R-INT	52.35±10%	64.72	

Capacity (kW)	Servo motor model MS1H*-*******-*****	Rotor inertia (J) (kg·cm^2)	Braking energy generated from rated speed to standstill: E_O (J)	Max. absorbable braking energy by the capacitor E_C (J)
4.4	MS1H3-44C15CB-**31R-INT	64.9±10%	80.23	114.43
	MS1H3-44C15CB-**34R-INT	72.55±10%	89.69	
0.05	MS1H4-05B30CB-**30R-INT	0.038±10%	0.19	9.3
	MS1H4-05B30CB-**32R-INT	0.04±10%	0.20	
0.1	MS1H4-10B30CB-**30R-INT	0.072±10%	0.36	9.3
	MS1H4-10B30CB-**32R-INT	0.074±10%	0.37	
0.05	MS1H4-05B30CB-**31R-INT	0.038±10%	0.19	9.3
	MS1H4-05B30CB-**34R-INT	0.04±10%	0.20	
0.1	MS1H4-10B30CB-**31R-INT	0.072±10%	0.50	9.3
	MS1H4-10B30CB-**34R-INT	0.074±10%	0.51	
0.2	MS1H4-20B30CB-**31R-INT	0.22±10%	1.09	9.3
	MS1H4-20B30CB-**34R-INT	0.23±10%	1.14	
0.4	MS1H4-40B30CB-**31R-INT	0.43±10%	2.13	18.59
	MS1H4-40B30CB-**34R-INT	0.44±10%	2.18	
0.55	MS1H4-55B30CB-**31R-INT	1.12±10%	5.54	32.42
0.75	MS1H4-75B30CB-**31R-INT	1.46±10%	7.22	32.42
	MS1H4-75B30CB-**34R-INT	1.51±10%	7.47	
1.0	MS1H4-10C30CB-**31R-INT	1.87±10%	9.25	32.42
	MS1H4-10C30CB-**34R-INT	1.97±10%	9.74	

- The following table shows the energy generated by a 400 V motor in decelerating from the rated speed to a standstill during no-load operation.

Table 23–18 400 V motor energy data

Capacity (kW)	Servo motor model MS1H*-*******-*****	Rotor inertia (J) (kg·cm^2)	Braking energy E_O generated in decelerating from rated speed to a standstill (J)	Max. absorbable braking energy by the capacitor E_C (J)
1.0	MS1H2-10C30CD-**31R-INT	1.78±10%	8.8	36.06
	MS1H2-10C30CD-**34R-INT	2.6±10%	12.86	
1.5	MS1H2-15C30CD-**31R-INT	2.35±10%	11.62	43.79
	MS1H2-15C30CD-**34R-INT	3.17±10%	15.68	
2.0	MS1H2-20C30CD-**31R-INT	2.92±10%	14.44	64.40
	MS1H2-20C30CD-**34R-INT	3.74±10%	18.49	
2.5	MS1H2-25C30CD-**31R-INT	3.49±10%	17.26	64.40
	MS1H2-25C30CD-**34R-INT	4.3±10%	21.26	
3.0	MS1H2-30C30CD-**31R-INT	6.4±10%	31.65	64.40
	MS1H2-30C30CD-**34R-INT	9.38±10%	46.38	
4.0	MS1H2-40C30CD-**31R-INT	9±10%	44.51	105.62
	MS1H2-40C30CD-**34R-INT	11.98±10%	59.24	

Capacity (kW)	Servo motor model MS1H*-*******-*****	Rotor inertia (J) (kg·cm^2)	Braking energy E_O generated in decelerating from rated speed to a standstill (J)	Max. absorbable braking energy by the capacitor E_C (J)
5.0	MS1H2-50C30CD-**31R-INT	11.6±10%	57.36	154.56
	MS1H2-50C30CD-**34R-INT	14.58±10%	72.10	
0.85	MS1H3-85B15CD-**31R-INT	13.56±10%	16.76	36.06
	MS1H3-85B15CD-**34R-INT	15.8±10%	19.53	
1.3	MS1H3-13C15CD-**31R-INT	19.25±10%	23.8	43.79
	MS1H3-13C15CD-**34R-INT	21.5±10%	26.58	
1.8	MS1H3-18C15CD-**31R-INT	24.9±10%	30.78	64.40
	MS1H3-18C15CD-**34R-INT	27.2±10%	33.63	
2.9	MS1H3-29C15CD-**31R-INT	44.7±10%	55.26	64.40
	MS1H3-29C15CD-**34R-INT	52.35±10%	64.72	
4.4	MS1H3-44C15CD-**31R-INT	64.9±10%	80.23	105.62
	MS1H3-44C15CD-**34R-INT	72.55±10%	89.69	
5.5	MS1H3-55C15CD-**31R-INT	86.9±10%	107.43	154.56
	MS1H3-55C15CD-**34R-INT	94.55±10%	116.89	
7.5	MS1H3-75C15CD-**31R-INT	127.5±10%	157.62	154.56
	MS1H3-75C15CD-**34R-INT	135.15±10%	167.08	
0.4	MS1H4-40B30CD-**31R-INT	0.43±10%	2.12	25.58
	MS1H4-40B30CD-**34R-INT	0.44±10%	2.17	
0.75	MS1H4-75B30CD-**31R-INT	1.46±10%	7.20	25.58
	MS1H4-75B30CD-**34R-INT	1.51±10%	7.45	

Note

The asterisk (*) indicates the encoder type, which can be A3 (23-bit multi-turn absolute encoder), A6 (26-bit multi-turn absolute encoder), or S6 (26-bit multi-turn absolute encoder of functional safety type)

If the total braking time T is known, you can determine whether an external braking resistor is required and the power required using the following flowchart and formula.

Braking resistor selection for rotary motor

- **Without external load torque**

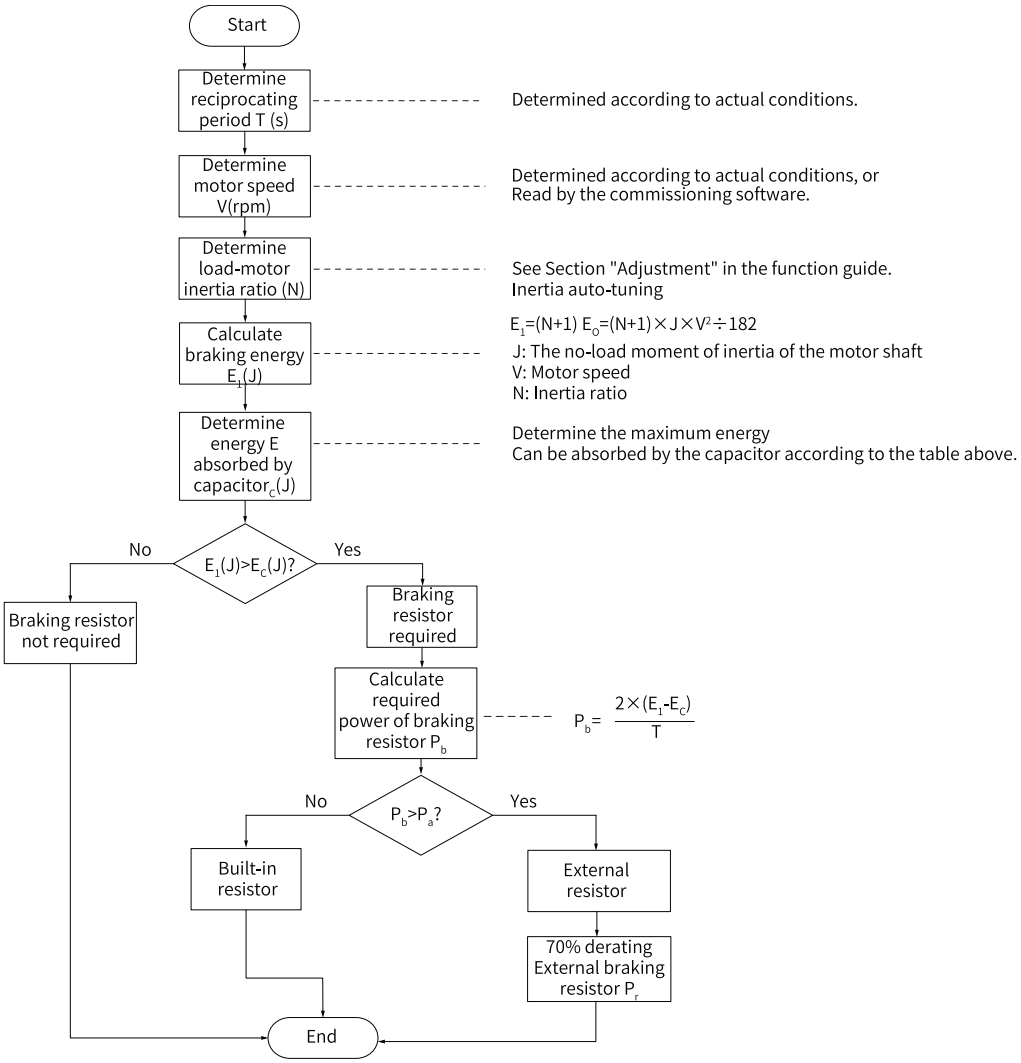


Figure 23-8 Flowchart for selecting the braking resistor

Table 23–19 Description of braking resistor selection factors

Factor	Unit	Definition
Reciprocating motion cycle T	s	Set it based on actual conditions.
Motor speed (V)	rpm	Determined based on actual operating conditions or read from the Inovance software tool.
Inertia ratio (N)	-	For details, see section "Tuning".
Rotor inertia (J)	kg·m²	For the specific rotor inertia of MS1 series motors, see *"Table 23-17 200 V motor energy data" on page 1436*
Braking energy E_1	J	$E_1 = (N + 1) \times J \times V^2 \div 182$
Energy absorbed by capacitor E_c	J	For the maximum braking energy absorbed by capacitor, see *"Table 23-17 200 V motor energy data" on page 1436*
Power of braking resistor (P_b)	W	$P_b = 2 \times (E_1 - E_C) \div T$
Power of built-in braking resistor (P_a)	W	The built-in braking resistor is not available in models S1R6 or S2R8 ($P_a = 0$). For details, see *"Table 23-16 Braking resistor specifications" on page 1434*

Note

- Take the process in which the motor decelerates from 3000 rpm to a standstill as an example, suppose the load inertia is N x motor inertia, then the braking energy is (N+1) x E_O when the motor decelerates from 3000 rpm to 0 rpm, and the energy consumed by the braking resistor is (N+1) x EO - EC (EC represents the energy absorbed by the capacitor). The energy consumed by the braking resistor is (N + 1) x E_O - E_C (E_C represents the energy absorbed by the capacitor). Suppose the reciprocating cycle is T, then the power of the braking resistor needed is 2 x [(N + 1) x E_O - E_C]/T. See *"Table 23-17 200 V motor energy data" on page 1436* and *"Table 23-18 400 V motor energy data" on page 1437* for values of E_O and E_C.
- Determine whether to use the braking resistor according to the preceding figure and select a built-in or an external braking resistor as needed. Then, set H02.25 accordingly.
- The resistor with aluminum case is recommended.

Take the H1 series 750 W model as an example. Assume that the reciprocating movement period T = 2s, maximum speed = 3000 RPM, and inertia ratio = 4. In this case, the required braking resistor power is:

$$P_b = \frac{2\times[(N+1)\times E_O - E_C]}{T} = \frac{2\times[(4+1)\times 6.824 - 32.422]}{2} = 1.698W$$

The calculated result is smaller than the processing capacity (P_a = 40 W) of the built-in braking resistor, so a built-in braking resistor is sufficient to meet the requirements.

If the inertia ratio is 10 and other conditions are the same, the required braking resistor power is:

$$P_b = \frac{2\times[(N+1)\times E_O - E_C]}{T} = \frac{2\times[(10+1)\times 6.824 - 32.422]}{2} = 42.642W$$

The calculated result is larger than the processing capacity (P_a = 40 W) of the built-in braking resistor. Therefore, an external braking resistor is required. The recommended power of the external braking resistor is $P_b \div (1 - 70\%)$ = 142.14 W.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
H02.21	2002-16h	Min. allowable resistance of braking resistor	1 to 1000	40	Ω	Read-only
H02.24	2002-19h	Resistor heat dissipation coefficient	10 to 100	30	%	Real time
H02.25	2002-1Ah	Braking resistor type	0: Built-in 1: External, natural cooling 2: External, forced air cooling 3: No resistor needed	3	-	Real time
H02.26	2002-1Bh	Power of external braking resistor	1 to 65535	40	W	Real time
H02.27	2002-1Ch	Resistance of external braking resistor	15 to 1000	50	Ω	Real time

- Braking resistor not needed

When $E_1 < E_C$, no braking resistor is needed, because the braking energy can be absorbed by the bus capacitor. In this case, set H02.25 to 3.

- Using the built-in braking resistor
  When $P_b < P_a$ and $E_1 > E_C$, use the built-in braking resistor. In this case, set H02.25 to 0.

  When using the built-in braking resistor, connect terminals $P_\oplus$ and D with a jumper bar.

- Using an external braking resistor
  When P_b is greater than P_a, use an external braking resistor. Set H02.25 to 1 or 2 based on the cooling mode of the braking resistor.

  Use the external braking resistor with 70% derated, that is, $P_r = P_b \div (1 - 70\%)$, and ensure the resistance of the braking resistor is higher than the minimum allowable resistance allowed by the servo drive. Remove the jumper bar between terminals $P_\oplus$ and D, and connect the external braking resistor between terminals $P_\oplus$ and C.

  For cables applicable to external braking resistors, see sections *"Cable Specifications (CE)" and "Cable Specifications (UL)" in the SV680P-INT Series Servo Drive Hardware Guide*. Set H02.25 to 1 or 2 based on the cooling mode of the braking resistor.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
H02.21	2002-16h	Min. allowable resistance of braking resistor	1 to 1000	40	Ω	Read-only
H02.25	2002-1Ah	Braking resistor type	0: Built-in 1: External, natural cooling 2: External, forced air cooling 3: No resistor needed	3	-	Real time
H02.26	2002-1Bh	Power of external braking resistor	1 to 65535	40	W	Real time
H02.27	2002-1Ch	Resistance of external braking resistor	15 to 1000	50	Ω	Real time

Caution

- Set the power and resistance of the external braking resistor in H02.26 and H02.27. Otherwise, this function may be unavailable.
- Make sure that the resistance of the external braking resistor is higher than or equal to the minimum allowable resistance.
- When the braking resistor is used at its rated power rather than the processing power (average value) in environments within the specified temperature range, the temperature of the resistor will rise to above 120°C under continuous braking. To ensure safety, cool the resistor down through forced air cooling or use a resistor equipped with a thermal switch. For the load characteristics of the braking resistor, consult with the manufacturer.

Set the heat dissipation coefficient based on the heat dissipation condition of the external braking resistor.

☆ Related parameters:

Parameter	Comm. address	Parameter name	Value range	Default value	Unit	Change mode
H02.24	2002-19h	Resistor heat dissipation coefficient	10 to 100	30	%	Real time

Note

Higher resistor heat dissipation coefficient indicates higher braking efficiency.

- **External load torque applied, motor in generating state**
  When rotation directions of the motor and shaft are the same, the motor is in the motoring state. In some special applications where the motor torque direction is opposite to the rotating direction, the motor is in generating state, and pumps the electric energy back to the servo drive.

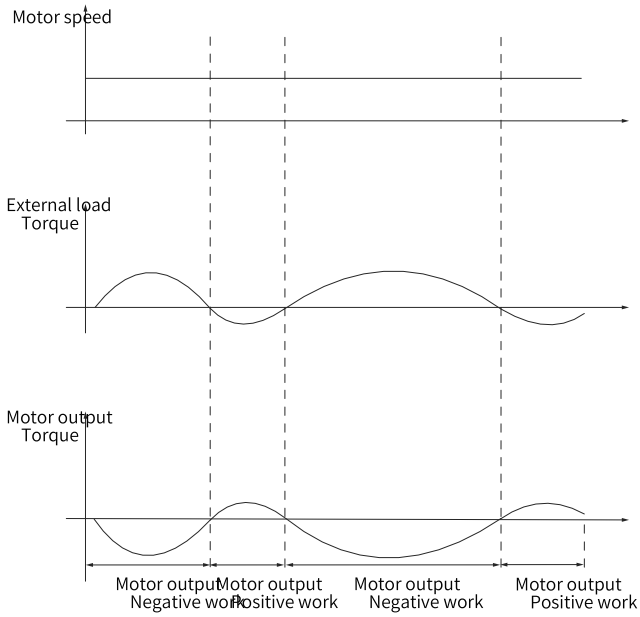


Figure 23-9 Example of the curve with external load torque

Take H1 series 750 W models (rated torque: 2.39 N·m) as an example. When the external load torque is 60% of the rated torque and the motor speed reaches 1500 RPM, the power fed back to the drive is (60% × 2.39) × (1500 × 2π/60) = 225 W. Because the braking resistor needs to be derated by 70%, the power of the external braking resistor is 225 ÷ (1 - 70%) = 750 W, with resistance being 50 Ω.

Braking resistor selection for direct drive

- **Without external load torque**

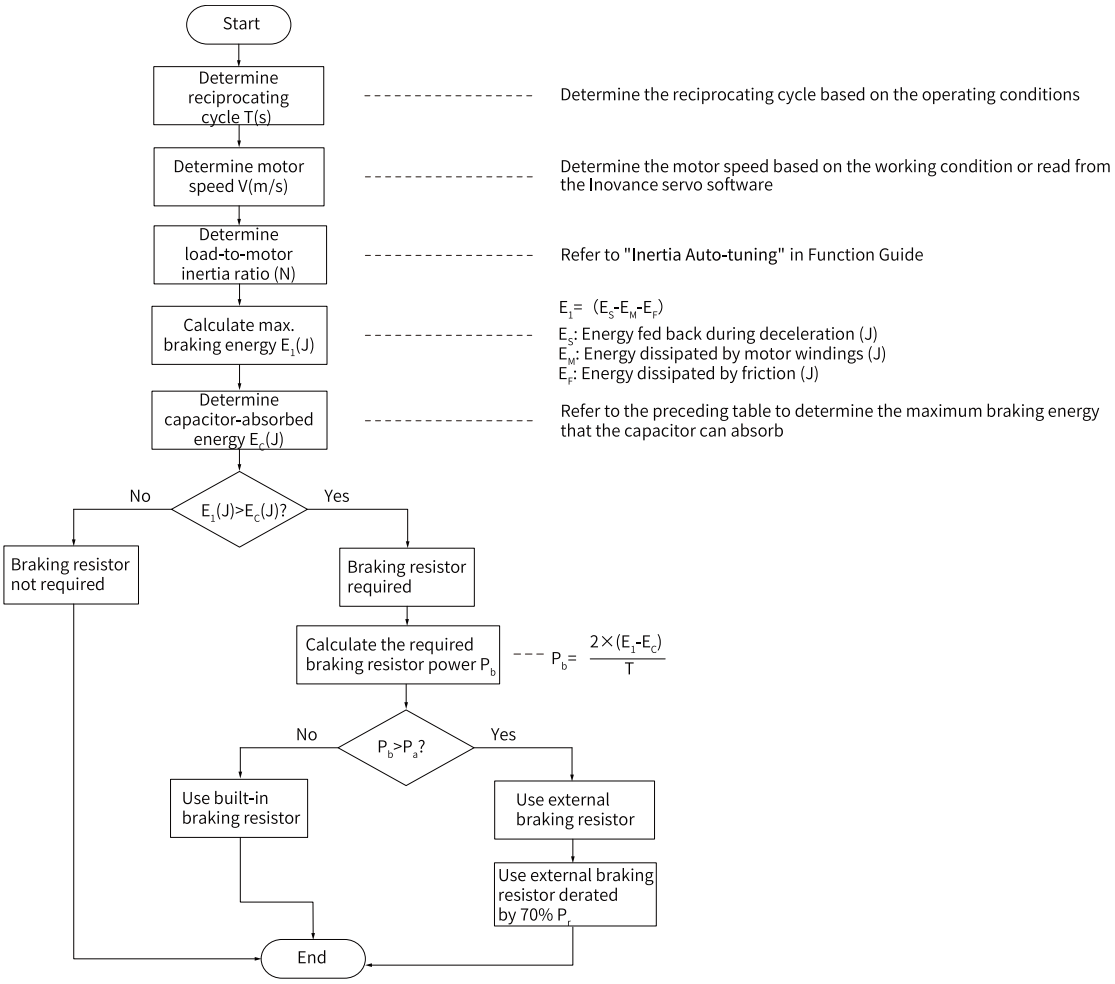


Figure 23-10 Flowchart for selecting the braking resistor

Note

- Determine whether to use a braking resistor, select a built-in or external braking resistor as needed, and then set H02.25.
- It is recommended to use a resistor enclosed by an aluminum case.

- **Calculate the energy returned at each deceleration**

$$E_S = \frac{1}{2} \times (M_M + M_L) \times (V_1^2 - V_2^2)$$

E_S: Feedback energy upon deceleration (J)

M_M: Rotor weight (kg)

M_L: Load Weight (kg)

V_1: Speed before deceleration (m/s)

V_2: Speed after deceleration (m/s)

- **Determine the energy consumed by the motor**

$$E_M = 3 \times I_M^2 \times (R_M/2) \times t_d$$

E_M: Energy consumed by motor winding (J)

I_M: Current at deceleration (A)

R_M : Motor phase resistance (Ω)

td_d : Deceleration time (s)

- **Determine the energy consumed by friction (direct drive motor friction loss is low, which can be ignored based on actual operating conditions)**

$$E_F = \frac{1}{2} \times T_f \times (V_1 - V_2) \times t_d$$

E_F : Energy consumed by friction (J)

T_f : Friction resistance (N)

V_1 : Speed before deceleration (m/s)

V_2 : Speed after deceleration (m/s)

td_d : Deceleration time (s)

- **Determine the energy consumed by the drive**

$$E_1 = E_F - E_M - E_F$$

E_1 : Energy consumed by the drive (J)

- **Determine the energy consumed by the braking resistor**
  - $E_1 > E_C$: An external braking resistor is required
  - $E_1 < E_C$: no braking resistor is required

- **Calculate the power of the braking resistor**

$$P_b = 2 \times (E_1 - E_C) / T$$
$$P_r = P_b / 0.3$$

P_b : Power needs to be processed by the braking resistor (W)

P_r : Recommended power for the braking resistor (W)

T: Repeated motor running cycle (s)

0.3: Resistor heat dissipation coefficient (set in H02.24)

- Take the S5R5 model as an example:
  Assume the following operating conditions: reciprocating cycle T = 2s, maximum running speed is 8 m/s, and a deceleration time of 0.05 s for acceleration to zero speed. The load weight is three times the motor rotor weight and the friction torque is 2.5 N·m. In the motor parameter settings, the motor rotor weight is 0.6 kg, the motor phase resistance is 1.53 Ω, and the force constant is 23.5 N/A. In this case:

  The deceleration current can be obtained through H0b.24 (Active value of phase current) when the drive monitors deceleration:

  $I_M = 15$ (A)

  Energy calculation:

$$E_S = \frac{1}{2} \times (1+3) \times 0.6 \times 8^2 = 76.8\ (J)$$
$$E_M = 3/15^2/\frac{1.53}{2} \times 0.05 = 25.82\ (J)$$
$$E_F = \frac{1}{2} \times 2.5 \times 8 \times 0.05 = 0.5\ (J)$$
$$E_1 = E_S - E_M - E_F = 50.48\ (J)$$

  Because $E_1 > E_C$, a braking resistor is required. The power of the braking resistor is as follows:

$P_b = 2 \times (50.48 - 32.42) / 2 = 18.06\ (W)$

Because $P_b < P_a$ (Processing capacity of the built-in braking resistor), the built-in braking resistor is applicable.

- **External load torque applied, motor in generating state**
  When rotation directions of the motor and shaft are the same, the motor is in the motoring state. In some special applications where the motor torque direction is opposite to the rotating direction, the motor is in generating state, and pumps the electric energy back to the servo drive.

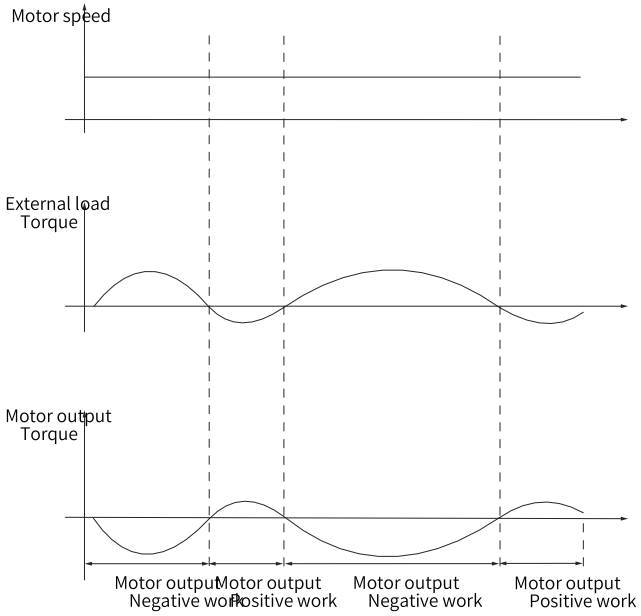


Figure 23-11 Example of the curve with external load torque

24 Certification and Standard Requirements

24.1 CE Certification



Figure 24-1 CE Marking

- The CE mark indicates compliance with the Low Voltage Directive LVD), Electromagnetic Compatibility (EMC), and Restriction of Hazardous Substances (RoHS) directives.
- The CE mark is required for engaging in commercial business (production, importation, and distribution) in Europe.
- The drive complies with LVD, EMC, and RoHS directives and carries the CE mark.
- Machines and devices integrated with this drive must also comply with CE requirements for distribution in Europe.
- The integrator who integrates this drive into other products and attaches CE mark to the final assembly has the responsibility of ensuring compliance with CE certification.

24.1.1 Requirements for Compliance with EMC

The drive is applicable to the first environment and second environment and complies with EMC directive 2014/30/EU and standard EN 61800-3.

As required by EMC Directive 2014/30/EU and standard EN IEC 61800-3, install an EMC filter on the input side of the drive and use shielded cables on the output side. Ensure the filter is grounded properly and the shield of the output cable is grounded 360 degrees.



When applied in the first environment, the drive may generate radio interference. In addition to the CE compliance requirements described in this chapter, take additional measures to prevent radio interference if necessary.

Introduction to EMC standards

Electromagnetic compatibility (EMC) describes the ability of electrical and electronic devices or systems to work properly in the electromagnetic environment without introducing electromagnetic interferences that disturb the operation of other local devices or systems. In other words, EMC includes two aspects: 1) The electromagnetic interference generated by a device during normal operation cannot exceed a certain limit. 2) The device must have sufficient immunity to the electromagnetic interference in the environment.

EN 61800-3 defines the following two types of environments.

- First environment: Environment that includes domestic premises, and establishments directly connected without intermediate transformers to a low-voltage power supply network which supplies buildings used for domestic purposes
- Second environment: Environment that includes all establishments other than those directly connected to a low-voltage power supply network which supplies buildings used for domestic purposes

Devices are divided into the following four categories based on the intended application environment.

- Category C1: a Power drive system (PDS) with the rated voltage less than 1000 V, intended for use in the first environment.
- Category C2 equipment: PDS with rated voltage less than 1000 V, which is neither a plug-in device nor a movable device and, when used in the first environment, is intended to be installed and commissioned only by professionals.
- Category C3 equipment: PDS with rated voltage less than 1000 V, intended for use in the second environment and not intended for use in the first environment.
- Category C4 equipment: PDS with rated voltage equal to or above 1000 V, or rated current equal to or above 400 A, or intended for use in complex systems in the second environment.

24.1.2 Requirements for Compliance with Low Voltage Directive

The drive has been tested in accordance with EN61800-5-1 to determine compliance with LVD. Observe the following requirements to enable machines and devices integrated with this drive to comply with the LVD.

Installation location

Install the drive in a place with overvoltage category III and pollution degree 1 or 2 as specified by EN61800-5-1.

Installation environment

For requirements of the installation environment, see *"5.2.2 Installation Environment" on page 68*.

Installation protection requirements

The drive must be installed in a fireproof cabinet with doors that provide effective electrical and mechanical protection. The installation must conform to local and regional laws and regulations and relevant IEC standards.

IP20-rated drives intended to be installed inside the cabinet must be installed in a structure that prevents intrusion of unwanted objects from the top and the front.

Wiring requirements of the main circuit

For wiring requirements of main circuit terminals, see *"6.3.2 Wiring Precautions and Requirements" on page 92*.

Requirements for protective devices

To comply with EN 61800-5-1 standards, install a fuse/circuit breaker on the input side of the drive to prevent accidents caused by short circuit in the internal circuit.

For recommended fuse models, see *"23.2.2 Fuse (CE)" on page 1421*. For recommended circuit breaker models, see *"23.2.5 Circuit Breaker (CE)" on page 1424*.

24.2 UL/cUL certification



Figure 24-2 UL/cUL mark

The UL/cUL mark commonly applies to products sold in the United States and Canada. Products with UL/cUL mark have been inspected and assessed by the UL organization. To pass UL/cUL certification, main built-in components of electrical products must also be UL certified.

The drive has been tested in accordance with UL 61800-5-1 and CSA C22.2 No.274 to determine compliance with UL/cUL standards. Observe the following requirements to enable machines and devices integrated with this drive to comply with UL/cUL standards.

Installation location

Install the drive in a place with overvoltage category III and pollution degree 1 or 2 as specified by UL61800-5-1.

Ambient temperature

According to the protection level, the ambient temperature must be maintained within the following range:

0°C to 50°C for open-type products

Installation requirements

Installation requirements for open-type drives:

The SV680PS-INT series servo drives are open-type drives that must be installed in a fireproof cabinet with the enclosure that provides effective electrical and mechanical protection. The installation must conform to local laws and regulations and related NEC requirements.

Requirements of main circuit wiring

Warning

On-site installation of output terminals (such as $P_{\oplus}$, C, and $N_{\ominus}$) is not allowed.

- Terminals ($P_{\oplus}$, C, $N_{\ominus}$) are for connecting optional accessories. Do not connect these terminals to an AC power supply.
- To protect the main circuit, separate and cover the surface that may come into contact with the main circuit.
- The control circuit is the internal safety extra-low voltage (SELV) circuit that must be strictly insulated and isolated from other circuits. Make sure that the control circuit is connected to the external SELV circuit.
- Prevent foreign matters from entering the wiring part of the terminal block.
- Do not solder the twisted conductors.
- The tightening torque may vary with terminals. Tighten terminal screws with the specified tightening torque. You can use the torque screwdriver, ratchet, or wrench.
- When using an electric screwdriver to tighten terminal screws, set a low speed to prevent damage to the terminal screws.
- Tighten the terminal screws at an angle lower than 5 degrees. Failure to comply may result in screw damage.

Control Circuit Wiring Requirements

Observe the requirements in UL508 during wiring.

Cable requirements

Cable dimensions must be compliant with requirements in NEC (National Electric Code) and CEC (Canadian Electrical Code) Part I and local regulations.

- Use cables with copper conductors.
- The recommended cables for the main circuit are 600 V class 2 heat-resistant indoor PVC cables that can work under temperature of 75°C continuously. The following conditions are premises for use of the cables.
  - Ambient temperature: < 40°C
  - Normal operating ratings

If the recommended cable specifications for peripheral devices or optional parts exceed the applicable cable specification range, contact Inovance.

Terminal cable selection

To comply with UL61800-5-1 and CSA C22.2 No. 274, power cables used for SV680PS-INT series servo drives must meet the following requirements:

- Compliant with NEC, Table 310-16 of NFPA70, and NFPA79.
- Comprised of copper conductors with a rated temperature not lower than 75°C (167°F)
- Compliant with 14AWG or higher.
- With a rated voltage not lower than the rated voltage of the servo drive
- It is recommended to use cables compliant with UL758 Style 2517 and Style 2586 as motor main circuit cables.

Requirements for protective devices

To comply with UL61800-5-1, install a fuse/circuit breaker on the input side of the drive to prevent accidents caused by short circuit in the internal circuit.

Install sufficient protective devices against short circuit in branch circuits according to applicable regulations and this guide. The drive is applicable to circuits with a rated breaking capacity lower than 5kA and 65 kA and a maximum voltage of 480 VAC (class 400 V).

Note

All breaker protective devices must be UL-certified.

For fuses and circuit breakers for North American markets, see *"23.2.3 Fuse (UL)" on page 1423* and *"23.2.6 Circuit Breaker (UL)" on page 1426*.

24.3 KC Certification



Figure 24-3 KC mark

Drives with the KC mark on their nameplates comply with the electromagnetic compatibility (EMC) directives of ROK.

이 기기는 업무용(A 급) 전자파적합기기로서 판매자 또는사용자는 이 점을 주의하시기 바라며, 가정외의 지역에서 사용하는 것을 목적으로 합니다.

For sellers or other users, please bear in mind that this device is an A-grade electromagnetic wave device.

This device is intended to be used in areas other than at home.

24.4 UKCA Certification



Products exported to The UK must have the UKCA mark on their nameplates. Currently, the CE mark is still acceptable by the UK.

24.5 Functional Safety Certification



EC directives and standards

EMC Directive 2014/30/EU Standard EN 61800-3: 2018

Machinery Directive 2006/42/EC (Safety Functions) Standard IEC 61800-5-2

25 Appendix

25.1 DI/DO Function Assignment

No.	Name	Function name	Description	Remarks
Description of DI signals				
FunIN.1	S-ON	Servo ON	Disabled: Servo motor disabled Enabled: Servo motor enabled	The corresponding terminal logic must be level-triggered. 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, and then use this function. The servo drive may, depending on the alarm type, continue operating after reset.
FunIN.3	GAIN-SEL	Gain switchover switch	• When H08.08 = 0: • Inactive: Speed control loop being PI control • Active: Speed control loop being P control • When H08.08=1 and H08.09=1: • Inactive: Fixed at 1st gain • Active: Fixed at 2nd gain	The corresponding terminal logic is recommended to be level-triggered.
FunIN.4	CMD-SEL	Main/Auxiliary reference switchover	Inactive: Current reference being A Active: Current running reference being B	The corresponding terminal logic is recommended to be level-triggered.
FunIN.5	DIR-SEL	Multi-reference direction	Inactive: Reference direction by default Active: Reverse reference direction	The corresponding terminal logic is recommended to be level-triggered.
FunIN.6	CMD1	Multi-reference switchover CMD1	Selects one from the 16 references.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.7	CMD2	Multi-reference switchover CMD2	Selects one from the 16 references.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.8	CMD3	Multi-reference switchover CMD3	Selects one from the 16 references.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.9	CMD4	Multi-reference switchover CMD4	Selects one from the 16 references.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.10	M1-SEL	Mode switchover M1-SEL	Perform switchover between speed control, position control, and torque control based on the selected control mode (values 3, 4, 5 of H02-00).	The corresponding terminal logic is recommended to be level-triggered.

No.	Name	Function name	Description	Remarks
FunIN.11	M2-SEL	Mode switchover M2-SEL	Perform switchover between speed control, position control, and torque control based on the selected control mode (value 6 of H02-00).	The corresponding terminal logic is recommended to be level-triggered.
FunIN.12	ZCLAMP	Zero clamp enabling signal	Active: Zero clamp enabled Inactive: Zero clamp disabled	The corresponding terminal logic is recommended to be level-triggered. • When H06.15 is set to a value larger than 100, zero clamp is executed when the speed falls below H06.15. Operation will be re-triggered only when the speed reference exceeds the sum of H06.15 + 20 rpm. • When H06.15 is set to a value smaller than 100, zero clamp is executed when the speed is lower than H06.15. Operation will be re-triggered only when the speed reference is greater than the sum of H06.15 + 10 rpm.
FunIN.13	INHIBIT	Position reference inhibited	Active: Pulse reference input inhibited Inactive: Pulse reference input allowed	The function is upgraded from pulse inhibited to position reference inhibited. Position references include internal and external position references. The corresponding terminal logic must be level-triggered.
FunIN.14	P-OT	Positive limit switch	Enabled: Forward drive inhibited Disabled: Forward drive allowed	When the mechanical movement is beyond the movable range, the overtravel prevention function will be activated. It is recommended to set the logic of the corresponding terminal to level valid.
FunIN.15	N-OT	Negative limit switch	When the mechanical movement is outside the allowed range, the overtravel prevention function is activated: 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). When H07.07 = 1: Active: The positive external torque limit is enabled. Inactive: The positive internal torque limit is enabled.	The corresponding terminal logic is recommended to be level-triggered.

No.	Name	Function name	Description	Remarks
FunIN.17	N-CL	Negative external torque limit	The torque limit source is switched based on H07.07 (Torque limit source). When H07.07 = 1: Active: The negative external torque limit is enabled. Inactive: The negative internal torque limit is enabled.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.18	JOGCMD+	Forward jog	Active: Input according to the command. Inactive: Reference 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: Reference input stopped.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.20	POSSTEP	Step reference	Active: Execute the step reference. Inactive: Reference being zero, in positioning state.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.21	HX1	Handwheel multiplying factor signal 1	HX1 active, HX2 inactive: X10. HX1 inactive, HX2 active: X100 Other: X1.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.22	HX2	Handwheel multiplying factor signal 2		
FunIN.23	HX_EN	Handwheel enable signal	Inactive: Execute position control as defined by H05-00. Active: Receive pulse signal from the handwheel for position control in position control mode	The corresponding terminal logic is recommended to be level-triggered.
FunIN.24	GEAR_SEL	Electronic gear ratio switchover	Inactive: Electronic gear ratio 1 Active: Electronic gear ratio 2	The corresponding terminal logic is recommended to be level-triggered.
FunIN.25	TOQDirSel	Torque reference direction	Inactive: Forward direction. Active: Reverse direction.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.26	SPDDirSel	Speed reference direction	Inactive: Forward direction. Active: Reverse direction.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.27	POSDirSel	Position reference direction	Inactive: Actual position reference direction same as the set direction. Active: Actual position reference direction opposite to the set direction.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.28	PosInSen	Multi-position reference signal enable	Inactive: Internal multi-reference ignored. Active: Internal multi-position enabled.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.29	XintFree	Interruption fixed length cleared	Inactive: Disabled Active: Enabled	-

No.	Name	Function name	Description	Remarks
FunIN.31	HomeSwitch	Home switch	Inactive: Not triggered. Active: 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 triggered), the servo drive forcibly changes it to 1 (high level triggered). If the logic is set to 3 (falling edge triggered), the servo drive forcibly changes it to 0 (low level triggered). If the logic is set to 4 (both rising edge and falling edge triggered), the servo drive forcibly changes it to 0 (low level triggered).
FunIN.32	HomingStart	Home return	Inactive: Disabled Active: Enabled	-
FunIN.33	XintInhibit	Interrupt positioning inhibited	Active: Interrupt positioning inhibited. Inactive: Interruption fixed length allowed	The corresponding terminal logic must be level-triggered. • If the logic is set to 2 (rising edge active), the servo drive forcibly changes it to 1 (active high). • If the logic is set to 3 (falling edge triggered), the servo drive forcibly changes it to 0 (low level triggered). • If the logic is set to 4 (both rising edge and falling edge triggered), the servo drive forcibly changes it to 0 (low level triggered).
FunIN.34	Emergence Stop	Emergency stop	Enabled: Position lock is applied after stop at zero speed. Disabled: Current running state unaffected.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.35	ClrPosErr	Position deviation cleared	Enabled: Position deviation cleared. Disabled: Not cleared.	It is recommended that this function be allocated to DI8 or DI9.
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.37	PulseInhibit	Pulse reference inhibited	The position reference source is pulse reference (H05.00 = 0) in position control mode: Inactive: Respond to pulse reference. Active: Not respond to pulse references	The corresponding terminal logic is recommended to be level-triggered.
FunIN.38	TouchProbe1	Touch probe 1	Disabled: Touch probe is not triggered. Enabled: Touch probe is triggerable.	The touch probe logic is only related to the touch probe function (60B8h).

No.	Name	Function name	Description	Remarks
FunIN.39	TouchProbe2	Touch probe 2	Disabled: Touch probe is not triggered. Enabled: Touch probe is triggerable.	The touch probe logic is only related to the touch probe function (60B8h).
FunIN.40	Multi-speed	Multi-speed	Inactive: Internal multi-speed reference ignored. Active: Internal multi-speed reference enabled.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.41	HomeRecord	Current position as the home	Inactive: Not triggered. Active: Triggered.	The corresponding terminal logic is recommended to be level-triggered.
FunIN.42	MultiBlockTrig	Axis control command executed immediately	Inactive: Axis control command not executed. Active: Axis control command immediately executed.	-
FunIN.43	MultiBlockWr	Axis control command not executed immediately	Inactive: Axis control command not executed. Active: Axis control command executed (not immediately).	-
FunIN.44	ClrCmdOkAndArrOk	Positioning and reference completed signal clear	Inactive: No action. Active: Cleared.	-
FunIN.45	XintEn	Interruption fixed length	Invalid: Interruption fixed length disabled. Active: Interrupt positioning enabled.	-
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.
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.

No.	Name	Function name	Description	Remarks
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: Pause the process segment.	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 clear	Inactive: Disabled Active: Enabled	-
FunIN.59	GantrySyncEnable	Gantry synchronization	Inactive: Disabled Active: Enabled	-
Description of DO signals				
FunOUT.1	S-RDY	Ready to switch on	The servo drive is ready to receive the S-ON signal: Active: The servo drive is not ready to switch on . Active: The servo drive is ready.	-
FunOUT.2	TGON	Motor rotation signal	Inactive: The absolute value of filtered motor speed is lower than the setpoint of H06.16. Active: The absolute value of filtered motor speed reaches the setpoint of H06.16.	-
FunOUT.3	ZERO	Zero speed signal	Inactive: The difference between motor speed feedback and reference value is larger than H06.19 (Threshold of zero speed output signal). Active: The difference between the motor speed feedback and the reference value is within the threshold defined by H06.19.	-

No.	Name	Function name	Description	Remarks
FunOUT.4	V-CMP	Speed consistency signal	In speed control mode, when the absolute value of the deviation between the motor rotational speed and the speed reference is smaller than the value of H06.17, this signal is valid.	-
FunOUT.5	COIN	Positioning completed	Inactive: Positioning not completed Active: Positioning completed	-
FunOUT.6	NEAR	Positioning almost completed	Inactive: The positioning deviation is excessive. Active: The positioning deviation is slight.	-
FunOUT.7	C-LT	Torque limited signal	Torque limit acknowledge signal: Active: Motor torque limited. Inactive: Motor torque not limited.	-
FunOUT.8	V-LT	Speed limited signal	Speed limit acknowledge signal in torque control mode: Active: Motor rotational speed limited. Invalid: Motor rotational speed not limited.	-
FunOUT.9	BK	Brake output signal	Active: The drive outputs the brake signal. Inactive: The drive does not output the brake signal.	-
FunOUT.10	WARN	Alarm	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	Active: Fault occurred on the servo drive. Inactive: No fault occurred on the servo drive or the fault has been reset.	-
FunOUT.15	Xintcoin	Interrupt positioning completed	Active: Interrupt positioning completed. Inactive: Interrupt positioning not completed.	-
FunOUT.16	HomeAttain	Home find	Homing status: Active: Homing is completed in position control status. Inactive: Homing not completed.	-

No.	Name	Function name	Description	Remarks
FunOUT.17	ElecHomeAttain	Electrical homing completed	Electrical homing status: Active: Electrical homing completed. Inactive: Electrical homing not completed.	-
FunOUT.18	ToqReach	Torque reached signal	Active: The absolute value of torque reference reaches the reference value. Inactive: The absolute value of torque reference is lower than the reference value.	-
FunOUT.19	V-Arr	Speed reached signal	Valid: Speed feedback reaches the set value. Invalid: Speed feedback smaller than the set value.	-
FunOUT.21	SrvOn	Enable operation completion	Valid: Operation enabled. Invalid: Operation not enabled.	-
FunOUT.22	CmdOk	Internal command completed	Inactive: Internal command transmission not completed. Active: Internal command transmission completed.	-
FunOUT.23	WrNextBlockEn	Write next command	Active: Writing the next segment allowed. Inactive: Writing the next segment inhibited.	-
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 drive does not pass the target position compare point. Active: The drive passes the target position compare 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.

No.	Name	Function name	Description	Remarks
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.
FunOUT.30	WARN OR ALM	Alarm or fault output	Active: An alarm or a fault occurred. Inactive: No alarm or fault.	-
FunOUT.31	Communication-forced DO		See *"Table 25-1 Communication-forced DO" on page 1460* .	-
FunOUT.32	EDM	EDM output	Active: STO triggered by the servo drive. Active: STO not triggered by the servo drive.	The EDM outputs active signals only when the 24 V input voltages for STO1 and STO2 are disconnected simultaneously.
FunOUT.33	GantryAlignStatus	Gantry alignment	Inactive: Alignment not done. Active: Alignment done.	-

Table 25–1 Communication-forced DO

Type	Data	Description
bit0	0	DO1 status unchanged.
	1	No output from DO1.
bit1	0	DO2 status unchanged.
	1	No output from DO2.
bit2	0	DO3 status unchanged.
	1	No output in DO3.
bit3	0	DO4 status unchanged.
	1	No output from DO4.
bit4	0	DO5 status unchanged.
	1	No output from DO5.

25.2 DIDO Function Assignment [safety parameter configuration]

This section introduces the configuration of DI and DO functions of the safety module. You need to operate on the safety parameter interface of InoDriverShop. The initial password is "111111".

Table 25–2 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

Value	Name	Function Name	Description
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
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 25–3 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

Value	Name	Function Name	Description
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

25.3 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.

PS00021321B00

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