MiSUMi

AC Servo driver
E-DHASxxE Series (EtherCAT Type)

User Manual

Ver1.0

Table of Contents

Preface 6

Safety precautions 7

Warranty Terms 10

Chapter 1 Overview 11

1.1 Product Introduction 11
1.2 Incoming Inspection 11
1.3 Model Number Structure 12
1.3.1 Servo driver .... **Error! Bookmark not defined.**
1.3.2 Servo Motor 12
1.4 Component Description 13
1.4.1 Servo driver Ports and Connectors 13
1.4.2 Motor Ports And Connectors 15
1.5 Servo driver Technical Specifications 15
1.5.1 Electrical Parameters 15
1.5.2 General specifications 16
1.6 Motor General Specifications 18
1.6.1 Mechanical Characteristic Specifications 18
1.6.2 Electrical Specifications of Motor's Brake 19
1.6.3 Load moment of inertia 19
1.7 Motor Specifications 19
1.8 Motor E-MASH2 Series 20

Chapter 2 Installation & Wiring 23

2.1 Servo driver Installation 23
2.1.1 Installation Site 23
2.1.2 Installation Environment 23
2.1.3 Servo driver Dimension 24
2.2 Servo Motor Installation 26
2.2.1 Installation Location 26
2.2.2 Installation Environment 26
2.2.3 Motor Dimensions 27
2.2.4 Installation Method and Precautions 29

Chapter 3 Wiring 30

3.1 E-DHASxxE Wiring Diagram 30
3.2 Electrical Wiring Diagram 31
3.3 Servo driver Ports 32
3.4 X1 Main/Control Circuit Power Supply 33
3.4.1 Main Power Supply Cable Selection 34
3.4.2 Single/Three phase power supply wiring diagram 35
3.5 X2 Motor Power Supply 36
3.5.1 Motor Power Cable Selection (Port X2) 36
3.6 X3 Holding Brake 38
3.6.1 Holding brake wiring diagram 39
3.7 CN1 I/O Signal 40
3.7.1 CN1 signal cable selection 40
3.8 CN2 Motor Encoder 41
3.8.1 CN2 Motor Encoder Cable And Connector Selection 42
3.9 CN3/CN4 – EtherCAT Communication Port 44
3.10 CN5 Gantry Communication Port 45
3.11 CN6 Safe Torque Off (STO) Port 45
3.12 CN7 2nd Encoder (External) 48
3.13 Analog and Z-phase open collector output CN8 49
3.14 USB Type-C Tuning Port 50
3.15 Regenerative resistor selection and connections 51
3.16 I/O Signal 53
3.16.1 Analog input signal 53
3.16.2 Common digital input 53
3.16.3 Common digital output 54
3.16.4 Probe input 55
3.16.5 Encoder crossover frequency output 55

3.16.6 Digital Input Signal Settings 55
3.16.7 Digital Output Signal Settings 56
3.17 Measures against electromagnetic interference 61
3.17.1 Grounding connection and other anti-interference wiring connections 61
3.17.2 Using line filter 61

Chapter 4 Servo driver Operation 63

4.1 Front Panel 63
4.1.1 Front Panel Structure 63
4.1.2 Panel Operation Flow 64
4.1.3 Front Panel Locking 65
4.1.4 Data Monitoring Mode 65
4.1.5 Parameters saving 76
4.1.6 Auxiliary function 77
4.1.7 Front panel warning indicator 82
4.2 Tuning Software 83
4.3 Electronic gear ratio 83
4.4 Get Started with Driver Operation 85
4.4.1 Checklist before operation 85
4.4.2 Power On 85
4.4.3 Trial Run 85
4.4.4 Motor rotational direction settings 86
4.5.3 Fron Panel Trial Run 87
4.4.5 Trial Run Using Debugging Software 87

Chapter 5 Parameter 94

5.1 Parameter List 94
5.1.1 Servo driver parameter 94
5.1.2 Object dictionary (5000h)- Manufacturer parameter 94
5.1.3 Object dictionary(6000h)-Motion parameter 96
5.2 Details of parameter 100
5.2.1 [Class 0] Basic Settings 100
5.2.2 [Class 1] Gain Adjustments 108
5.2.3 [Class 2] Vibration Suppression 116
5.2.4 [Class 3] Velocity Control 124
5.2.5 [Class 4] I/O Interface Setting 126
5.2.6 [Class 5] Extension settings 135
5.2.7 [Class 6] Other settings 141
5.2.8 [Class 7] Factory settings 145
5.2.9 ［Class C］ Position Comparison 146
5.2.10 [Class D] Gantry Settings 149
5.2.11 [Class 11] Driver parameters 151
5.3 402 Observer 153

Chapter 6 Adjustment and Application 170

6.1 Gain Adjustment 170
6.2 Inertia ratio identification 172
6.2.1 Online inertia determination 172
6.2.2 Offline inertia determination 173
6.3 Easy Tuning 177
6.3.1 One-click Tuning 177
6.3.2 Single Parameter Tuning 184
6.4 Auto gain adjustment (rigidity level selection) 193
6.4.1 Overview 193
6.4.2 How to operate 194
6.5 Manual gain adjustment (Basic) 198
6.5.1 Overview 198
6.5.2 Parameters adjustment under different control modes 201
6.5.3 Gain switching 202
6.6 Manual Gain Adjustment Function (Application) 207
6.6.1 Model following control (MFC) 207
6.6.2 Zero tracking control 208
6.6.3 Feedforward gain 210
6.6.4 3rd Gain Switching 211
6.6.5 Friction compensation function 213
6.7 Vibration Suppression 214

6.7.1 Mechanical resonance suppression 214
6.7.2 End vibration suppression 216
6.7.3 Mechanical properties analysis 217
6.8 Multiturn absolute encoder 217
6.8.1 Parameters setting 218
6.8.2 Read absolute position 218
6.8.3 Absolute Encoder Related Alarm 222
6.8.4 Battery kit 223
6.9 Probe 223
6.9.1 Probe function 225
6.9.2 Related Objects 225
6.9.3 Signal Input of EXT1 and EXT2 226
6.9.4 Probe Control Word 60B8h 226
6.9.5 Probe Status Word 60B9h 226
6.9.6 Latch Position Register 226
6.9.7 Latch Counter Register 227
6.9.8 Probe operation 227
6.9.9 Probe mode 227
6.10 Safety Functions 228
6.10.1 Velocity limit function 228
6.10.2 Servo stop mode 228
6.10.3 Max. time to stop after disabling 229
6.10.4 External brake deactivation output signal BRK-OFF 230
6.10.5 Emergency stop function 231
6.11 Position comparison 232
6.12 Full closed loop control 238
6.13 Black box 239
6.14 Gantry Function Application 242
6.14.1 Function Overview 242
6.14.2 Related parameters 244
6.14.3 Implementation steps 245
6.14.4 Precautions 248

Chapter 7 EtherCAT communication 249

7.1 EtherCAT principle function 249
7.2 Synchronous Mode 250
7.2.1 Free Running Mode 250
7.2.2 Distributed clock synchronization mode 250
7.3 EtherCAT state machine 250
7.4 CANopen over EtherCAT (CoE) 252
7.4.1 Network structure of E-DHASxx E 252
7.4.2 Object dictionary 253
7.4.3 Service Data Object (SDO) 253
7.4.4 Process Data Object (PDO) 253
7.5 Network status display 256

Chapter 8 Control Mode 257

8.1 E-DHASxxE Series Servo System Motion Control Instructions 257
8.2 CIA402 State Machine 258
8.3 Driver Control Mode Setting 260
8.3.1 Supported control mode (6502h) 260
8.3.2 Operational mode setting (6060h) and Operational mode display (6061h) 260
8.4 Common Functions for All Modes 261
8.4.1 Digital input/ output setting and status display 261
8.4.2 Motor Rotational Direction 261
8.4.3 Stop Settings 261
8.4.4 Position mode – Electronic Gear 262
8.4.5 Position Limits 263
8.4.6 CiA DSP402 Control Word 264
8.4.7 Status Word 264
8.4.8 Synchronous cycle time setting 265
8.4.9 Driver Enabling 265
8.5 Position Mode（CSP、PP、HM） 266
8.5.1 Common Functions of Position Mode 266
8.5.2 Cyclic Synchronous Position Mode (CSP) 267
8.5.3 Protocol Position Mode (PP) 268

8.5.4 Homing mode (HM) 271
8.6 Velocity Control Mode（CSV、PV） 294
8.6.1 Common Functions of Velocity Control 294
8.6.2 Cyclic Synchronous Velocity Mode (CSV) 295
8.6.3 Profile Velocity Mode (PV) 296
8.7 Torque Mode（CST、PT） 297
8.7.1 Common Functions of Torque Mode 297
8.7.2 Cyclic Synchronous Torque Mode (CST) 298
8.7.3 Profile Torque Mode (PT) 298
Chapter 9 Timing Chart 300
9.1 Servo Enabled 300
9.2 Servo Stop 301
Chapter 10 Warning and Alarm 315
10.1 Servo driver warning 315
10.2 Servo driver alarm 315
10.3 Alarm Handling 322
10.4 EtherCAT Communication Alarm 337
10.4.1 Network failure 337
10.5 Alarm clearing 347
10.5.1 Servo driver Alarm 347
10.5.2 Communication alarm clear 347
Chapter 11 Peripheral Devices 348
11.1 Peripheral Device Overview Table 348
11.2 Fuses, Contactors, and Circuit Breakers 348
11.2.1 Fuses 348
11.2.2 Electromagnetic Contactors 348
11.2.3 Circuit Breakers 349
11.2.4 AC Input Reactor 349
11.2.5 EMC Filter 349
11.2.6 Magnetic Rings and Clamps 349

Preface

Thank you for purchasing the E-DHASxxE Series AC Servo driver.
This series features dynamic braking, built-in brake output (no external relay required), and optional STO, gantry sync, and full closed-loop control. It is ideal for automation in industries like semiconductors, lithium batteries, photovoltaics, electronics, and machine tools—delivering high-performance solutions for improved efficiency.
This manual covers essential usage instructions, installation, basic setup, maintenance, and parameter details.
First-time users should read carefully. For any questions, please contact our technical support team.
Thank you for choosing us!

How to Obtain the Manual
This manual is not included with the product shipment.
To obtain the PDF electronic version, please visit the official MISUMI website:
Vietnam: https://vn.misumi-ec.com
Thailand: https://th.misumi-ec.com
Malaysia: https://my.misumi-ec.com
India: https://in.misumi-ec.com
Singapore: https://sg.misumi-ec.com
Indonesia: https://id.misumi-ec.com
and download it from the corresponding product series page.

Caution!
Improper operation may cause unexpected accidents. Please read this manual carefully before using the system.
Due to product improvements, the contents of this manual are subject to change without prior notice.
Our factory will not be responsible for any changes made by the user to the product, and the product warranty will be invalidated.

Caution: This equipment is not intended for use in residential environments and may not provide adequate protection to radio reception in such environments.

Safety precautions

In order to prevent personal injury and property damage, the following statements are made for matters that must be followed. When reading this manual, please pay special attention to the following warning signs:

⚠Warning: “Warning” Incorrect operation may cause death or serious injury.
⚠Caution: “Caution” Incorrect operation may cause injury or equipment damage.
⚠Notice: “Notice” Improper use may damage the product or equipment.

Safety Rules
⚠Warning This product is not intended for safety-critical machinery or systems. Users must implement proper safety measures to prevent accidents.
Inspection
⚠Caution Do not install if the product or accessories are damaged or rusted upon unpacking. Do not install if there is water inside, missing parts, or damaged components. Check the packing list carefully; do not install if it does not match the product.
⚠Notice Do not forcibly remove packaging or handle roughly to avoid damage to components. Do not use damaged or faulty products.
Storage and Transportation
⚠Caution Store and transport the product according to specified environmental conditions. Do not stack too high to prevent falls. Ensure proper packaging during transit. Do not drag cables, motor shafts, or encoders when handling servo motors. Avoid applying external force or impacts to servo drivers and motors.
⚠Notice Handle the product with care, lift and place gently, and watch your footing to prevent trips or drops, which may cause injury or damage. During storage or transport, avoid direct contact with terminals or drive circuits without electrostatic protection to prevent damage. Avoid storing or transporting in places exposed to water, rain, direct sunlight, strong electric or magnetic fields, or severe vibration. Do not store the product for more than 3 months; if stored longer, apply stricter protection and inspections. Do not mix-pack this product with items that could affect or damage it during transport.
Installation
⚠Warning Only trained professionals with electrical knowledge are allowed to operate. Operation by unqualified personnel is strictly prohibited

⚠Caution

Servo driver and Servo Motor:
Do not install on or near flammable materials to prevent fire.
Avoid vibration and strictly prohibit impacts.
Do not install if the unit is damaged or has missing parts.
Discharge static electricity before operating buttons or switches on the drive, or equipment damage may occur.

Servo driver:
Must be installed inside a control cabinet with sufficient protection rating.
Maintain adequate clearance from other devices.
Ensure proper heat dissipation. If installed in a sealed environment, use cooling devices (fans or air conditioners) to meet environmental requirements, or overheating/fire may result.
Prevent the entry of dust, corrosive gases, conductive materials, liquids, and flammable or explosive substances.

Servo Motor：
Must be mounted securely to prevent loosening due to vibration.
Prevent liquid ingress to avoid motor or encoder damage.
Do not strike the motor or shaft to avoid encoder damage.
The motor shaft must not be subjected to loads beyond its rated limits.

Wiring

⚠Caution

Only qualified personnel may perform wiring or inspection.
Wait at least 10 minutes after power-off before starting.
Properly ground the servo driver and motor to avoid electric shock.
Incorrect voltage or polarity may cause accidents or explosions.
Connect wires only after installation is complete.
Ensure wire insulation and avoid pinching to prevent shock.
Never wire, open covers, or touch circuits with power on.

⚠Caution

Wiring must be correct and secure to avoid malfunction or damage
Do not reverse U/V/W motor terminals or connect to AC power
Connect motor directly to the servo driver—no capacitors, inductors, or filters
Prevent conductive parts or wire ends from entering the drive
Keep wires and heat-sensitive parts away from heatsinks and motors
Do not reverse the flyback diode on output signal relays
Use cables with proper gauge and shielding; ground shield at one end
Follow ESD precautions and wear an anti-static wrist strap
For control circuits, use twisted shielded wire and ground the shield to the terminal

Power-On

⚠Warning

Before power-on, ensure proper installation and secure wiring of control, main power, and motor output circuits.
Do not touch any terminals while the product is powered on.

Debugging Operation

⚠Caution

Before power-on, confirm proper installation, secure wiring, and correct power within rating.
During setup, run motor unloaded first; verify settings before load testing to avoid damage.

Usage

⚠Caution An emergency stop circuit must be installed to immediately stop operation and cut power in case of an accident. Before resetting an alarm, ensure the run signal is off to prevent sudden restart. Use the servo driver only with the specified servo motor. Avoid frequently turning the servo system power on and off to prevent damage. The servo driver and motor may become hot during and shortly after operation; do not touch the heatsink or motor. Do not modify the servo system.
Troubleshooting
⚠Caution High voltage may remain in the servo driver for some time after power off; do not disconnect wires or touch terminals within 5 minutes. Only qualified personnel with proper knowledge should perform disassembly and maintenance.
⚠Caution After an alarm, troubleshoot and clear the cause, then reset the alarm before restarting. Keep away from the machine when power returns after a blackout, as it may start unexpectedly (the design should prevent hazards on restart).
System Matching
⚠Notice The servo motor's rated torque must exceed the effective continuous load torque. The load inertia to servo motor inertia ratio should be below the recommended value. The servo driver and motor must be used as a matched pair.

Other Notes **Dynamic brake**

- The dynamic brake should only be used for emergency stops during faults or sudden power loss. Do not trigger faults or power loss frequently.
- At high speeds, ensure the dynamic brake has at least a 5-minute interval between activations to prevent damage to the internal brake circuit.
- In rotating machinery, after dynamic braking stops the motor, the motor may be driven by the load on the shaft and act as a generator. Continuous external rotation for a long time can cause short-circuit current in the dynamic brake, potentially leading to smoke, fire, or motor damage.

Safety Signs To ensure safe operation, always follow the safety signs on the equipment.
The safety signs are explained as follows:

Warranty Terms

For products purchased from MISUMI (the "Company") via official product catalogs or MISUMI's official websites (including all global/regional domains, affiliated platforms, apps, and mini-programs—collectively, the "Official Website"), the warranty is governed by the usage guidelines and warranty terms stated on the Official Website or in the catalogs ("Warranty Terms").
These Warranty Terms do not apply to custom-made products. Placing an order or using a product implies acceptance of the Warranty Terms.
If the product includes a manufacturer's warranty, that warranty shall take precedence over these Warranty Terms.
Warranty Scope and Period
The warranty covers defects such as damage, deformation, or faults (collectively "defects") attributable to the Company. The customer must document and notify the Company in writing within the warranty period (defined below). If the Company confirms the defect is its responsibility, it will repair or replace the defective product partially or fully at no cost.
However, if any of the following conditions apply, or if the Company's website or product catalog states that repair or replacement is not authorized, the warranty will not apply.

1) Defects from use outside general industrial applications, excluding transport vehicles, medical devices, and household electronics.
2) Defects from use in aerospace, nuclear, military, or weapons applications.
3) Defects caused by customer's careless or incorrect handling.
4) Defects caused by natural disasters (e.g., earthquakes, floods, fires).
5) Defects from not following specifications, usage instructions, or related documents on the website or catalog.
6) Defects caused by customer's modification, repair, or disassembly.
7) Defects caused by other equipment.
8) Defects from use outside purchased Misumi Subsidiary and the areas it handles.
9) Defects due to inexperience or use beyond intended purpose or method.
10) Defects caused by customer violating usage rules or contracts.
11) Defects discovered or occurring after resale to third parties.
12) Other cases where repair or replacement is not accepted as stated on the website or catalog.

The warranty period for this product is one year from the date of shipment by the Company.
Minor scratches, stains, dents, or discoloration that do not affect use are not considered defects. However, if these are deemed severe by the Company, they will be treated as defects.
Customers must verify the product name, model, quantity, and condition within one week of receipt, and check against specifications on the website or catalog. Any defects must be reported in writing to MISUMI Customer Service within this period. If no notification is received, the product is considered accepted and free of defects.
Repairs or replacements after the warranty period or outside the warranty scope will be charged.
Depending on the product's nature, production date, or specifications, repairs or replacements may not be possible
Disclaimer
Except as required by usage rules or product quality laws, the Company is not liable for any damages, losses, or costs caused by product defects, including defects in products made with it, recalls, or production stoppages.
If the customer violates usage precautions, they lose all rights to compensation from the Company.
Compensation for damages caused by product defects is limited to the purchase price of the damaged product.
Orders will not be accepted without the customer's agreement to this limit.
If the Company is not the manufacturer as defined by product quality laws, the customer may seek liability directly from the actual manufacturer.
For damages caused by or related to the following reasons, the customer has no right to claim any compensation or reimbursement from the Company:

1) Damages caused by using defective products or resulting production line stoppages.
2) Damages caused by violating usage rules, product catalogs, or warranty terms.
3) Damages resulting from the customer's intentional or negligent actions.
4) Damages caused by force majeure events beyond control.
5) Damages arising from intellectual property disputes related to product use.
6) Damages caused by export delays or prohibitions due to laws or regulations.
7) Losses resulting from defects found after the product is resold to third parties.

Precautions
Repairs or replacements must be done by returning the product; no on-site service.
Product discontinuation may prevent replacement with the same item.
The Company may update warranty terms; continued orders mean acceptance.

Chapter 1 Overview

1.1 Product Introduction

AC servo technology has matured since its development in the early 1990s, with continuously improving performance. It is now widely used in automation fields such as CNC machine tools, printing and packaging machines, textile machinery, and automated production lines.
The E-DHASxxE series covers a power range from 100W to 1000W and supports EtherCAT communication protocol and works with the corresponding communication interface. It enables multi-axis servo driver networking with upper controllers (including PLCs or control systems).
Additionally, the E-DHASxxE series features the latest auto-tuning capabilities, including stiffness level setting, inertia identification, black box function, and vibration suppression—making the servo driver easy to operate and debug.
Paired with the high-response E-MAS□2 servo motors (equipped with 23-bit multi-turn absolute encoders), the system ensures stable and reliable performance. It also supports full closed-loop control and super tracking functions, offering more complete and powerful functionality.
Key advantages of E-DHASxxE series:

- Wide speed range and constant torque:
- Speed ratio up to 1:5000, with stable torque from low to high speed.
- High speed and precision:
- Max motor speed up to 7000 rpm; supports 26-bit multi-turn absolute encoders.
- Simple and flexible control:
- Operating modes and performance can be adjusted via parameters to suit different needs.

Note
Maximum speed varies by motor model

1.2 Incoming Inspection

Upon receipt, the following inspections must be performed:

- The packaging box is intact, and the goods are not damaged during transportation.
- Verify the nameplates on the servo driver and servo motor to ensure the received goods match the order.
- Check the packing list to confirm all accessories are included.

Note:

- Do not install any servo system that is damaged or has missing parts.
- The servo driver must be used with a servo motor of matching specifications.
- If you have any questions after receiving the goods, please contact the supplier or our company.

List of Accessories

Driver Model	Accessory Name	Part number	Qty
100W~1kW	9-PIN Main Power Connector (X1 terminal) + Insertion Tool	11601072	1
	4-PIN Motor Power Connector (X2 terminal)	11601070	1
	2-PIN Brake Connector (X3 terminal)	11601071	1
	SCSI 26-PIN Connector (CN1 terminal)	11601050	1
	STO Connector (CN6 terminal)	94500580	1
	Frequency Division Terminal Connector	11601430	1
	Frequency Division Terminal Pin	11601404	6
	1394 6-PIN Connector (CN2 terminal)	11600961	1
	1394 10-PIN Connector (Full-featured version)	11601056	1

Note: The debugging software for the E-DHASxxE series must be obtained separately by contacting Misumi or downloading it from the official MISUMI website.

1.3 Model Number Structure

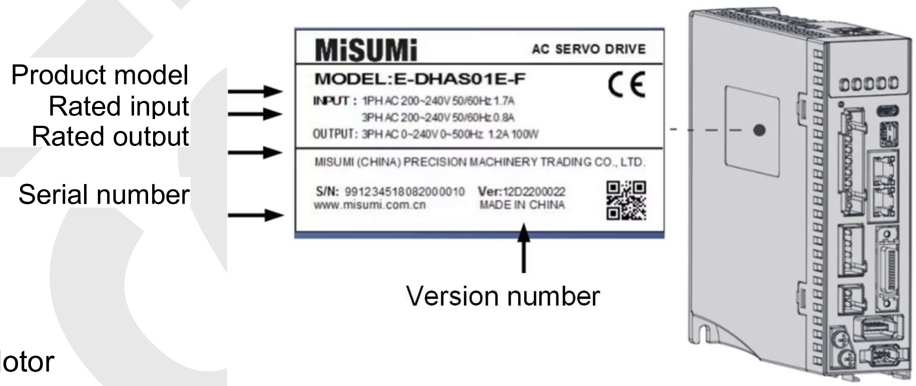
1.3.1 Servo driver

E-DHAS 01 E - F □

① ② ③ ④ ⑤

① **Product Series** E-DHAS: High-end AC Servo driver	② **Power Rating (W)** 01：100W 04：400W 08：750W 10：1000W	③ **Product Type** P: Pulse Train + RS485 E: EtherCAT
④ **Design Version** F: Full-feature version		⑤ **Voltage Level (V)** Blank: 220V

Driver Label



1.3.2 Servo Motor

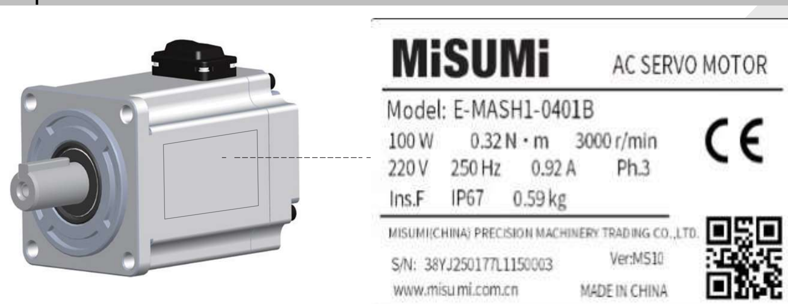
E-MAS Series Servo Motor Model Identification

E-MAS H 2 - 04 01 □ B □

① ② ③ ④ ⑤ ⑥ ⑦ ⑧

① Product Category E-MAS: MISUMI E-MAS series Servo Motor	④ Frame Size (mm) 04: 40mm 06: 60mm 08: 80mm	⑦ Brake Type Blank: No brake B: With brake
② Inertia Type S: Low Inertia H: High Inertia	⑤ Power Rating (W) 01：100W 02：200W 04：400W 08：750W 10：1000W	⑧ Connector Type Blank: Straight plug
③ Product Series 2: General type, 23-bit encoder	⑥ Voltage Level (V) Blank: 220V	

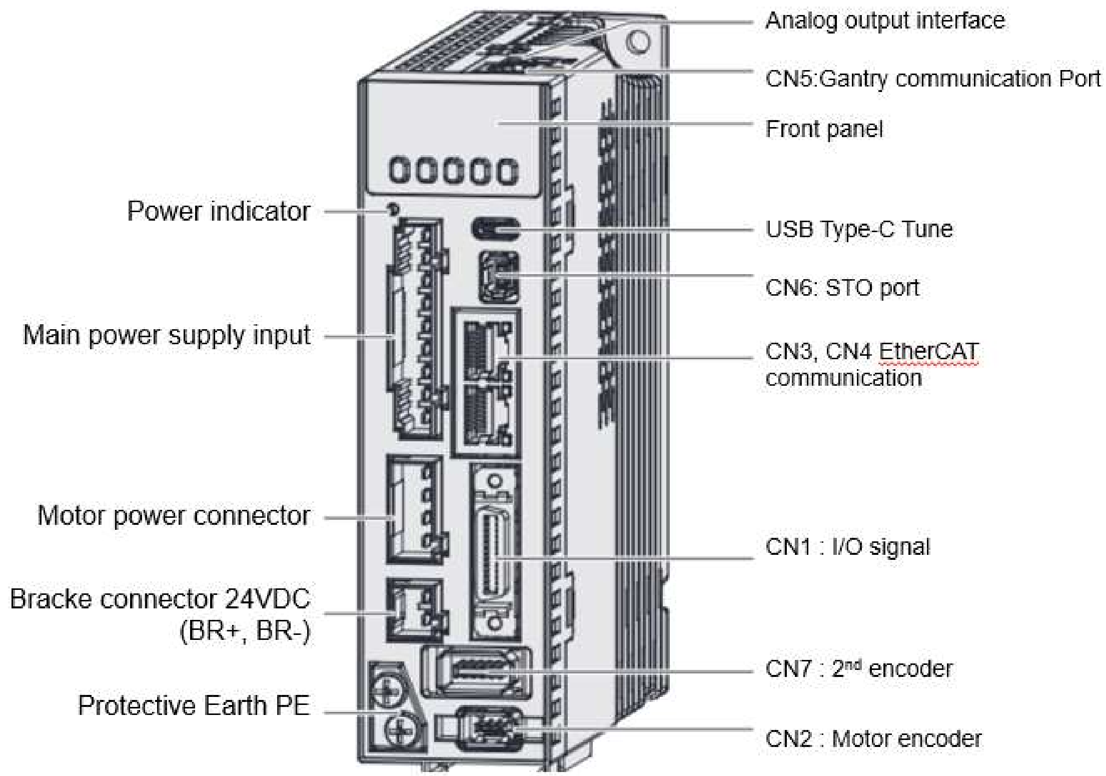
Servo Motor Nameplate Overview



1.4 Component Description

1.4.1 Servo driver Ports and Connectors

E-DHAS01E~E-DHAS10E



Parts & Connectors	Description
Front Panel	Including an LED display and 5 buttons. LED display is used to display servo driver status and parameter settings. 5 buttons： M ：To switch between different modes and parameters ◀ ：Switch between value ▲ ：Switch between sub-menus/Increase ▼ ：Switch between sub-menus/Decrease S : Enter
Type-C Data Port	Connect to computer for tuning of servo driver. Parameters of the servo driver can be modified without connecting to main power supply.
CN1 I/O signal	I/O signal connection terminals (SCSI-26PIN)
CN2 Motor encoder	Connect to motor encoder
CN3 CN4 RS485 Communication Port	Connect to controller with RS485 interface

Parts & Connectors	Description
CN6 STO (Safety Torque Off)	STO connecters. Used for any application requiring STO functions.
CN7 2nd encoder	Connect to external encoder (Supports ABZ incremental encoder only.)
Holding Brake 24VDC	BR+/BR- brake terminals
Power-on indicator light	Lights up when servo driver is connected to main power supply. Please do not touch the power terminal immediately after power off as the capacitor might require some time to discharge.
Main power supply 220VAC	**L1C、L2C** ：Control circuit power supply (Single phase 220VAC) **L1、L2、L3**：Main power supply 220VAC Note: E-DHASxxE series supports 1P/3P 220VAC main power supply **P+, B1, B2**: Connect B1 and B2 to use internal regenerative resistor; If an external regenerative resistor is needed, connect it to P+ and B2, disconnect B1 and B2.
Motor connectors	U, V, W Motor connector: Connect to U,V,W terminals on servo motor PE motor earth terminal: Connect to motor PE terminal
Protective Earth PE	Connect to PE of main power supply. For grounding

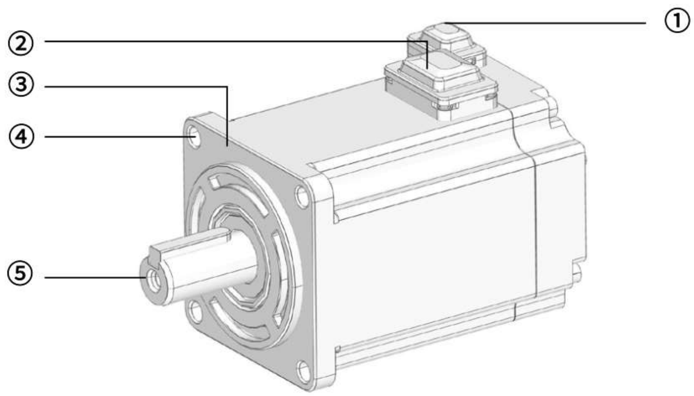
Note:
- All power levels of the E-DHASxxE series drives have built-in regenerative braking resistors.
- To use an external regenerative resistor, short B1 and B2.
- If you intend to use an external resistor, remove the shorting jumper and connect the external resistor between P+ and B2.
- The thickness may vary across different power levels, but the components are the same.

1.4.2 Motor Ports And Connectors

Servo motor appearance and components description

Motor（40&60&80 Frame size）

Direct plug-in servo motor（40&60&80 Frame size）



No.	Component Name
①	Encoder connector
②	Power connector
③	Motor flange
④	Mounting hole
⑤	Motor shaft

1.5 Servo driver Technical Specifications

1.5.1 Electrical Parameters

E-DHASxxE Drive Series		100	400	750	1000
Power Rating (W)		100	400	750	1000
Rated Current（A）		1.2	2.8	5.5	7.0
Peak Current (A)		4.8	9.3	16.9	21.0
Control circuit power supply		1-Phase AC 200V~240V，-10%~+10%，50/60Hz			
Main power supply		1-Phase/ 3-Phase AC 200V~240V，-10%~+10%，50/60Hz			
Regenerative resistor	Resistance (Ω)	100	100	100	100
	Power rating (W)	50	50	50	50
	Braking resistor function	The entire series has built-in regenerative braking resistors and also supports external braking resistors			
Cooling method		Air-cooled		Fan-cooled	
Dimension H*L*W(mm)		150*150*43		150*160*55	

1.5.2 General specifications

Ports	Descriptions
USB Type-C	Modify or read driver parameters without connecting to main power supply
Crossover Frequency Output	Supports phase A/B/Z differential crossover frequency output Supports phase Z open collector crossover frequency output
Analog Input	2 analog inputs（AI1/AI2）,-10V~+10V, Max. voltage: ±12V
Analog Output	2 analog outputs（AO1/AO2）, -10V~+10V
Digital Input	8 Digital Inputs (Supports common anode or cathode connection)
	1. Clear Alarm （A-CLR） 2. Positive limit switch (POT) 3. Negative limit switch (NOT) 4. Homing switch (HOME-SWITCH) 5. Emergency stop (E-Stop)
Digital Output	3 Digital outputs（3 double-ended, DO1~DO3）
	1. Alarm (ALM) 2. Servo ready (SRDY) 3. External brake off (BRK-OFF) 4. Positioning completed (INP) 5. Velocity at arrival (AT-SPEED) 6. Torque limiting command (TLC) 7. Zero speed position (ZSP) 8. Velocity coincidence (V-COIN) 9. Position command (P-CMD) 10. Velocity limit (V-LIMIT) 11. Velocity command (V-CMD) 12. Servo enabled (SRV-ST) 13. Homing done (HOME-OK) 14. Position comparison (CMP-OUT)
Safe Torque Off (STO)	Available for all E-DHASxxE series servo drivers
Encoder #2	
Holding brake	Internal holding brake. External relay not needed
Communication Port	EtherCAT Protocol, RJ45 port
Control Mode	
Position	Profile Position Mode (PP)
	Cyclic Synchronous Position Mode (CSP)
	Homing Mode (HM)
Velocity	Profile Velocity Mode (PV)
	Cyclic Synchronous Velocity Mode (CSV)
Torque	Profile Torque Mode (PT)
	Cyclic Synchronous Torque Mode (CST)
Control Features	
Drive Mode	IGBT SVPWM sinusoidal wave drive
Feedback Method	Encoder: RS485 Protocol
Standardized Parameters	Quick tuning of servo driver parameters can be achieved through PC tuning tools.
Easy-to-use	One-click tuning, Single parameter tuning, Black box, Zero tracking control
Notch Filter	Mechanical resonance suppression. Supports up to 3 filters,50Hz~4000Hz
Vibration suppression	End vibration suppression
DI/DO settings	Digital inputs and outputs can be set accordingly
Alarm	Overcurrent. Overvoltage. Undervoltage. Overheat. Overload. Overtravel. Single-Phasing. Regenerative resistor error. Position deviation error. Encoder feedback error. Excessive braking rate. EEPROM error
Front Panel	5 push buttons, 8-segments display, 5 warning LEDs

Software	Using MISUMI EDrive debugging software, you can adjust current, position, and velocity loop parameters, modify I/O signal levels and motor settings, import/export parameters, and monitor speed and position error waveforms during trapezoidal wave tests.	
Communication	**USB Type-C**	Modbus USB2.0 (No need to connect driver to power supply)
	EtherCAT	RJ45. Communication up to 128 axes to a host
Dynamic Brake	Internal dynamic brake	
Position Comparison	42 position comparison outputs	
Suitable Load Inertia	30 times smaller than motor inertia	

Note:

- Please install the servo driver within this range of ambient temperature.
- When storing it in an electrical cabinet, the temperature inside the cabinet should not exceed this value.

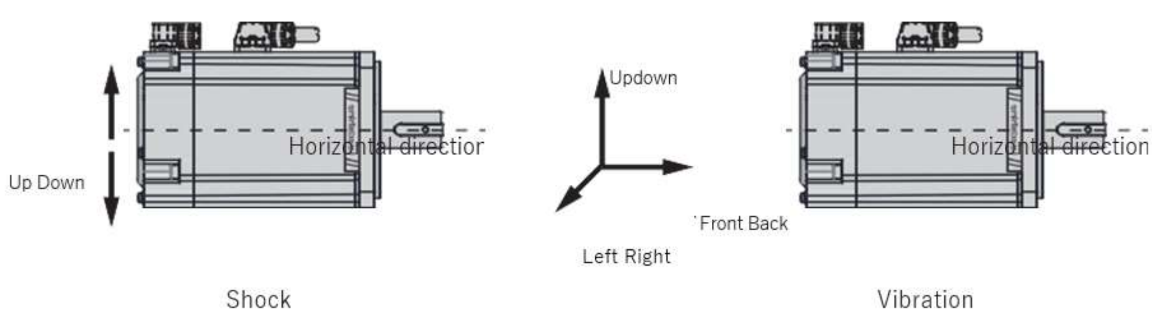
1.6 Motor General Specifications

1.6.1 Mechanical Characteristic Specifications

Item		Description
Duty Cycle		Continuous
Vibration Class		V15
Insulation Resistance		DC500V, over 100 MΩ
Excitation Method		Permanent Magnet
Mounting Method		Flange Type
Thermal Class		Class F
Insulation Voltage		AC1500V for 1 minute
Enclosure Protection		IP67 (excluding shaft end and cable outlet)
Rotation Direction		CCW (counterclockwise) when viewed from the load side under forward command
Environmental Conditions	Temperature	0℃ ~40℃（No Freezing）
	Humidity	20%~80%（No condensation）
	Installation Location	• Indoor, free from corrosive or explosive gases • Well-ventilated, minimal dust, debris, or humidity • Easy to inspect and clean • Operate normally below 1000m; derate above 1000m • Free from strong magnetic fields • Away from heat sources such as furnaces • For environments with grinding fluid, oil mist, iron dust, or cutting debris, select models with oil seal
	Storage Environment	When storing the motor unpowered, comply with the following: • Storage temperature: -20°C ~ +60°C (non-freezing) • Storage humidity: 20% ~ 80% RH (non-condensing)
Shock Resistance [1]	Shock acceleration (measured at flange face):	490m/s^2
Vibration Resistance [2]	Vibration acceleration (measured at flange face)	49m/s^2

Note

- [1] Shock resistance applies in the vertical direction when the motor is mounted horizontally.
- [2] Vibration resistance applies in all three directions (up/down, left/right, front/back) for horizontal mounting.
- Actual vibration levels vary by application; verify with real-world use.



1.6.2 Electrical Specifications of Motor's Brake

Motor Model	Holding Torque (N·m)	Supply Voltage (VDC)±10%	Closing Voltage (V)	Release Voltage (V)	Release Time (ms)	Closing time (ms)	Rotary clearance (°)
E-MASH2-0401B	≥ 0.4	24	≤ 16	≥ 1	≤ 20	≤ 40	＜ 1.5
E-MASH2-0602B	≥ 1.5		≤ 16	≥ 1	≤ 20	≤ 50	≤ 1
E-MASH2-0604B	≥ 1.5		≤ 16	≥ 1	≤ 20	≤ 50	≤ 1
E-MASH2-0808B	≥ 3.2		≤ 16	≥ 1	≤ 40	≤ 60	≤ 1
E-MASH2-0810B	≥ 3.2		≤ 16	≥ 1	≤ 40	≤ 60	≤ 1

1.6.3 Load moment of inertia

Load inertia is the inertia of the load. Larger load inertia reduces responsiveness and may cause instability. Servo motors have limits on allowable load inertia, which vary by drive conditions.
Exceeding this limit can trigger an overvoltage alarm during deceleration or an overload alarm if the servo has a built-in braking resistor.
If alarms occur, take appropriate corrective actions:

- Reduce the torque limit.
- Decrease the deceleration rate.
- Lower the maximum speed.
- If alarms persist after these measures, use an external braking resistor.

⚠Caution
Even when using a built-in braking resistor, under certain regenerative drive conditions, the generated energy may exceed the allowable dissipation capacity (W) of the built-in resistor. In such cases, an external braking resistor is required.

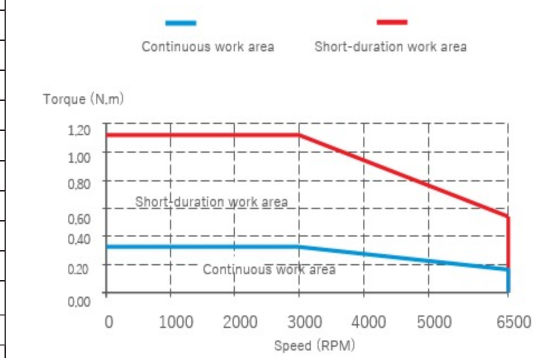
1.7 Motor Specifications

Motor Model	Power (W)	Rated torque (N·m)	Rated speed (rpm)	Maximum speed (rpm)	Moment of inertia (kgm²×10⁻⁴)	Voltage (V)
E-MASH2-0401	100	0.32	3000	6500	0.062	220
E-MASH2-0401B (With Brake)					0.072	
E-MASH2-0602	200	0.64			0.28	
E-MASH2-0602B (With Brake)					0.3	
E-MASH2-0604	400	1.27			0.56	
E-MASH2-0604B (With Brake)					0.58	
E-MASH2-0808	750	2.39			1.5	
E-MASH2-0808B (With Brake)					1.65	
E-MASH2-0810	1	3.18			2	
E-MASH2-0810B (With Brake)					2.15	

1.8 Motor E-MASH2 Series

E-MASH2-0401(B)

Motor Specifications			Torque-speed characteristics
Frame size(mm)	40		
Inertia	High inertia		
Rated power (kW)	0.1		
Rated voltage (V)	220		
Rated torque (N·m)	0.32		
Maximum torque (N·m)	1.11		
Rated current (A)	0.92		
Maximum current (A)	3.36		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6500		
Torque coefficient	0.383		
(Nm/A (rms))	Without brake	0.062	
	With brake	0.072	



Brake specifications

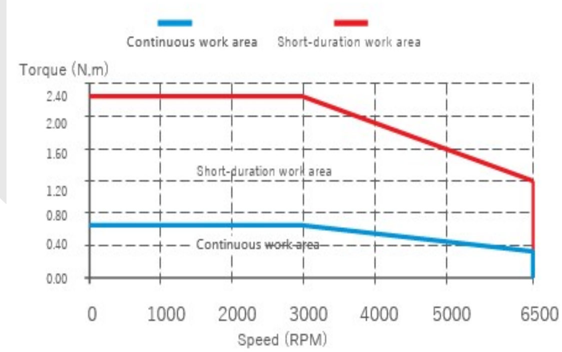
Holding Torque (N·m)	Supply Voltage (VDC)	Rated Power (W)	Excitation current (A)	Release Time (ms)	Closing time (ms)	Rotary clearance (°)
＞ 0.4	24	6.9	0.25	≤ 40	≤ 20	＜ 1.5°

Allowable load

Shaft length (mm)	Radial allowable load (N)	Axial allowable load (N)
25	78	54

E-MASH2-0602(B)

Motor Specifications			Torque-speed characteristics
Frame size(mm)	60		
Inertia	High inertia		
Rated power (kW)	0.2		
Rated voltage (V)	220		
Rated torque (N·m)	0.64		
Maximum torque (N·m)	2.23		
Rated current (A)	1.5		
Maximum current (A)	5.4		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6500		
Torque coefficient	0.447		
(Nm/A (rms))	Without brake	0.28	
	With brake	0.30	



Brake specifications

Holding Torque (N·m)	Supply Voltage (VDC)	Rated Power (W)	Excitation current (A)	Release Time (ms)	Closing time (ms)	Rotary clearance (°)
＞ 1.5	24	8.3	0.31	≤ 50	≤ 20	＜ 1°

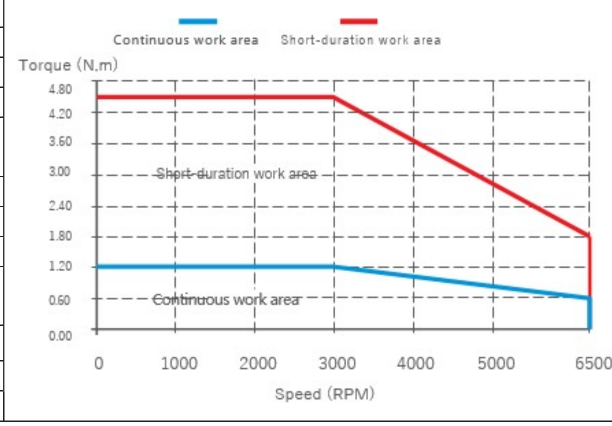
Allowable load

Shaft length (mm)	Radial allowable load (N)	Axial allowable load (N)
30	245	74

E-MASH2-0604(B)

Motor Specifications		
Frame size(mm)	60	
Inertia	High inertia	
Rated power (kW)	0.4	
Rated voltage (V)	220	
Rated torque (N·m)	1.27	
Maximum torque (N·m)	4.46	
Rated current (A)	2.1	
Maximum current (A)	7.6	
Rated speed (rpm)	3000	
Maximum speed (rpm)	6500	
Torque coefficient	0.645	
(Nm/A (rms))	Without brake	0.56
	With brake	0.58

Torque-speed characteristics



Brake specifications

Holding Torque (N·m)	Supply Voltage (VDC)	Rated Power (W)	Excitation current (A)	Release Time (ms)	Closing time (ms)	Rotary clearance (°)
＞ 1.5	24	8.3	0.31	≤ 50	≤ 20	≤ ±1°

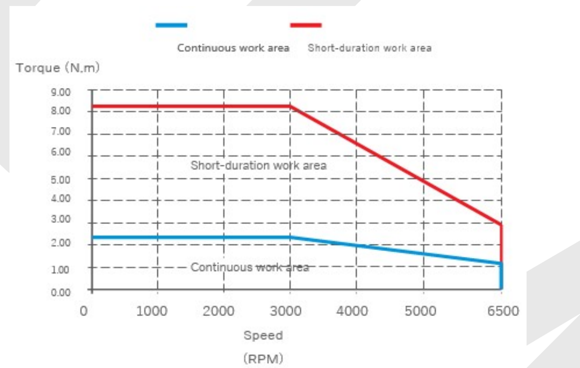
Allowable load

Shaft length (mm)	Radial allowable load (N)	Axial allowable load (N)
30	245	74

E-MASH2-0808(B)

Motor Specifications		
Frame size(mm)	80	
Inertia	High inertia	
Rated power (kW)	0.75	
Rated voltage (V)	220	
Rated torque (N·m)	2.39	
Maximum torque (N·m)	8.36	
Rated current (A)	4.1	
Maximum current (A)	15.4	
Rated speed (rpm)	3000	
Maximum speed (rpm)	6500	
Torque coefficient	0.645	
(Nm/A (rms))	Without brake	1.5
	With brake	1.65

Torque-speed characteristics



Brake specifications

Holding Torque (N·m)	Supply Voltage (VDC)	Rated Power (W)	Excitation current (A)	Release Time (ms)	Closing time (ms)	Rotary clearance (°)
＞ 3.2	24	11.5	0.48	≤ 60	＜ 40	<1°

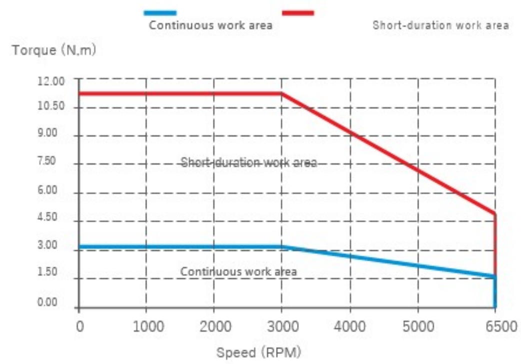
Allowable load

Shaft length (mm)	Radial allowable load (N)	Axial allowable load (N)
35	392	147

E-MASH2-0810(B)

Motor Specifications			
Frame size(mm)	80		
Inertia	High inertia		
Rated power (kW)	1		
Rated voltage (V)	220		
Rated torque (N·m)	3.18		
Maximum torque (N·m)	11.2		
Rated current (A)	5.7		
Maximum current (A)	21		
Rated speed (rpm)	3000		
Maximum speed (rpm)	6500		
Torque coefficient	0.634		
(Nm/A (rms))	Without brake	2	
	With brake	2.13	

Torque-speed characteristics



■ Brake specifications

Holding Torque (N·m)	Supply Voltage (VDC)	Rated Power（W）	Excitation current（A）	Release Time (ms)	Closing time (ms)	Rotary clearance (°)
>3.2	24	11.5	0.48	≤ 60	≤ 40	＜ 1

■ Allowable load

Shaft length (mm)	Radial allowable load (N)	Axial allowable load (N)
35	392	147

Chapter 2 Installation & Wiring

2.1 Servo driver Installation

2.1.1 Installation Site

- Install the drive indoors, inside a control cabinet that is protected from rain and direct sunlight. Do not place flammable materials nearby. This product is not waterproof.
- Do not use this product in environments containing corrosive gases such as hydrogen sulfide, sulfur dioxide, chlorine, ammonia, chlorinated gases, acids, alkalis, or salts, nor near flammable gases or combustible materials.
- Avoid installing in areas with high temperature, humidity, dust, or metal particles.
- Install in a location with minimal vibration.
- Preferably install in a well-ventilated, dry, and dust-free environment. Prevent oil, metal dust, water, or other foreign substances from entering the product.

2.1.2 Installation Environment

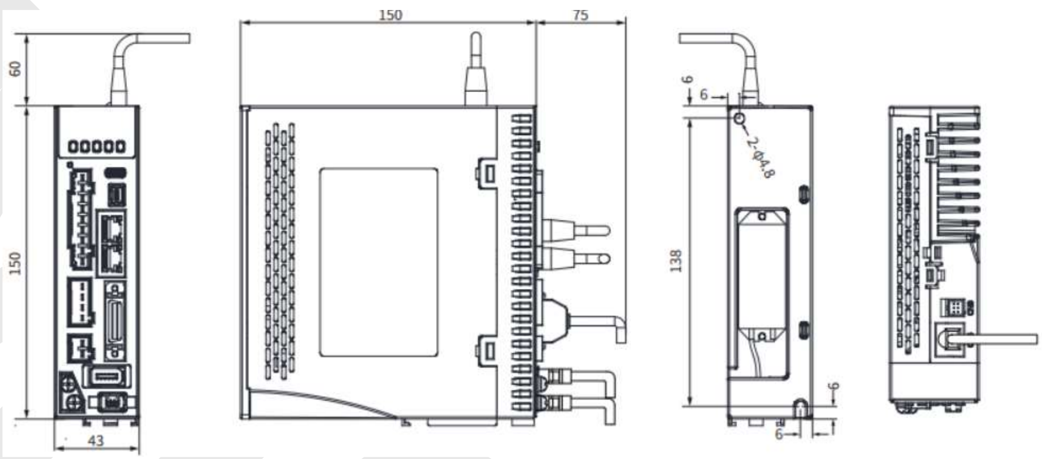
Item	Condition
Temperature	Storage: -20-80℃ (Condensation free); Not more than 72 hours if stored in over 65℃ Installation: 0~+55℃ (Not frozen); Lower performance at over 45℃
Humidity	Under 90%RH (Condensation free)
Altitude	Max. altitude of 2000m. 100% performance at 1000m or below. Performance decreases by 1% with every increase of 100m from 1000m.
Vibration	Less than 0.5G (4.9m/s2) 10-60Hz (non-continuous working)
IP ratings	IP20

Note:

- Operating temperature: 0 to +60 °C. Derating is required when operating above 40 °C.
- When temperature decreases and humidity increases, condensation is likely to occur.
- If storage temperature exceeds +60 °C, do not store continuously at this temperature for more than 72 hours

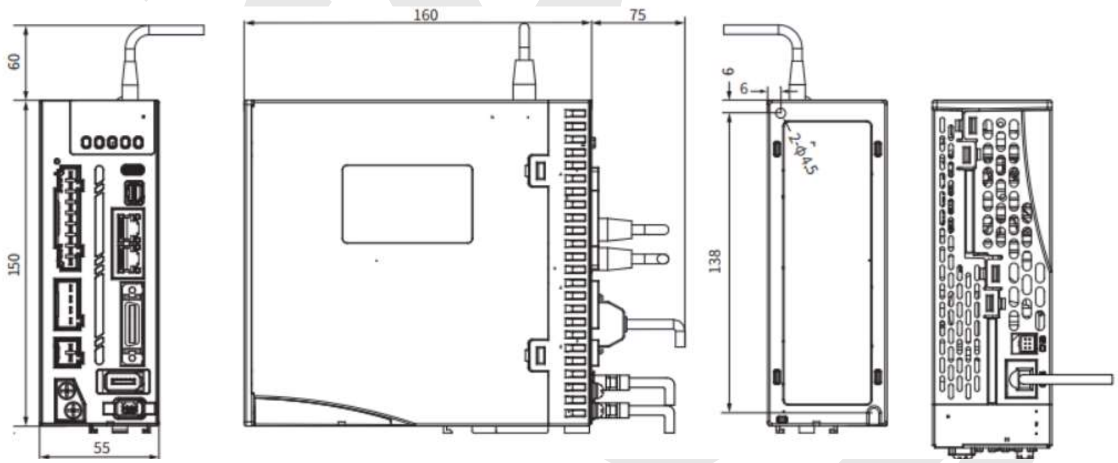
2.1.3 Servo driver Dimension

Size 1：E-DHAS01E、E-DHAS04E



150mm x 150mm x 43mm

Size 2：E-DHAS08E、E-DHAS10E

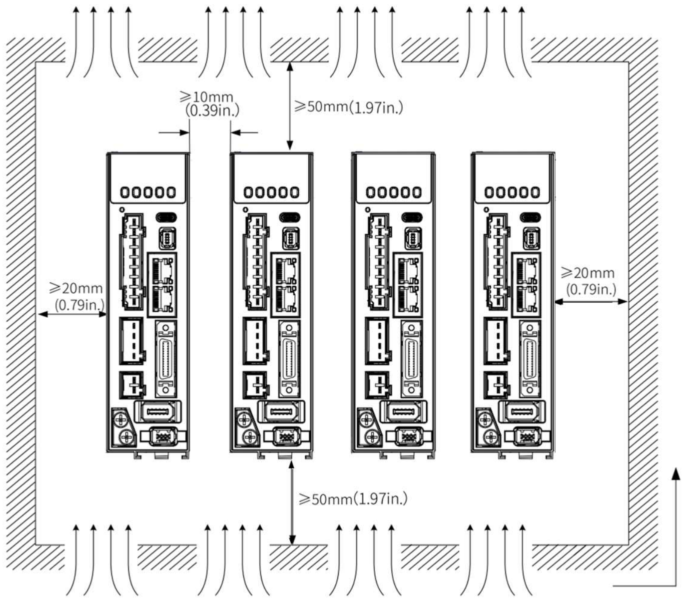


150mm x 160mm x 55mm

Space requirement for installation

In order to ensure efficient heat dissipation, please leave at least 10mm installation space in between drivers. If drivers need to be mounted compactly, please leave at 1mm of installation space. Please keep in mind that under such conditions, the drivers can only run at 75% of actual load rate.

Air flow out



Air flow in

Installation method

Please install the driver vertical to ground facing forward for better heat dissipation. Always install in rows and use heat insulation board to separate between rows.
Cooling fans are recommended for drivers to achieve optimal performance.

Grounding

PE terminals must be grounded to prevent electrocution hazard or electromagnetic interference.

Wiring

Please ensure there is no liquid around the wiring and connectors as liquid leakage may cause serious damage to the driver(s).

RJ45 port cover

Please cover unconnected RJ45 port(s) on top of the driver to prevent dust or liquid from damaging the ports.

Battery kit

If there is a need for battery kit, please remember to leave a room in the electrical cabinet for it.

2.2 Servo Motor Installation

Please carefully read the precautions and installation methods in this chapter!

- Use a screw-type puller tool when installing or removing pulleys.
- Do not strike the motor shaft or encoder to avoid vibration or impact damage.
- Do not drag the motor by its shaft, cables, or encoder when handling.
- The motor shaft must not be subjected to excessive axial or radial loads, as this may cause damage.
- It is recommended to use a flexible coupling to connect the load.
- Ensure the motor is mounted securely with anti-loosening measures; use lock washers when fastening the motor.

2.2.1 Installation Location

- Installation conditions may affect the lifespan of a motor
- Please keep away from corrosive fluid and combustibles.
- If dusty working environment is unavoidable, please use motors with oil seal.
- Please keep away from heat source.
- If motor is used in enclosed environment without heat dissipation, motor lifespan will be short.
- Please check and clean the installation spot before installation.

2.2.2 Installation Environment

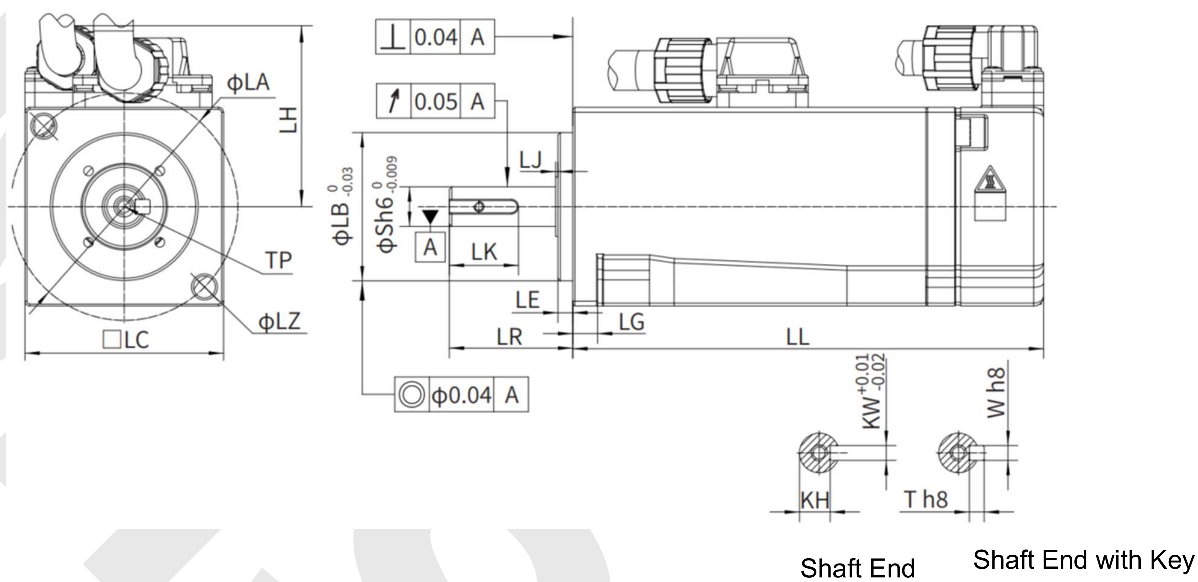
Item	Condition
Operating Temperature	0°C to +40°C (up to +60°C with derating; non-freezing)
Operating Humidity	Below 90% RH (no condensation or icing)
Storage Temperature	-20°C to +60°C (max 85°C for up to 72 hours)
Storage Humidity	Below 90% RH (no condensation or icing)
Atmosphere	Indoor (no direct sunlight), free of corrosive or flammable gases
Altitude	Below 1000m for normal use; derating required above 1000m (up to 2000m)
Vibration Grade	Less than 5G (49 m/s²)
Shock Resistance	Less than 50G (490 m/s²)
Protection Rating	IP65 (E-MASH2 series motors up to IP67)

Note:

- Operating temperature: 0 to +60 °C. Derating is required when operating above 40 °C.
- When temperature decreases and humidity increases, condensation is likely to occur.
- If storage temperature exceeds +60 °C, do not store continuously at this temperature for more than 72 hours.

2.2.3 Motor Dimensions

E-MASH2 40 Motor Frame (Unit: mm)

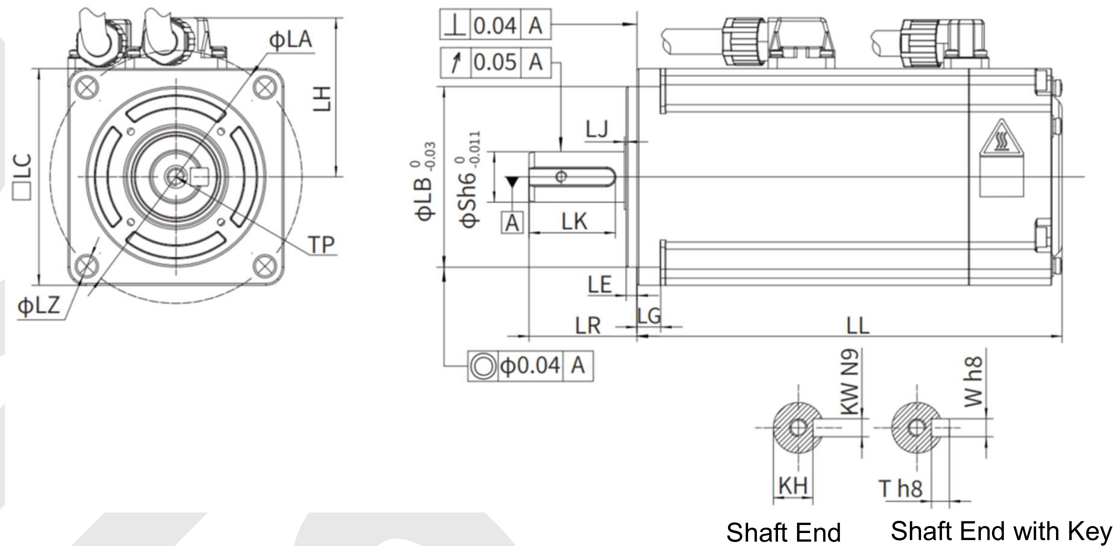


The above diagrams are for reference only. Please refer to the actual dimensions for installation.

Motor Model	LL	LC	LR	LA	LZ	LH	LG	LE	LJ	S	LB	TP	LK	KH	KW	W	T	Weight (kg)
E-MASH2-0401	67.7	40	25	46	4.5	38MAX	5	3	3	8	30	M3X8	14	6.2	3	3	3	0.46
E-MASH2-0401B	95	40	25	46	4.5	38MAX	5	3	3	8	30	M3X8	14	6.2	3	3	3	0.68

Note: In the motor model, “B” indicates a brake-equipped motor.

E-MASH2 60/80 Motor Frame (Unit: mm)



The above diagrams are for reference only. Please refer to the actual dimensions for installation.

Motor Model	LL	LC	LR	LA	LZ	LH	LG	LE	LJ	S	LB	TP	LK	KH	KW	W	T	Weight (kg)
E-MASH2-0602	71.8	60	30	70	5.5	37.5MAX	6.6	3	3	14	50	M5X12	22.5	11	5	5	5	0.9
E-MASH2-0602B	101.1	60	30	70	5.5	37.5MAX	6.6	3	3	14	50	M5X12	22.5	11	5	5	5	1.3
E-MASH2-0604	88.8	60	30	70	5.5	37.5MAX	6.6	3	3	14	50	M5X12	22.5	11	5	5	5	1.3
E-MASH2-0604B	118.1	60	30	70	5.5	37.5MAX	6.6	3	3	14	50	M5X12	22.5	11	5	5	5	1.55
E-MASH2-0808	90.9	80	35	90	6.5	57.5MAX	8.1	3	3	19	70	M5X15	25	15.5	6	6	6	2.12
E-MASH2-0808B	121.9	80	35	90	6.5	57.5MAX	8.1	3	3	19	70	M5X15	25	15.5	6	6	6	2.7
E-MASH2-0810	103.9	80	35	90	6.5	57.5MAX	8.1	3	3	19	70	M5X15	25	15.5	6	6	6	2.7
E-MASH2-0810B	134.9	80	35	90	6.5	57.5MAX	8.1	3	3	19	70	M5X15	25	15.5	6	6	6	3.2

Note: In the motor model, “B” indicates a brake-equipped motor.

2.2.4 Installation Method and Precautions

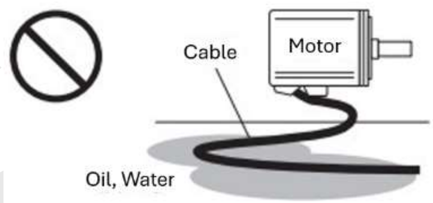
Installation Method

The motor can be installed vertically or horizontally, but the following requirements must be observed:

- Horizontal Installation
- Position the cable outlet facing downward to prevent oil or water from entering the motor.
- Vertical Installation
- When installing a motor with a reducer in the axial direction, use a motor with an oil seal to prevent reducer oil from leaking into the motor.

Oil- and waterproofing

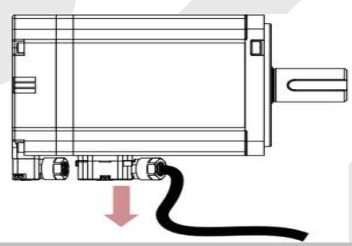
- Do not submerge motor/cable under oil/water
- Please use a motor with oil seal when paired with a reducer to prevent reducer oil from leaking into the motor.



Conditions for use of servo motors with oil seals:
— Make sure the oil level is below the lip of the oil seal during use.
— When installing the servo motor vertically upward, do not allow oil to enter the lip of the oil seal.

- When using in places with water dripping, please use it after confirming the protection level of the servo motor.
- In applications with liquid, please install the motor with the wiring port facing downward
- Do not use in an environment where oil and water often splash onto the motor body.

(As shown below), prevent liquid from flowing along the cable to the motor body.



Cable stress

- Do not the bend the cable especially at each ends of the connectors.
- Make sure to not let the cables be too tight and under tremendous stress especially thinner cables such as signal cables

Connectors

- Please to remove any conductive foreign objects from the connectors before installation
- The connectors are made of resin. May not withstand impact.
- Please hold the driver during transportation, not the cables.
- Leave enough “bend” on the connector cables to ensure less stress upon installation.

Encoder & coupling

- During installation or removal of coupling, please do not hit the motor shaft with a hammer as it would cause damage to internal encoder.
- Please make sure to centralize the motor shaft and coupling, it might cause damage to motor or encoder due to vibration.
- Please make sure axial and radial load is within the limits specified as it might affect the lifespan of the motor or cause damage to it.

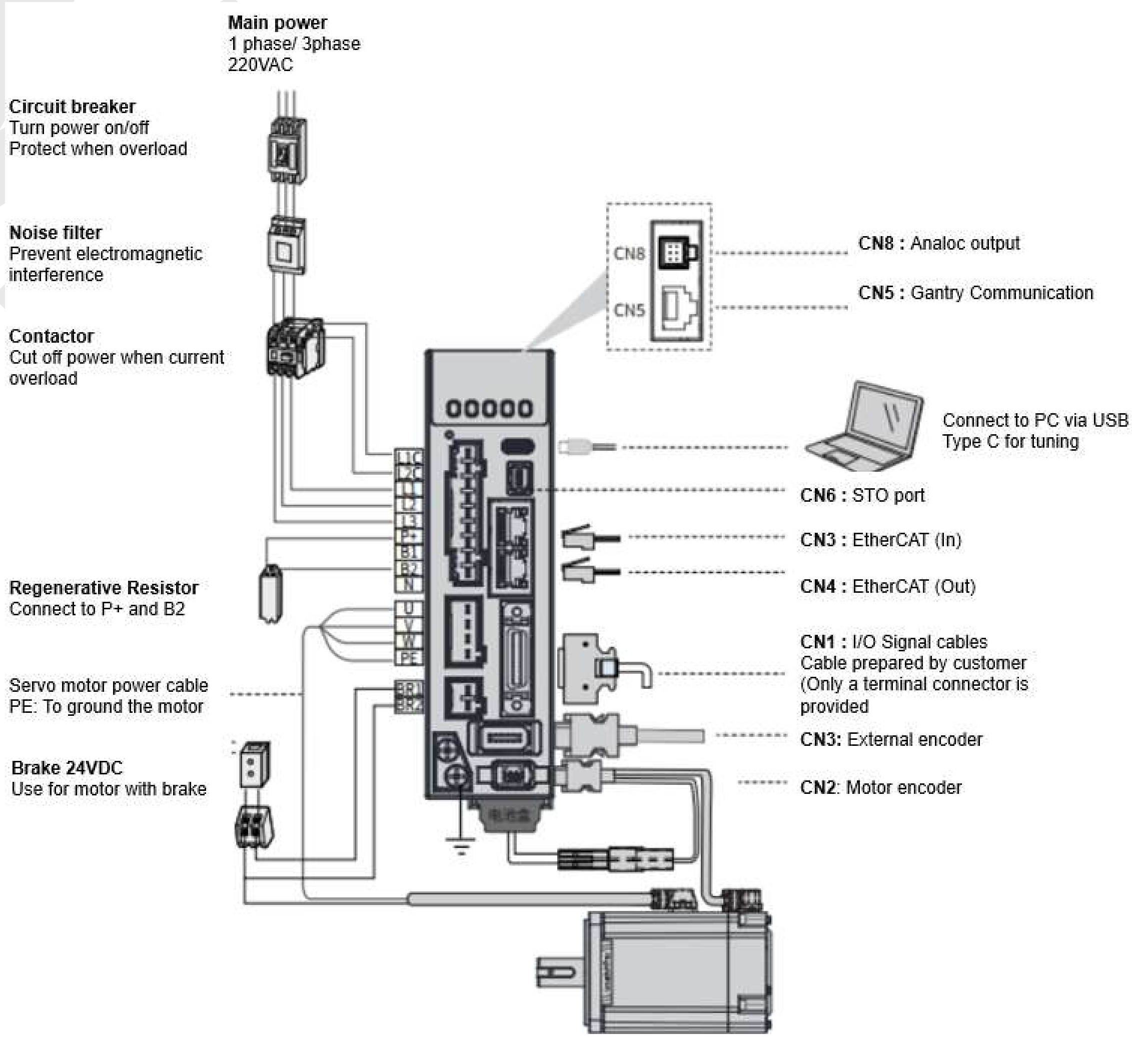
Motor brake cable connection precautions

- For motors with a brake and a magnetic encoder, brake wiring must respect polarity to avoid interference that can cause alarms, accuracy loss, or vibrations. For motors with a photoelectric encoder, polarity in brake wiring doesn’t matter

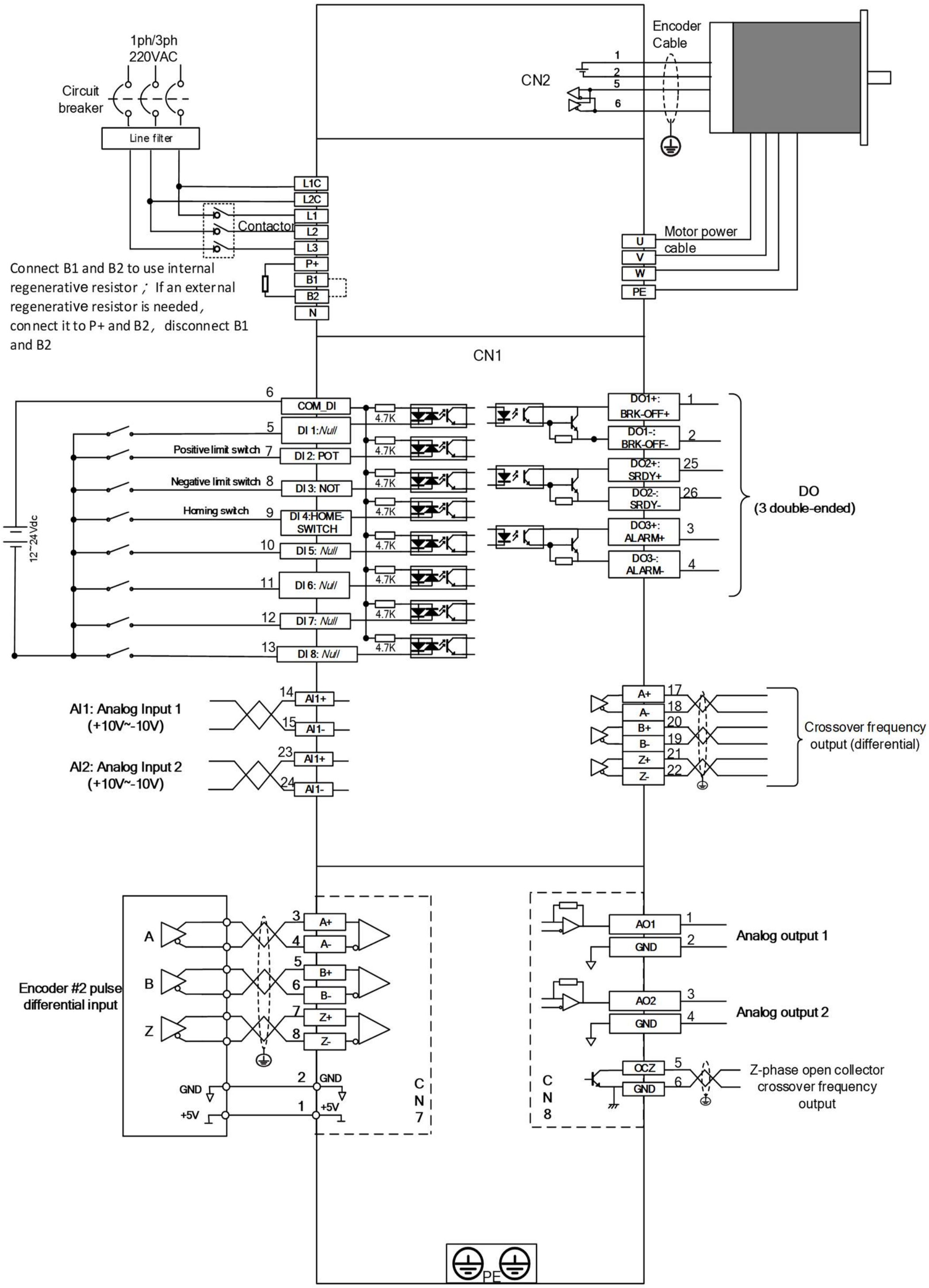
Chapter 3 Wiring

3.1 E-DHASxxE Wiring Diagram

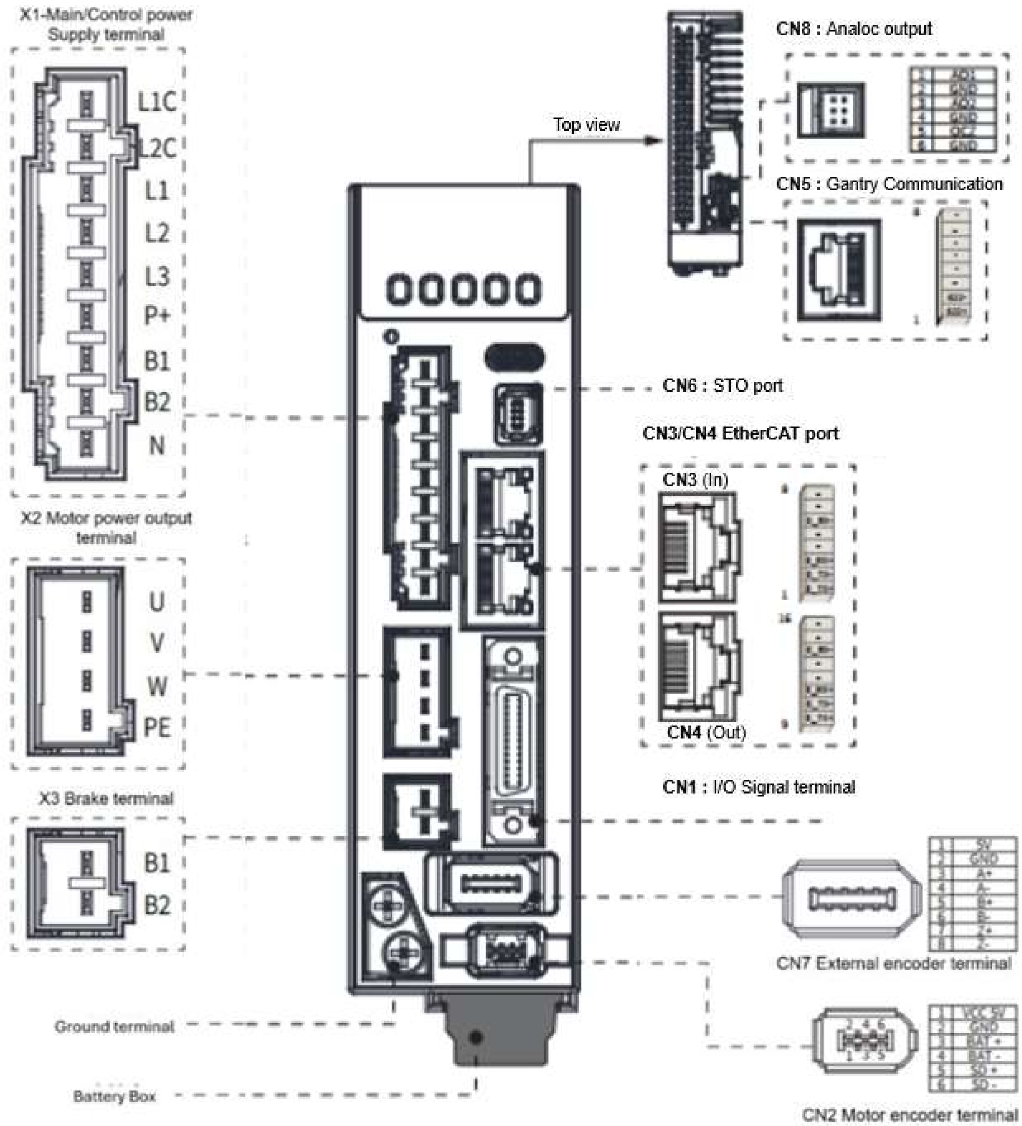
E-DHASxxE 220VAC Wiring Diagram



3.2 Electrical Wiring Diagram



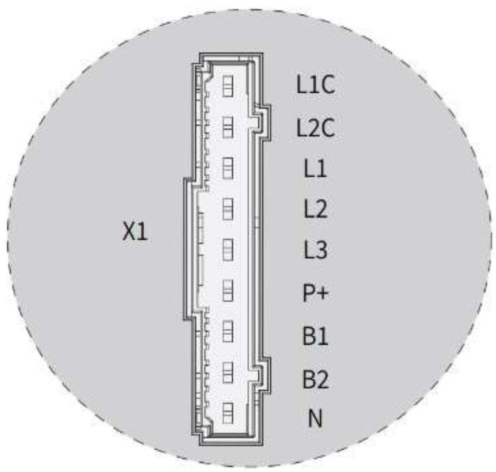
3.3 Servo driver Ports



Port	Description
CN1	I/O Signal (26 pins)
CN2	Motor encoder feedback input
CN3	EtherCAT（IN）Communication Port
CN4	EtherCAT（OUT）Communication Port
CN5	RS422 Communication Port
CN6	Safe Torque Off (STO)
CN7	2nd Encoder feedback input (External)
CN8	Analog output/Z-phase open collector output
X1/X2	Main/Control circuit power supply; Motor power supply
X3	Holding Brake
USB	USB Type-C (Connect to PC)

Only the full-function version includes CN6&CN7 terminals and supports the corresponding features

3.4 X1 Main/Control Circuit Power Supply



Pin	Label	Explanation	Remarks
L1C	Control circuit L1	Control circuit power supply. Single phase 220VAC	① Optional isolated switching power supply； ② Connecting to 380VAC will cause damage to driver； ③ Line filter is suggested in environment with strong interference； Use a fuseless circuit breaker to turn on/off power supply to driver.
L2C	Control circuit L2		
L1	Main power supply L1	Single phase 220VAC. Supports 1ph/3ph 220VAC, -10%～+10%,50/60Hz	
L2	Main power supply L2		
L3	Main power supply L3		
P +	DC Bus positive terminal	1. Internal DC bus positive terminal 2、External regenerative resistor P terminal	Connect B1 and B2 to use internal regenerative resistor If an external regenerative resistor is needed, connect it to P+ and B2, disconnect B1 and B2.
B1	Regenerative resistor terminal	Internal regenerative resistant drawing terminal	
B2	Regenerative resistor terminal	Internal IGBT transistor	
N	DC Bus negative terminal	Internal DC bus negative terminal	Please don’t connect to any cable

3.4.1 Main Power Supply Cable Selection

Please connect to L1C/L2C (Control circuit) and L1/L2/L3 (Main power) to rated power supply voltage for the driver to operate under normal working condition. Driver will not function without both connected properly.

Main power supply wire gauge

Driver	Wire diameter (mm2/AWG)				
	Rated Input Current (A)	**L1、L2、L3**	**P+, (B2)Br**	**U、V、W**	**PE**
Single Phase 220V					
E-DHAS01E	2.0	1.3/AWG16	2.1/AWG14	0.52/AWG14	0.52/AWG14
E-DHAS04E	5.0	1.3/AWG16	2.1/AWG14	0.52/AWG14	0.52/AWG14
E-DHAS08E	7.9	1.3/AWG16	2.1/AWG14	0.52/AWG14	0.52/AWG14
E-DHAS10E	9.6	2.1/AWG14	2.1/AWG14	0.52/AWG14	0.52/AWG14

*If 3-phase 220VAC is used, wire diameter could be smaller than the listed above.

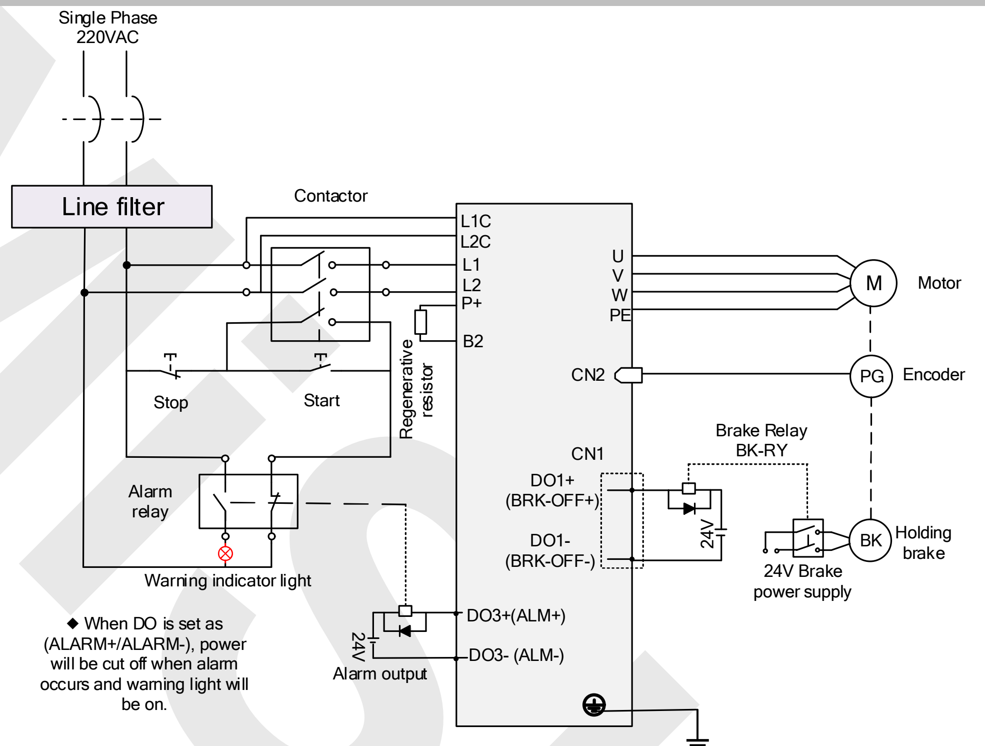
- For 3-phase 220V, L1/L2/L3 wires can be thinner than single-phase.
- Use a thick ground wire and ground the PE terminals of both driver and motor at one point (resistance < 100 Ω).
- Use a 3-phase isolation transformer to reduce electric shock risk.
- Add a noise filter to improve interference resistance.
- Install a non-fuse breaker (NFB) to cut power during driver faults.

The CN1 is used for control signal wiring, CN2 is encoder feedback signal wiring.

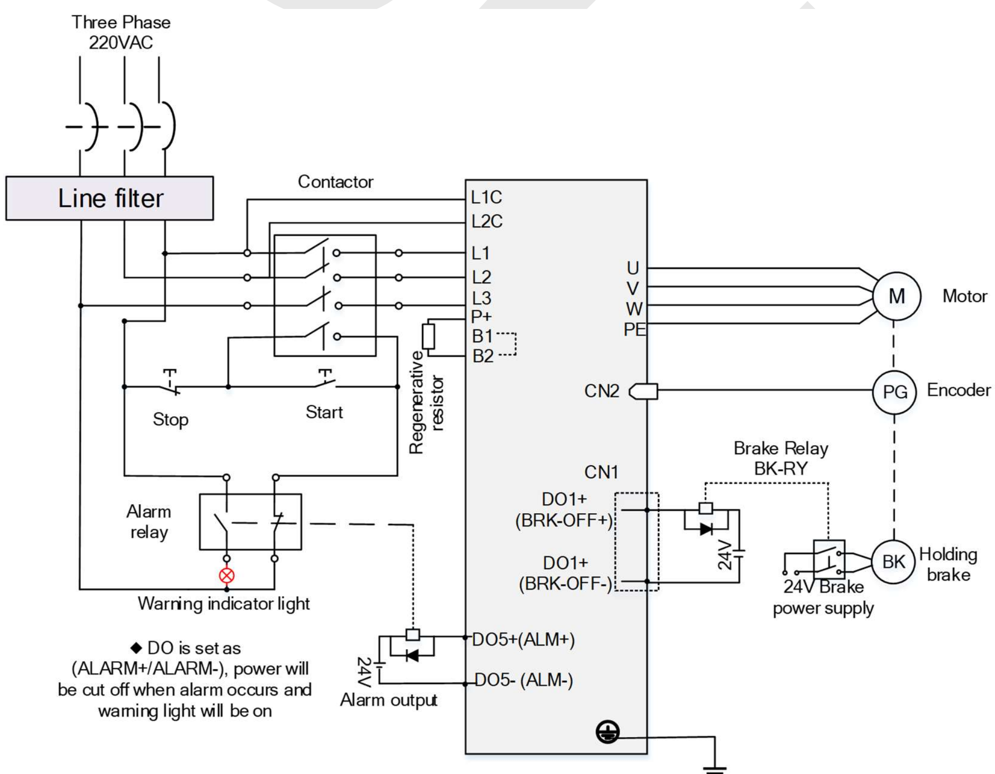
- Use shielded cables (twisted preferred): CN1 ≥ 0.14 mm², CN2 ≥ 0.25 mm²; connect shield to FG.
- Limit cable length: CN1 ≤ 3 m, CN2 ≤ 20 m.
- Keep cables away from power lines to reduce interference.
- Add surge protection: diode for DC coils, RC snubber for AC coils
- Notice
- U, V, W must match motor windings—no reversal.
  Secure cables away from heat sources to avoid heat damage to insulation.
  The servo driver contains large electrolytic capacitors that retain high voltage even after power off, wait5 minutes after power off before touching driver or motor.

3.4.2 Single/Three phase power supply wiring diagram

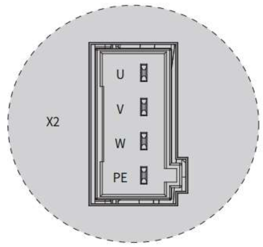
Single Phase 220VAC



Three Phase 220VAC

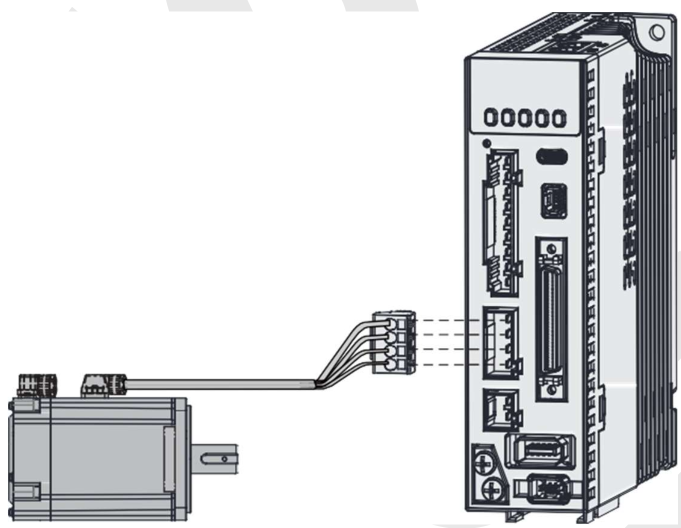


3.5 X2 Motor Power Supply



Pin	Label	Explanation	Remarks
U	U terminal	To motor U terminal	① Please make sure U, V, W terminals of driver and motor are correctly connected. ② Connect motor PE to driver PE and ground.
V	V terminal	To motor V terminal	
W	W terminal	To motor W terminal	
PE	PE	Motor frame	

3.5.1 Motor Power Cable Selection (Port X2)



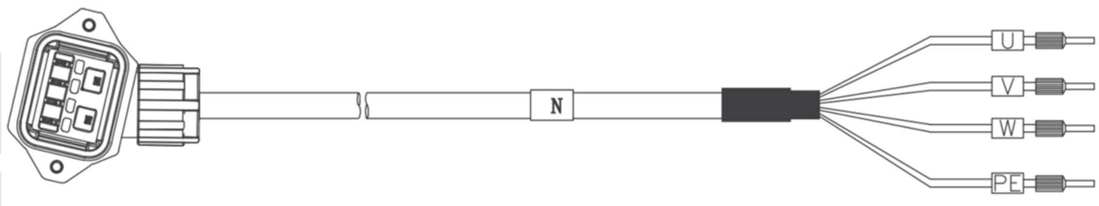
Example of motor power cable connection using an AMP electrical connector
Please connect the wires to corresponding terminals as labeled.

Motor winding power cable:

- Available in standard lengths of **1.5M**, **3M**, or **5M**.
- Below are our commonly used cable models:
  (*M* indicates cable length, e.g., 1M5 = 1.5 meters.
- Indicates cable exit direction: -*N* for axial, -*R* for reverse exit.)

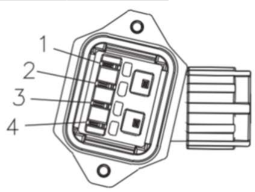
E-MASH2 Series Frame Size 80 and below

Direct connector E-CASP*M*-* without holding brake



Motor side Driver side

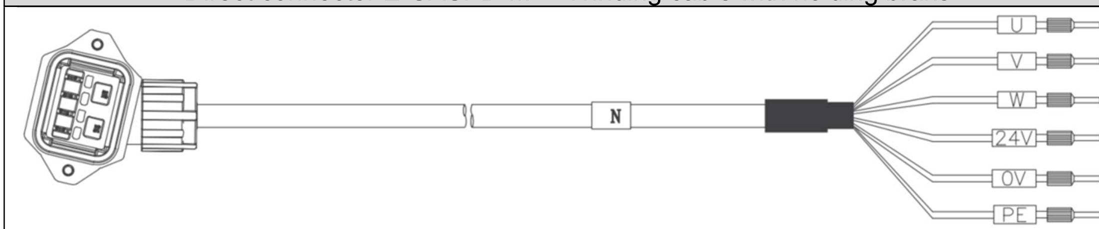
Driver cable pin



Pins

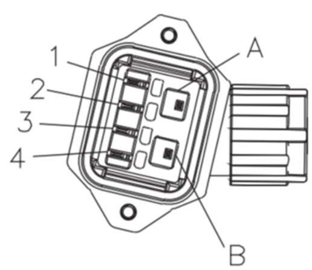
Motor	Color	Driver
1	Blue	U
2	Black	V
3	Red	W
4	Yellow- green	PE

Direct connector E-CASPB*M*-* Winding cable with holding brake



Motor side Driver side

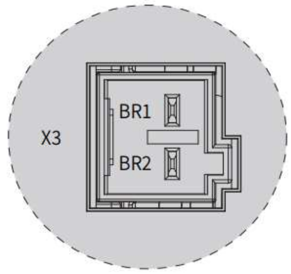
Motor cable pin



Pin

Motor	Color	Driver
1	Blue	U
2	Black	V
3	Red	W
4	Yellow- green	PE
A	Black	0V
B	Red	24V

3.6 X3 Holding Brake



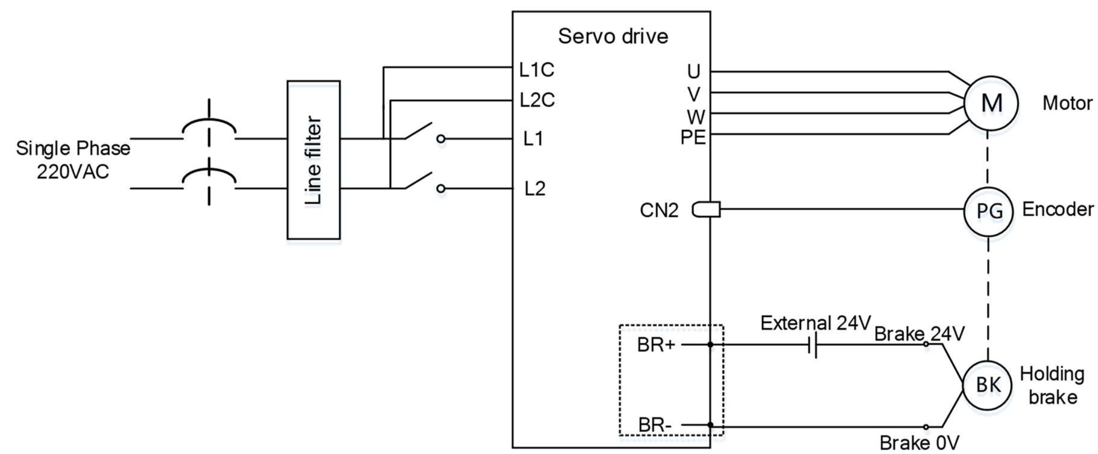
Pin	Label	Explanation	Remarks
BR+ （BR1）	Brake positive terminal	Connect to external power supply 24v negative terminal	No need of an external relay
BR- (BR2)	Brake negative terminal	Connect to motor brake terminal 0V	

Note:
The holding brake cable is integrated with the motor power cable. Please refer to Section 3.6.1 'Motor Power Cable Selection' to select a cable type with or without a brake."

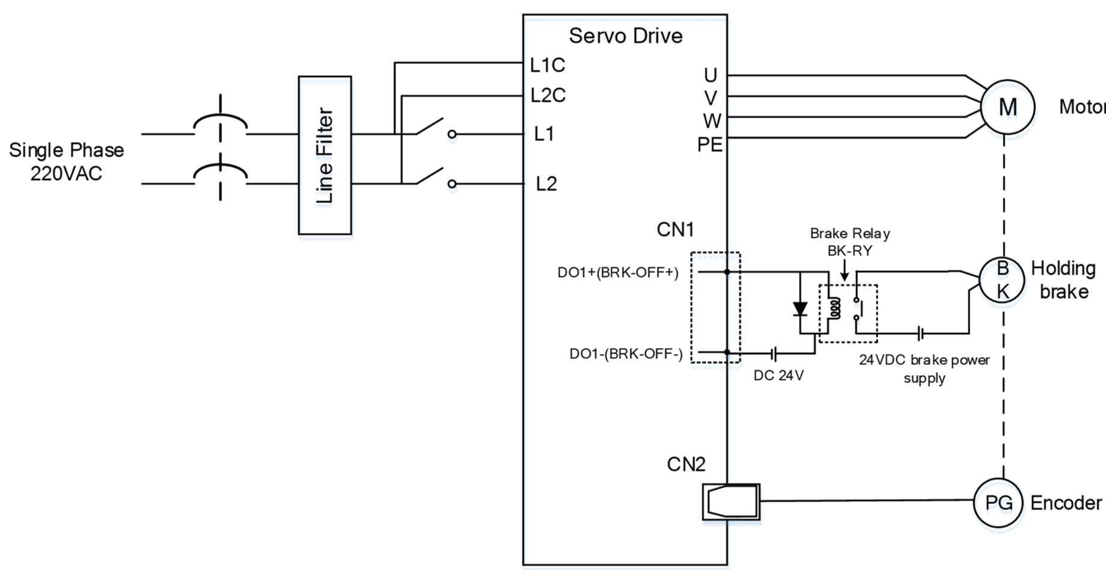
3.6.1 Holding brake wiring diagram

Holding brake is activated when servo driver is not powered on to prevent axis from moving due to gravitational pull or other external forces by locking the motor in place. Usually used on axis mounted vertically to the ground so that the load would not drop under gravitational force when the driver is powered off or when alarm occurs.
E-DHASxxE series servo drivers support direct drive holding brake. Please connect BR+ and BR- to an external 24v power supply and motor brake terminal to control the holding brake. There is no need for an external relay.

1. Using internal holding brake output port X3 (Easy wiring, no need for an extra relay)

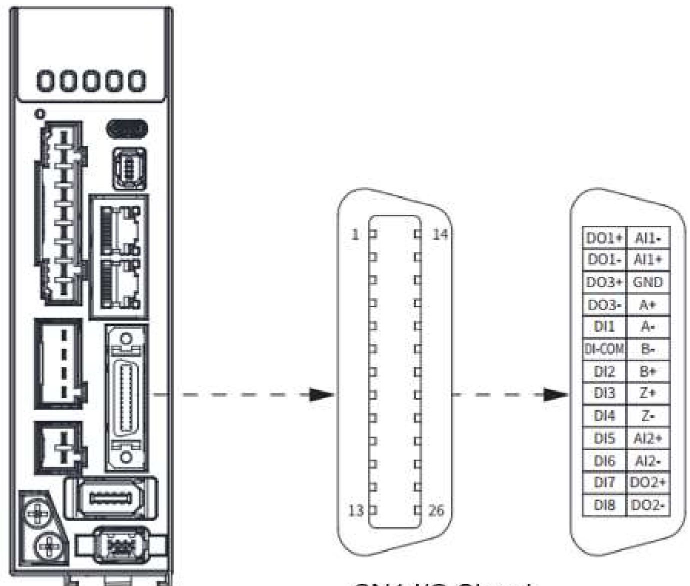


2.Connect to the DO(BRK+/BRK-)



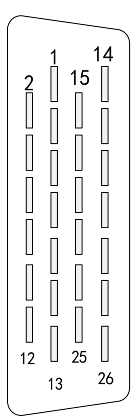
3.7 CN1 I/O Signal

E-DHASxxE series servo drivers use SCSI 26-Pin connector.



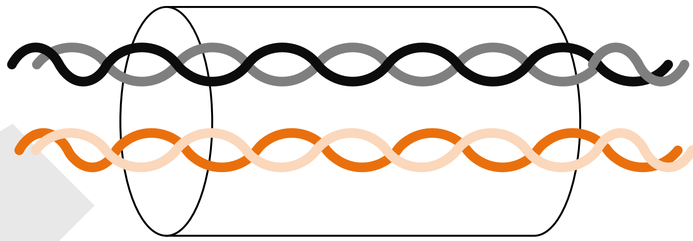
CN1 I/O Signal

Note: It is recommended to use 24-26AWG cables for CN1

Port	Diagram	Pin	Label	Signal	Description	
CN1		6	DI-COM	Input	Common digital input	
		5	DI1	-	Digital input 1	
		7	DI2	POT	Positive limit switch	
		8	DI3	NOT	Negative limit switch	
		9	DI4	HOME-SWITCH	Homing switch	
		10	DI5	-	Digital input 5	Supports probe latching compensation
		11	DI6	-	Digital input 6	
		12	DI7	-	Digital input 7	
		13	DI8	-	Digital input 8	
		1	DO1+	BRK-OFF+	External brake released signal	
		2	DO1-	BRK-OFF-		
		25	DO2+	S-RDY+	Servo ready signal output	
		26	DO2-	S-RDY-		
		3	DO3+	ALM+	Alarm output	
		4	DO3-	ALM-		
		17	A+	Differential output	Phase A crossover frequency output	
		18	A-			
		20	B+		Phase B crossover frequency output	
		19	B-			
		21	Z+		Phase Z crossover frequency output	
		22	Z-			
		16	GND	Signal ground	Signal ground	
		14	AI1+	AI1	Analog input 1	
		15	AI1-			
		16	AI2+	AI2	Analog input 2	
		17	AI2-			
		Frame		FG	Ground	

3.7.1 CN1 signal cable selection

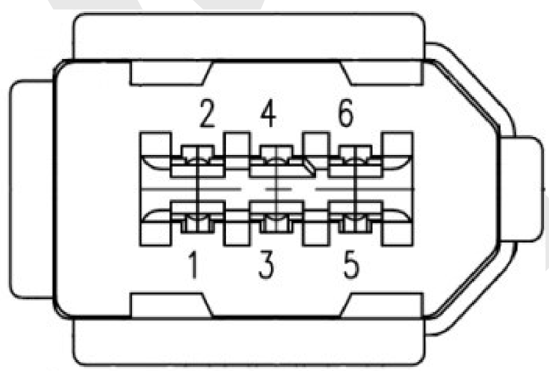
To ensure I/O signal to not be affected by electromagnetic interference, a shielded cable is recommended for this application.



Cables for different analogue signals should be used in isolated shielded cable while cables for digital signals should be shielded twisted pair cable. Cables for CN1 connectors should be 24-28AWG in diameter.

Please keep at least 30cm from main power supply/control circuit power cable (L1C/L2C/L1/L2/L3，U/V/W) to prevent electromagnetic interference of I/O signals.

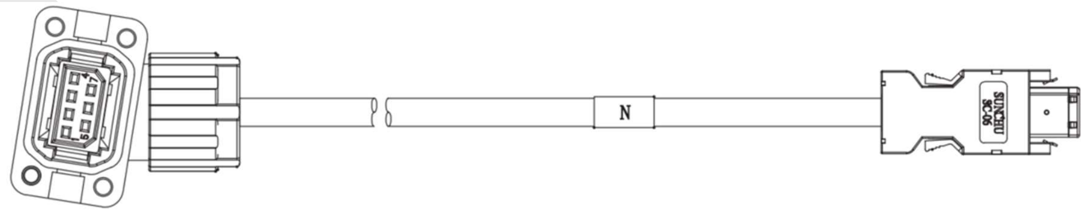
3.8 CN2 Motor Encoder



Port	Pin	Signal	Explanation
CN2	1	VCC5V	Power supply 5V
	2	GND	Power supply ground
	3	BAT+	Battery positive terminal
	4	BAT-	Battery negative terminal
	5	SD+	SSI Data+
	6	SD-	SSI Data-
	Frame	PE	Shield grounding

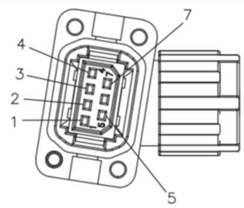
3.8.1 CN2 Motor Encoder Cable And Connector Selection

Direct connector E-CAS1E*M* Incremental encoder



Motor side Driver side

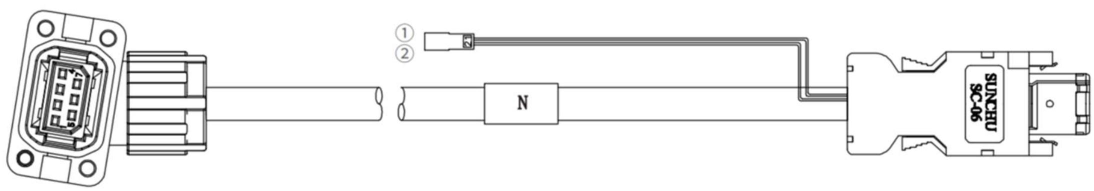
Motor cable pin



Pin

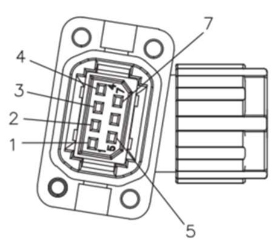
Motor	Driver	Signal
1	Frame	Shielded
2	1	1 (+5V)
3	2	2 (0V)
4	5	5 (SD+)
5	6	6 (SD-)

Direct connector E-CAS2E*M*-* Absolute encoder



Motor side Driver side

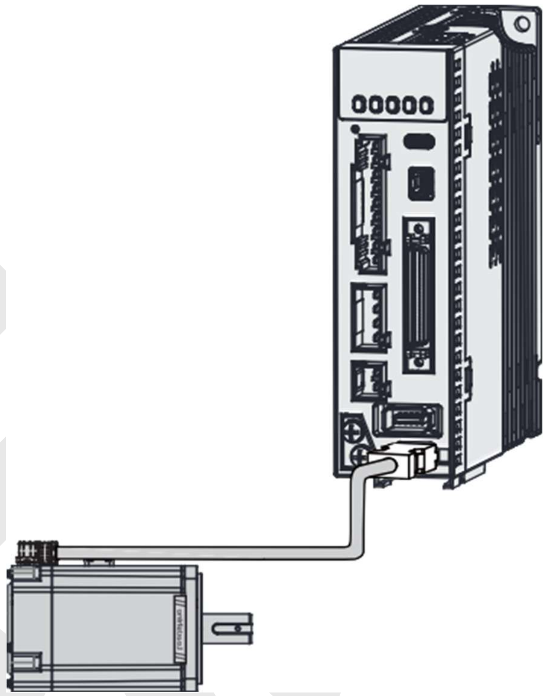
Motor cable pin



Pin

Motor	Driver	Signal
1	Frame	Shielded
2	1	1 (+5V)
3	2	2 (0V)
4	5	5 (SD+)
5	6	6 (SD-)
6	3	① (BAT+)
7	4	② (BAT-)

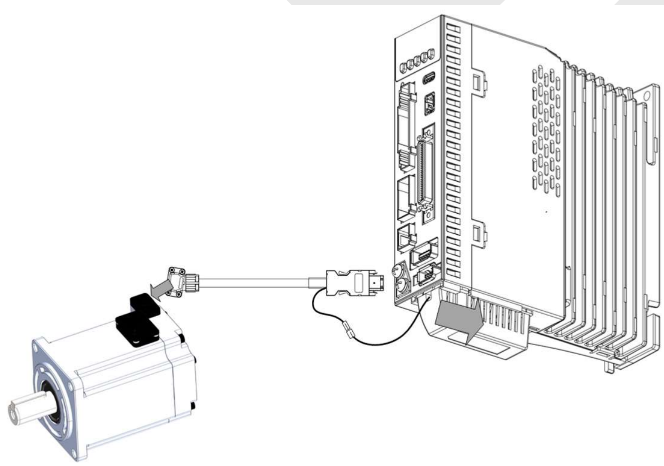
Servo driver and Motor Encoder Wiring Example



Ensure both drive-side and motor-side shields are properly grounded; otherwise, false alarms may occur.
It is recommended to use shielded twisted pair encoder cables. Do not use overly long cables.
Route encoder cables separately from power cables. Keep at least 30 cm distance to avoid interference.

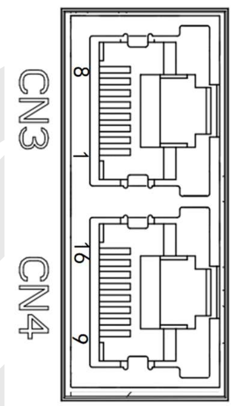
Battery box for absolute encoder

Battery box installation as shown below:
When using our direct-wired motors that come with external battery wires (but no built-in battery box), the battery box can be mounted on the drive for connection.

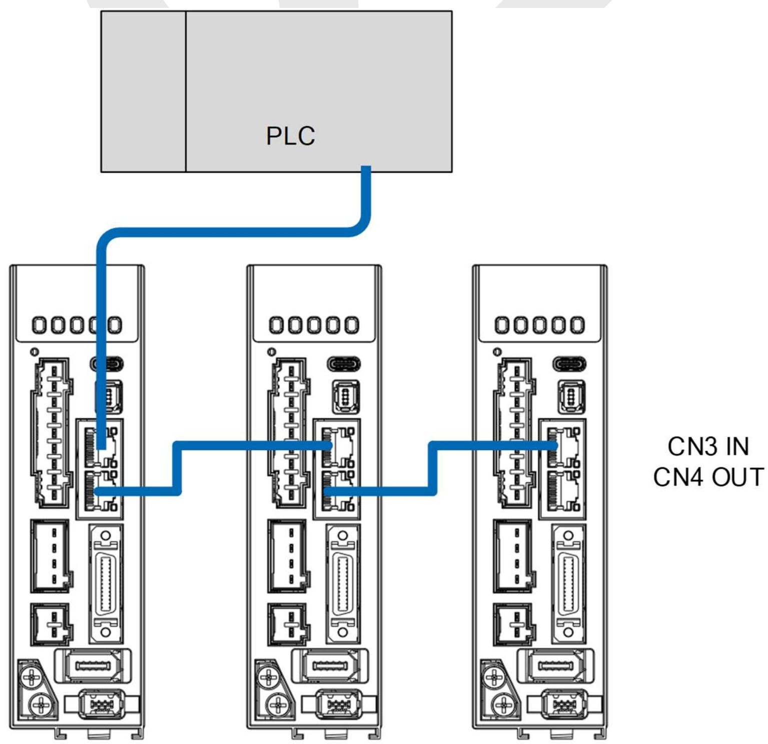


3.9 CN3/CN4 – EtherCAT Communication Port

E-DHASxxE series supports EtherCAT communication protocol which enables communication between single/multi axes and master device.

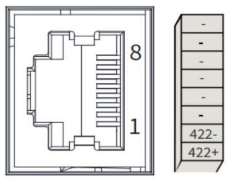
Port	Diagram	Pin	Signal	Description
CN3 CN4		1, 9	E_TX+	EtherCAT Data sending positive terminal
		2, 10	E_TX-	EtherCAT Data sending negative terminal
		3, 11	E_RX+	EtherCAT Data receiving positive terminal
		4, 12	--	--
		5, 13	--	--
		6, 14	E_RX-	EtherCAT Data receiving negative terminal
		7, 15	--	--
		8, 16	--	--
		Frame	PE	Shielding grounded

EtherCAT communication can be between multiple drivers and a master device or single driver and a master device.

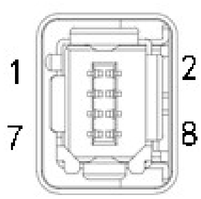


3.10 CN5 Gantry Communication Port

The E-DHASxxE-F series drive supports gantry communication function. CN5 is the gantry master-slave axis communication port. Master and slave axes exchange data via Ethernet cable.

Port	Diagram	Pin	Signal	Description
CN5		1	422+	RS422 Data TX Positive
		2	422-	RS422 Data TX Negative
		3	--	--
		4	--	--
		5	--	--
		6	--	--
		7	--	--
		8	--	--
		Frame	PE	Shielding grounded

3.11 CN6 Safe Torque Off (STO) Port

Port	Pin	Signal	Description	Remarks
	1	24V	24v power supply	Connect to SF1 and SF2 when not in use. Do not use to supply power.
	2	0V	Reference ground	
	3	SF1-	Control signal 1 negative input	When SF1 = OFF or SF2 = OFF, STO is enabled.
	4	SF1+	Control signal 1 positive input	
	5	SF2 -	Control signal 2 negative input	
	6	SF2+	Control signal 2 positive input	
	7	EDM-	External monitoring device (EDM) with differential double ended output	When SF1 = OFF and SF2 = OFF, EDM = ON
	8	EDM+		

Introduction to Safe Torque Off (STO)

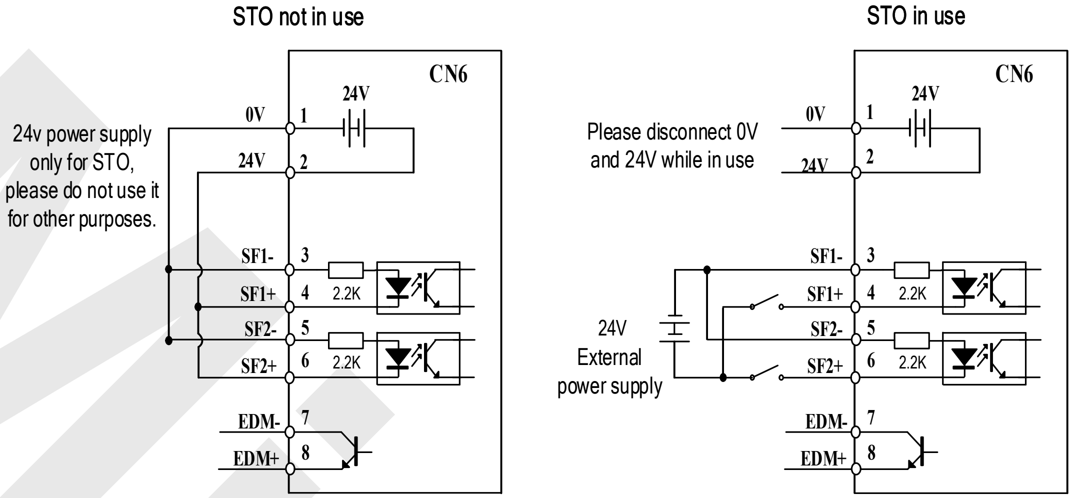
Function: Cut off motor current supply physically (through mechanical means)
STO module (CN6 connector) consists of 2 input channels. It cuts off the motor current supply by blocking of PWM control signal from the power module. When the motor current is cut off, the motor will still move under inertia and stops gradually.
The STO function is set up ready to be used by factory default. Please remove STO connector if it is not needed.

STO functional principle

STO module cuts off the motor current supply and stops motor gradually by blocking of PWM control signal from the power module through 2 isolated circuits. When an STO error occurs, the actual status of STO can be determined by the EDM status feedback.

SF1 Input	SF2 Input	EDM Output	PWM Control	Alarm
ON	ON	OFF	Normal	-
ON	OFF	OFF	Blocked	Er 1c2
OFF	ON	OFF	Blocked	Er 1c1
OFF	OFF	ON	Blocked	Er 1c0

STO wiring diagram

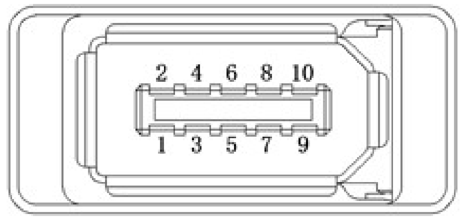


Please take precautions when enabling STO functions as servo driver will lose control over the motion of the motor. Motor might drop under gravitational pull (vertically mounted load) or move when external forces are applied to it. Alternatively, motor with holding brake can be chosen.
STO is not meant to cut off the power supply of the servo drivers and motors completely. Please power off and wait for a few minutes before starting maintenance work.
It is recommended to use an isolated power supply for STO signal input as any current leakage might cause STO malfunction.
Please remove the shorting connector from the STO port and use the STO cable provided if the function is required.

STO Alarm Reset Mechanism

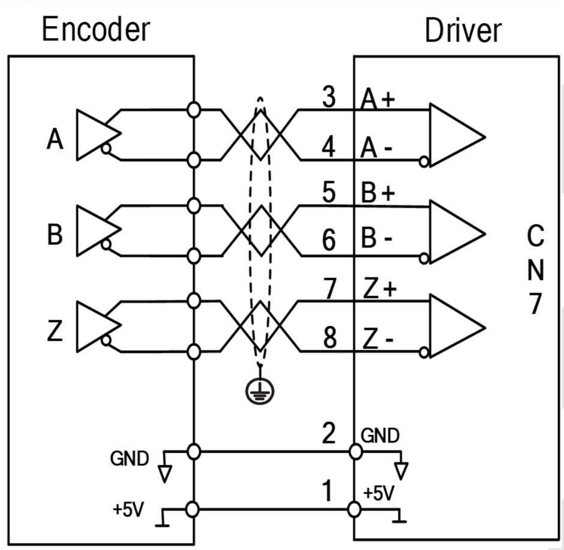
STO1 Input Status	STO2 Input Status	Alarm Reset Method
OFF → ON	ON	Reset via host, upper PC, or power cycle (Er 1C1)
ON	OFF → ON	Reset via host, upper PC, or power cycle (Er 1C2)
OFF → ON	OFF → ON	Auto reset (Er 1C0)

3.12 CN7 2nd Encoder (External)



Pin	Signal	Description
1	5V	Power supply 5V
2	GND	Power supply ground
3	A+	Phase A+ pulse input
4	A-	Phase A- pulse input
5	B+	Phase B+ pulse input
6	B-	Phase B- pulse input
7	Z+	Phase Z+ pulse input
8	Z-	Phase Z- pulse input
Frame	FG	Shield grounding

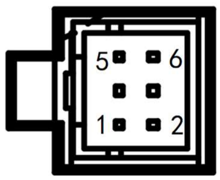
External encoder pulse input



Please connect the encoder reference ground terminal to driver ground terminal.
Recommended to use double winding cable with shielding foil, Connect the shielding foil to CN7 connector to reduce noise interference.
External encoder input method: Differential input

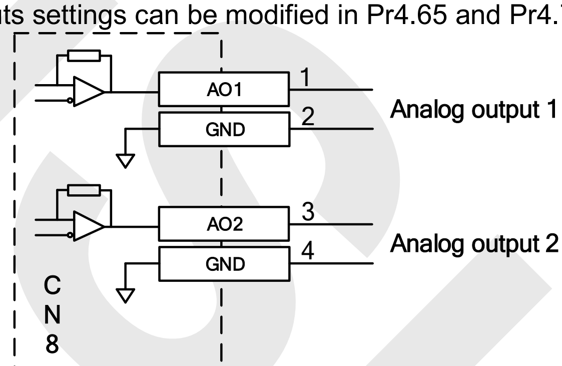
3.13 Analog and Z-phase open collector output CN8

CN8 has 2 analog outputs and 1 Z-phase open collector output

Port	Diagram	Pin	Signal	Description	Remarks
CN8		1	AO1	Analog output 1	
		2	GND	Signal ground	
		3	AO2	Analog output 2	
		4	GND	Signal ground	
		5	OCZ	Z-Phase open collector output	Only NPN Open collector output
		6	GND	Signal ground	

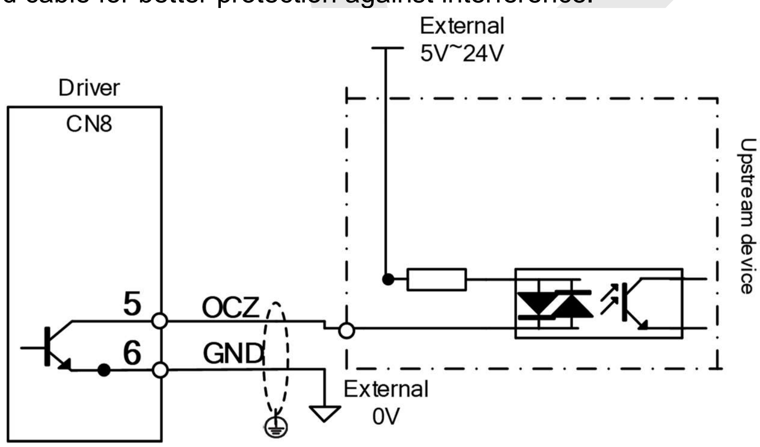
Analog outputs

Both analog outputs settings can be modified in Pr4.65 and Pr4.70.



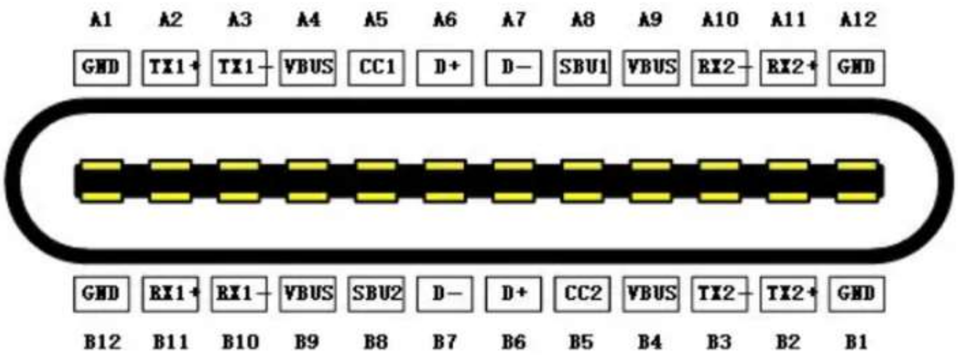
Encoder Z-phase crossover frequency output (Open Collector)

Encoder output signal will be through Open Collector after frequency division. Please connect ground terminal of external power supply to CN6 pin 6 signal ground using double winding shielded cable for better protection against interference.



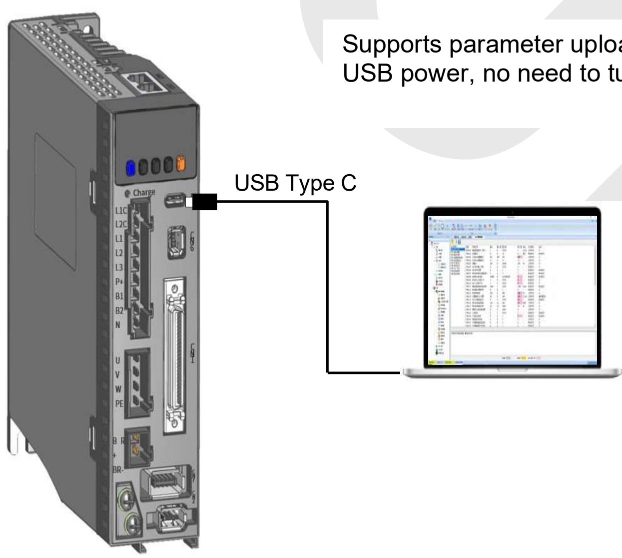
3.14 USB Type-C Tuning Port

E-DHASxxE series servo driver can be connected to PC for performance tuning, data monitoring and parameters modifying using a **USB Type-C data cable**. Can be done without the servo driver connecting to main power supply.



Port	Pin	Signal	Description
USB Type-C	A4, B4, A9, B9	VCC 5V	Power supply positive terminal 5V
	A12, B12, A1, B1	GND	Power supply negative terminal
	A6, B6	D+	USB data positive terminal
	A7, B7	D-	USB data negative terminal
	Frame	USB_GND	Ground through capacitor

PC Turning Port Wiring Example



3.15 Regenerative resistor selection and connections

The use of regenerative resistor

When the motor opposes the direction of rotation as in deceleration or vertical axis escalation, part of the regenerative energy will be delivered back to the driver. This energy will first be stored in internal capacitors of the driver. When the energy stored in the capacitors reach the maximum capacity, a regenerative resistor is required the excessive energy to prevent over-voltage.

Model	Resistance (Ω)	Power rating (W)	Minimum resistance allowed (Ω)	Minimum power allowed (W)
E-DHAS01E	100	50	50	50
E-DHAS04E	100	50	50	50
E-DHAS08E	100	50	40	50
E-DHAS10E	100	50	30	75

If detailed data such as acceleration/deceleration times (motion cycles), torque during acceleration/deceleration, and load inertia are unavailable, you may skip the following selection steps and choose a suitable regenerative braking resistor using the method described below.

To connect an external braking resistor, configure the following parameters:
P07.31 Discharge Mode = 0 to enable resistor discharge function
P00.16 / P00.17 to set the correct regenerative resistor power and resistance value

Selection of regenerative resistor

E-DHASxxE series servo drivers are equipped with internal regenerative resistor. If an external resistor is needed, please refer to the table below.

Calculation of regenerative resistance under normal operation

Steps:
1. Determine if driver comes with a regenerative resistor. If not, please prepare a regenerative resistor with resistance value higher than might be required.
2. Monitor the load rate of the regenerative resistor using front panel (d14). Set the driver on high velocity back and forth motions with high acceleration/deceleration.
3.Please make sure to obtain the value under following conditions: Driver temperature < 60℃, d14<80(Won't trigger alarm), Regenerative resistor is not fuming, No overvoltage alarm (Err120).

Pb(Regenerative power rating) = Resistor power rating x Regenerative load rate (%)

Please choose a regenerative resistor with power rating Pr about **2-4 times the value of Pb** in considered of harsh working conditions and some 'headroom'.
If the calculated Pr value is less than internal resistor power rating, external resistor is not required.

$$R(\text{Max. required regenerative resistance}) = (380^2 - 370^2)/Pr$$

Problem diagnostics related to regenerative resistor:
If driver temperature is high, reduce regenerative energy power rating or use an external regenerative resistor.
If regenerative resistor is fuming, reduce regenerative energy power rating or use an external regenerative resistor with higher power rating.
If d14 is overly large or increasing too fast, reduce regenerative energy power rating or use an external regenerative resistor with higher power rating.

If driver overvoltage alarm (Er120) occurs, please use an external regenerative resistor with lower resistance or connect another resistor in parallel.

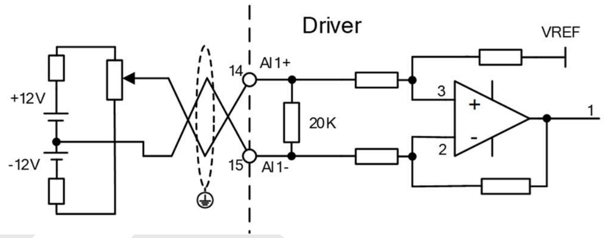
Please take following precautions before installing an external regenerative resistor.
1. Please set the correct resistance value in P00.16 and resistor power rating P00.17 for the external regenerative resistor.
2. Please ensure the resistance value is higher or equals to the recommended values in table 2-3. Regenerative resistors are generally connected in series but they can also be connected in parallel to lower the total resistance.
3. Please provided enough cooling for the regenerative resistor as it can reach above 100℃ under continuous working conditions.
4. The min. resistance of the regenerative resistor is dependent on the IGBT of the regenerative resistor circuit. Please refer to the table above.

3.16 I/O Signal

3.16.1 Analog input signal

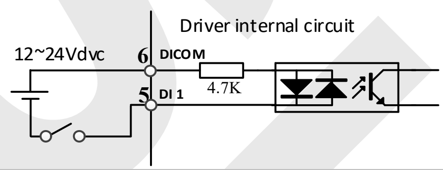
CN1 Pin	Signal	Description
14	AI1+	Differential, Input voltage: ±10VDC, Input resistance: 20kΩ
15	AI1-	
23	AI2+	
24	AI2-	

If variable resistor or resistor is needed, please refer to following diagram.



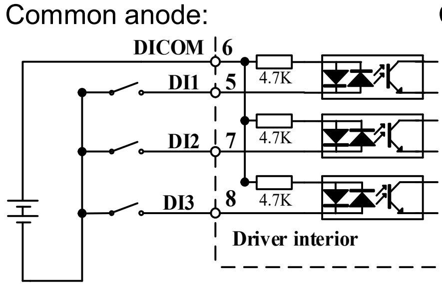
3.16.2 Common digital input

The internal circuit of common input is a bidirectional optocoupler which supports common anode and common cathode configurations. There are 2 types of outputs from master device: Relay output and Open Collector output as shown below.

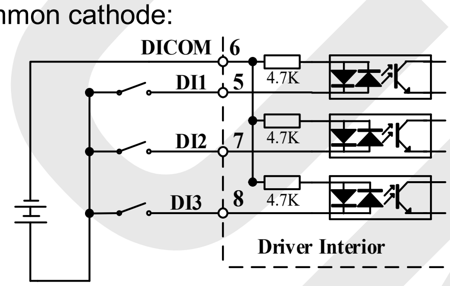


① Output from master device: Relay

Common anode:

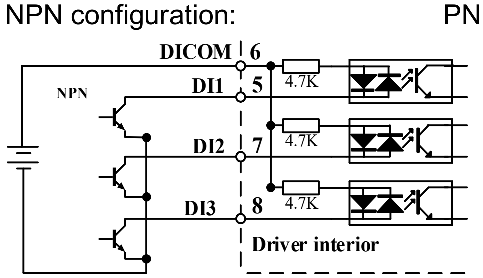


Common cathode:

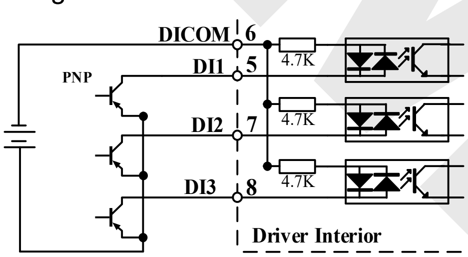


② Output from master device: Open Collector

NPN configuration:



PNP configuration:

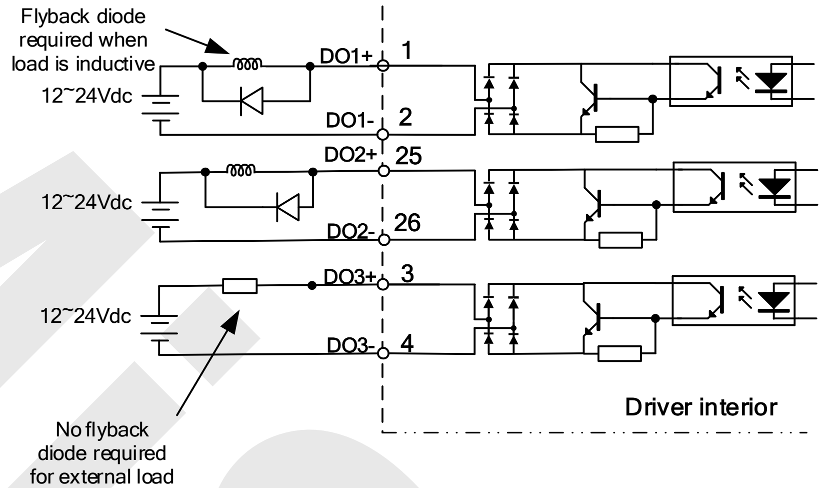


Please prepare switching power supply with output of 12-24VDC, current≥ 100mA;

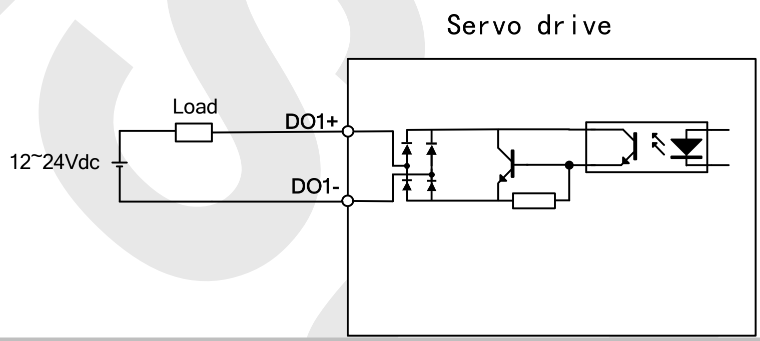
3.16.3 Common digital output

There are 3 digital outputs which are double-ended with isolated 24v power supply.

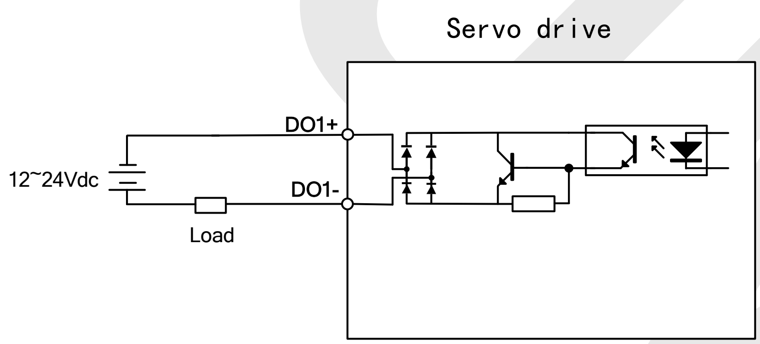
Double-ended output DO1-DO3



NPN configuration DO1-DO3



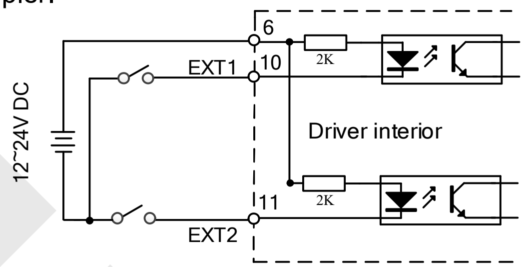
PNP configuration DO1-DO3



- Power supply is provided by user. Please be aware that reversed power supply polarity might cause damage to the driver.
- When it is an open collector output, max current: 50mA, max supplying voltage: 25V. Please ensure the switching power supply fulfills the conditions.
- If the load is an inductive load such as a relay, please connect a flyback diode in parallel in reverse. A wrong installation of the flyback diode might cause damage to the driver.
- Pin 12, 40 and 41 are 2 single ended outputs; pin 11+10 and 35+34, pin 37+36 and 39+38 are 2 double ended outputs.

3.16.4 Probe input

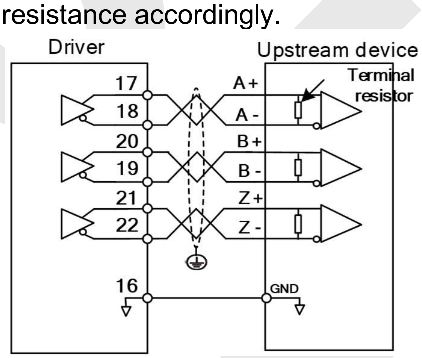
E-DHASxxE series servo drivers use DI5 and DI6 as probe input terminals. DI5/DI6 is default as probe function if no other function is assigned to them. Internal circuit is a bidirectional optocoupler.



3.16.5 Encoder crossover frequency output

Pin	Signal	Description	
17	A+	Motor encoder A-phase crossover frequency output	Differential, High≥2.5VDC, Low≤0.5VDC, Max current±20mA
18	A−		
20	B+	Motor encoder B-phase crossover frequency output	
19	B−		
21	Z+	Motor encoder Z-phase crossover frequency output	
22	Z−		
16	GND	Open collector signal ground	

When upstream device uses differential receiving, please install terminal resistor between differential input circuits. Set resistance accordingly.



3.16.6 Digital Input Signal Settings

CN1 PIN	Signal	Parameter	Default function	Default status
6	DI-COM	-	Common DI	-
5	DI1	Pr4.00	-	Normally open
7	DI2	Pr4.01	POT	Normally open
8	DI3	Pr4.02	NOT	Normally open
9	DI4	Pr4.03	HOME-SWITCH	Normally open
10	DI5	Pr4.04	-	Normally open
11	DI6	Pr4.05	-	Normally open
12	DI7	Pr4.06	-	Normally open
13	DI8	Pr4.07	-	Normally open

- When limit switch or emergency stop is used, POT, NOT and E-STOP signal will be normally close (NC) by default. Please make sure there is no safety concern if these signals need to be set to normally open (NO).
- Servo driver power on signal (SRV-ON) is set as normally open (NO) as default. Please make sure there is no safety concern if this signal needs to be set to normally close (NC).
- If a same function is assigned to multiple pins, Er210 might occur.

3.16.7 Digital Output Signal Settings

CN1	Signal	Parameter	Function
1	DO1+	Pr4.10	External break released BRK-OFF
2	DO1-		
25	DO2+	Pr4.11	Servo Ready S-RDY
26	DO2-		
3	DO3+	Pr4.12	Servo Alarm （ALARM）
4	DO3-		

- Digital output functions can be assigned to multiple pins at the same time.

Theoretical selection of regenerative resistor

Without external loading torque, the need for an external regenerative resistor can be determined as the flow chart below

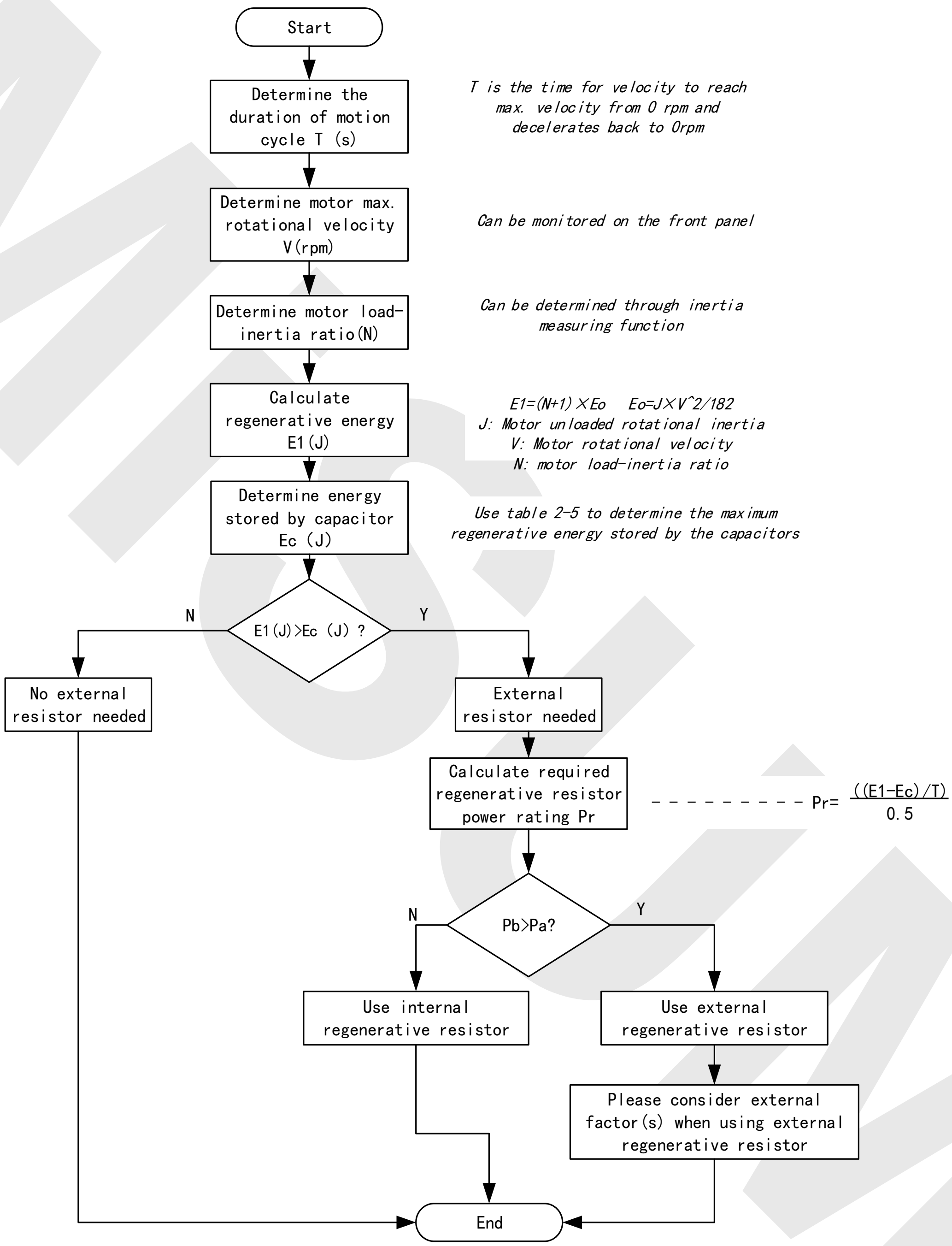
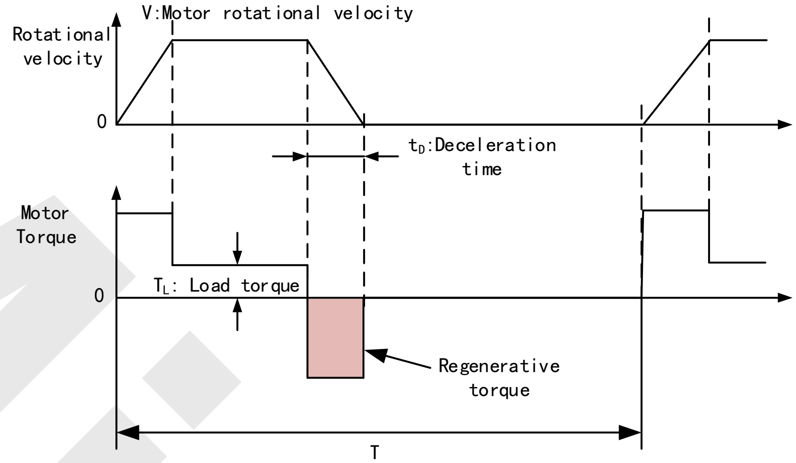


Diagram below shows the acceleration and deceleration cycle periods and the regenerative torque that occurs during the process.



Steps to calculate capacity of regenerative resistor

Steps	Calculation	Symbol	Formula
1	Servo system regenerative energy	E1	$E1=(N+1)\times J\times V^2/182$
2	Depleted energy from loss of load system during acceleration	E_L	$E_L = (\pi/60)\ V\times T_L\times tD$ *If loss is not determined, please assume E_L = 0.*
3	Depleted energy due to motor coil resistance.	E_M	$E_M=(U^2/R)\times tD$ R= coil resistance, U = operating voltage *If R is not determined, please assume E_M = 0.*
4	Energy stored by internal DC capacitors	Ec	Please refer to table 2-5
5	Depleted energy due to regenerative resistance	E_K	E_K=E1-(EL+EM+EC), If loss is ignored, EK=E1-EC
6	Required power rating of regenerative resistor	Pr	$Pr=E_K/(0.5\times T)$

Internal capacitor capacity and rotor inertia

E-DHASxxE Drive	Servo Motor	Rotor Inertia ($\times 10^{-4}$kg.m^2)	Max. regenerative energy stored in capacitor Ec(J)
E-DHAS01E	E-MASH2-0401	0.048	13.46
E-DHAS04E	E-MASH2-0604	0.58	13.47
E-DHAS08E	E-MASH2-0808	1.66	22.85
E-DHAS10E	E-MASH2-0810	2.03	27.74

There are motors with low, medium and high inertia. Different motor models have different rotor inertia. Please refer to product catalogue for more information on rotor inertia.

Calculation examples:
Servo driver: E-DHAS08E, Servo Motor: E-MASH2-0808. When T = 2s, rotational velocity = 3000rpm, load inertia is 5 times of motor inertia.

E-DHASxxE Drivers	Servo motor	Rotor Inertia (× 10^{-4}kg.m^2)	Max. regenerative energy stored in capacitor Ec(J)
750W	E-MASH2-0808	1.66	22.85

Regenerative energy produced:

$$E1 = \frac{(N+1) \times J \times V^2}{182} = \frac{(5+1) \times 1.66 \times 3000^2}{182} = 49.3J$$

If E1<Ec, internal capacitors can't take in excessive regenerative energy, regenerative resistor is required.
Required regenerative resistor power rating Pr:

$$Pr = \frac{(E1 - Ec)}{0.5T} = \frac{49.3 - 22.85}{0.5 \times 2} = 26.45W$$

Hence, with the internal regenerative resistor Pa = 75W, Pr<Pa, no external regenerative resistor is required.

Let's assume if the load inertia is 15 times of motor inertia, Pr = 108.6W, Pr>Pa, external regenerative resistor is required. And to consider for harsh working environment,

Pr(external)=108.6/(1-40%)=181 W

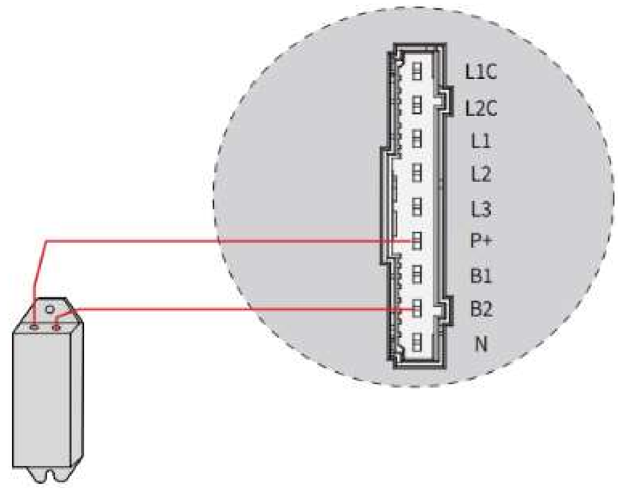
When selecting the resistance of the regenerative resistor, please be higher than the minimum value recommended in table 2-3 but lower than Rmax

Rmax =(380^2-370^2)/Pr=7500/108.6=69Ω

In conclusion, a regenerative resistor with resistance 40Ω - 70Ω and power rating 110W to 180W can be chosen.

Please take note that theoretical calculations of regenerative resistance is not as accurate as calculations done under normal operation.

Regenerative resistor connection



If B1 and B2 are connected, internal regenerative resistor is now functional; if an external regenerative resistor is required, please disconnect B1 and B2 and connect P+ to B1 to prevent overcurrent.
Please do not connect external regenerative resistor directly to N or it might cause fire hazard.
Please refer to the section above to select minimum allowable resistance for the external regenerative resistor or it might damage the driver.
Please confirm P00.16 and P00.17 before using any regenerative resistor.
Do not set the regenerative resistor near any flammable object.

3.17 Measures against electromagnetic interference

To reduce interference, please take the following measures:
I/O signal cable > 3m; Encoder cable > 20m
Use cable with larger diameter for grounding
①Grounding resistance > 100Ω
②When there are multiple drivers connected in parallel, PE terminal of the main power supply and ground terminal of servo drivers must be connected to copper ground bar in the electrical cabinet and the copper ground bar needs to be connected to the metal frame of the cabinet.
Please install a line filter on main power supply cable to prevent interference from radio frequency.
In order to prevent malfunctions caused by electromagnetic interference, please take following measures:

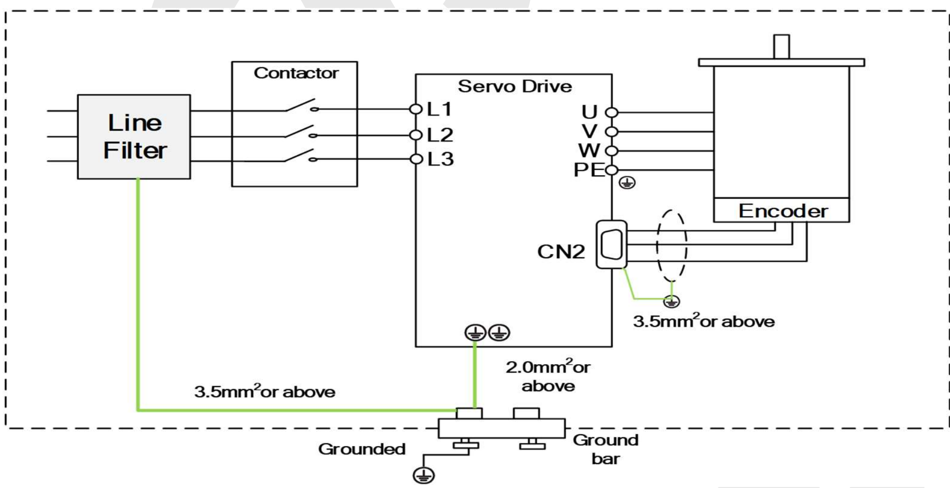
①Install master device and line filter close to the servo driver

②Install surge suppressor for relay and contactor

③Please separate signal/encoder cable from power cable with a space of at least 30cm

④Install a line filter for the main power supply if a device with high frequency generation such as a welding machine exists nearby

3.17.1 Grounding connection and other anti-interference wiring connections

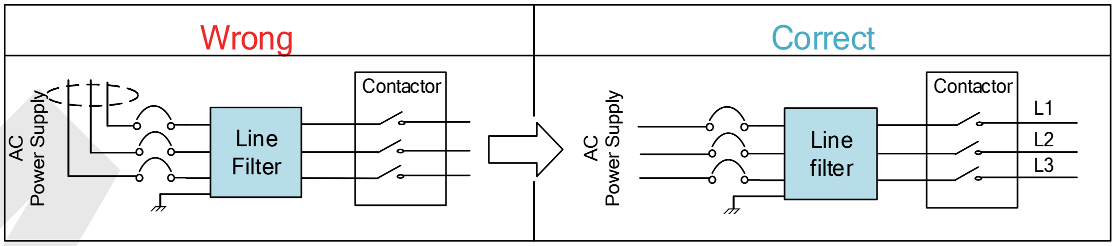


Servo motor frame should be grounded. Please connect the PE terminal of servo motor and servo driver and ground them together to reduce interference.
Ground both ends of the foil shield of encoder cable.

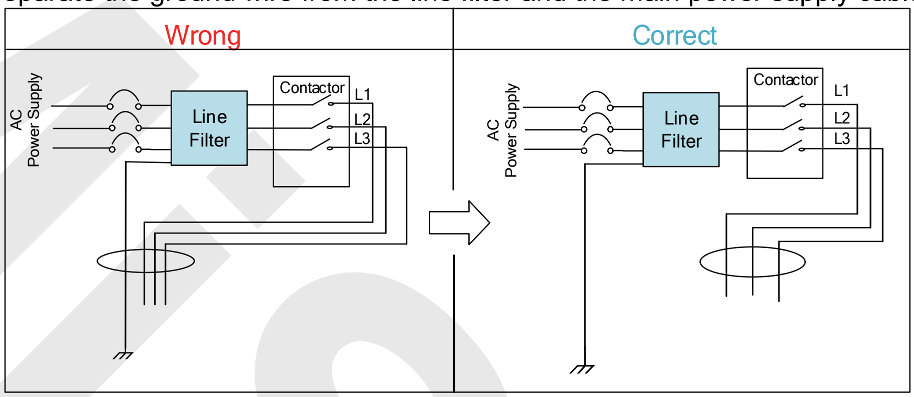
3.17.2 Using line filter

To reduce interference from main power supply cable and to prevent from affecting other sensitive components around the servo driver, please choose a line filter based on actual supply current. Please do be aware of the following mistake when installing a line filter.

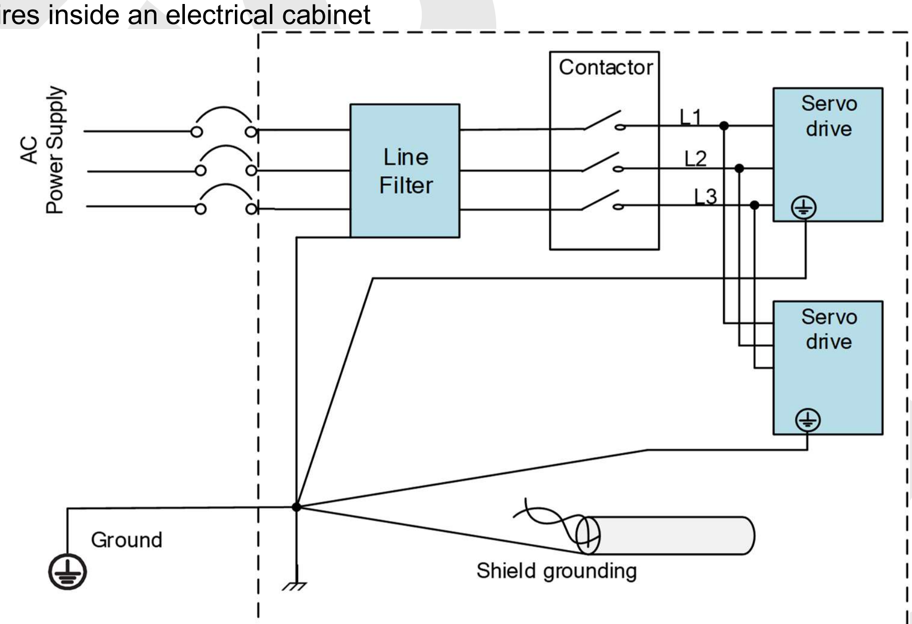
Do not band the main power supply cable together.



Separate the ground wire from the line filter and the main power supply cable.



Ground wires inside an electrical cabinet

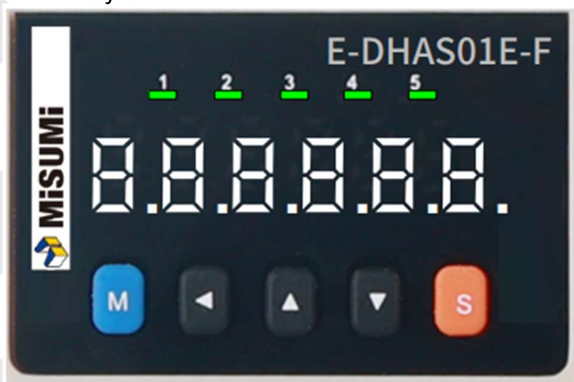


Chapter 4 Servo driver Operation

4.1 Front Panel

4.1.1 Front Panel Structure

Servo driver front panel consists of 5 push buttons , a 8-segments display and 5 green LED as warning indicators. Can be used for displaying of status, alarms, functions, parameters setting and auxiliary functions.

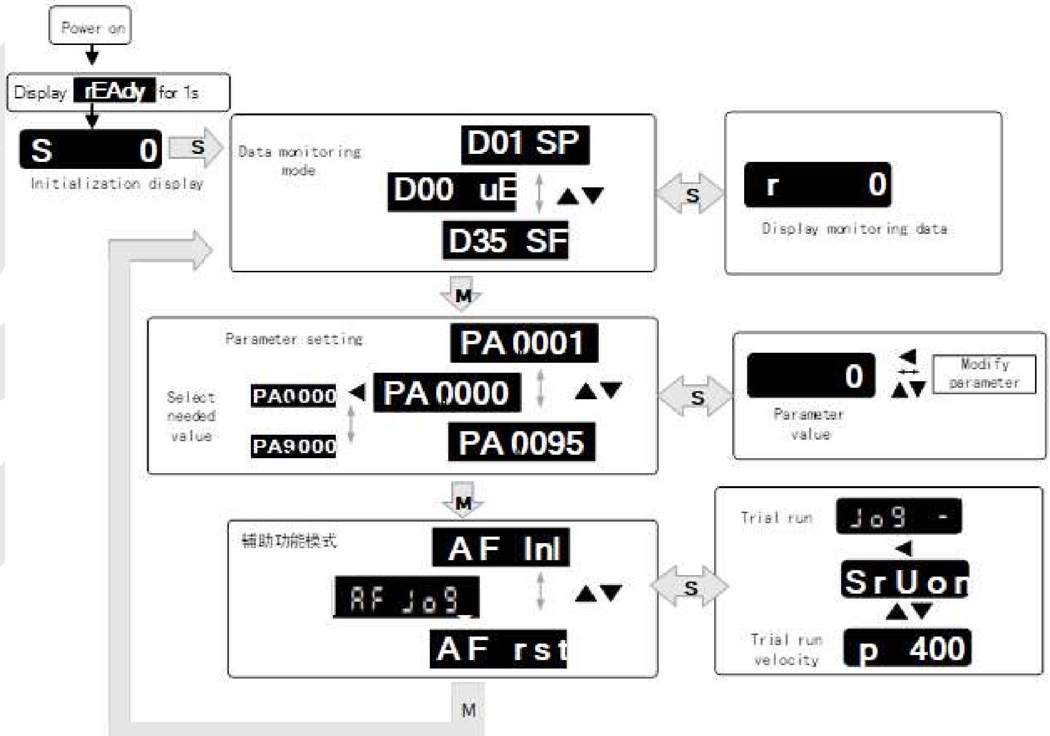


Front panel

Buttons and functions

Label	Symbol	Function
Display	/	Consists of 5 push buttons, an 8-segments display and 5 green LED as warning indicators
Mode	**M**	To switch between 3 modes: 1. Data monitoring mode: To monitor changes of motion data values 2. Parameters setting mode: To set parameters 3. Auxiliary functions mode: To operate common functions, such as trial run, alarm clearing
Enter	**S**	To enter or confirm
Up	▲	To switch between sub-menus / Increase
Down	▼	To switch between sub-menus / Decrease
Left	◀	To switch between values

4.1.2 Panel Operation Flow



Flow diagram of panel operation

(1) rESEt will be displayed for about 1 second after driver is powered on. Then, automatically enters data monitoring mode and displays initial data value. Otherwise, alarm code will be displayed if error occurs.

(2) Press **M** key to switch between modes.

Data monitoring mode → Parameters setting mode → Auxiliary functions mode

Alarm code will be displayed regardless of any mode if alarm occurs. Press **M** to switch to other modes.

(3) Press ▲ or ▼ to select the type of parameters in data monitoring mode. Press **S** to confirm.

(4) Press ◀ to select current segment in parameters settings mode. Press ▲ or ▼ to increase/decrease the value of segment. Press **S** to confirm the modified value(s) and save the parameters.

4.1.3 Front Panel Locking

To prevent any misuse of the front panel, it can be locked. Limitations when locked are as shown below.

Mode	Limitation
Data monitoring	Not limited
Parameters setting	Parameters can only be read, not modified.
Auxiliary functions	Not limited

To lock and unlock the front panel

<table>
<tr><th></th><th>Front Panel</th><th>EDrive</th></tr>
<tr><td>Lock</td><td colspan="2">①Set P05.35 = 1.
②Restart driver.
③Front panel is now locked.</td></tr>
<tr><td>Unlock</td><td>① Please refer to auxiliary function
AFUnL
② Front panel is now unlocked.</td><td>① Set P05.35 = 0.
② Front panel is now unlocked.</td></tr>
</table>

4.1.4 Data Monitoring Mode

E-DHAS series servo driver offers the function to monitor different types of data in data monitoring mode. After entering this mode, press **S** to monitor any data that starts with d. Press **S** again to get back to data monitoring mode and **M** to switch to any other modes.

Data list in data monitoring mode

No.	Label	Descriptions	Display	Unit	Data Format (x = numerical value)
0	d00uE	Position command deviation	d00uE	pulse	“xxxx”
1	d01SP	Motor velocity	d01SP	r/min	“r xxxx” – Motor actual velocity “F xxxx” – External encoder feedback velocity
2	d02CS	Position control command velocity	d02CS	r/min	“xxxx”
3	d03Cu	Velocity control command velocity	d03Cu	r/min	“xxxx”
4	d04tr	Actual feedback torque	d04tr	%	“xxxx”
5	d05nP	Feedback pulse sum	d05nP	pulse	“xxxx”
6	d06cP	Command pulse sum	d06CP	pulse	“xxxx”
7	d07	Maximum torque during motion	d07	/	“d xxxx” – Max torque % “V xxxx”- Average load ratio
8	d08FP	Internal command position sum	d08FP	pulse	“xxxx”
9	d09cn	Control mode	d09Cn	/	Position: “Ct PoS” Velocity: “Ct SPd ” Torque: “Ct trq”
10	d10Io	I/O signal status	d10 Io	/	-

11	d11Ai	Analog input	d11Ai	V	-
12	d12Er	Alarm cause and record	d12Er	/	"Er xxx" Alarm code
13	d13rn	Warning	d13rn	/	"H xxx" Warning code
14	d14r9	Regeneration load factor	d14r9	%	"xxx"
15	d15oL	Overload factor	d15oL	%	"L xxx" – Motor overload % "d xxx" – Driver overload %
16	d16Jr	Inertia ratio	d16Jr	%	"xxx"
17	d17ch	Motor not running cause	d17Ch	/	"CP xxx" Error code
18	d18ic	No. of changes in I/O signals	d18ic	/	"xxx"
19	d19	Internal use	d19	/	" xxxx"
20	d20Ab	CSP position command sum	d20Ab	puls e	" xxxx"
21	d21AE	Single turn encoder data	d21AE	puls e	"A xxxx" – motor encoder single turn data "F xxxx" – external encoder single turn data
22	d22rE	Multiturn encoder data	d22rE	r	" xxxx"
23	d23 id	485 received frame	d23id	/	"id xxx" "Fr xxx"
24	d24PE	Position deviation	d24PE	Unit	"A xxxx" – Position deviation "F xxxx" – Full closed loop deviation (Command unit) "H xxxx" - Full closed loop deviation (Encoder unit)
25	d25PF	Motor electrical angle	d25PF	puls e	" xxxx"
26	d26hy	Motor mechanical angle	d26hy	puls e	" xxxx"
27	d27 Pn	Voltage across PN	d27Pn	V	" xxxx"
28	d28 no	Software version	d28no	/	"d xxx Servo software" "F xx Communication software" "p xxx Servo power rating" "C xx CPLD software"
29	d29AS	Internal usage	d29AS	/	"A xxxx" "F xxxx" – external encoder serial no.
30	d30NS	No. of times of encoder communication error	d30sE	/	"A xxxx" – Motor encoder communication error count "F xxxx" – External encoder communication error count
31	d31 tE	Accumulated uptime	d31tE	/	" xxxx"
32	d32Au	Automatic motor identification	d32Au	/	"r xxx Motor no." "E xxx Servo no."
33	d33At	Driver temperature	d33At	℃	"d xxx" – driver temperature "C xxx" – MCU temperature
34	d34	Servo status	d34	/	"xxx"

35	d35 SF	Internal usage	d35SF	/	"xxxxxx"
43	d43	External encoder Z-Phase counter	D43	/	"xxxxxx"
44	d44	External encoder pulse count per revolution	D44	pulse	"xxxxxx"
45	d45	External encoder direction	D45	/	"xxxxxx"
46	d46	Position compared to current position	D46	/	"xxxxxx"
Following are parameters related to EtherCAT bus					
36	d36	Synchronizing cycle	d36dc	ms	"xxxxxx"
37	d37	No. of times of synchronization loss	d37sc	/	"xxxxxx"
38	d38	Synchronization Type	d38st	freerun/DC	"xxxxxx"
39	d39	If DC is running	d39dr	/	"xxxxxx"
40	d40	Acceleration and deceleration status	d40sn	/	"xxxxxx"
41	d41	Object dictionary address	d41od	/	"xxxxxx" Index(4 bit)+subindex(2 bit)
42	d42	Object dictionary value	d42od	/	"xxxxxx" 1、If OD does not exist, ODNEXT is displayed. 2、If OD is out of range, ODRNG is displayed.

" -08St " is displayed after power on (When servo is not enabled).

Description of data monitoring function

When using the front panel to monitor data, data is divided in low/high bit and positive/negative.

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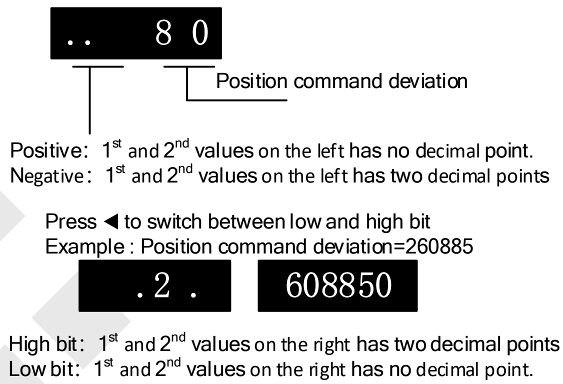
High bit: 1st and 2nd values on the right has two decimal points
Low bit: 1st and 2nd values on the right has no decimal point.

. . 50　　50

Positive: 1st and 2nd values on the left has no decimal point.
Negative: 1st and 2nd values on the left has two decimal points

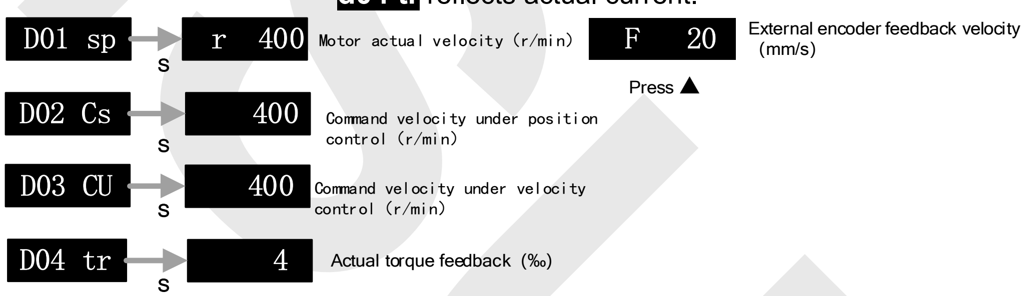
1. d00uE Position command deviation

Shows high bit and low bit of position deviation

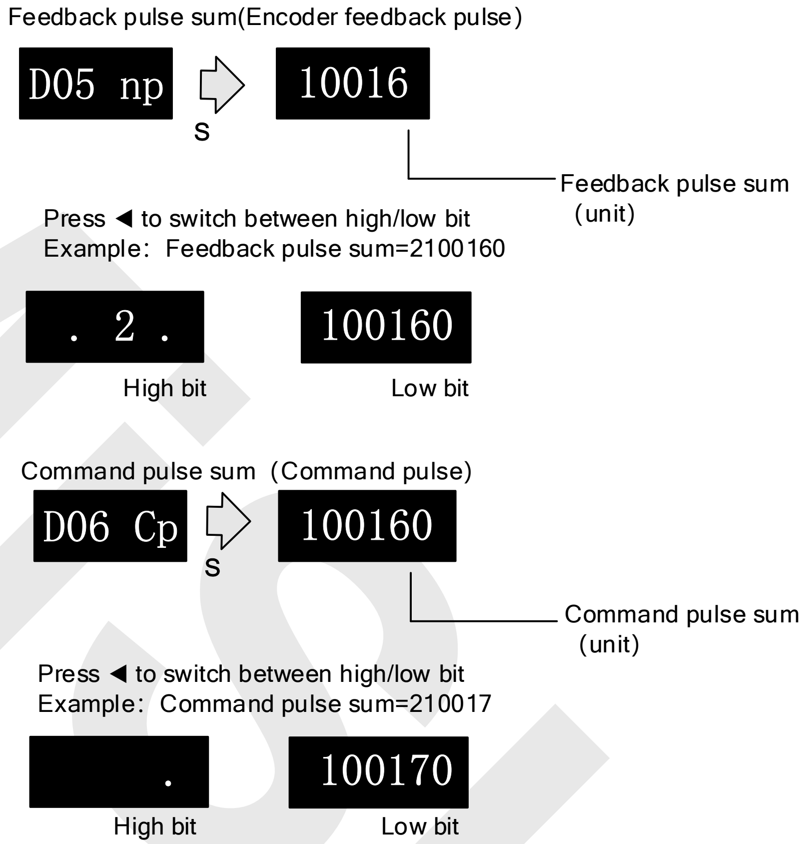


2. d01SP Motor velocity, d02CS Position control command velocity, d03CU Velocity control command velocity, d04 tr Actual torque feedback

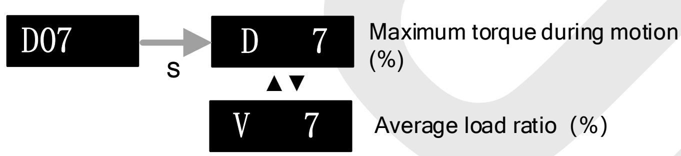
d04 tr reflects actual current.



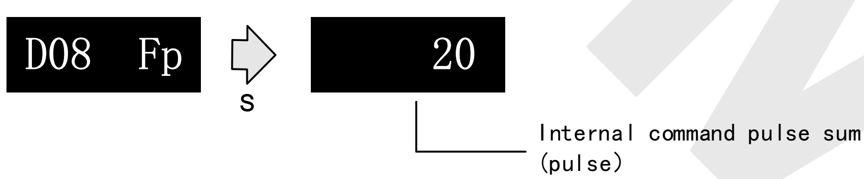
3. d05nP Feedback pulse sum d06CP Command pulse sum



4. d07 Maximum torque during motion



5. d08FP Internal command pulse sum



6. d09Cn Control mode

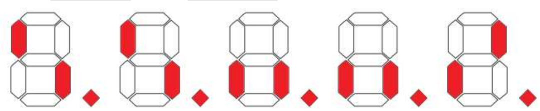
D09 Cn → S

Ct pos	Position control mode
Ct spd	Velocity control mode
Ct trq	Torque control mode

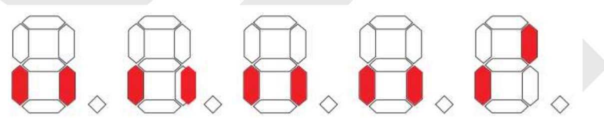
7. d10Io I/O signal status

When the top half of the digital tube is lighted, the signal is valid; when the bottom half of the digital tube is lighted, the signal is not valid. Decimal points represent I/O status, input when lighted, output when not lighted.

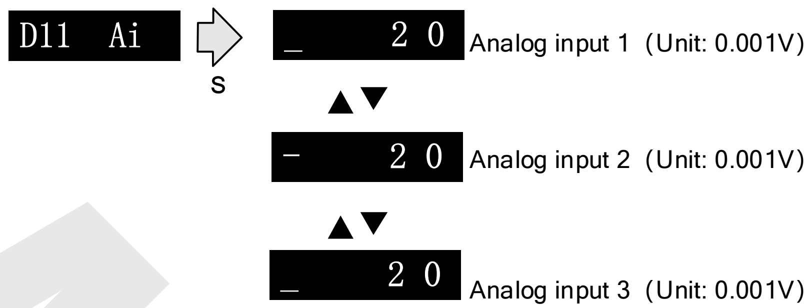
- **Input:** From low to high bit(Right to left) DI1,DI2….DI10. Decimal point is lighted to represent input signals.
  In the example below, DI1, DI8 and DI10 input signal is valid; DI2-DI7, DI9 input signal is invalid.



- **Output:** From low to high bit(Right to left) DO1,DO2….DO10. Decimal point is not lighted to represent output signals.
  In the example below, DO1 output signal is valid; DO2-DO10 output signal is invalid.

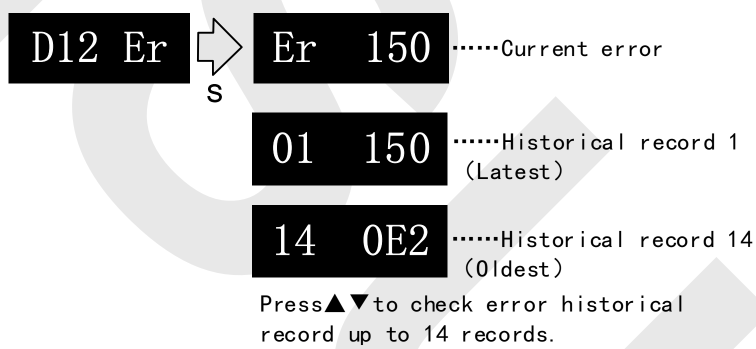


8. d11Ai Analog input



3 analog inputs can be monitored through d11. Left most bar at the top: 1st analog input; at the middle: 2nd analog input; at the bottom 3rd analog input. Points on 4th and 5th value means negative value.

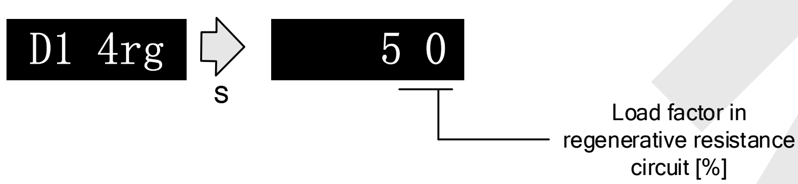
9. d12Er Alarm cause and historical record



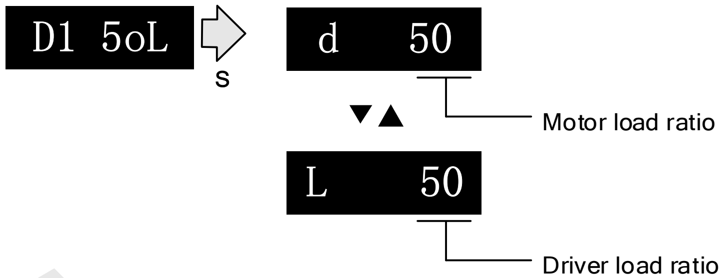
Please refer to the alarm list table in chapter 8 for alarms that can be recorded.

10. d14rg Regenerative load factor d15oL Overload factor

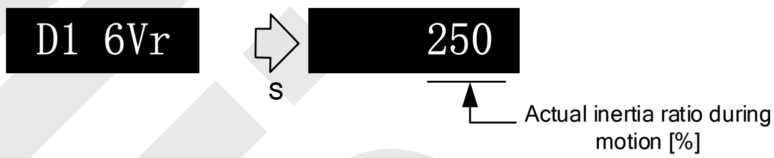
Regenerative load factor（Er120 might occur, if the value increases indefinitely）



Overload factor（Er100 might occur, if d increases indefinitely Er101 might occur, if L increases indefinitely）

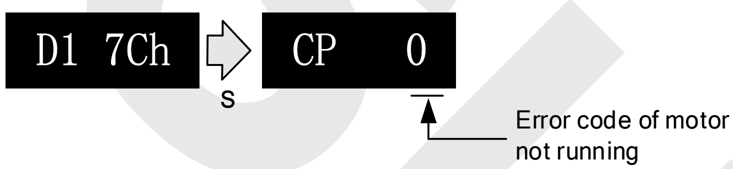


11、d16Jr Inertia ratio



Use auxiliary function **AF_GL** or EDrive to measure the inertia ratio. The result will be shown on **D1 6Vr**, hold M to write the value in Pr0.04.

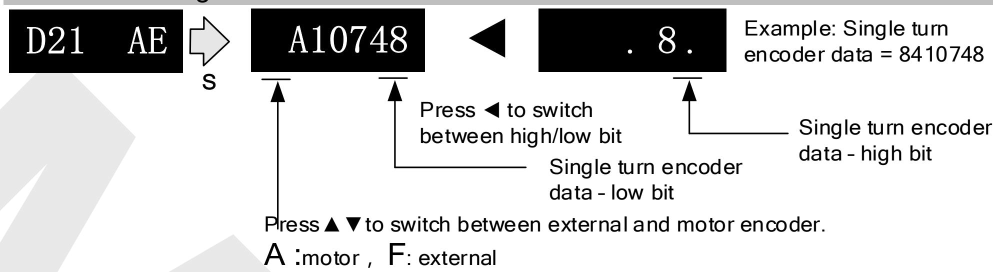
12、d17Ch Motor not running cause



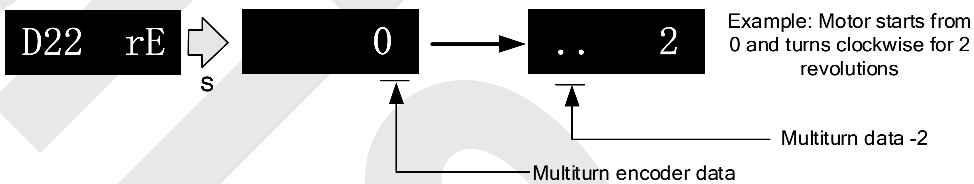
"d17Ch" Motor No Running Cause - Codes & Descriptions

Display Code	Description	Content
CP 0	Normal	
CP 1	DC bus undervoltage	Check if DC bus voltage is too low on D27
CP 2	No SRV-ON signal	Servo-ON input (SRV-ON) is not connected to COM-
CP 3	POT/NOT input valid	P05.04 = 0, POT is in open circuit, velocity command is in positive direction NOT is in open circuit, velocity command is in negative direction
CP 4	Driver alarm	/
CP 5	Relay not clicked	Check input voltage
CP 6	Pulse input prohibited (INH)	P05.18=0
CP 7	Position command too low	No command or too low
CP 8	CL valid	P05.17=0, deviation counter connected to COM-
CP 9	Zero speed clamp valid	P03.15 = 1, Zero speed clamp input is open

13、d21AE Single turn encoder data d22rE Multiturn encoder data

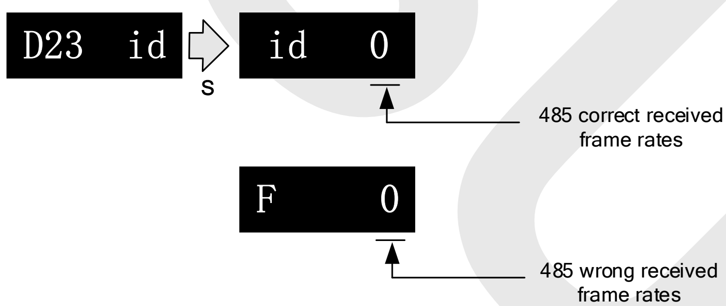


For 23-bit encoder, single turn encoder data = 0~8388607. Each value corresponds to certain position in a single revolution of the rotor, clockwise motion as negative, counterclockwise motion as positive. When counterclockwise single turn data > 8388607, multiturn data +1, clockwise single turn data < 0, multiturn data -1.

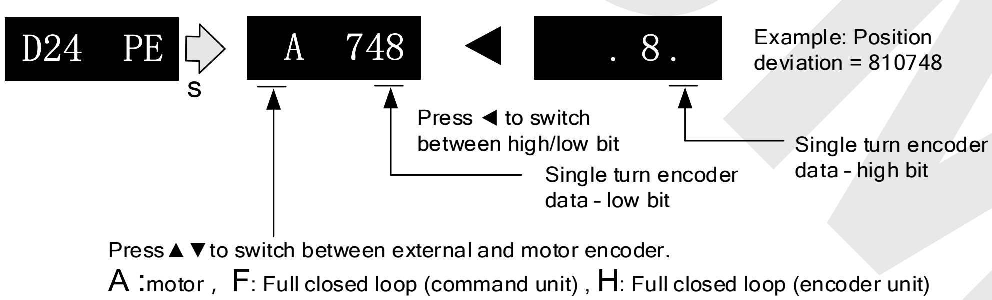


Multiturn encoder data range: -32768~+32767, As no. of revolution goes over range, 32767 will jump to -32768, -32767(counter clockwise); -32768 will jump to 32767、 32766 (clockwise)

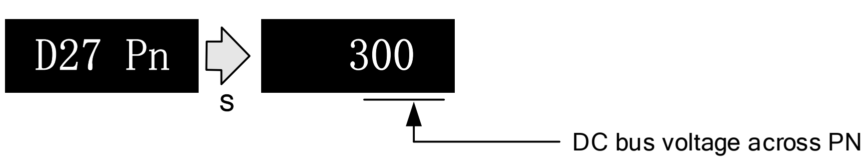
14.d23id 485 received frame



15. d24PE Position deviation



15. d27Pn DC bus voltage



16. d28no Software version

D28 no → S → d 024 .....Servo firmware version (DSP)

▲▼

C 000 .....CPLD Version

▲▼

F 013 .....Communication software version

▲▼

P 400 .....Servo drive power rating

17. d31tE Accumulated operation time

D31 tE → S → 1 2 5 6

Accumulated uptime (hour)

Press ◀ to switch between high/low bit

Low bit 1 2 5 6 ⟷ .0 . High bit

18. d34 Servo driver status display

Driver status: 402 state machine, EtherCAT communication, running mode, running

Communication status
Always On: EtherCAT communication successful
Blinking: Data transfering

402 State Machine
OFF(1: Top tube on)
Ready(2: Mid tube on)
ON(3: Top, Mid, Bottom tube on)
Operation(0: Enabled)
Emergency stop(Side tubes on)
Other status (-)

EtherCAT Communication Status
0 OFF
1 Init
2 Pre-Op
4 Safe-Op
8 Op
- Others

Running mode
(1/3/4/6/8/9/A, Other no supported)

Running mode
rn: Rotation
St: Stop

Display setting at power on

- Default setting for initialization display settings at power on is **d34**,if any other display is required, please set on P05.28.

Please refer to P05.28 for any display content required on the front panel during initialization

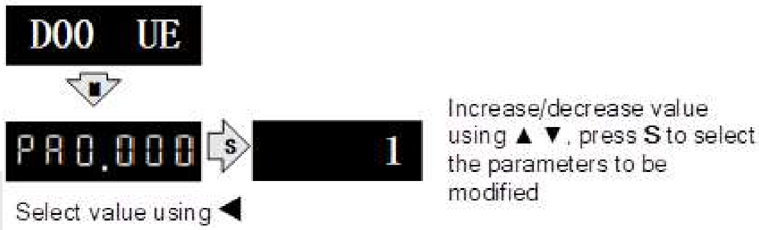
P05.28	Name	LED initial status			Mode			F
	Range	0~42	Unit	—	Default	34	Index	2528h
	Activation	After restart						

To set content display on front panel of the servo driver at servo driver power on.

Set value	Content	Set value	Content	Set value	Content
0	Position command deviation	15	Overload rate	30	No. of encoder communication error
1	Motor speed	16	Inertia ratio	31	Accumulated operation time
2	Position command velocity	17	No rotation cause	32	Automatic motor identification
3	Velocity control command	18	No. of changes in I/O signals	33	Driver temperature
4	Actual feedback torque	19	Number of over current signals	34	Servo status
5	Sum of feedback pulse	20	Absolute encoder data	35	/
6	Sum of command pulse	21	Single turn position	36	Synchronous period
7	Maximum torque during motion	22	Multiturn position	37	No. of synchronous loss
8	/	23	Communication axis address	38	Synchronous type
9	Control mode	24	Encoder position deviation	39	Whether DC is running or not
10	I/O signal status	25	Motor electrical angle	40	Acceleration/Deceleration status
11	/	26	Motor mechanical Angle	41	Sub-index of OD index
12	Error cause and history record	27	Voltage across PN	42	Value of sub-index of OD index
13	Alarm code	28	Software version		
14	Regenerative load rate	29	/		

4.1.5 Parameters saving

Save using driver's front panel

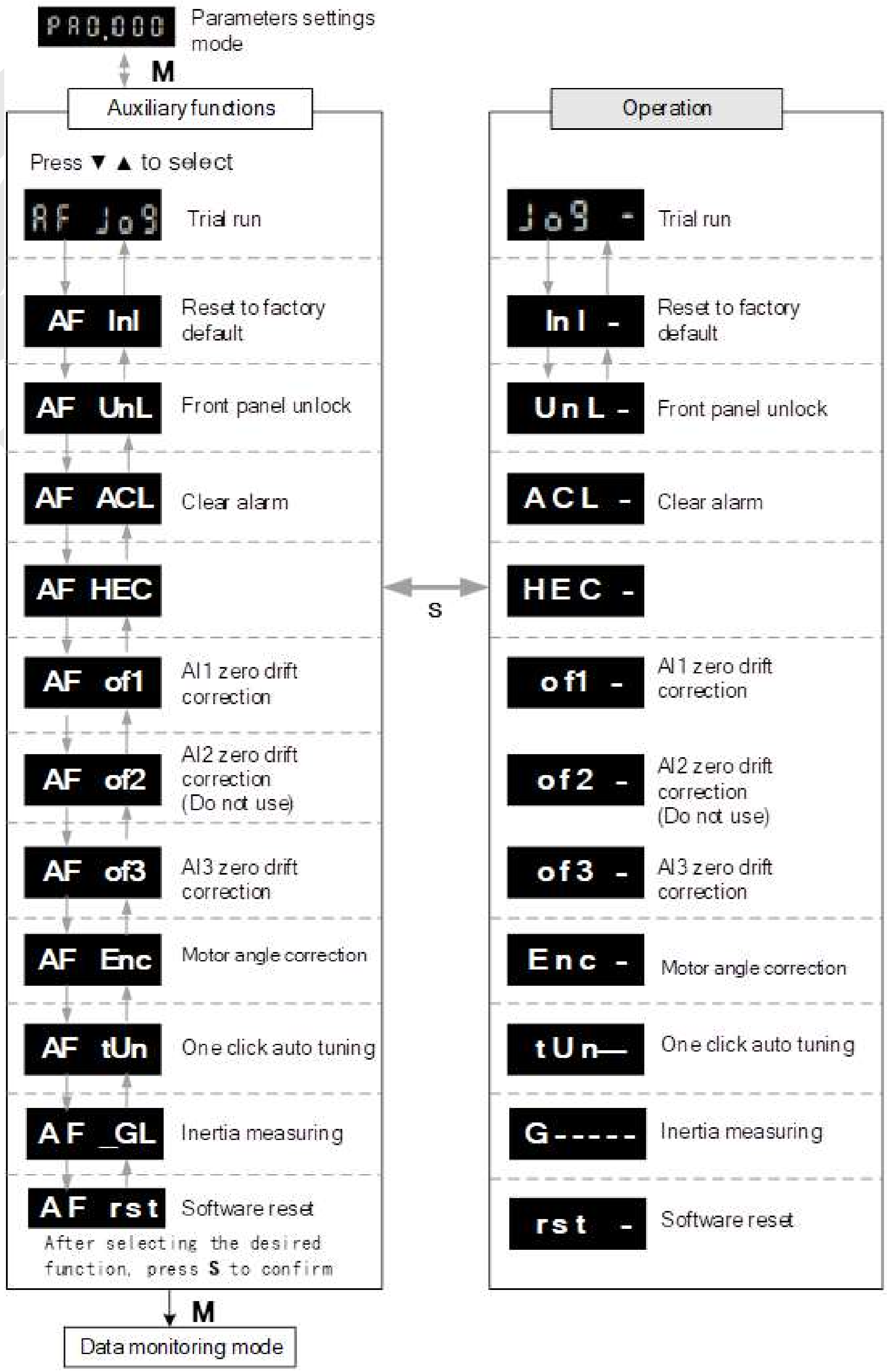


After modifying the selected parameter to desired values, press **S** to confirm and save the changes. If the parameter is modified but user does not want to save the changes, press **M** to exit without saving. Some parameter modifications will only take effect after the driver is restarted.

Save using object dictionary

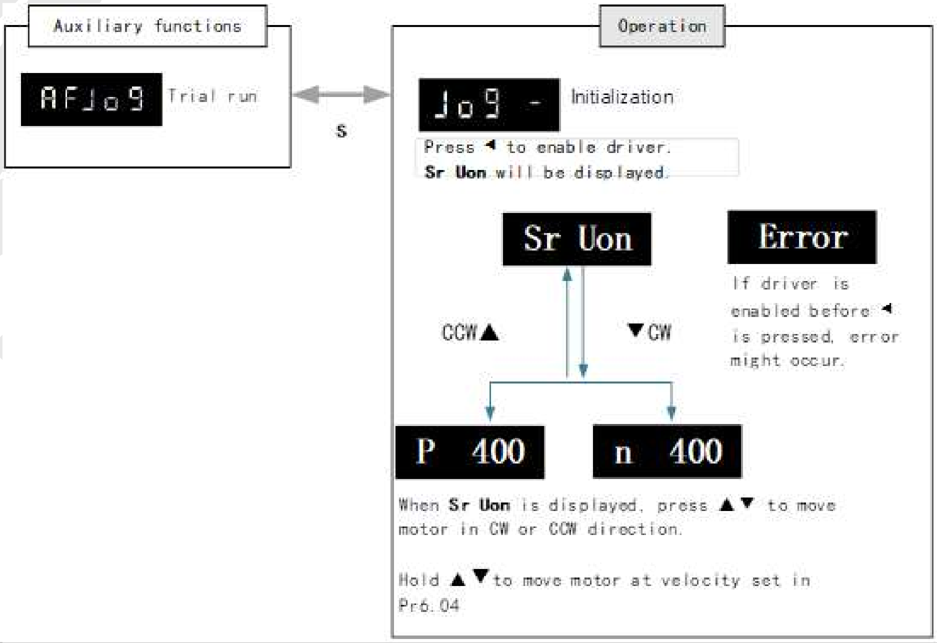
Objects	Types	Explanations
0x1010-01	ALL parameters	Master device can save **all** parameters to EEPROM using 0x1010-01. When the driver detects 0x1010-01 data from master device as 0x65766173, driver will save current parameters to EEPROM. After saving, 1010-01=1.
0x1010-02	Communication parameters	Master device can save communication parameters to EEPROM using 0x1010-02. When the driver detects 0x1010-02 data from master device as 0x65766173, driver will save current parameters to EEPROM. After saving, 1010-02=1.
0x1010-03	402 parameters	Master device can save 402 parameters to EEPROM using 0x1010-01. When the driver detects 0x1010-03 data from master device as 0x65766173, driver will save current parameters to EEPROM. After saving, 1010-03=1.
0x1010-04	Manufacturer's parameters	Master device can save manufacturer's parameters to EEPROM using 0x1010-01. When the driver detects 0x1010-01 data from master device as 0x65766173, driver will save current parameters to EEPROM (including 0x2000 to 0x5FFF parameters and electronic gear ratio parameters)

4.1.6 Auxiliary function



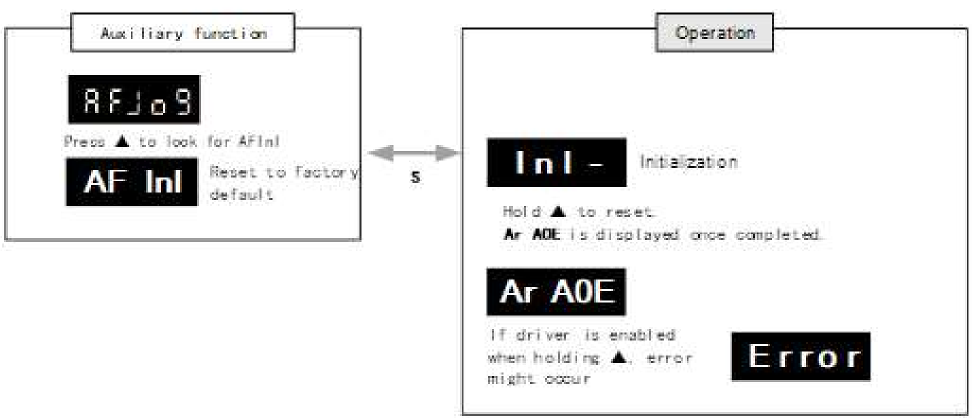
AF Jog Trial run

- Please disable servo driver before performing any trial run.
- Please don't modify gain related parameters during trial run to prevent any occurrence of mechanical vibrations.
- Only use trial run when P00.01 set to 0, 1, 6.
- Please check P06.04 (JOG velocity) and P06.25 (JOG acceleration) before running.
- Press **S** to exit trial run.

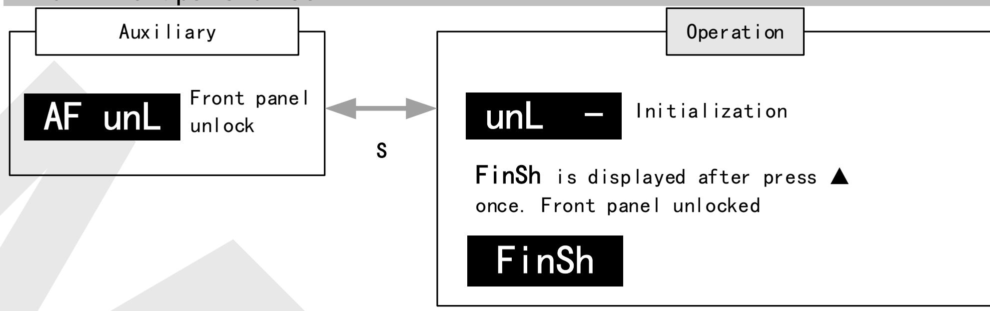


AF Inl Reset to factory default

To reset parameters settings to factory default. Can be used to reset parameters using auxiliary function on front panel or using object dictionary.

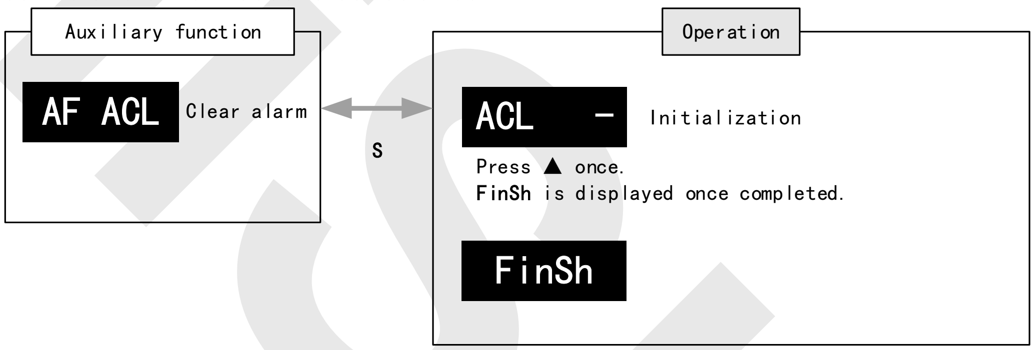


AF unL Front panel unlock



AF ACL Clear alarm

Alarm can be cleared using this auxiliary function but before that, the error needs to be solved and driver needs to be restarted.

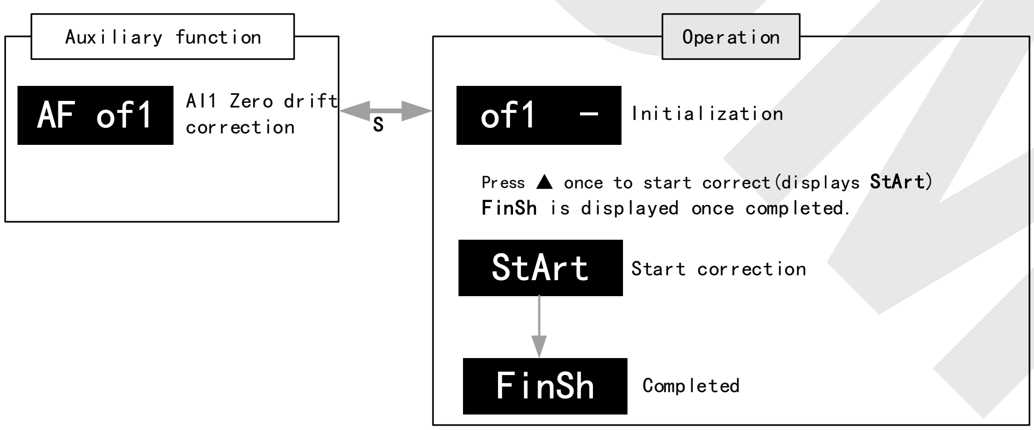


For alarms that can be cleared using this function, please refer to table in Chapter 8.

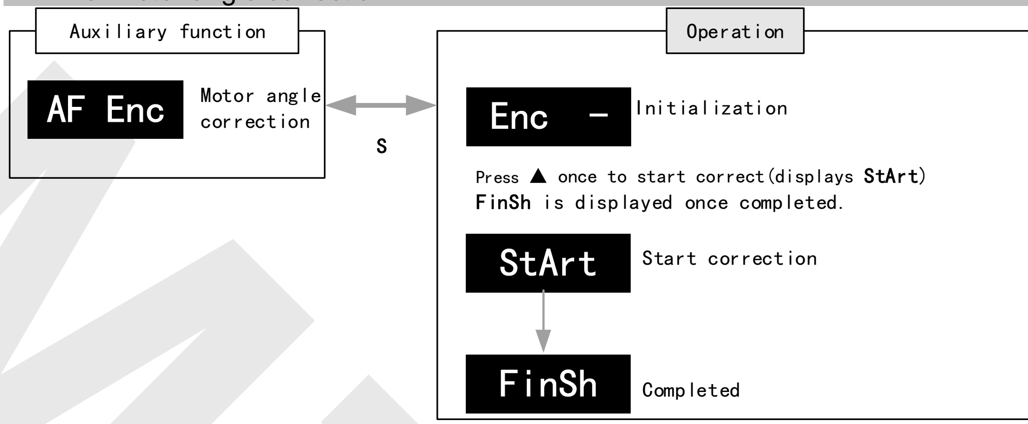
AF of1 - AF of3 Analog input AI1-3 zero drift correction

Auto adjustment of analog input zero drift settings

Analog input	Parameter (Zero drift settings)
AI1	P04.22
AI2	P04.25
AI3	P04.28



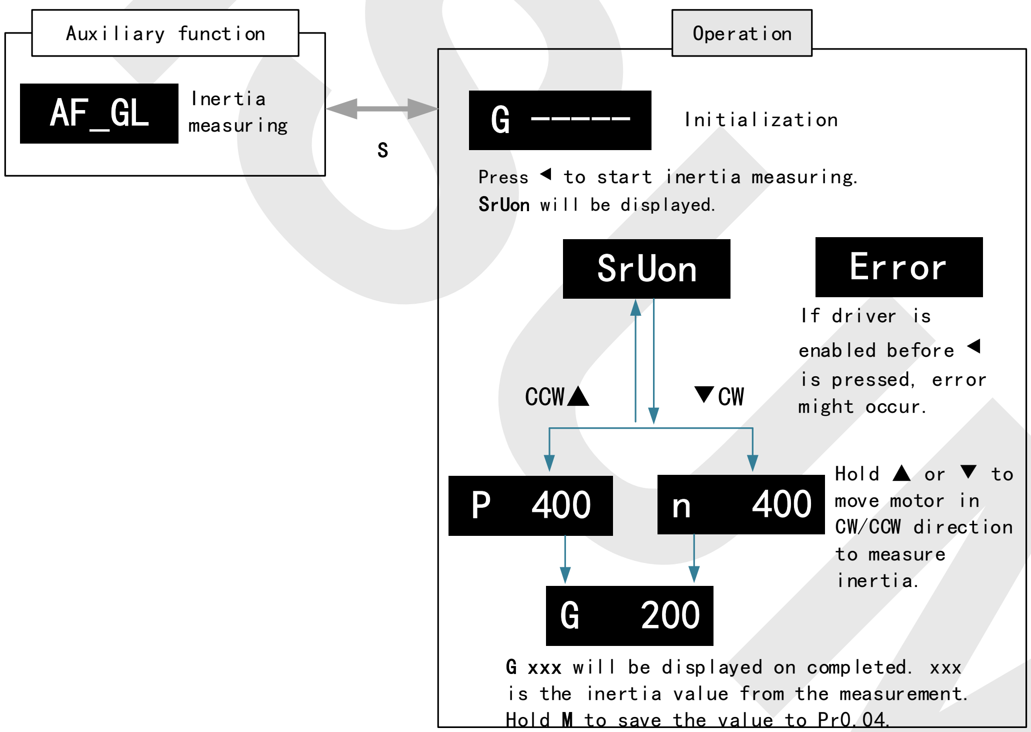
AF Enc Motor angle correction



AF_GL Inertia measuring

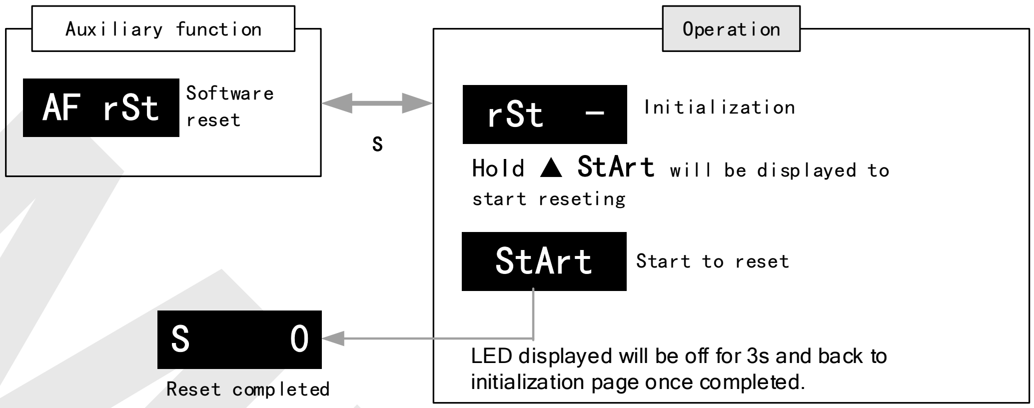
Please make sure: 1. Velocity < 300RPM, average velocity duration < 50ms
2. Acceleration/Deceleration time < 500ms

Press **S** to exit and disable the driver once completed.



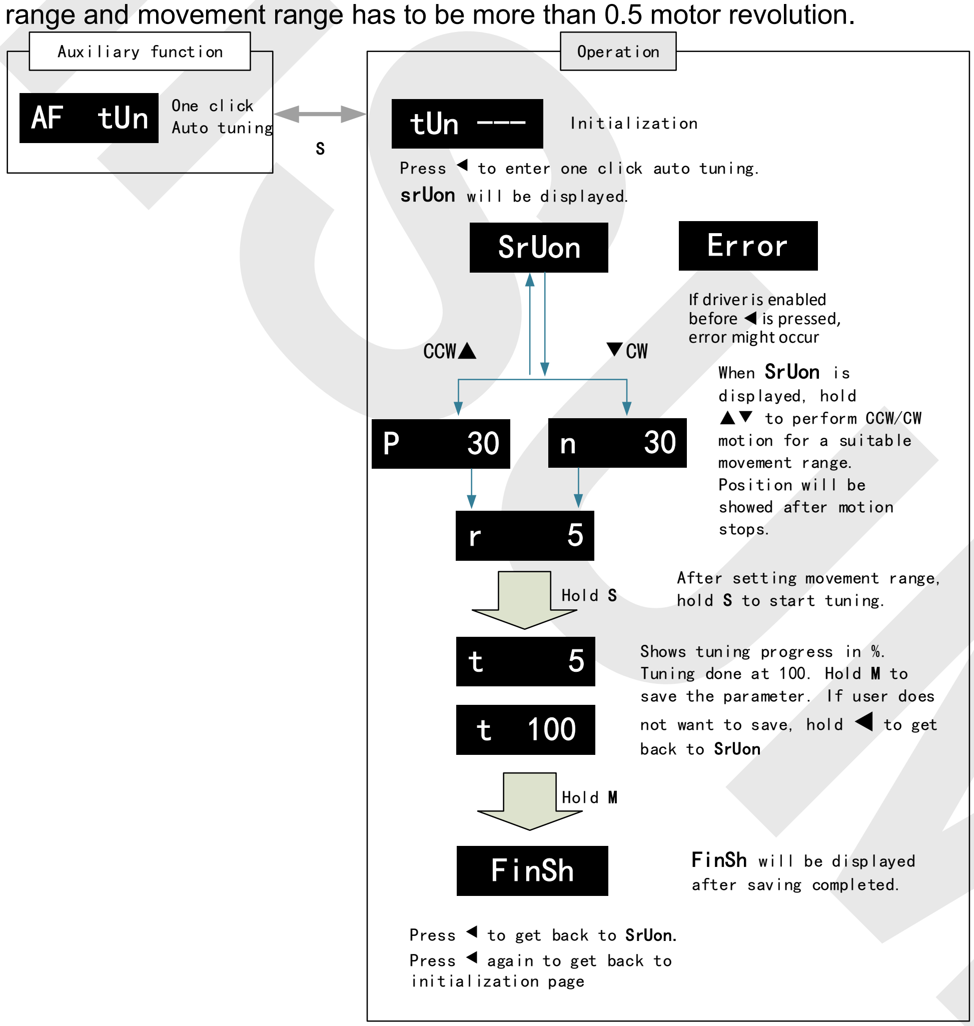
AF rSt Software reset

Software reset is used mainly on parameters modification that takes effect only after driver restart.

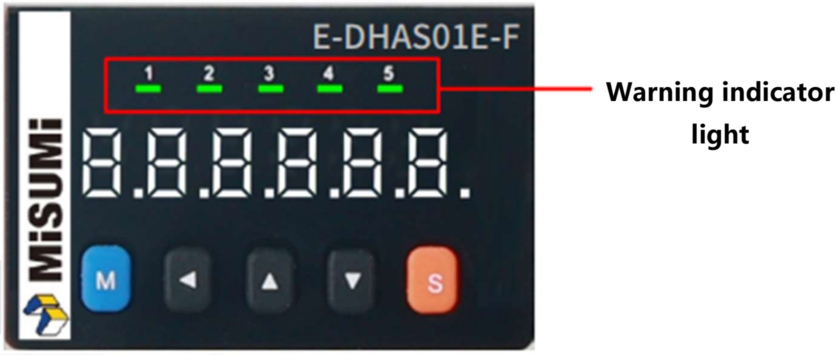


AF_tun One click auto tuning

One click auto tuning can be applied by operating the front panel. Set simple movement range and movement range has to be more than 0.5 motor revolution.



4.1.7 Front panel warning indicator



Warning indicator light status

1. Servo powered on but disabled: All 5 LEDs off
2. Servo powered on and enabled: All 5 LEDs lighted in cycles.
3. Warning status: All 5 LEDs lit in accordance with assigned signals. Please refer to the table below.

<table>
<tr><th>Warning indicator</th><th>Parameter</th><th>Assignment</th></tr>
<tr><td>LED 1</td><td>P04.74</td><td rowspan="5">
<table>
<tr><th>Set value</th><th>Signal</th></tr>
<tr><td>[0]</td><td>Null</td></tr>
<tr><td>1</td><td>Negative limit switch</td></tr>
<tr><td>2</td><td>Battery low voltage</td></tr>
<tr><td>3</td><td>Overload</td></tr>
<tr><td>4</td><td>Torque limit</td></tr>
<tr><td>5</td><td>Positive limit switch</td></tr>
</table>
</td></tr>
<tr><td>LED 2</td><td>P04.75</td></tr>
<tr><td>LED 3</td><td>P04.76</td></tr>
<tr><td>LED 4</td><td>P04.77</td></tr>
<tr><td>LED 5</td><td>P04.78</td></tr>
</table>

4.2 Tuning Software

Our company provides free download and usage of the debugging software MISUMI EDrive via our website. When used with a debugging cable, one end connects to a PC and the other to the Type-C port of the servo driver, enabling communication between the PC and the servo driver.

Main Functions of MISUMI EDrive

■ System Monitoring: Monitor the servo driver's operating status, alarms, and capture/save real-time operation data.
Key modules include:

- Oscilloscope function
- Alarm display
- Status monitoring (corresponds to front panel motion data monitoring)
- Oscilloscope: Supports single/multi-frame high-precision sampling, overlapping waveforms, analog and digital channels, and dual cursors for waveform analysis.

■ Auto Tuning: Automatically adjusts gain parameters based on simple operating condition settings.
■ Parameter Management: Read and download all parameters from P00 to P09, load previously saved parameter files, modify and write parameters to the driver, save to EEPROM, and restore factory settings.
■ IO Configuration: Configure or monitor IO signals via the IO settings interface, with support for forced IO input/output.
■ Trial Run (JOG): Perform simple forward/reverse motor movements. Supports position and speed test runs.
■ Inertia Identification: Identify load inertia through a series of actions and write the actual inertia ratio to P00.04 via parameter management.
■ Mechanical Characteristic Analysis: Analyze the system’s resonance frequency and apply notch filters for improvement.
■ Gain Adjustment: Adjust servo rigidity level and tuning method. In manual mode, individual parameters can be modified. In standard/real-time mode, predefined rigidity tables are used, and individual parameters cannot be changed.
■ Position Comparison: Configure up to 42 position comparison points.
■ Black Box: Read and analyze servo black box data using the debugging software.

Notes:

Supports USB-powered connection to the driver, allowing parameter modification via MISUMI EDrive without external power.
Recommended to use a Windows 10 PC.
Serial port driver vendors no longer support Windows 7, which may cause disconnection after power cycling the driver.
If using Windows 7, you may need to replug the debugging cable to reconnect.

4.3 Electronic gear ratio

When loaded axis moved for 1 command unit, it corresponds to motor encoder unit which is converted in more comprehensible physical units such as μm. The use of electronic gear ratio is to turn the movement in physical units to required pulse count equivalency.

Electronic gear ratio = $\frac{\text{Rotor movement (Encoder unit)}}{\text{Loaded axis movement(Command unit)}}$

Rotor might be connected to load through reducer or other mechanical structures. Hence, the gear ratio is closely related to reducer gear ratio, position encoder resolution and mechanical dimensions related parameters.

Electronic gear ratio = $\frac{\text{Encoder resolution}}{\text{Loaded axis resolution}}$

Electronic gear can be set through P00.08. If P00.08 ≠ 0, P00.08 is valid. If P00.08 = 0, object dictionary 6092-01 is valid.
Command pulse count per motor revolution needs to be ≥ Encoder Pulse Count per Revolution / 8000.

E-DHAS series comes with motors has resolution 23-bit encoder. Pulse count per revolution for 23-bit encoder = 8388608. From the condition above, the command pulse count per motor revolution for 23-bit encoder ≥ 1049.

P00.08	Name	Command pulse counts per revolution			Mode					F
	Range	0~8388608	Unit	P-	Default	0	Index		2008h	
	Activation	After restart								
	Pulses per revolution can be set using object dictionary 608F, 6091, 6092. However, P00.08 has higher priority.									

Index 608Fh-01	**Name**	Encoder resolution			**Unit**	Encoder unit	**Structure**	VAR	**Type**	UInt 32
	Access	RO	**Mapping**	TPDO	**Mode**	F	**Range**	1~2147483647	**Default**	0
	To set encoder resolution									
Index 6091h-01	**Name**	Electronic gear ratio numerator			**Unit**	r	**Structure**	VAR	**Type**	Dint 32
	Access	RW	**Mapping**	RPDO	**Mode**	F	**Range**	1-2147483647	**Default**	1
	To set electronic gear ratio numerator									
Index 6091h-02	**Name**	Electronic gear ratio denominator			**Unit**	r	**Structure**	VAR	**Type**	Dint 32
	Access	RW	**Mapping**	RPDO	**Mode**	F	**Range**	1-2147483647	**Default**	1
	To set electronic gear ratio denominator									
Index 6092h-01	**Name**	Number of pulses per rotation			**Unit**	Command unit/r	**Structure**	VAR	**Type**	UInt 32
	Access	RW	**Mapping**	RPDO	**Mode**	F	**Range**	1~2147483647	**Default**	10000
	If 6092h-01(Feed constant) is not equal to 608Fh(Position encoder resolution), then: Electronic gear ratio = Encoder resolution / 6092h-01 If 6092h-01(Feed constant) is equal to 608Fh(Position encoder resolution), then: Electronic gear ratio = 6091-01 / 6092h-01									

4.4 Get Started with Driver Operation

4.4.1 Checklist before operation

No.	Description
Power supply	
1	The voltage of main and control circuit power supply is within rated values.
2	Power supply polarity is rightly connected.
Wiring	
1	Power supply input is rightly connected.
2	Driver’s power output UVW matches UVW terminals on the main circuit.
3	No short circuit of driver’s input and output UVW terminals.
4	Signal cables are correctly and well connected.
5	Drivers and motors are connected to ground
6	All cables under stress within recommended range.
7	No foreign conductive objects inside/outside the driver.
Mechanical	
1	Driver and external holding brake are not place near combustibles.
2	Installations of driver, motor and axis is fastened.
3	Movement of motors and mechanical axes are not obstructed.

4.4.2 Power On

Connect AC single/3 phases 200-240V power supply into main power supply L1, L2, L3 terminals and 220V power supply into control circuit power supply L1C, L2C. After power on, light indicator will light up and front panel will display **rESEt**, then LED initial status will be displayed. Driver is ready for operation if no alarm occurs.
For singe phase 200-240V, connect L1 and L2

4.4.3 Trial Run

Servo driver must be disabled before performing trial run. For safety precautions, please JOG under minimal velocity.

Related Parameters

No.	Parameters	Label	Set value	Unit
1	P00.01	Control mode settings	9	/
2	P06.04	JOG trial run command velocity	User defined	r/min
3	P06.25	Trial run acc-/deceleration time	User defined	ms/1000rpm

- Please make sure the mechanical axis is within the range of motion and travelled distance should not be too long to avoid collision.
- Set optimal velocity and acceleration for trial run (not too high!)
- Do not modify any gain related parameters during motion to avoid vibration.

Please refer to “Section 4.6 Auxiliary function/AF Jog Trial Run” for detailed explanations on how to perform trial run using front panel operation

4.4.4 Motor rotational direction settings

Motor rotational direction can be changed through P00.06 without changing the polarity of the input command.

P00.06	Name	Command polarity inversion			Mode							F
	Range	0 ~ 1	Unit	—	Default	0		Index		2006h		
	Activation	After restart										

Used to change the rotational direction of the motor.

Set value	Details
0	Polarity of the command is not inversed. The direction of rotation is consistent with the polarity of command.
1	Polarity of command is inversed. The direction of rotation is opposite to the polarity of command.

Note: Rotational direction of the motor is recommended to be set through object dictionary 607E. However, P00.06 has higher priority than object dictionary 607E. 607E only takes effect when P00.06 = 0.

4.5.3 Fron Panel Trial Run

JOG Test Run (Jogging Control) Operation Procedure

Set all parameters related to jogging control.

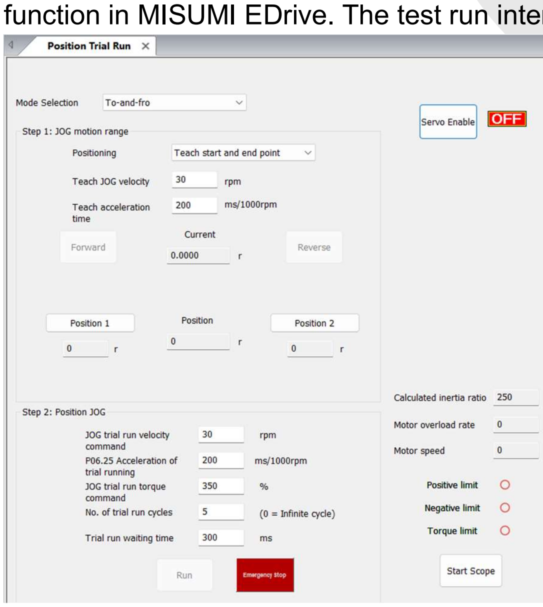
1) After successfully writing the parameters, power off and restart the driver.
2) Ensure the driver is in a disabled state to enter JOG control mode.
3) Enter the "AF Jog" submenu under Auxiliary Functions Mode.
4) Press the SET key once — the display should show "Jog -".
5) Press ◀ key once — if there are no issues, the display should show "SrUon". If "Error" appears, press the ▲ key again — it should then show "SrUon". If it still shows "Error", switch to the "d17Ch" submenu under Data Monitoring Mode to check why the motor is not rotating. Troubleshoot the issue and retry.
6) In Position JOG Mode, once "SrUon" is displayed, hold the ▲ key to increase motor speed up to the maximum set in P06.04, and the motor will run forward continuously. Release the ▲ key to decelerate and stop — the display should return to "SrUon". Hold the ▼ arrow key to run the motor in reverse at increasing speed up to P06.04. Release the ▼ key to decelerate and stop — the display should return to "SrUon". If the motor does not rotate, check the "d17Ch" submenu in Data Monitoring Mode to identify the issue and retry after resolving it.
7) During the JOG test run, press the SET key to exit JOG control mode.

4.4.5 Trial Run Using Debugging Software

Use the MISUMI EDrive debugging software to perform test runs on the servo driver and motor.

Debugging Software Trial Run Procedure

1) Wiring Check:
   - Confirm correct wiring for power input and motor output.
   - Use a Type-C cable to connect the servo driver to the PC for communication.
2) Confirm Power Supply Voltage, ensure it is within the rated range.
3) After establishing communication between the PC and the driver, open the test run function in MISUMI EDrive. The test run interface will appear.

- 

4) Set to Reciprocating Motion Mode, choose positioning start/end point operation mode. After clicking Enable, the red OFF will turn green ON. Set the teaching motion attributes — avoid high speeds to prevent collisions. Use the forward/reverse motion buttons to teach and set the desired start and end points.
5) STEP-2: Configure JOG motion attributes. Execute the set motion within the taught range. Set the number of repetitions for reciprocating motion based on the planned path.
6) During operation, use the monitoring panel on the right to view: Estimated inertia, Motor speed, Motor load rate and Limit status indicators.

Class	Label	EtherCAT Address	Panel display	Activation	Valid Mode						
[Class 0] P00. Basic settingsa	Model-following bandwidth	2000h	P0000	Immediate							F
	Control Mode Settings	2001h	P0001	After restart							F
	Real time Auto Gain Adjusting	2002h	P0002	Immediate							F
	Real time auto stiffness adjusting	2003h	P0003	Immediate							F
	Inertia ratio	2004h	P0004	Immediate							F
	Command polarity inversion	2006h	P0006	After restart							F
	Probe signal polarity settings	2007h	P0007	After restart							F
	Command pulse counts per revolution	2008h	P0008	After restart	PP	PV		HM	CSP	CSV	
	Encoder pulse output per revolution	2011	P0011	After restart							F
	Pulse output logic inversion	2012	P0012	After restart							F
	1st Torque Limit	2013h	P0013	Immediate							F
	Excessive Position Deviation Settings	2014h	P0014	Immediate	PP			HM	CSP		
	Absolute Encoder settings	2015h	P0015	After restart							F
	Regenerative resistance	2016h	P0016	Immediate							F
	Regenerative resistor power rating	2017h	P0017	Immediate							F
	Friction compensation setting	2019h	P0019	Immediate							F
	EtherCAT slave ID	2023h	P0023	After restart							F
	Source of slave ID	2024h	P0024	After restart							F
	Synchronous compensation time 1	2025h	P0025	After restart					CSP		
	Synchronous compensation time 2	2026h	P0026	After restart					CSP		
	Synchronization mode command delay cycle counts	2027h	P0027	After restart					CSP		
	CSP mode safe self-running position setting	2028h	P0028	Immediate					CSP		
	Encoder feedback mode	2030h	P0030	Immediate							F
	External encoder type	2031h	P0031	After restart							F
	External encoder direction	2032h	P0032	After restart							F
	Excessive hybrid deviation	2033h	P0033	After restart							F
	Clear excess hybrid control deviation	2034h	P0034	After restart							F
	External encoder frequency divider numerator	2035h	P0035	After restart							F
	External encoder frequency divider denominator	2036h	P0036	After restart							F
	External encoder feedback pulse count per revolution	2037h	P0037	After restart							F
	Z-signal pulse input source	2038h	P0038	After restart							F
	1st position loop gain	2100h	P0100	Immediate	PP			HM	CSP		
	1st velocity loop gain	2101h	P0101	Immediate							F
	1st Integral Time Constant of Velocity Loop	2102h	P0102	Immediate							F
	1st velocity detection filter	2103h	P0103	Immediate							F
	1st Torque Filter Time Constant	2104h	P0104	Immediate							F
	2nd Position Loop Gain	2105h	P0105	Immediate	PP			HM	CSP		
	2nd velocity loop gain	2106h	P0106	Immediate							F
	2nd Integral Time Constant of	2107h	P0107	Immediate							F

Class	Label	EtherCAT Address	Panel display	Activation	Valid Mode						
[Class 1] P01. Gain adjustments	Velocity Loop										
	2nd velocity detection filter	2108h	P0108	Immediate							F
	2nd Torque Filter Time Constant	2109h	P0109	Immediate							F
	Velocity feed forward gain	2110h	P0110	Immediate	PP			HM	CSP		
	Velocity feed forward filter time constant	2111h	P0111	Immediate	PP			HM	CSP		
	Torque feed forward gain	2112h	P0112	Immediate	PP	PV		HM	CSP	CSV	
	Torque feed forward filter time constant	2113h	P0113	Immediate	PP	PV		HM	CSP	CSV	
	Position control gain switching mode	2115h	P0115	Immediate							F
	Position control gain switching level	2117h	P0117	Immediate							F
	Hysteresis at position control switching	2118h	P0118	Immediate							F
	Position gain switching time	2119h	P0119	Immediate							F
	External ABZ encoder filter time	2136h	P0136	Immediate	PP				CSP		
	Special function registry	2137h	P0137	Immediate							F
	Special function registry 1	2138h	P0138	Immediate							F
	Special function registry 2	2139h	P0139	Immediate							F
[Class 2] Vibration suppression	Adaptive filtering mode settings	2200h	P0200	Immediate							F
	1st notch frequency	2201h	P0201	Immediate							F
	1st notch bandwidth selection	2202h	P0202	Immediate							F
	1st notch depth selection	2203h	P0203	Immediate							F
	2nd notch frequency	2204h	P0204	Immediate							F
	2nd notch bandwidth selection	2205h	P0205	Immediate							F
	2nd notch depth selection	2206h	P0206	Immediate							F
	3rd notch frequency	2207h	P0207	Immediate							F
	3rd notch bandwidth selection	2208h	P0208	Immediate							F
	3rd notch depth selection	2209h	P0209	Immediate							F
	1st damping frequency	2214h	P0214	Immediate							F
	2nd damping frequency	2216h	P0216	Immediate							F
	Position command smoothing filter	2222h	P0222	Keep stop							F
	Position command FIR filter	2223h	P0223	Disable	PP			HM	CSP		
	5th resonant frequency	2231h	P0231	Immediate	PP			HM	CSP		
	5th resonant Q value	2232h	P0232	Immediate							F
	5th anti-resonant frequency	2233h	P0233	Immediate							F
	5th anti-resonant Q value	2234h	P0234	Immediate							F
	6th resonant frequency	2235h	P0235	Immediate							F
	6th resonant Q value	2236h	P0236	Immediate							F
	6th anti-resonant frequency	2237h	P0237	Immediate							F
	6th anti-resonant Q value	2238h	P0238	Immediate							F
	Adjustment mode	2248h	P0248	Immediate							F
	MFC type	2250h	P0250	Immediate							F
	Velocity feedforward compensation coefficient	2251h	P0251	Immediate	PP			HM	CSP		
	Torque feedforward compensation coefficient	2252h	P0252	Immediate	PP	PV		HM	CSP	CSV	

Class	Label	EtherCAT Address	Panel display	Activation	Valid Mode						
	Dynamic friction compensation coefficient	2253h	P0253	Immediate							F
	Overshoot time coefficient	2254h	P0254	Immediate							F
	Overshoot suppression gain	2255h	P0255	Immediate							F
[Class 3] P03. Velocity control	Acceleration time settings	2312h	P0312	Immediate		PV				CSV	
	Deceleration time settings	2313h	P0313	Immediate		PV				CSV	
	Sigmoid acceleration/deceleration settings	2314h	P0314	Disable		PV				CSV	
	Zero speed clamp level	2316h	P0316	Immediate		PV				CSV	
	Position mode zero speed	2323h	P0323	Immediate		PV				CSV	
[Class 4] P04. I/O monitoring settings	Input selection DI1	2400h	P0400	Immediate							F
	Input selection DI2	2401h	P0401	Immediate							F
	Input selection DI3	2402h	P0402	Immediate							F
	Input selection DI4	2403h	P0403	Immediate							F
	Input selection DI5	2404h	P0404	Immediate							F
	Input selection DI6	2405h	P0405	Immediate							F
	Input selection DI7	2406h	P0406	Immediate							F
	Input selection DI8	2407h	P0407	Immediate							F
	Output selection DO1	2410h	P0410	Immediate							F
	Output selection DO2	2411h	P0411	Immediate							F
	Output selection DO3	2412h	P0412	Immediate							F
	Analog input 1 zero drift	2422h	P0422	Immediate							F
	Analog input 1 filter	2423h	P0423	Immediate							F
	Analog input 1 overvoltage	2424h	P0424	Immediate							F
	Analog input 2 zero drift	2425h	P0425	Immediate							F
	Analog input 2 filter	2426h	P0426	Immediate							F
	Analog input 2 overvoltage	2427h	P0427	Immediate							F
	Positioning complete range	2431h	P0431	Immediate	PP			HM	CSP		
	Positioning complete output setting	2432h	P0432	Immediate	PP			HM	CSP		
	INP positioning delay time	2433h	P0433	Immediate	PP			HM	CSP		F
	Zero speed	2434h	P0434	Immediate							F
	Velocity coincidence range	2435h	P0435	Immediate			PV			CSV	
	Arrival velocity	2436h	P0436	Immediate			PV			CSV	
	Motor power-off delay time	2437h	P0437	Immediate							F
	Delay time for holding brake release	2438h	P0438	Immediate							F
	Holding brake activation velocity	2439h	P0439	Immediate							F
	Emergency stop function	2443h	P0443	Immediate							F
	AO1 output	2464h	P0464	Immediate							F
	AO1 signal	2465h	P0465	Immediate							F
	AO1 amplification	2466h	P0466	Immediate							F
	AO1 communication settings	2467h	P0467	Immediate							F
	AO1 offset	2468h	P0468	Immediate							F
	AO2 output	2469h	P0469	Immediate							F
	AO2 signal	2470h	P0470	Immediate							F
	AO2 amplification	2471h	P0471	Immediate							F
	AO2 communication settings	2472h	P0472	Immediate							F

Class	Label	EtherCAT Address	Panel display	Activation	Valid Mode						
	AO2 offset	2473h	P0473	Immediate							F
	Warning indicator light 1 signal	2474h	P0474	Immediate							F
	Warning indicator light 2 signal	2475h	P0475	Immediate							F
	Warning indicator light 3 signal	2476h	P0476	Immediate							F
	Warning indicator light 4 signal	2477h	P0477	Immediate							F
	Warning indicator light 5 signal	2478h	P0478	Immediate							F
[Class 5] P05. Extension settings	Driver prohibition input settings	2504h	P0504	Immediate							F
	Servo-off mode	2506h	P0506	After restart							F
	Main power-off detection time	2509h	P0509	Immediate							F
	Servo-off due to alarm mode	2510h	P0510	After restart							F
	Servo braking torque setting	2511h	P0511	Immediate							F
	Overload level setting	2512h	P0512	Immediate							F
	Overspeed level settings	2513h	P0513	Immediate							F
	I/O digital filter	2515h	P0515	Immediate							F
	Counter clearing input mode	2517h	P0514	Immediate							F
	Position unit settings	2520h	P0520	After restart	PP			HM	CSP		
	Torque limit selection	2521h	P0521	Immediate							F
	2nd torque limit	2522h	P0522	Immediate							F
	LED initial status	2528h	P0528	After restart							F
	Torque limit detection time during torque initialization	2537h	P0537	Immediate							F
	3rd torque limit	2539h	P0539	Immediate							F
	D41 set value	2540h	P0540	Immediate							F
	Frequency divider output – Z-signal polarity	2542h	P0542	After restart							F
	Frequency divider output – Z-signal width	2543h	P0543	After restart							F
	Frequency divider output source	2544h	P0544	After restart							F
	External encoder overspeed feedback threshold	2545h	P0545	Immediate							F
	Vent overload level	2546h	P0546	Immediate							F
[Class 6] P06. Extra settings	Encoder zero position compensation	2601h	P0601	After restart							F
	JOG trial run torque command	2603h	P0603	Immediate							F
	JOG trial run velocity command	2604h	P0604	Immediate	PP			HM	CSP		
	Position 3rd gain valid time	2605h	P0605	Immediate	PP			HM	CSP		
	Position 3rd gain scale factor	2606h	P0606	Immediate	PP			HM	CSP		
	Torque command additional value	2607h	P0607	Immediate							F
	Positive direction torque compensation value	2608h	P0608	Immediate							F
	Negative direction torque compensation value	2609h	P0609	Immediate							F
	Current response settings	2611h	P0611	Immediate							F
	Max. time to stop after disabling	2614h	P0614	Immediate							F
	Trial run distance	2620h	P0620	Immediate							F
	Trial run waiting time	2621h	P0621	Immediate							F
	No. of trial run cycles	2622h	P0622	Immediate							F
	Trial run acceleration	2625h	P0625	Immediate							F
	Velocity observer gain	2628h	P0628	Immediate							F

Class	Label	EtherCAT Address	Panel display	Activation	Valid Mode						
	Velocity observer bandwidth	2629h	P0629	Immediate							F
	Frame error window time	2634h	P0634	Immediate							F
	Frame error window	2635h	P0635	Immediate							F
	Absolute value rotation mode denominator setting	2654h	P0654	After restart	PP			HM	CSP		
	Rotor blocked torque limit threshold	2656h	P0656	Immediate							F
	Z-signal sustaining time	2661h	P0661	Immediate							F
	Absolute multiturn data upper limit	2663h	P0663	After restart							F
[Class c] P0C. Position Comparision	Position Comparison Enable	27A4-01	P0C00	Immediate							F
	Position Comparison Mode Selection	27A4-02	P0C01	Immediate							F
	Pulse Width of Position Comparison Output	27A4-03	P0C02	Immediate							F
	Delay Compensation of Position Comparison Output	27A4-04	P0C03	Immediate							F
	Start Point of Position Comparison	27A4-05	P0C04	Immediate							F
	End Point of Position Comparison	27A4-06	P0C05	Immediate							F
	Cycle Count in Constant Loop Mode	27A4-07	P0C06	Immediate							F
	Use Current Position as Zero Point (Position Comparison)	27A4-08	P0C07	Immediate							F
	Offset of Zero Point in Position Comparison	27A4-09	P0C08	Immediate							F
	Target Value of Position Comparison Point 1~42	27A4-15~27A4-3E	P0C020~P0C061	Immediate							F
	Attributes of Position Comparison Point 1 & 2	27A4-47	P0C70	Immediate							F
[Class D] P0D. Gantry Settings	Gantry Configuration	27A5-01	P0D00	After restart							F
	Gantry Slave Axis Command Mode	27A5-02	P0D01	Disable							F
	Gantry Tuning Gain 1	27A5-03	P0D02	Disable							F
	Gantry Position Synchronization Deviation Threshold	27A5-04	P0D03	Immediate							F
	Gantry Torque Deviation Threshold	27A5-05	P0D04	Immediate							F
	Gantry Tuning Gain 2	27A5-06	P0D05	Keep stop							F
	Position Gain	27A5-07	P0D06	Immediate							F
	Velocity Gain	27A5-08	P0D07	Immediate							F
	Velocity Integral	27A5-09	P0D08	Immediate							F
	Homing Mode	27A5-0A	P0D09	After restart							F
	Alignment Mode	27A5-0B	P0D10	After restart							F
	Gantry Origin Offset	27A5-0C	P0D11	Disable							F
[Class 11] P11. Driver parameters	MCU 1 Version	27A9-01	P1100	After restart							F
	MCU 2 Version	27A9-02	P1101	After restart							F
	FPGA Version	27A9-03	P1102	After restart							F
	Death Zone Compensation Factor 1	27A9-13	P1112	Immediate							F
	Death Zone Compensation Factor 2	27A9-14	P1113	Immediate							F
	Analog 1 Zero Drift	27A9-17	P1116	Immediate							F
	Analog 2 Zero Drift	27A9-18	P1117	Immediate							F
	Analog 3 Zero Drift	27A9-19	P1118	Immediate							F
	Regenerative Vent Control Mode	27A9-32	P1131	After restart							F

Chapter 5 Parameter

5.1 Parameter List

Panel Display as follows:

Parameter Valid Mode
CSP: Valid in cyclic synchronous position mode
CSV: Valid in cyclic synchronous velocity mode
CST: Valid in cyclic synchronous torque mode
HM: Valid in homing mode
PP: Valid in profile position mode
PV: Valid in profile velocity mode
PT: Valid in profile torque mode
F: Valid in ALL modes

5.1.1 Servo driver parameter

5.1.2 Object dictionary (5000h)- Manufacturer parameter

Index	Sub index	Label	Unit	Default	Min	Max	Details
5004	01	RPDO length		8	0	64	
	02	TPDO length		17	0	64	
	03	The number of RPDO		1	0	4	
	04	The number of TPDO		1	0	2	
	05	Sync0 Watchdog counter		0	0	65535	
	06	Reserved			0	65535	
	07	Sync0 Watchdog limit		4	0	65535	73B alarm threshold value, set to zero shield
	08	Sync0 Drift watchdog counter		0	0	65535	
	09	Sync0 Drift watchdog limit		4	0	65535	73C alarm threshold value, set to zero shield
	0A	SM2 watchdog counter		0	0	65535	
	0B	SM2 Watchdog limit		4	0	65535	73A alarm threshold value, set to zero shield
	0C	Application layer SM2/Sync0 watchdog counter		0			
	0D	Application layer SM2/Sync0 watchdog limit		4			
	0E	Reserved			0	500	
	0F	Time interval between SM2 and Sync0	ns	0	0	1000000000	832h Alarm detection
5006	00	Synchronous		0xFFF	0	0xFFF	Bit0:818h Alarm enable switch

<table>
<tr><td></td><td></td><td>alarm setting</td><td></td><td>F</td><td></td><td>F</td><td>Bit1: 819h
Bit2: 81Ah
Bit3: 824h
Bit4: 825h
Bit5: Reserved
Bit6: Reserved
Bit7: 82Ch
Bit8: 82Dh
Bit9: 832h
Bit10~15: Reserved
Notes: 0 invalid；1 valid</td></tr>
<tr><td>5010</td><td>00</td><td>PDO watchdog overtime</td><td>ms</td><td>0</td><td>0</td><td>60000</td><td>0：invalid；
> 0：valid；
Unit： ms；
Such as RPDO timeout alarm 818h, TPDO timeout alarm 819h</td></tr>
<tr><td>5012</td><td>04</td><td>Homing setting</td><td>-</td><td>5</td><td colspan="3">Bit0：Abnormal signal protection
0：invalid； 1：valid
Bit1：pull back if overtravel while final stop
0：invalid； 1：valid
Bit2/Bit3：
<table>
<tr><td>Bit2</td><td>Bit 3</td><td>Positive limit position</td><td>Negative limit position</td><td>Feedback after the homing pro</td></tr>
<tr><td>0</td><td>0</td><td>607D-02+ 607C</td><td>607D-01 + 607C</td><td>6064 = 607C</td></tr>
<tr><td>0</td><td>1</td><td>607D-02- 607C</td><td>607D-01 - 607C</td><td>6064 = -607C</td></tr>
<tr><td>1</td><td>-</td><td>607D-02</td><td>607D-01</td><td>6064 = 0</td></tr>
</table>
Bit4: Deal with Overtravel between the high speed and low speed during homing process
0：Homing process error (set 6041h bit13=1)；
1：As normal, continue homing process</td></tr>
<tr><td>5400</td><td>01</td><td>Set synchronization cycle minimum value</td><td>us</td><td>250</td><td>125</td><td>1000</td><td></td></tr>
<tr><td>5400</td><td>02</td><td>Set synchronization cycle maximum value</td><td>us</td><td>10000</td><td>4000</td><td>20000</td><td></td></tr>
<tr><td rowspan="5">5500</td><td>01</td><td>Absolute encoder multiturn number</td><td>r</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>02</td><td>Encoder single turn position</td><td>Pulse</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>03</td><td>Encoder feedback position 32 bit low</td><td>Pulse</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>04</td><td>Encoder feedback position 32 bit high</td><td>Pulse</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>05</td><td>The actual</td><td>Unit</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
</table>

		mechanical position 32 bit low					
	06	The actual mechanical position 32 bit high	Unit	-	-	-	-
	07	Number of encoder communication exceptions		-	-	-	-
5501	01	Motor Speed	r/min	-	-	-	-
	02	Speed of position command	r/min	-	-	-	-
	03	Speed command	r/min	-	-	-	-
	04	Actual torque	0.1%	-	-	-	-
	05	Torque command	0.1%	-	-	-	-
	06	Relative position error	Pulse	-	-	-	-
	07	Internal position command	Pulse	-	-	-	-
	08	Overload ratio	0.1%	-	-	-	-
	09	Discharge load rate	0.1%	-	-	-	-
	0A	Inertia ratio	%	-	-	-	-
	0B	Actual positive torque limit value	0.1%	-	-	-	-
	0C	Actual negative torque limit value	0.1%	-	-	-	-
	0D	U phase current detect value	0.1%	-	-	-	-
	0E	W phase current detect value	0.1%	-	-	-	-
5502	01	DI input signal	-	-	-	-	-
	02	SO output signal	-	-	-	-	-
	03	Reserved	-	-	-	-	-
	04	Reserved	-	-	-	-	-
	05	Bus voltage	V	-	-	-	-
	06	Temperature	℃	-	-	-	-
	07	Power on time	S	-	-	-	-

5.1.3 Object dictionary(6000h)-Motion parameter

Index	Sub-index	Label	Unit	Default	Min	Max	Mode
603F	0	Error code	-	0x0	0x0	0xFFFF	F
6040	0	Control word	-	0x0	0x0	0xFFFF	F
6041	0	Status word	-	0x0	0x0	0xFFFF	F
605A	0	Quick stop option code	-	2	0	7	F
605B	0	Motor deceleration-stopping mode selection	-	0	0	1	F
605C	0	Axis disabled-stopping mode selection	-	0	0	1	F
605D	0	Pause-stopping mode selection	-	1	1	3	F
605E	0	Alarm - stopping mode selection	-	0	0	2	F

6060	0	Operation mode selection	-	8	1	11	F
6061	0	Operation mode display	-	0	0	10	F
6062	0	Position command	Command unit	0	-2147483648	2147483647	CSP/PP/HM
6063	0	Actual internal position	Encoder unit	0	-2147483648	2147483647	F
6064	0	Actual position feedback	Command unit	-	-2147483648	2147483647	F
6065	0	Position deviation window	Command unit	30000	0	2147483647	PP/CSP/HM
6066	0	Position deviation detection time	ms	10	0	65535	PP/CSP/HM
6067	0	Position window	Command unit/s	0	0	2147483647	PP/CSP/HM
6068	0	Position window time	ms	0	0	65535	PP/CSP/HM
606B	0	Internal command velocity	Command unit/s	0	-2147483648	2147483647	CSV/PV
606C	0	Velocity feedback	Command unit/s	0	-2147483648	2147483647	PP/CSP/HM
606D	0	Velocity window	Command unit /s	10	0	65535	PV/CSV
606E	0	Velocity window time	ms	0	0	65535	PV/CSV
606F	0	Zero-speed threshold	Command unit/s	10	0	65535	PV/CSV
6071	0	Target torque	0.001	0	-32768	32767	CST/PT
6072	0	Maximum torque	0.001	3000	0	65535	F
6073	0	Maximum current	0.001	3000	-	65535	F
6074	0	Internal command torque	0.001	0	-32768	32767	F
6075	0	Motor current rating	mA	3000	0	2147483647	F
6077	0	Actual torque	0.1%	0	-32768	32767	F
6079	0	DC bus voltage	mV	0	0	2147483647	F
607A	0	Target position	Command unit	0	-2147483648	2147483647	CSP/PP
607C	0	Homing position offset	Command unit	0	-2147483648	2147483647	HM
607D	1	Min. software limit	Command unit	0	-2147483648	2147483647	CSP/PP
	2	Max. software limit	Command unit	0	-2147483648	2147483647	CSP/PP
607E	0	Motor rotational direction	-	0x0	0x0	0xFF	F
607F	0	Maximum protocol velocity	Command unit /s	2147483647	0	2147483647	PP/HM/PV/C

								ST
6080	0	Maximum motor velocity	r/min	6000	0	2147483647	F
6081	0	Profile velocity	Command unit /s	10000	0	2147483647	PP
6083	0	Profile acceleration	Command unit /s^2	10000	1	2147483647	PP/PV/
6084	0	Profile deceleration	Command unit /s^2	10000	1	2147483647	PP/PV
6085	0	Emergency stop deceleration	Command unit /s^2	10000000	1	2147483647	CSP/CSV/PP/PV/HM
6087	0	Torque slope	0.001/s	5000	1	2147483647	PT
608F	1	Encoder resolution	Encoder unit	0	0	2147483647	F
6091	1	Electronic gear ratio numerator	r	1	1	2147483647	F
	2	Electronic gear ratio denominator	r	1	1	2147483647	F
6092	1	Number of pulses per rotation	Command unit/r	10000	1	2147483647	F
6098	0	Homing method	-	19	-6	37	HM
6099	1	High velocity homing	Command unit /s	10000	0	2147483647	HM
	2	Low velocity homing	Command unit /s	5000	0	2147483647	HM
609A	0	Homing acceleration /deceleration	Command unit /s^2	500000	1	2147483647	HM
60B0	0	Position feedforward	Command unit	0	-2147483648	2147483647	CSP
60B1	0	Velocity feedforward	Command unit /s	0	-2147483648	2147483647	CSP/CSV/PP/PV/HM
60B2	0	Torque feedforward	0.001	0	-32768	32767	F
60B8	0	Probe function	-	0x0	0x0	0xFFFF	F
60B9	0	Probe status	-	0x0	0x0	0xFFFF	F
60BA	0	Probe 1 rising edge captured position	Command unit	0	-2147483648	2147483647	F
60BB	0	Probe 1 falling edge captured position	Command unit	0	-2147483648	2147483647	F
60BC	0	Probe 2 rising edge captured position	Command unit	0	-2147483648	2147483647	F
60BD	0	Probe 2 falling edge captured position	Command unit	0	-2147483648	2147483647	F
60C5	0	Protocol maximum acceleration	Command unit /s^2	100000000	1	2147483647	F
60C6	0	Protocol maximum deceleration	Command unit /s^2	100000000	1	2147483647	F
60D5	0	Probe 1 rising edge captured count(s)	-	0	0	65535	F

60D6	0	Probe 1 falling edge captured count(s)	-	0	0	65535	F
60D7	0	Probe 2 rising edge captured count(s)	-	0	0	65535	F
60D8	0	Probe 2 falling edge captured count(s)	-	0	0	65535	F
60E0	0	Max. torque in positive direction	0.001	3000	0	65535	F
60E1	0	Max. torque in negative direction	0.001	3000	0	65535	F
60F4	0	Actual following error	Command unit	0	-2147483648	2147483647	CSP/PP/HM
60FA	0	Position loop velocity output	Command unit /s	0	-2147483648	2147483647	CSP/PP/HM
60FC	0	Internal command position	Encoder unit	0	-2147483648	2147483647	CSP/PP/HM
60FD	0	Input status	-	0x0	0x0	0x7FFFFFFF	F
60FE	1	Output valid	-	0x0	0x0	0x7FFFFFFF	F
	2	Output enabled	-	0x0	0x0	0x7FFFFFFF	F
60FF	0	Target velocity	Command unit /s	0	-2147483648	2147483647	CSV/PV
6502	0	Supported operation modes	-	0x0	0x0	0x7FFFFFFF	F

5.2 Details of parameter

Panel Display as follows:

Parameter valid under following modes
CSP: Cyclic synchronous position mode
CSV: Cyclic synchronous velocity mode
CST: Cyclic synchronous torque mode
HM: Homing mode
PP: Profile position mode
PV: Profile velocity mode
PT: Profile torque mode
F: All modes

5.2.1 [Class 0] Basic Settings

P00.00	Label	Model-following bandwidth			Valid Mode			F
	Range	0~5000	Unit	0.1Hz	Default	1	Index	2000h
	Activation	Immediate						

Model-following bandwidth, also known as model-following control (MFC), is used to control the position loop to improve the responsiveness to commands, speed up positioning time and reduce following error. The effect is obvious especially in low and medium mechanical stiffness.

Value	Explanation
0	Disable the function.
1	Enable the function to set bandwidth automatically, recommended for most applications. P00.00=P01.01
2~9	Reserved by the manufacturer, do not set.
10~5000	*Recommended settings for belt application: 30<P00.00<100.*

P00.00>9: Model-following bandwidth value set by P00.00.
10<P00.00<5000: Specifies the bandwidth.

P00.01	Label	Control Mode Settings			Valid Mode			F
	Range	0~9	Unit	—	Default	9	Index	2001h
	Activation	After restart						

Set value to use following control modes：

Value	Content	Details
0-8	Reserved	Reserved
9	EtherCAT mode	PP/PV/PT/HM/CSP/CSV/CST

P00.02	Label	Real time Auto Gain Adjusting			Valid Mode			F
	Range	0x0~0xFFF	Unit	—	Default	0x001	Index	2002h
	Activation	Immediate						

Set up the mode of the real time auto gain adjusting.

Data bits	Category	Settings	Application
0x00_	Motion setting mode	Used to set motion setting mode, which can be selected according to the motion characteristics or setting requirements. Generally, it is recommended to select mode 1 with good generality when there is no special requirement, mode 2 when rapid positioning is needed If mode 1 and mode 2 cannot meet the requirements, please choose mode 0.	
		0: Manual	P00.03 invalid. Gain value must be adjusted manually and accordingly.
		1: Standard	P00.03 valid. Quick gain adjusting can be achieved by changing P00.03 stiffness value. Gain switching is not used in this mode, suitable for applications with requirements for stability.
		2: Positioning	P00.03 valid. Quick gain adjusting can be achieved by changing P00.03 stiffness value. This mode is suitable for applications requiring quick positioning. Not recommended for load mounted vertical to ground, or please compensate for the load using P06.07
0x0_0	Load type setting	Used to select the load type, choose according to load-inertia ratio and mechanical structure.	
		0: Rigid structure	This mode prioritizes system responsiveness. Use this mode when there is a relatively rigid structure with low load inertia. Typical application including directly connected high-precision gearbox, lead screw, gears, etc.
		1: High inertia	For applications with higher load inertia (10 times or above), gain settings take into account both machine stability and responsiveness. Not recommended to set stiffness above 15 for high load inertia.
		2: Flexible structure	This mode prioritizes system stability. Use this mode when there is low rigidity structure with high load inertia. Typical applications included belts and chains.
0x_00	reserved		

The setting type combination is a hexadecimal standard, as follows:

Setting type combination	Application type
0X000	Rigid structure Manual
0X001	Rigid structure +Standard
0X002	Rigid structure +Positioning
0X010	High inertia + Manual
0X011	High inertia + Standard
0X012	High inertia + Positioning
0X020	Flexible structure + Manual
0X021	Flexible structure +Standard
0X022	Flexible structure +Positioning

P00.03	Label	Real time auto stiffness adjusting			Mode							F
	Range	50 ~ 81	Unit	—	Default	70	Index		2003h			
	Activation	Immediate										

Valid when P00.03 = 1,2

Low → Mechanical stiffness → High

Low → Servo gain → High

81.80······70.69.68······51.50

Low → Responsiveness → High

Lower values ensure better system responsiveness and mechanical stiffness but machine vibration might occur, please set accordingly.

P00.04	Label	Inertia ratio			Mode							F
	Range	0~20000	Unit	%	Default	250	Index		2004h			
	Activation	Immediate										

P00.04=(load inertia/motor rotational inertia)×100%

Notice:
Set inertia ratio according to actual load inertia. When both are uniform, actual motor velocity loop responsiveness and gain settings will be consistent. If inertia ratio is greater than actual value, velocity loop gain settings will be higher and vice versa.

P00.06	Label	Command polarity inversion			Mode							F
	Range	0 ~ 1	Unit	—	Default	0	Index		2006h			
	Activation	After restart										

Used to change the rotational direction of the motor.

Set value	Details
0	Polarity of the command is not inversed. The direction of rotation is consistent with the polarity of command.
1	Polarity of command is inversed. The direction of rotation is opposite to the polarity of command.

Note: Rotational direction of the motor is recommended to be set through object dictionary 607E. However, P00.06 has higher priority than object dictionary 607E. 607E only takes effect when P00.06 = 0.

P00.07	Label	Probe signal polarity settings			Mode							F
	Range	0 ~ 3	Unit	—	Default	3	Index		2007h			
	Activation	After restart										

Probe signal polarity settings take effect when P00.01 = 9

Set value	Details
0	Probe 1 & 2 polarity inversion
1	Probe 2 polarity inversion

2	Probe 1 polarity inversion
3	No polarity inversion for probe 1 & 2

If P00.01 ≠ 9, P00.07 = Command pulse input mode settings.

Command pulse input

Command Polarity inversion (P00.06)	Command pulse input mode settings (P00.07)	Command Pulse Mode	Positive signal	Negative signal
【0】	0 *or* 2	90°phase difference 2 phase pulse （Phase A+ Phase B）		
	1	CW pulse sequence ＋ CCW pulse sequence		
	【3】	Pulse sequence ＋ Directional symbol		
1	0 *or* 2	90°phase difference 2 phase pulse （Phase A＋Phase B）		
	1	CW pulse sequence ＋ CCW pulse sequence		
	3	Pulse sequence ＋ Directional symbol		

Command pulse input signal max. frequency and min. duration needed

Command pulse input interface		Max. Frequency	Min. duration needed（μs）					
			t1	t2	t3	t4	t5	t6
Pulse sequence interface	Differential drive	500 kHz	2	1	1	1	1	1
	Open collector	200 kHz	5	2.5	2.5	2.5	2.5	2.5

Please set >0.1μs for the duration between rising and falling edge of command pulse input signal.

1 revolution with 2500 pulses 2-phase pulse input when P00.07=0 or 2, P00.08 = 10000;
1 revolution with 10000 pulses 1-phase pulse input when P00.07=1 or 3, P00.08 0 10000

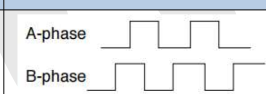
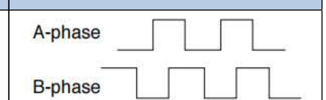
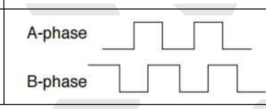
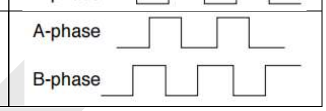
P00.08	Label	Command pulse counts per revolution			Mode							**F**
	Range	0~8388608	Unit	P-	Default	0	Index		2008h			
	Activation	After restart										
	Pulses per revolution can be set using object dictionary 608F, 6091, 6092. However, P00.08 has higher priority.											

P00.11	Label	Encoder pulse output per revolution			Mode							F
	Range	0~65535	Unit	P/r	Default	2500	Index			2011		
	Activation	After restart										

Including rising and falling edge of phase A and B, so encoder actual differential output pulse count = P00.11 x 4
Please make sure: Motor rotational speed x P00.11 x 4≤1MHz. If exceeds, alarm Er280 might occur.

P00.12	Label	Pulse output logic inversion			Mode							F
	Range	0~1	Unit	-	Default	0	Index			2012		
	Activation	After restart										

To set phase B logic and output source from encoder pulse output.
Pulse output logic inversion

P00.12	Phase B logic	CW direction	CCW direction
[0]	Not inverted		
[1]	Inverted		

P00.13	Label	1st Torque Limit			Mode							F
	Range	0~500	Unit	%	Default	300	Index			2013h		
	Activation	Immediate										

1st torque limit is set according to ratio percentage of motor rated current. Do not exceed max driver output current.
Actual torque limit is the smaller value of P00.13 and object dictionary 6072

P00.14	Label	Excessive Position Deviation Settings			Mode	PP			HM	CSP		
	Range	0~500	Unit	0.1rev	Default	30	Index			2014h		
	Activation	Immediate										

Please set threshold value for position deviation accordingly. Default factory setting = 30, Er180 will be triggered if positive deviation is in excess of 3 revolutions.

P00.15	Label	Absolute Encoder settings			Mode	PP			HM	CSP		
	Range	0~32767	Unit	-	Default	0	Index			2015h		
	Activation	Immediate										

0: Incremental mode:
Used as an incremental encoder. Doesn't retain position data on power off. Unlimited travel distance.
1: Multiturn linear mode:
Used as a multiturn absolute encoder. Retrain position data on power off. For applications

with fixed travel distance and no multiturn data overflow. **2: Multiturn rotary mode**: Used as a multiturn absolute encoder. Retrain position data on power off. Actual data feedback in between 0-(P06.63). Unlimited travel distance. **3: Single turn absolute mode:** Used when travel distance is within 1 revolution of the encoder. Data overflow will trigger alarm. **5:** Clear multiturn alarm and activate multiturn absolute function. Will switch to multiturn mode once alarm cleared, if remains at 5 after 3s, please solve according to Er153. **9:** Clear multiturn position, reset multiturn alarm and activate multiturn absolute function. Will switch to multiturn mode once alarm cleared, if remains at 9 after 3s, please solve according to Er153. Please disable axis before setting to 9 and home the axis before using.

P00.16	Label	Regenerative resistance			Mode							F
	Range	40~500	Unit	Ohm	Default	100	Index			2016h		
	Activation	Immediate										
	To set resistance value of regenerative resistor											

P00.17	Label	Regenerative resistor power rating			Mode							F
	Range	20~5000	Unit	W	Default	50	Index			2017h		
	Activation	Immediate										
	To set power rating of regenerative resistor. P00.16 and P00.17 determines the threshold value of Er 120. Please set accordingly or it might trigger false alarm or damage to servo driver. *Note: If external regenerative resistor is used, please set according to its labeled power rating.*											

P00.19	Label	Friction compensation setting			Mode							F
	Range	0~1000	Unit	-	Default	0	Index			2019h		
	Activation	Immediate										
	Friction compensation setting = 0, default = 1; Friction compensation setting = x, indicating x+1/10000 of friction compensation runway;											

P00.23	Label	EtherCAT slave ID			Mode							F
	Range	0~32767	Unit	—	Default	2	Index			2023h		
	Activation	After restart										
	Set ID number of the slave station under EtherCAT mode											
P00.24	Label	Source of slave ID			Mode							F
	Range	0~1	Unit	—	Default	1	Index			2024h		
	Activation	After restart										
	0: Master device automatically assigns a slave address. 1：The slave ID = P00.23											

P00.25	Label	Synchronous compensation time 1			Mode					CSP		

	Range	1~100	Unit	0.1us	Default	10	Index	2025h
	Activation	After restart						

Synchronous dithering compensation range. Used for master device with poor synchronization.

P00.26	Label	Synchronous compensation time 2			Mode	CSP		
	Range	1~2000	Unit	0.1us	Default	50	Index	2026h
	Activation	After restart						

Synchronous dithering compensation range. Used for master device with poor synchronization.

P00.27	Label	Synchronization mode command delay cycle counts			Mode	CSP		
	Range	1~50	Unit	-	Default	0	Index	2027h
	Activation	After restart						

Driver delays N position loop cycle counts to receive position command from master device. To solve motor jitter caused by master device with poor synchronization.

P00.28	Label	CSP mode safe self-running position setting			Mode	CSP		
	Range	0~10000	Unit	-	Default	10	Index	2028h
	Activation	Immediate						

Synchronous dithering compensation range. Used for master device with poor synchronization.

P00.30	Label	Encoder feedback mode			Mode	F		
	Range	0~1	Unit	-	Default	0	Index	2030h
	Activation	Immediate						

To set encoder feedback source.

Set value	Description
【0】	Feedback from motor（Internal）encoder
1	Use under full closed loop control, external encoder feedback

P00.31	Label	External encoder type			Mode	F		
	Range	0~3	Unit	-	Default	0	Index	2031h
	Activation	Immediate						

Set value	Description
【0】	ABZ encoder
1~3	*Reserved for future upgrades*

P00.32	Label	External encoder direction			Mode	F		
	Range	0~1	Unit	-	Default	0	Index	2032h
	Activation	Immediate						

Set value	Description
【0】	Default direction
1	Inversed direction

P00.33	Label	Excessive hybrid deviation			Mode	PP, HM, CSP		
	Range	0~134217728	Unit	Command unit	Default	16000	Index	2033h
	Activation	After restart						

To set the excessive hybrid deviation threshold value, please set accordingly. Use in full closed loop control. Factory default: 16000. Er191 might occur if position deviation during hybrid control exceeds 16000 pulse counts.

P00.34	Label	Clear hybrid control deviation			Mode	PP, HM, CSP		
	Range	0~100	Unit	R	Default	0	Index	2034h
	Activation	After restart						

To set condition to clear position deviation under hybrid control mode (Full closed loop)

Set value	Description
【0】	OFF
1~100	Revolution count to clear hybrid control deviation

P00.35	Label	External encoder frequency divider numerator			Mode	F		
	Range	$0\sim2^{23}$	Unit	-	Default	0	Index	2035h
	Activation	After restart						

When P00.35 = 0, numerator = resolution of encoder

P00.36	Label	External encoder frequency divider denominator			Mode							F
	Range	$0\sim2^{23}$	Unit	-	Default	0	Index	2036h				
	Activation	After restart										

When P00.37 = 0, External encoder feedback pulse count per revolution = P00.36

P00.37	Label	External encoder feedback pulse count per revolution			Mode							F
	Range	$0\sim2^{31}$	Unit	-	Default	0	Index	2037h				
	Activation	After restart										

Set value	Pulse count
【0】	P00.36
$1\sim2^{31}$	P00.37

P00.38	Label	Z-signal pulse input source			Mode							F
	Range	0~3	Unit	-	Default	0	Index	2038h				
	Activation	After restart										

Set value	Bit 1 (Probe Z-signal)	Bit 0 (Homing Z-Signal)
【0】	Motor Z-signal	Motor Z-signal
1	Motor Z-signal	External encoder Z-signal
2	External encoder Z-signal	Motor Z-signal
3	External encoder Z-signal	External encoder Z-signal

5.2.2 [Class 1] Gain Adjustments

P01.00	Label	1st position loop gain			Mode	PP			HM	CSP		
	Range	0~30000	Unit	0.1/s	Default	320	Index	2100h				
	Activation	Immediate										

Higher position loop gain value improves the responsiveness of the servo driver and lessens the positioning time.
Position loop gain value shouldn't exceed responsiveness of the mechanical system and take in consideration velocity loop gain, if not it might cause vibration, mechanical noise and overtravel.
As velocity loop gain is based on position loop gain, please set both values accordingly.
Recommended range: 1.2≤P01.00/P01.01≤1.8

P01.01	Label	1st velocity loop gain			Mode							F
	Range	1~32767	Unit	0.1Hz	Default	180	Index	2101h				
	Activation	Immediate										

To determine the responsiveness of the velocity loop. If inertia ratio of P00.04 is uniform with actual inertia ratio, velocity loop responsiveness = P01.01.
To increase position loop gain and improve responsiveness of the whole system, velocity loop gain must be set at higher value. Please notice that if the velocity loop gain is too high, it might cause vibration.

P01.02	Label	1st Integral Time Constant of Velocity			Mode							F

		Loop							
	Range	1~10000	Unit	0.1ms	Default	310	Index	2102h	
	Activation	Immediate							

If auto gain adjusting function is not enabled, P01.02 is activated.
The lower the set value, the closer the lag error at stop to 0 but might cause vibration. If the value set is overly large, overshoot, delay of positioning time duration and lowered responsiveness might occur.
Set 10000 to deactivate P01.02.

Recommended range: 50000≤P01.01xP01.02≤150000

For example: Velocity loop gain P01.01=500(0.1Hz), which is 50Hz. Integral time constant of velocity loop should be 100(0.1ms)≤P01.02≤300(0.1ms)

P01.03	Label	1st velocity detection filter			Mode			F
	Range	0~10000	Unit	—	Default	15	Index	2103h
	Activation	Immediate						

This filter is a low pass filter. It blocks high frequencies which cause system instability from velocity feedback data. The higher the set value, lower frequencies will be blocked and velocity responsiveness will also be lowered. P01.03 needs to match velocity loop gain. Please refer to the following table.

Set Value	Velocity Detection Filter Cut-off Frequency(Hz)	Set Value	Velocity Detection Filter Cut-off Frequency(Hz)
0	2500	16	750
1	2250	17	700
2	2100	18	650
3	2000	19	600
4	1800	20	550
5	1600	21	500
6	1500	22	450
7	1400	23	400
8	1300	24	350
9	1200	25	300
10	1100	26	250
11	1000	27	200
12	950	28	175
13	900	29	150
14	850	30	125
15	800	31	100

P01.04	Label	1st Torque Filter Time Constant	Mode							**F**
	Range	0~2500	Unit	0.01ms	Default	126	Index	2104h		
	Activation	Immediate								

To set torque command low-pass filter, add a filter delay time constant to torque command and filter out the high frequencies in the command.
Often used to reduce or eliminate some noise or vibration during motor operation, but it will reduce the responsiveness of current loop, resulting in undermining velocity loop and position loop control. P01.04 needs to match velocity loop gain.
Recommended range: 1,000,000/(2π×P01.04) ≥P01.01×4

For example: Velocity loop gain P01.01=180(0.1Hz) which is 18Hz. Time constant of torque filter should be P01.01≤221(0.01ms)
If mechanical vibration is due to servo driver, adjusting P01.04 might eliminate the vibration. The smaller the value, the better the responsiveness but also subjected to machine conditions. If the value is too large, it might lower the responsiveness of current loop.
With higher P01.01 value settings and no resonance, reduce P01.04 value;
With lower P01.01 value settings, increase P01.04 value to lower motor noise.

P01.05	Label	2nd Position Loop Gain	Mode	**PP**			**HM**	**CSP**		
	Range	0~30000	Unit	0.1/s	Default	380	Index	2105h		
	Activation	Immediate								

P01.06	Label	2nd velocity loop gain	Mode							**F**
	Range	1~32767	Unit	0.1Hz	Default	180	Index	2106h		
	Activation	Immediate								

P01.07	Label	2nd Integral Time Constant of Velocity Loop	Mode							**F**
	Range	1~10000	Unit	0.1ms	Default	10000	Index	2107h		
	Activation	Immediate								

P01.08	Label	2nd velocity detection filter	Mode							**F**
	Range	0~31	Unit	—	Default	15	Index	2108h		
	Activation	Immediate								

P01.09	Label	2nd Torque Filter Time Constant			Mode							**F**
	Range	0~2500	Unit	0.01ms	Default	126	Index		2109h			
	Activation	Immediate										
	Position loop, velocity loop, velocity detection filter, torque command filter each have 2 pairs of gain or time constant (1st and 2nd).											

P01.10	Label	Velocity feed forward gain			Mode	**PP**			**HM**	**CSP**		
	Range	0~1000	Unit	0.10%	Default	300	Index		2110h			
	Activation	Immediate										
	Used for decreasing following error caused by low responsiveness of velocity loop. Might cause overshoot or increase in noise if set value is too high.											

P01.11	Label	Velocity feed forward filter time constant			Mode	**PP**			**HM**	**CSP**		
	Range	0~6400	Unit	0.01ms	Default	50	Index		2111h			
	Activation	Immediate										

Set velocity feed forward low pass filter to eliminate high or abnormal frequencies in velocity feed forward command. Often used when position command with low resolution or high electronic gear ration to smoothen velocity feed forward.
Position deviation under constant velocity can be lowered with higher velocity feed forward gain. Please refer to the equation below.

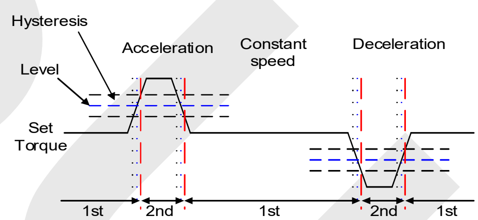
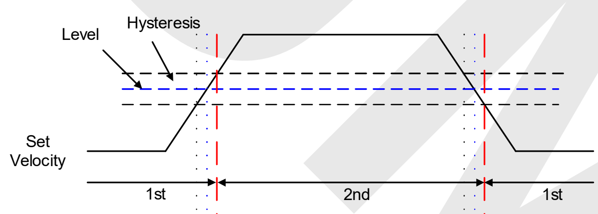
Position deviation[Unit]= $\frac{Set\ velocity[\frac{Uint}{s}]}{Position\ loop\ gain[Hz]}\ x\ \frac{100 - Velocity\ feed\ foward\ gain[\%]}{100}$

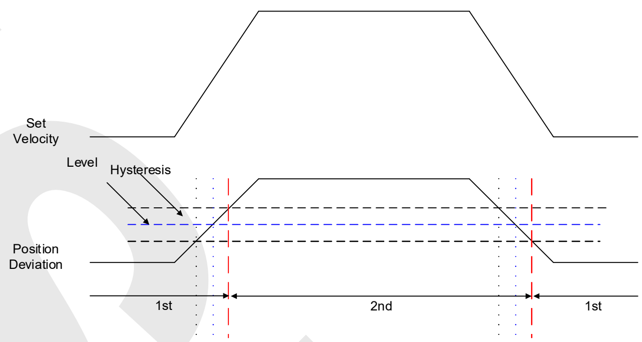
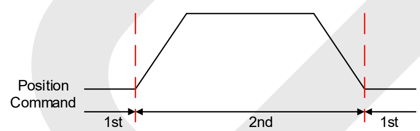
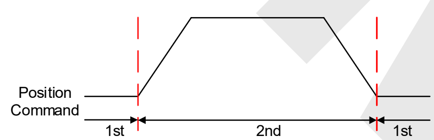
P01.12	Label	Torque feed forward gain			Mode	**PP**	**PV**	**HM**	**CSP**	**CSV**		
	Range	0~1000	Unit	0.1%	Default	0	Index		2112h			
	Activation	Immediate										
	Before using torque feed forward, please set correct inertia ratio. By increasing torque feed forward gain, position deviation on constant acceleration/deceleration can be reduced to close to 0. Under ideal condition and trapezoidal speed profile, position deviation of the whole motion can be reduced to close to 0. In reality, perturbation torque will always exist, hence position deviation can never be 0.											

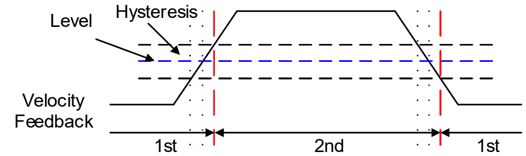
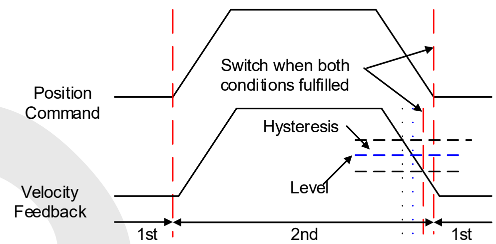
P01.13	Label	Torque feed forward filter time constant			Mode	PP	PV	HM	CSP	CSV		
	Range	0~6400	Unit	0.01ms	Default	0		Index		2113h		
	Activation	Immediate										

Low pass filter to eliminate abnormal or high frequencies in torque feed forward command. Usually used when encoder has lower resolution or precision.
Noise reduces if torque feed forward filter time constant is set higher but position deviation will increase at acceleration varied points.

P01.15	Label	Position control gain switching mode			Mode							F
	Range	0~11	Unit	—	Default	0		Index		2115h		
	Activation	Immediate										

Set Value	Condition	Gain switching condition
0	1^{st} gain fixed	Fixed on using 1^{st} gain(P01.00-P01.04)
1	2^{nd} gain fixed	Fixed on using 2^{nd} gain (P01.05-P01.09)
2	Reserved	
3	High set torque	Switch to 2^{nd} gain when set torque command absolute value larger than (level + hysteresis)[%] Switch to 1^{st} gain when set torque command absolute value smaller than (level + hysteresis)[%] 
4	Reserved	Reserved
5	High set velocity	 Valid for position and velocity control. Switch to 2^{nd} gain when set velocity command absolute value larger than (level + hysteresis)[r/min] Switch to 1^{st} gain when set velocity command absolute value smaller than (level-hysteresis)[r/min]

6	Large position deviation	Valid for position control. Switch to 2nd gain when position deviation absolute value larger than (level + hysteresis)[pulse] Switch to 1st gain when position deviation absolute value smaller than (level-hysteresis)[pulse] 
7	Pending position command	Valid for position control. Switch to 2nd gain if position command ≠ 0 Switch to 1st gain if position command **remains = 0** throughout the duration of delay time. 
8	Not yet in position	Valid for position control. Switch to 2nd gain if position command is not completed. Switch to 1st gain if position command **remains uncompleted** throughout the duration of delay time. 
9	High actual velocity	Valid for position control. Switch to 2nd gain when actual velocity absolute value larger than (level + hysteresis)[r/min] Switch to 1st gain when actual velocity absolute value remains smaller throughout the duration of delay time than (level-hysteresis)[r/min]

		
10	Pending position command +actual velocity	Valid for position control. Switch to 2nd gain if position command ≠ 0 Switch to 1st gain if positional command = 0 throughout the duration of delay time and absolute value of actual velocity remains smaller than (level - hysteresis) (r/min) 

For position control mode, set P01.15=3,5,6,9,10;
For velocity control mode, set P01.15=3,5,9;

*** Above 'level' and 'hysteresis' are in correspondence to P01.17 Position control gain switching level and P01.18 Hysteresis at position control switching.*

P01.17	Label	Position control gain switching level			Mode			**F**
	Range	0~20000	Unit	Mode dependent	Default	50	Index	2117h
	Activation	Immediate						

Set threshold value for gain switching to occur.
Unit is mode dependent.

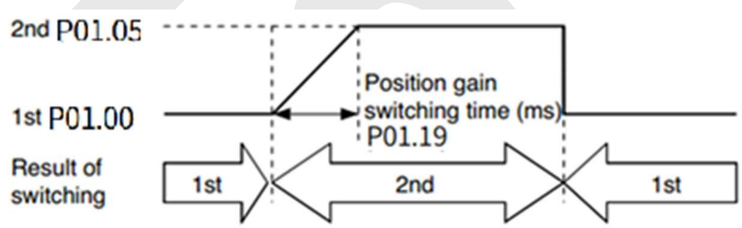
Switching condition	**Unit**
Position	Encoder pulse count
Velocity	RPM
Torque	%

Please set level ≥ hysteresis

P01.18	Label	Hysteresis at position control switching			Mode							F
	Range	0~20000	Unit	Mode dependent	Default	33	Index	2118h				
	Activation	Immediate										
	To eliminate the instability of gain switching. Used in combination with P01.17 using the same unit. If level< hysteresis, drive will set internally hysteresis = level.											

P01.19	Label	Position gain switching time			Mode							F
	Range	0~10000	Unit	0.1ms	Default	33	Index	2119h				
	Activation	Immediate										

During position control, to ease torque changes and vibration due to rapid changes in position loop gain, set suitable P01.19 value
For example: 1st (P01.00) <-> 2nd (P01.05)



P01.36	Label	External ABZ encoder filter time			Mode	PP			C SP			
	Range	0~300	Unit	0.01us	Default	20	Index	2136h				
	Activation	Immediate										
	To set filter time for external ABZ encoder											

P01.39	Label	Special function registry 2			Mode							F
	Range	0-0xFFFF	Unit	0.01us	Default	0	Index	2139h				
	Activation	Immediate										

Set value	Description
【0】	Reserved
1	=1, activate full closed loop during trial run
2	=1, hybrid position deviation clearing

5.2.3 [Class 2] Vibration Suppression

P02.00	Label	Adaptive filtering mode settings			Mode							F
	Range	0~4	Unit	-	Default	0	Index			2200h		
	Activation	Immediate										

Set value	Explanation	
0	Adaptive filter: invalid	Parameters related to 3rd and 4th notch filter remain unchanged
1	Adaptive filter: 1 filter valid for once.	1 adaptive filter becomes valid. 3rd notch filter related parameters updated accordingly. P02.00 switches automatically to 0 once updated.
2	Adaptive filter: 1 filter remains valid	1 adaptive filter becomes valid. 3rd notch filter related parameters will keep updating accordingly.
3-4	Reserved	-

P02.01	Label	1st notch frequency			Mode							F
	Range	50~4000	Unit	Hz	Default	4000	Index			2201h		
	Activation	Immediate										

Set center frequency of 1st torque command notch filter.
Set P02.01 to 4000 to deactivate notch filter

P02.02	Label	1st notch bandwidth selection			Mode							F
	Range	0~20	Unit	-	Default	4	Index			2202h		
	Activation	Immediate										

Set notch bandwidth for 1st resonant notch filter.
Under normal circumstances, please use factory default settings. If resonance is under control, in combination with P02.01 and P02.03, P02.02 can be reduced to improve current loop responsiveness which allows higher mechanical stiffness settings.

P02.03	Label	1st notch depth selection			Mode							F
	Range	0~99	Unit	-	Default	0	Index	2203h				
	Activation	Immediate										

Set notch depth for 1st resonant notch filter.
Under normal circumstances, please use factory default settings. If resonance is under control, in combination with P02.01 and P02.02, P02.03 can be reduced to improve current loop responsiveness which allows higher mechanical stiffness settings.

P02.04	Label	2nd notch frequency			Mode							F
	Range	50~4000	Unit	Hz	Default	4000	Index	2204h				
	Activation	Immediate										

Set center frequency of 2nd torque command notch filter.
Set P02.04 to 4000 to deactivate notch filter

P02.05	Label	2nd notch bandwidth selection			Mode							F
	Range	0~20	Unit	-	Default	4	Index	2205h				
	Activation	Immediate										

Set notch bandwidth for 2nd resonant notch filter.
Under normal circumstances, please use factory default settings. If resonance is under control, in combination with P02.04 and P02.06, P02.05 can be reduced to improve current loop responsiveness which allows higher mechanical stiffness settings.

P02.06	Label	2nd notch depth selection			Mode							F
	Range	0~99	Unit	-	Default	0	Index	2206h				
	Activation	Immediate										

Set notch depth for 1st resonant notch filter.
When P02.06 value is higher, notch depth becomes shallow, phase lag reduces. Under normal circumstances, please use factory default settings. If resonance is under control, in combination with P02.04 and P02.05, P02.06 can be reduced to improve current loop responsiveness which allows higher mechanical stiffness settings.

P02.07	Label	3rd notch frequency			Mode							F
	Range	50~4000	Unit	Hz	Default	4000	Index	2207h				
	Activation	Immediate										

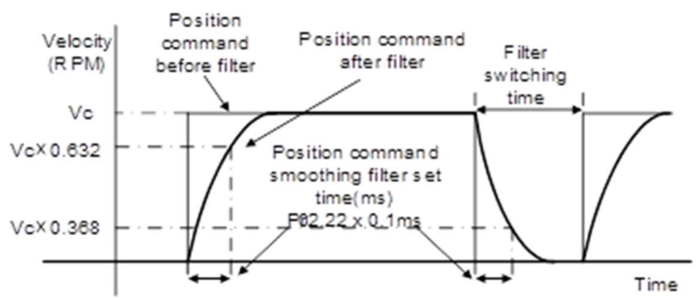
Set center frequency of 3rd torque command notch filter.
Set P02.07 to 4000 to deactivate notch filter

P02.08	Label	3rd notch bandwidth selection			Mode							F
	Range	0~20	Unit	-	Default	4	Index			2287h		
	Activation	Immediate										
Set notch bandwidth for 3rd resonant notch filter. Under normal circumstances, please use factory default settings.												

P02.09	Label	3rd notch depth selection			Mode							F
	Range	0~99	Unit	-	Default	0	Index			2206h		
	Activation	Immediate										
Set notch depth for 1st resonant notch filter. When P02.09 value is higher, notch depth becomes shallow, phase lag reduces.												

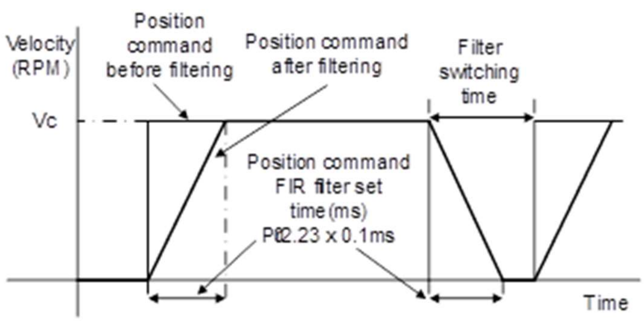
P02.14	Label	1st damping frequency			Mode							F
	Range	0~2000	Unit	0.1Hz	Default	0	Index			2214h		
	Activation	Immediate										
0: Deactivate To suppress wobble at load end. Often used when wobble of flexible structure due to high deceleration upon stopping. Especially effective for wobble with frequencies under 100Hz. Set P02.15 to wobble frequency (wobble frequency can be determined using tracing function of EDrive)												

P02.16	Label	2nd damping frequency			Mode							F
	Range	0~2000	Unit	0.1Hz	Default	0	Index			2216h		
	Activation	Immediate										
0: Deactivate To suppress wobble at load end. Often used when wobble of flexible structure due to high deceleration upon stopping. Especially effective for wobble with frequencies under 100Hz. Set P02.15 to wobble frequency (wobble frequency can be determined using tracing function of EDrive)												

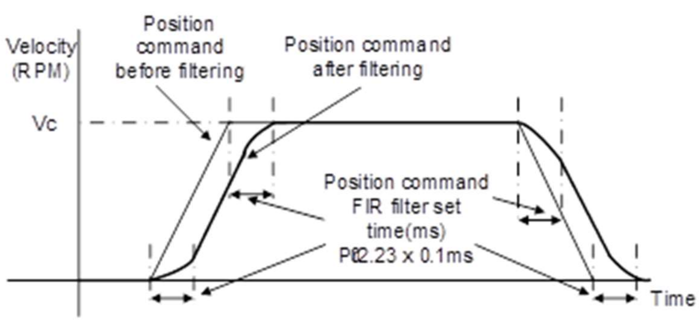
<table>
<tr><td rowspan="3">P02.22</td><td>Label</td><td colspan="2">Position command smoothing filter</td><td>Mode</td><td>PP</td><td></td><td></td><td>HM</td><td>CSP</td><td></td><td></td></tr>
<tr><td>Range</td><td>0~32767</td><td>Unit</td><td>0.1ms</td><td>Default</td><td colspan="2">0</td><td colspan="2">Index</td><td colspan="2">2222h</td></tr>
<tr><td>Activation</td><td colspan="10">Stop axis</td></tr>
<tr><td colspan="12">To set time constant of 1 time delay filter of position command.
To set time constant of 1 time delay filter, according to target velocity Vc square wave command as show below.

Usually applied when there is rather sharp acceleration which might cause motor overshoot or undershoot. To smoothen command signal, reduces impact to machines and eliminate vibration. If P02.22 is set too high, overall time will be lengthened.</td></tr>
</table>

P02.23	Label	Position command FIR filter			Mode	PP			HM	CSP		
	Range	0~10000	Unit	0.1ms	Default	0	Index			2223h		
	Activation	Disable axis										

As shown below, when target velocity Vc square wave command reaches Vc, it becomes trapezoidal wave after filtering.



As shown below, when target velocity Vc trapezoidal command reaches Vc, it becomes S wave after filtering.



Usually applied when there is rather sharp acceleration which might cause motor overshoot or undershoot. To smoothen command signal, reduces impact to machines and eliminate vibration. If P02.23 is set too high, overall time will be lengthened.

***Please wait for command to stop and after filter idle time to modify P02.23.*
Filter switching time = (P02.23 set value x 0.1ms + 0.25ms)

P02.31	Label	5th resonant frequency			Mode							F
	Range	50~4000	Unit	Hz	Default	4000	Index			2231h		
	Activation	Immediate										

To set zero-valued eigenfrequency of 5th resonant notch filter. P02.31 corresponds to machine specific resonant frequency.
Notch filter deactivated if P02.31 is set to any value.

P02.32	Label	5^{th} resonant Q value			Mode			F
	Range	0~10000	Unit	Hz	Default	0	Index	2232h
	Activation	Immediate						
	To set notch Q value of 5^{th} resonant notch filter							

P02.33	Label	5^{th} anti-resonant frequency			Mode			F
	Range	50~40000	Unit	Hz	Default	4000	Index	2233h
	Activation	Immediate						
	To set zero-valued eigenfrequency of 5^{th} resonant notch filter. P02.31 corresponds to machine-specific anti-resonant frequency.							

P02.34	Label	5^{th} anti-resonant Q value			Mode			F
	Range	0~9900	Unit	Hz	Default	0	Index	2234h
	Activation	Immediate						
	To set resonant Q value of 5^{th} resonant notch filter							

P02.35	Label	6^{th} resonant frequency			Mode			F
	Range	50~4000	Unit	Hz	Default	4000	Index	2235h
	Activation	Immediate						
	To set zero-valued eigenfrequency of 6^{th} resonant notch filter. P02.35 corresponds to machine-specific resonant frequency. Notch filter deactivated if P02.31 is set to any value.							

P02.36	Label	6^{th} resonant Q value			Mode			F
	Range	0~10000	Unit	Hz	Default	0	Index	2236h
	Activation	Immediate						
	To set notch Q value of 6^{th} resonant notch filter							

P02.37	Label	6^{th} anti-resonant frequency			Mode			F
	Range	50~40000	Unit	Hz	Default	4000	Index	2237h
	Activation	Immediate						
	To set zero-valued eigenfrequency of 6^{th} resonant notch filter. P02.37 corresponds to machine-specific anti-resonant frequency.							

P02.38	Label	6th anti-resonant Q value			Mode							F
	Range	0~9900	Unit	Hz	Default	0	Index	2238h				
	Activation	Immediate										

To set resonant Q value of 6th resonant notch filter

P02.48	Label	Adjustments mode			Mode							F
	Range	0~1	Unit	-	Default	0	Index	2248h				
	Activation	Immediate										

To turn on/off automatic adjustments

Set value	Description
【0】	Turn off automatic adjustments
1	Activate automatic adjustments, real time inertia measuring and vibration suppression. Inertia measuring deactivated after reaching 4 times in 5 minutes, triggering conditions: changes in mechanical stiffness.

P02.50	Label	MFC type			Mode	PP			CSP			
	Range	0~3	Unit	-	Default	0	Index	2250h				
	Activation	After restart										

Set value	Description
【0】	Model following control
1	Zero tracking control
2	*3 inertia (future upgrade)*
3	*Path following (future upgrade)*

P02.51	Label	Velocity feedforward compensation coefficient			Mode	PP			CSP			
	Range	-10000~10000	Unit	-	Default	0	Index	2251h				
	Activation	Immediate										

To compensate for velocity feedforward

P02.52	Label	Torque feedforward compensation coefficient			Mode	PP	PV		CSP	CSV		
	Range	-10000~10000	Unit	Hz	Default	0	Index	2252h				
	Activation	Immediate										

To compensate for torque feedforward

P02.53	Label	Dynamic friction compensation coefficient			Mode							F
	Range	0~1000	Unit	%	Default	0		Index		2253h		
	Activation	Immediate										

To set ratio of rated torque/rated rotational speed, to compensate for dynamic friction during motion and have better control over acceleration/deceleration.

$$\text{Dynamic friction coefficient} = \left| \frac{\text{Torque(Rotational speed 1)} - \text{Torque(Rotational speed 2)}}{\text{Rotational speed 1} - \text{Rotational speed 2}} * \text{rated rotational speed} \right|$$

When there is an excess position deviation during acceleration/deceleration, please adjust P02.53 to reduce the deviation to 0.

P02.54	Label	Overshoot time coefficient			Mode							F
	Range	0~10000	Unit	-	Default	0		Index		2254h		
	Activation	Immediate										

To set overtravel time coefficient

P02.55	Label	Overshoot suppression gain			Mode							F
	Range	0~1000	Unit	-	Default	0		Index		2255h		
	Activation	Immediate										

Suppression improves with larger set value but might affect the performance of MFC. Please use with caution for any value above 100.

5.2.4 [Class 3] Velocity Control

P03.12	Label	Acceleration time settings			Mode		PV				CSV
	Range	0~10000	Unit	ms/ (1000RPM)	Default	0	Index		2312h		
	Activation	Immediate									
P03.13	Label	Deceleration time settings			Mode		PV				CSV
	Range	0~10000	Unit	ms/ (1000RPM)	Default	0	Index		2313h		
	Activation	Immediate									

Set max acceleration/deceleration for velocity command.

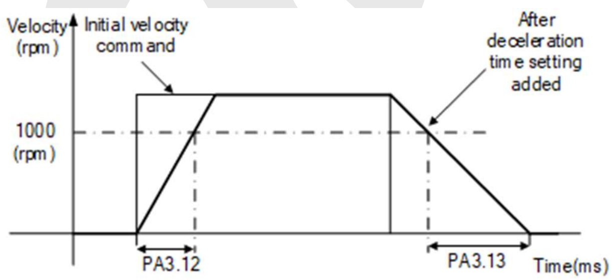
If target velocity = *x* [rpm], max acceleration = *a* [unit: rpm/ms], acceleration time = *t* [ms]
P03.12 = *1000/a*
P03.13 = *1000/a*
a = x/t

Velocity (rpm) Initial acceleration time

With added acceleration deceleration time settings

For example: If motor is to achieve 1500rpm in 30s, *a=1500/30=50rpm/ms*
P03.12 = 1000/*a*= *20.* Hence when P03.12 = 20, motor can achieve 1500rpm in 30s.

1000 (rpm)

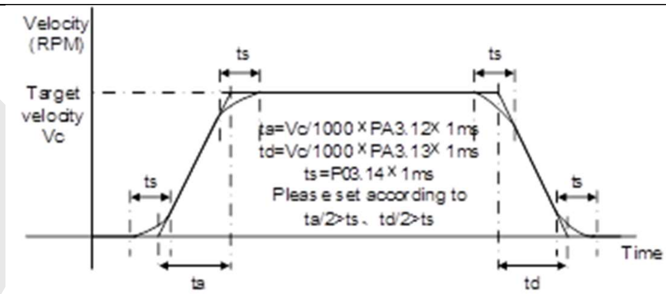


Usually used when there is rapid acceleration or trapezoidal wave velocity command due to many different internal speed segments under velocity control mode which causes instable while motor in motion.

Under velocity control mode, 6083 and 6084 is limited by P03.12 and P03.13 correspondingly.

P03.14	Label	Sigmoid acceleration/deceleration settings			Mode		PV				CSV
	Range	0~1000	Unit	ms	Default	0	Index		2314h		
	Activation	Axis disable									

To set sigmoid acceleration and deceleration turning point in accordance to P03.12 and P03.13.



P03.15	Label	Zero speed clamp function selection			Mode							F
	Range	0~3	Unit	-	Default	0	Index	2315h				
	Activation	Immediate										

Set value	Zero speed clamp function
0	Invalid: zero speed clamp deactivated
1	Velocity command is forced to 0 when the zero speed clamp (ZEROSPD) input signal is valid.
2	Velocity command is forced to 0 when actual velocity is lower than P03.16.
3	Includes conditions from 1 and 2

P03.16	Label	Zero speed clamp level			Mode		PV				CSV	
	Range	10~2000	Unit	RPM	Default	30	Index	2316h				
	Activation	Immediate										

Velocity command is forced to 0 when actual velocity is lower than P03.16 and after static time set in P03.23

P03.23	Label	Zero speed clamp static time			Mode		PV				CSV	
	Range	0~32767	Unit	ms	Default	0	Index	2323h				
	Activation	Immediate										

To set delay time for zero speed clamp.
To prevent creeping at low speed, velocity command forced to 0 when velocity goes under P03.16 after time set in P03.23

5.2.5 [Class 4] I/O Interface Setting

P04.00	Label	Input selection DI1			Mode							F
	Range	0x0~0xFF	Unit	—	Default	0x0		Index			2400h	
	Activation	Immediate										
P04.01	Label	Input selection DI2			Mode							F
	Range	0x0~0xFF	Unit	—	Default	0x1		Index			2401h	
	Activation	Immediate										
P04.02	Label	Input selection DI3			Mode							F
	Range	0x0~0xFF	Unit	—	Default	0x2		Index			2402h	
	Activation	Immediate										
P04.03	Label	Input selection DI4			Mode							F
	Range	0x0~0xFF	Unit	—	Default	0x16		Index			2403h	
	Activation	Immediate										
P04.04	Label	Input selection DI5			Mode							F
	Range	0x0~0xFF	Unit	—	Default	0x0		Index			2404h	
	Activation	Immediate										
P04.05	Label	Input selection D16			Mode							F
	Range	0x0~0xFF	Unit	—	Default	0x0		Index			2405h	
	Activation	Immediate										
P04.06	Label	Input selection DI7			Mode							F
	Range	0x0~0xFF	Unit	—	Default	0x4		Index			2406h	
	Activation	Immediate										
P04.07	Label	Input selection DI8			Mode							F
	Range	0x0~0xFF	Unit	—	Default	0x0		Index			2407h	
	Activation	Immediate										

Digital input DI allocation using hexadecimal system

Input	Symbol	Set value		0x60FD(bit)
		Normally open	Normally close	
Invalid	—	0h	-	×
Positive limit switch	POT	1h	81h	Bit1
Negative limit switch	NOT	2h	82h	Bit0
Clear alarm	A-CLR	4h	-	×
Forced alarm	E-STOP	14h	94h	×
Home switch	HOME-SWITCH	16h	96h	Bit2

- Please don't set anything other than listed in table above.
- Normally open: Valid when input = ON Normally close: Valid when input = OFF
- Er210 might occur if same function is allocated to different channels at the same time

- Channel that has no value doesn't affect driver motion.
- Front panel is of hexadecimal system.
- P04.00 – P04.07 corresponds to DI1 – DI8. External sensors can be connected if the parameters are all set to 0. Controller will read 60FD bit4 – 11 to get DI1 – DI8 actual status.

P04.10	Label	Output selection DO1			Mode								**F**
	Range	0x0~0xF F	Unit	—	Default	0x1		Index			2410h		
	Activation	Immediate											
P04.11	Label	Output selection DO2			Mode								**F**
	Range	0x0~0xF F	Unit	—	Default	0x3		Index			2411h		
	Activation	Immediate											
P04.12	Label	Output selection DO3			Mode								**F**
	Range	0x0~0xF F	Unit	—	Default	0x4		Index			2412h		
	Activation	Immediate											

Digital output DO allocation using hexadecimal system.

Output	**Symbol**	**Set value**	
		Normally open	**Normally close**
Master device control	—	00h	-
Alarm	ALM	01h	81h
Servo-Ready	S-RDY	02h	82h
External brake released	BRK-OFF	03h	83h
Positioning completed	INP	04h	84h
At-speed	AT-SPEED	05h	85h
Torque limit signal	TLC	06h	86h
Zero speed clamp detection	ZSP	07h	87h
Velocity coincidence	V-COIN	08h	88h
Position command ON/OFF	P-CMD	0Bh	8Bh
Velocity limit signal	V-LIMIT	0Dh	8Dh
Velocity command ON/OFF	V-CMD	0Fh	8Fh
Servo status	SRV-ST	12h	92h
Homing done	HOME-OK	22h	A2h
Position comparison	CMP-OUT	14h	94h

Please don't set any other than the outputs listed in the table above.

- Normally open：Active low
- Normally close：Active high
- Front panel is of hexadecimal system.
- P04.10 – P04.12 corresponds to DO1 – DO3. If all parameters are set to 0, master device controls the outputs, object dictionary 0x60FE sub-index 01 bit16-18 corresponds to DO1-DO3.

P04.22	Label	Analog input 1 zero drift			Mode			F
	Range	-32766~32766	Unit	0.3mv	Default	0	Index	2422h
	Activation	Immediate						
	To set zero drift compensation value for zero drift correction.							
P04.23	Label	Analog input 1 filter			Mode			F
	Range	0~6400	Unit	0.01ms	Default	0	Index	2423h
	Activation	Immediate						
	To set a delay filter time coefficient for AI1 input voltage. When filter time takes effect, input voltage will be smoothen.							
P04.24	Label	Analog input 1 overvoltage			Mode			F
	Range	0~100	Unit	0.1V	Default	0	Index	2424h
	Activation	Immediate						
	When P04.23 = 0, P04.23 invalid. Er270 might occur when the input voltage of AI1 is higher than the voltage after zero drift correction.							
P04.25	Label	Analog input 2 zero drift			Mode			F
	Range	-32766-32766	Unit	-	Default	1	Index	2425h
	Activation	Immediate						
	To set zero drift compensation value for zero drift correction.							
P04.26	Label	Analog input 2 filter			Mode			F
	Range	0~6400	Unit	-	Default	1	Index	2426h
	Activation	Immediate						
	To set a delay filter time coefficient for AI1 input voltage. When filter time takes effect, input voltage will be smoothen.							
P04.27	Label	Analog filter 2 overvoltage			Mode			F
	Range	0~100	Unit	-	Default	1	Index	2427h
	Activation	Immediate						
	When P04.27 = 0, P04.27 invalid. Er270 might occur when the input voltage of AI1 is higher than the voltage after zero drift correction.							

P04.31	Label	Positioning complete range			Mode	PP	HM	CSP	
	Range	0~10000	Unit	Command unit	Default	20	Index	2431h	
	Activation	Immediate							
	To set position deviation range of INP1 positioning completed output signal.								

P04.32	Label	Positioning complete output setting			Mode	PP	HM	CSP	
	Range	0~4	Unit	-	Default	1	Index	2432h	

	Activation	Immediate

Output conditions of INP1 positioning completed output signal

Set value	Positioning completed signal
0	Signal valid when the position deviation is smaller than P04.31
1	Signal valid when there is no position command and position deviation is smaller than P04.31
2	Signal valid when there is no position command, zero-speed clamp detection (ZSP) signal is ON and the positional deviation is smaller than P04.31
3	Signal valid when there is no position command and position deviation is smaller than P04.31. Signal ON when within the time set in P04.33 otherwise OFF.
4	When there is no command, position detection starts after the delay time set in P04.33. Signal valid when there is no position command and positional deviation is smaller than P04.31.

P04.33	Label	INP positioning delay time			Mode	PP			HM	CSP		
	Range	0~15000	Unit	1ms	Default	0	Index			2433h		
	Activation	Immediate										

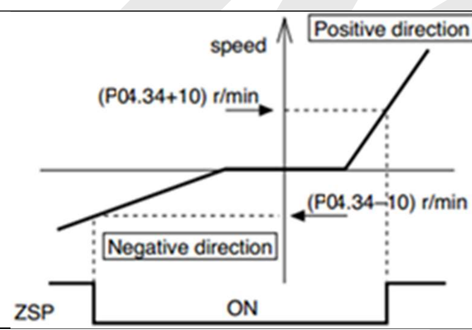
To set delay time when P04.32 = 3

Set value	Positioning completed signal
0	Indefinite delay time, signal ON until next position command
1-15000	OFF within the time set; ON after time set. Switch OFF after receiving next position command.

P04.34	Label	Zero speed			Mode							F
	Range	1~2000	Unit	RPM	Default	50	Index			2434h		
	Activation	Immediate										

To set threshold value for zero speed clamp detection.
Zero speed clamp detection (ZSP) output signal valid when motor speed goes under the value set in P04.34

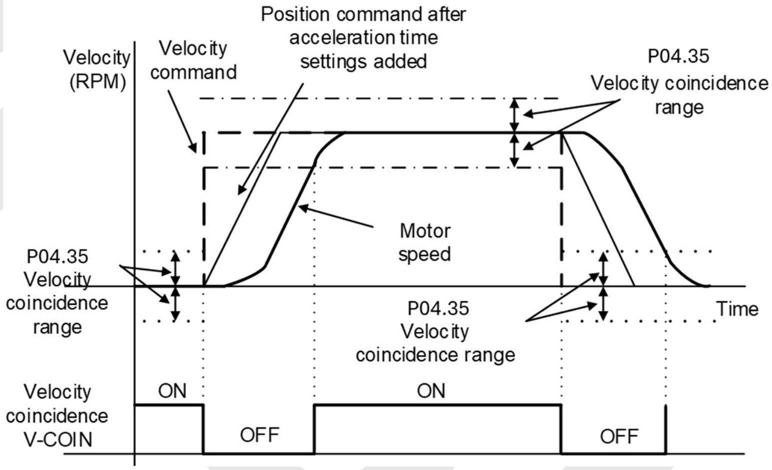
- Disregard the direction of rotation, valid for both directions.
- Hysteresis of 10RPM. Please refer to diagram on the right side.



P04.35	Label	Velocity coincidence range			Mode		PV			CSV	
	Range	10~2000	Unit	RPM	Default	50	Index			2435h	
	Activation	Immediate									

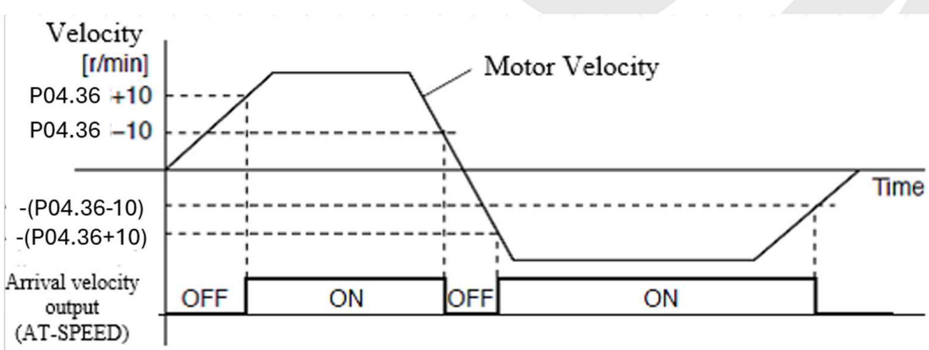
If the difference between velocity command and motor actual speed is below P04.35, Velocity coincidence (V-COIN) output signal valid.

Due to 10RPM hysteresis:
Velocity coincidence output OFF -> ON timing (P04.35 -10) r/min
Velocity coincidence output ON -> OFF timing (P04.35 +10) r/min



P04.36	Label	Arrival velocity (AT-speed)			Mode		PV			CSV	
	Range	10~2000	Unit	RPM	Default	1000	Index			2436h	
	Activation	Immediate									

When motor velocity > P04.36, AT-speed output signal is valid.
Detection using 10RPM hysteresis.

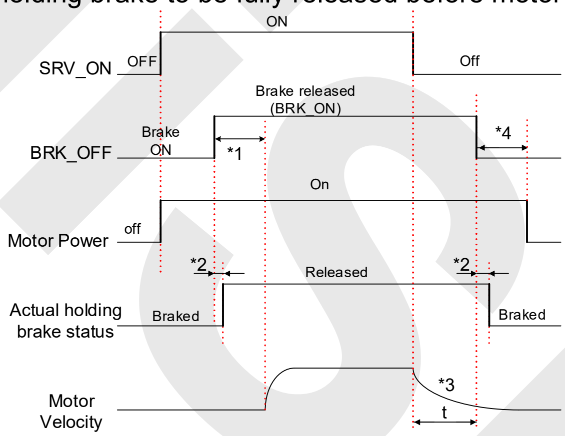


P04.37	Label	Motor power-off delay time			Mode			F
	Range	0~3000	Unit	1ms	Default	100	Index	2437h
	Activation	Immediate						

- To set delay time for holding brake to be activated after motor power off to prevent axis from sliding.

P04.38	Label	Delay time for holding brake release			Mode			F
	Range	0~3000	Unit	1ms	Default	0	Index	2438h
	Activation	Immediate						

- To set delay time for holding brake to be released after motor power on. Motor will remain at current position and input command is masked to allow holding brake to be fully released before motor is set in motion.



*1: Delay time set in P04.38
*2: Delay time from the moment BRK_OFF signal is given until actual holding brake is released or BRK_ON signal is given until actual holding brake is activated. It is dependent on the holding brake of the motor.
*3: Deceleration time is determined by P06.14 or if motor speed goes below P04.39, whichever comes first. BRK_OFF given after deceleration time.
*4: P04.37 set time value.

Delay time from the moment SRV_ON is given until BRK_OFF switch to BRK_ON, is less than 500ms.

P04.39	Label	Holding brake activation speed			Mode			F
	Range	30~3000	Unit	RPM	Default	30	Index	2439h
	Activation	Immediate						

To set the activation speed for which holding brake will be activated.
When SRV-OFF signal is given, motor decelerates, after it reaches below P04.39 and P06.14 is not yet reached, BRK_OFF is given.
BRK_OFF signal is determined by P06.14 or if motor speed goes below P04.39, whichever comes first.

Application:
1. After disabling axis, P06.14 has been reached but motor speed is still above P04.39, BRK_OFF signal given.
2. After disabling axis, P06.14 has not been reached but motor speed is below P04.39, BRK_OFF signal given.

P04.43	Label	Emergency stop function			Mode	F
	Range	0~1	Unit	-	Default	0	Index	2443h
	Activation	Immediate				

0：Emergency stop is valid, servo driver will be forced to STOP and alarm occurs.
1：Emergency stop is invalid, servo driver will not be forced to STOP.

P04.64	Label	AO1 output mode			Mode	F		
	Range	0~1	Unit	-	Default	0	Index	2464h
	Activation	Immediate						

Set value	Description
【0】	Negative/Positive value: -10~10V
1	Absolute value output: 0~10V
Other	Reserved

P04.65	Label	AO1 signal			Mode	F		
	Range	0x0~0x7FFFFFFF	Unit	-	Default	0	Index	2465h
	Activation	Immediate						

Bit 0 – 15: AO signal source; Bit 16 – 31: DO extension channel

Bit0~Bit15	Signal source
0x0	-
0x1	Motor rotational speed（V/krpm）
0x2	Position command velocity（V/krpm）
0x3	Internal position command velocity（V/krpm）
0x4	Torque command（0.03V/0.01）
0x5	Position command deviation（mV/Command unit）
0x6	Position command deviation（mV/Encoder unit）
0x7	Analog 1（V/V）
0x8	Analog 2（V/V）
0x9	Analog 3（V/V）
0xA	Extension DO（0V/5V）
0xB	As per P04.67

Bit 16 – 31: Only available when AO signal source = 0xA

Bit16~Bit31	Channel
01h	Alarm output
02h	Servo ready
03h	External brake released
04h	Positioning completed
…	Please refer to P04.12 for other signal channels

P04.66	Label	AO1 amplification			Mode	F		
	Range	-10000~10000	Unit	0.01	Default	100	Index	2466h
	Activation	Immediate						

To set the amplification of AO1, actual voltage output = amplification x theoretical voltage

P04.67	Label	AO1 communication	Mode	F

		setting							
	Range	-10000~10000	Unit	-	Default	0	Index	2467h	
	Activation	Immediate							

Available when AO1 = 0xB, AO1 output = output setting of P04.67

P04.68	Label	AO1 offset			Mode				F
	Range	-10000~10000	Unit	-	Default	0	Index	2468h	
	Activation	Immediate							

To set AO1 offset value.

P04.69	Label	AO2 output mode			Mode				F
	Range	0~10	Unit	-	Default	0	Index	2469h	
	Activation	Immediate							

Set value	Description
【0】	Negative/Positive value: -10~10V
1	Absolute value output: 0~10V
Other	Reserved

P04.70	Label	AO2 signal			Mode				F
	Range	0x0~0x7FFFFFFF	Unit	-	Default	0	Index	2470h	
	Activation	Immediate							

Bit 0 – 15: AO signal source; Bit 16 – 31: DO extension channel

Bit0~Bit15	Signal source
0x0	-
0x1	Motor rotational speed（V/krpm）
0x2	Position command velocity（V/krpm）
0x3	Internal position command velocity（V/krpm）
0x4	Torque command（0.03V/0.01）
0x5	Position command deviation（mV/Command unit）
0x6	Position command deviation（mV/Encoder unit）
0x7	Analog 1（V/V）
0x8	Analog 2（V/V）
0x9	Analog 3（V/V）
0xA	Extension DO（0V/5V）
0xB	As per P04.72

Bit 16 – 31: Only available when AO signal source = 0xA

Bit16~Bit31	Channel
01h	Alarm output
02h	Servo ready
03h	External brake released
04h	Positioning completed
…	Please refer to P04.12 for other signal channels

P04.71	Label	AO2 amplification			Mode				F

	Range	-10000~10000	Unit	-	Default	0	Index	2471h
	Activation	Immediate						
	To set the amplification of AO2, actual voltage output = amplification x theoretical voltage							
P04.72	Label	AO2 communication setting			Mode			F
	Range	-10000~10000	Unit	-	Default	0	Index	2472h
	Activation	Immediate						
	Available when AO1 = 0xB, AO1 output = output setting of P04.72							
P04.73	Label	AO2 offset			Mode			F
	Range	-10000~10000	Unit	-	Default	0	Index	2473h
	Activation	Immediate						
	To set AO2 offset value.							

P04.74	Label	Warning indicator light 1 signal			Mode			F
	Range	0~100	Unit	-	Default	1	Index	2474h
	Activation	Immediate						
	To select warning signal for warning indicator light 1, as the table in P04.78							
P04.75	Label	Warning indicator light 2 signal			Mode			F
	Range	0~100	Unit	-	Default	2	Index	2475h
	Activation	Immediate						
	To select warning signal for warning indicator light 2, as the table in P04.78							
P04.76	Label	Warning indicator light 3 signal			Mode			F
	Range	0~100	Unit	-	Default	3	Index	2476h
	Activation	Immediate						
	To select warning signal for warning indicator light 3, as the table in P04.78							
P04.77	Label	Warning indicator light 4 signal			Mode			F
	Range	0~100	Unit	-	Default	4	Index	2477h
	Activation	Immediate						
	To select warning signal for warning indicator light 4, as the table in P04.78							
P04.78	Label	Warning indicator light 5 signal			Mode			F
	Range	0~100	Unit	-	Default	5	Index	2478h
	Activation	Immediate						

To select warning signal for warning indicator light 1

Set value	Signal
【0】	None
1	Negative limit
2	Battery low voltage
3	Overload
4	Torque limit
5	Positive limit
other	*Reserved*

During normal operation, warning indicator light will be lighted in a cycle.

5.2.6 [Class 5] Extension settings

P05.04	Label	Driver prohibition input settings			Mode		F
	Range	0~2	Unit	—	Default	0	Index 2504h
	Activation	Immediate					

To set driver prohibition input (POT/NOT): If set to 1, no effect on homing mode.

Set value	Explanation
0	POT → Positive direction drive prohibited NOT → Negative direction drive prohibited
1	POT and NOT invalid
2	Any single sided input from POT or NOT might cause Er260

In homing mode, POT/NOT invalid, please set object dictionary 5012-04 bit0=1

P05.06	Label	Servo-off mode			Mode		F
	Range	0~5	Unit	—	Default	0	Index 2506h
	Activation	After restart					

To set servo driver disable mode and status.

Set value	Explanation: *Mode*	Explanation: *Status*
0	Servo braking	Dynamic braking
1	Free stopping	Dynamic braking
2	Dynamic braking	Dynamic braking
3	Servo braking	Free-run
4	Free stopping	Free-run
5	Dynamic braking	Free-run

P05.09	Label	Main power-off detection time			Mode		F
	Range	50~2000	Unit	ms	Default	50	Index 2509h
	Activation	Immediate					

To set duration time for detection of main power-off or low voltage supply.

P05.10	Label	Servo-off due to alarm mode	Mode	F

	Range	0~2	Unit	-	Default	0	Index	2510h
	Activation	After restart						

To set servo driver disable mode and status if alarm is triggered.
Alarm type 2:

Set value	Explanation	
	Mode	*Status*
0	Servo braking	Dynamic braking
1	Free stopping	Dynamic braking
2	Dynamic braking	Dynamic braking
3	Servo braking	Free-run
4	Free stopping	Free-run
5	Dynamic braking	Free-run

Alarm type 1:

Set value	Explanation	
	Mode	*Status*
0	Dynamic braking	Dynamic braking
1		
2		
3	Servo braking	Free-run
4	Free stopping	Free-run
5	Dynamic braking	Free-run

P05.11	Label	Servo braking torque setting			Mode							F
	Range	0~500	Unit	%	Default	0	Index	2511h				
	Activation	Immediate										

To set torque limit for servo braking mode.
If P05.11 = 0, use torque limit as under normal situation.
Between max. torque 6072 and P05.11, actual torque limit will take smaller value.

P05.12	Label	Overload level setting			Mode							F
	Range	0~115	Unit	%	Default	0	Index	2512h				
	Activation	Immediate										

If P05.12 = 0, overload level = 115%
Use only when overload level degradation is needed.

P05.13	Label	Overspeed level settings			Mode							F
	Range	0~10000	Unit	RPM	Default	0	Index	2513h				
	Activation	Immediate										

If motor speed exceeds P05.13, Er1A0 might occur.
When P05.13 = 0, overspeed level = max. motor speed x 1.2

P05.15	Label	I/O digital filter			Mode							F
	Range	0~255	Unit	0.1ms	Default	10	Index			2515h		
	Activation	Immediate										

Digital filtering of I/O input. Overly large value set will cause control delay.

P05.17	Label	Counter clearing input mode			Mode							F
	Range	0~4	Unit	-	Default	3	Index			2515h		
	Activation	Immediate										

To set the clearing conditions for deviation counter clearing input signal.

Set value	Condition
0/2/4	Invalid
1	Always clear
3	Clear only once

P05.20	Label	Position unit settings			Mode	PP			HM	CSP		
	Range	0~2	Unit	—	Default	2	Index			2520h		
	Activation	Disable										

Set value	Unit
0	Encoder unit
1	Command unit
2	0.0001rev

Command unit: Pulse from host
Encoder unit: Pulse from encoder
P05.20 only changes the unit use on host tracing function, has no relation with any position related parameters.

P05.21	Label	Torque limit selection			Mode	PP			HM	CSP		
	Range	0~2	Unit	—	Default	2	Index			2521h		
	Activation	Immediate										

Set value	Positive limit value	Negative limit value
0	P00.13	P00.13
1	P00.13	P05.22
2	60E0	60E1

Between max. torque 6072 and P05.21, actual torque limit will take smaller value.

P05.22	Label	2nd torque limit			Mode						F
	Range	0~500	Unit	%	Default	300	Index		2522h		
	Activation	Immediate									

Limited by motor max. torque.
Between max. torque 6072 and P05.22, actual torque limit will take smaller value.

P05.28	Label	LED initial status			Mode						F
	Range	0~42	Unit	—	Default	34	Index		2528h		
	Activation	After restart									

To set content display on front panel of the servo driver at servo driver power on.

Set value	Content	Set value	Content	Set value	Content
0	Position command deviation	15	Overload rate	30	No. of encoder communication error
1	Motor speed	16	Inertia ratio	31	Accumulated operation time
2	Position command velocity	17	No rotation cause	32	Automatic motor identification
3	Velocity control command	18	No. of changes in I/O signals	33	Driver temperature
4	Actual feedback torque	19	Number of over current signals	34	Servo status
5	Sum of feedback pulse	20	Absolute encoder data	35	/
6	Sum of command pulse	21	Single turn position	36	Synchronous period
7	Maximum torque during motion	22	Multiturn position	37	No. of synchronous loss
8	/	23	Communication axis address	38	Synchronous type
9	Control mode	24	Encoder position deviation	39	Whether DC is running or not
10	I/O signal status	25	Motor electrical angle	40	Acceleration/Deceleration status
11	/	26	Motor mechanical Angle	41	Sub-index of OD index
12	Error cause and history record	27	Voltage across PN	42	Value of sub-index of OD index
13	Alarm code	28	Software version		
14	Regenerative load rate	29	/		

P05.37	Label	Torque limit duration during initialization			Mode							F
	Range	0~5000	Unit	ms	Default	500	Index			2537h		
	Activation	Immediate										
To set time threshold for output torque to reach limit under torque initialization mode. Only applicable for torque initialization method -6 to -1 Under torque initialization mode, motor torque reached P05.39 and the duration reaches P05.37 before moving into next step.												

P05.39	Label	3rd torque limit			Mode							F
	Range	0~500	Unit	%	Default	80	Index			2539h		
	Activation	Immediate										
To set torque limit during torque initialization Between max. torque 6072 and P05.22, actual torque limit will take smaller value.												

P05.40	Label	D41 set value			Mode							F
	Range	0x0~0xFFFFF	Unit	%	Default	0X30C	Index			2540h		
	Activation	Immediate										
Set object word monitored by D41, index (left 4 bits) + sub-index (right 1 bit), if monitoring 0x6092-01, set P05.40 to 0x60921.												

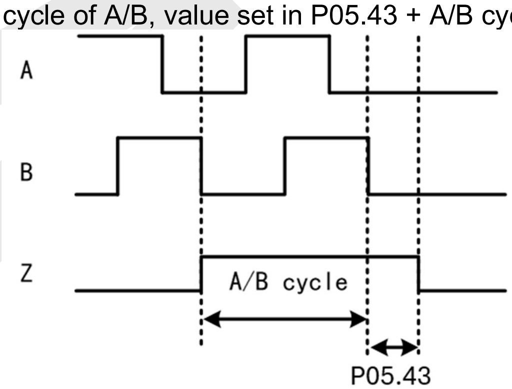
P05.42	Label	Frequency divider output - ABZ signal polarity			Mode							F
	Range	0~7	Unit	-	Default	0	Index			2542h		
	Activation	After restart										

Bit	Polarity	Description
Bit0	0 = Positive 1 = Negative	Z polarity setting of frequency divider output and position comparison
Bit1	0 = Positive 1 = Negative	Only valid in position comparison. Polarity setting when phase A frequency divider as position comparison output
Bit2	0 = Positive	Only valid in position comparison. Polarity setting when phase B frequency divider as position comparison output

P05.43	Label	Frequency divider output – Z-signal width			Mode							F		
	Range	0~500	Unit	μs	Default	0		Index	2543h					
	Activation	After restart												

Set value	Description
【0】	Z bandwidth equivalent to 1 cycle of A/B
1~500	Delay setting on top of A/B cycle width

When P05.43 = 0, width of frequency divider output Z-signal is equivalent to width of 1 cycle of A/B, value set in P05.43 + A/B cycle width = delay setting.



P05.44	Label	Frequency divider output source			Mode							F		
	Range	0~4	Unit	-	Default	0		Index	2544h					
	Activation	After restart												

Set Value	Description
【0】	Position feedback of encoder #1(motor encoder)
1	Position feedback of encoder #2(external encoder)
2	Reserved
3	Pulse input command position synchronous output; position comparison not available in this mode
4	Frequency divider output prohibited

P05.45	Label	External encoder overspeed feedback threshold			Mode							F		
	Range	0~10000	Unit	rpm	Default	0		Index	2545h					
	Activation	Immediate												

To set external encoder overspeed feedback threshold

P05.46	Label	Vent overload level			Mode							F		
	Range	0~115	Unit	%	Default	0		Index	2546h					
	Activation	Immediate												

Set value	Description
【0】	Default level: 80%
1~115	Set vent overload level accordingly

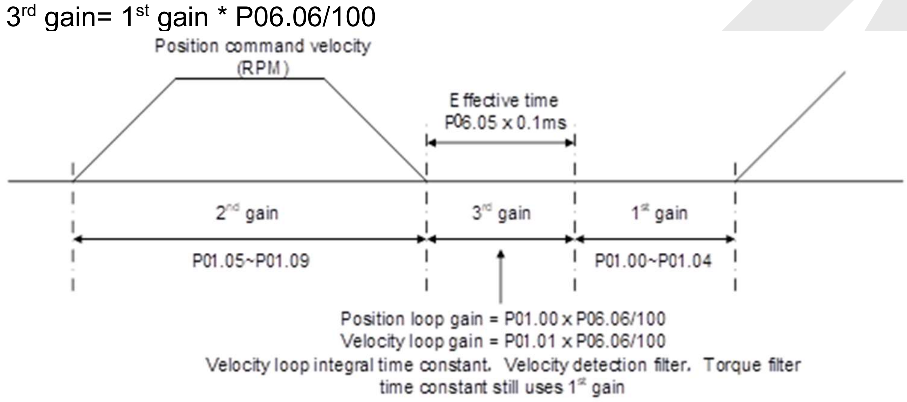
5.2.7 [Class 6] Other settings

P06.01	Label	Encoder zero position compensation			Mode							**F**
	Range	0~360	Unit	°	Default	0	Index	2601h				
	Activation	After restart										
	Angle of the encoder after zero position calibration											

P06.03	Label	JOG trial run torque command			Mode							**F**
	Range	0~350	Unit	%	Default	350	Index	2603h				
	Activation	Immediate										
	To set torque for JOG trial run command.											
P06.04	Label	JOG trial run velocity command			Mode							**F**
	Range	0~10000	Unit	r/min	Default	30	Index	2604h				
	Activation	Immediate										
	To set velocity for JOG trial run command.											

P06.05	Label	Position 3rd gain valid time			Mode	**PP**			**HM**	**CSP**		
	Range	0~10000	Unit	0.1ms	Default	0	Index	2605h				
	Activation	Immediate										
	To set time for 3rd gain to be valid When not in use, set P06.05=0, P06.06=100											
P06.06	Label	Position 3rd gain scale factor			Mode	**PP**			**HM**	**CSP**		
	Range	0~1000	Unit	100%	Default	100	Index	2606h				
	Activation	Immediate										

Set up the 3rd gain by multiplying factor of the 1st gain
3rd gain= 1st gain * P06.06/100



Only effective under position control mode, set P06.05≠0, 3rd gain function activated, set 3rd gain value in P06.06. When 2nd gain switches to 1st gain, will go through 3rd, switching time value set in P01.19.
Above diagram is illustrated using P01.15 = 7.

P06.07	Label	Torque command additional value			Mode			F
	Range	-100~100	Unit	%	Default	0	Index	2607h
	Activation	Immediate						
	To set torque forward feed additional value of vertical axis. Applicable for loaded vertical axis, compensate constant torque. Application: When load move along vertical axis, pick any point from the whole motion and stop the load at that particular point with motor enabled but not rotating. Record output torque value from d04, use that value as torque command additional value (compensation value)							
P06.08	Label	Positive direction torque compensation value			Mode			F
	Range	-100~100	Unit	%	Default	0	Index	2608h
	Activation	Immediate						
P06.09	Label	Negative direction torque compensation value			Mode			F
	Range	-100~100	Unit	%	Default	0	Index	2609h
	Activation	Immediate						
	To reduce the effect of mechanical friction in the movement(s) of the axis. Compensation values can be set according to needs for both rotational directions. Applications: 1. When motor is at constant speed, d04 will deliver torque values. Torque value in positive direction = T1; Torque value in negative direction = T2 $P06.08/P06.09 = T\frac{\|T1-T2\|}{2}$							

P06.11	Label	Current response settings			Mode			F
	Range	50~100	Unit	%	Default	100	Index	2611h
	Activation	Immediate						
	To set driver current loop related effective value ratio							

P06.14	Label	Max. time to stop after disabling			Mode			F
	Range	0~3000	Unit	ms	Default	500	Index	2614h
	Activation	Immediate						
	To set the max. time allowed for the axis to stop on emergency stop or normal axis disabling. After disabling axis, if motor speed is still higher than P04.39 but the time set in P06.14 is reached, BRK_ON given and holding brake activated. BRK_ON given time is determined by P06.14 or when motor speed goes below P04.39, whichever comes first.							

Applications: 1. After disabling axis, if motor speed is still higher than P04.39 but the time set in P06.14 is reached, BRK_ON given and holding brake activated. 2. After disabling axis, if motor speed is already lower than P04.39 but the time set in P06.14 is not yet reached, BRK_ON given and holding brake activated.

P06.20	Label	Trial run distance			Mode			F
	Range	0~1200	Unit	0.1rev	Default	10	Index	2620h
	Activation	Immediate						
JOG (Position control) : Distance travel of each motion								

P06.21	Label	Trial run waiting time			Mode			F
	Range	0~30000	Unit	ms	Default	300	Index	2621h
	Activation	Immediate						
JOG (Position control) : Waiting time after each motion								

P06.22	Label	No. of trial run cycles			Mode			F
	Range	0~32767	Unit	PCS	Default	5	Index	2622h
	Activation	Immediate						
JOG (Position control) : No. of cycles								

P06.25	Label	Trial run acceleration			Mode			F
	Range	0~10000	Unit	ms/(1000rpm)	Default	200	Index	2625h
	Activation	Immediate						
To set the acceleration/deceleration time for JOG command between 0 rpm to 1000 rpm								

P06.28	Label	Velocity observer gain			Mode			F
	Range	0~32767	Unit	—	Default	0	Index	2628h
	Activation	Immediate						
0: Default stable gain; Modifications are not recommended.								

P06.29	Label	Velocity observer bandwidth			Mode			F
	Range	0~32767	Unit	ms	Default	0	Index	2629h
	Activation	Immediate						
0: Default stable bandwidth; Modifications are recommended.								

P06.34	Label	Frame error window time			Mode							F
	Range	0~32767	Unit	ms	Default	100	Index	2634h				
	Activation	Immediate										
	To set EtherCAT data frame error detection window time											

P06.35	Label	Frame error window			Mode							F
	Range	0~32767	Unit	-	Default	50	Index	2635h				
	Activation	Immediate										
	To set EtherCAT data frame error detection window											

P06.54	Label	Absolute value rotation mode denominator setting			Mode	PP			HM	CSP		
	Range	0~32766	Unit	-	Default	0	Index	2654h				
	Activation	After restart										
	To set denominator of absolute encoder in rotational mode. When P00.15 = 2 and use in combination with P06.54: Feedback load position 6064= $\frac{PA6.63}{PA6.54}$ x Electronic gear ratio											

P06.56	Label	Blocked rotor alarm torque threshold			Mode							
	Range	0~300	Unit	%	Default	300	Index	2656h				
	Activation	Immediate										
	To set the torque threshold of blocked rotor to trigger alarm. (Alarm triggered if torque output% larger than threshold value & under 10rpm) If P06.56 = 0, blocked rotor alarm deactivated. (This applicable only to 220VAC drivers) If motor speed is 10rpm or above, Er102 won't be triggered.											

P06.59	Label	Homing mode position threshold			Mode							
	Range	0~100	Unit	0.00001rev	Default	5	Index	2659h				
	Activation	Immediate										
	To set position threshold for homing mode.											

P06.61	Label	Z signal holding time			Mode							F
	Range	0~100	Unit	ms	Default	10	Index	2661h				
	Activation	Immediate										
	To set the holding time for Z signal to maintain active high Application: 1. Z signal for 60FDH； 2. Z signal for homing process 3. Z-phase frequency output pulse width. Unit = 0.1ms; Please set P06.61≥0.2ms if used for 3 applications as above											

P06.63	Label	Absolute multiturn data upper limit			Mode							F
	Range	0~32766	Unit	rev	Default	0	Index		2663h			
	Activation	After restart										

To set upper limit of multiturn data with absolute encoder set as rotational mode.
When P00.15 = 2 and use in combination with P06.54:

- Feedback load position 6064= $\frac{PA6.63}{PA6.54}$ x Electronic gear ratio

5.2.8 [Class 7] Factory settings

Please take precaution when modifying Class 7 parameters. Might cause driver errors

P07.15	Label	Motor model			Mode							F
	Range	0x0~0x7FFF	Unit	-	Default	0x200	Property		R/W			
	Activation	After restart			Data length		16 bit					

Set value	Description
0x100	Read from EEPROM
[0x200]	Read from Encoder

When P07.15 = 0x200(2xx):

Parameter	Label
P07.00	Current loop gain
P07.01	Current loop integral time
P07.05	No. of motor pole pairs
P07.06	Motor phase resistance
P07.07	Motor D/Q induction
P07.08	Motor back EMF coefficient
P07.09	Motor torque coefficient
P07.10	Motor rated rotational speed
P07.11	Motor max. rotational speed
P07.12	Motor rated current
P07.13	Motor rotor inertia
P07.14	Driver power rating
P07.16	Encoder
P07.17	Motor max. current
P07.18	Encoder index angle compensation

P07.16	Label	Encoder			Mode							F
	Range	0x0~0x200	Unit	-	Default	As per encoder	Property		R/W			
	Activation	After restart			Data length		16 bit					

Set value	Description
0x0	17-bit encoder
0x7	23-bit encoder

P07.54	Label	External grating ruler precision			Mode							F
	Range	1-1000000	Unit	nm	Default	100	Property		R/W			
	Activation	After restart			Data length		16 bit					

To select external grating ruler precision

5.2.9［Class C］Position Comparison

P0C.00	Label	Enable position comparison			Mode			F
	Range	0~1	Unit	%	Default	0	Index	27A4-01
	Activation	Immediate						

Set Value	Description
【0】	Disable
1	Enable （Rising edge）

P0C.01	Label	Position comparison mode			Mode			F
	Range	0~255	Unit	-	Default	0	Index	27A4-02
	Activation	Immediate						

Set value	Description
【0】	Sequential comparison mode
128	Reciprocating comparison mode

Detailed explanations are available in Chapter 6 Application under Position Comparison section

P0C.02	Label	Position comparison pulse output width			Mode			F
	Range	0~4095	Unit	ms	Default	0.1ms	Index	27A4-03
	Activation	Immediate						

To set output signal pulse width of position comparison

P0C.03	Label	Position comparison output delay time compensation			Mode			F
	Range	-10000~10000	Unit	0.1μs	Default	0	Index	27A4-04
	Activation	After restart						

To set delay time compensation for delay due to DO/ frequency divider

P0C.04	Label	Position comparison starting point			Mode			F
	Range	1~42	Unit	-	Default	1	Index	27A4-05
	Activation	Immediate						

To set the starting point of position comparison.

P0C.05	Label	Position comparison end point			Mode			F
	Range	1~42	Unit	-	Default	1	Index	27A4-06
	Activation	Immediate						

To set the end point of position comparison.

P0C.06	Label	No. of cycle for N cycles comparison			Mode			F
	Range	1~50000	Unit	-	Default	1	Index	27A4-07
	Activation	Immediate						
	To set the number of cycles for N cycles comparison in position comparison.							

P0C.07	Label	Position comparison – set current position as origin			Mode			F
	Range	0~1	Unit	-	Default	0	Index	27A4-08
	Activation	Immediate						

Set Value	Description
【0】	Disable
1	Enable （Rising edge）

Set origin for position comparison, set current position as origin at rising edge.

P0C.08	Label	Position comparison – Offset to origin			Mode			F
	Range	-2^{31}~2^{31}-1	Unit	-	Default	0	Index	27A4-09
	Activation	Immediate						
	To set offset value of position in comparison to origin set in P0C.07							

To set target position and its attributes for position comparison.

P0C.20 – P0C.61	Label	Position comparison 1-42 target value			Mode			F
	Range	-2^{31}~2^{31}-1	Unit	Command unit	Default	0	Index	27A4-15 ~ 27A4-3E
	Activation	Immediate						
	When the target position(value) is reached, position comparison output will be depended on the position comparison properties value set.							
P0C.70	Label	Position comparison 1 & 2 attributes value			Mode			F
	Range	0x0~0xFFFFFFFF	Unit	Command unit	Default	0	Index	27A4-47
	Activation	Immediate						

Bit	Position comparison 1
0	Positive traversal comparison. 0=OFF,1=ON
1	Negative traversal comparison. 0=OFF,1=ON
2~5	Reserved
6	Output property settings： =0：Pulse mode =1：Flipping mode
7	DO1
8	DO2

9	DO3
10~12	Reserved
13	Frequency divider Phase A output
14	Frequency divider Phase B output
15	Frequency divider Phase Z output

Bit	Position comparison 2
16	Positive traversal comparison. 0=OFF,1=ON
17	Negative traversal comparison. 0=OFF,1=ON
18~21	Reserved
22	Output property settings： =0：Pulse mode =1：Flipping mode
23	DO1
24	DO2
25	DO3
26~28	Reserved
29	Frequency divider Phase A output
30	Frequency divider Phase B output
31	Frequency divider Phase Z output

5.2.10 [Class D] Gantry Settings

P0D.00	**Label**	Gantry Configuration			**Valid mode(s)**	-	-	-	-	-	F
	Range	0~15	**Default**	0	**Unit**	-					
	Valid	Restart	**Index**	0x27A5	SubIndex	0x01	**Attribute**	R/W			

Bit 0: Gantry function switch — 0: Off, 1: On
Bit 1: Master/Slave axis switch — 0: Slave axis, 1: Master axis
Bit 2: PWM synchronization switch — 0: Sync off, 1: Sync on
(Master axis should have sync off; slave axis should have sync on)
Bit 3: Slave axis partial parameter sync control bit
0: Synchronized
1: Not synchronized
Note:
Setting value 3: Gantry master axis is active
Setting value 5: Gantry slave axis is active

P0D.01	**Label**	Gantry Slave Axis Command Mode			**Valid mode(s)**	-	-	-	-	-	F
	Range	0~1	**Default**	0	**Unit**	-					
	Valid	Re-enable	**Index**	0x27A5	SubIndex	0x02	**Attribute**	R/W			

0: Torque (force) command synchronization
1: Position command synchronization

P0D.02	**Label**	Gantry Tuning Gain 1			**Valid mode(s)**	-	-	-	-	-	F
	Range	1~300	**Default**	100	**Unit**	-					
	Valid	Re-enable	**Index**	0x27A5	SubIndex	0x03	**Attribute**	R/W			

Gantry Synchronization Feedback Compensation Gain. Only effective in position command synchronization mode
0: Gain is 0 — equivalent to center position feedback; minimal torque deviation, maximum position deviation
100: Default value — 100% gain; balances torque and position deviation
1–100: For rigid gantry systems — lower values reduce torque deviation during motion
100–300: For flexible gantry systems — higher values reduce position deviation during motion

P0D.03	**Label**	Gantry Position Synchronization Deviation Threshold			**Valid mode(s)**	-	-	-	-	-	F
	Range	0~2^26	**Default**	10000	**Unit**	-					
	Valid	Immediate	**Index**	0x27A5	SubIndex	0x04	**Attribute**	R/W			

0: Suppress position synchronization deviation alarm

P0D.04	**Label**	Gantry Torque Deviation Threshold			**Valid mode(s)**	-	-	-	-	-	F
	Range	0~7500	**Default**	500	**Unit**	-					
	Valid	Immediate	**Index**	0x27A5	**SubIndex**	0x05	**Attribute**	R/W			
0: Suppress torque synchronization deviation alarm											

P0D.05	**Label**	Gantry Tuning Gain 2			**Valid mode(s)**	-	-	-	-	-	F
	Range	0~1000	**Default**	0	**Unit**	-					
	Valid	Immediate	**Index**	0x27A5	**SubIndex**	0x06	**Attribute**	R/W			
Co-motion Controller Parameters. Only effective in position command synchronization mode. 0: Disable torque deviation suppression 1–1000: Higher values improve suppression of torque deviation, but reduce the maximum gain of the speed loop Typically enabled in rigid gantry systems. If high speed loop gain is required, avoid setting this value too high. Can be used in conjunction with P06.73 to suppress torque deviation											

P0D.06	**Label**	Position Gain			**Valid mode(s)**	-	-	-	-	-	F
	Range	0~32767	**Default**	0	**Unit**	-					
	Valid	Immediate	**Index**	0x27A5	**SubIndex**	0x07	**Attribute**	R/W			
P0D.07	**Label**	Velocity Gain			**Valid mode(s)**	-	-	-	-	-	F
	Range	0~32767	**Default**	0	**Unit**	-					
	Valid	Immediate	**Index**	0x27A5	**SubIndex**	0x08	**Attribute**	R/W			
P0D.08	**Label**	Velocity Integral			**Valid mode(s)**	-	-	-	-	-	F
	Range	0~32767	**Default**	0	**Unit**	-					
	Valid	Immediate	**Index**	0x27A5	**SubIndex**	0x09	**Attribute**	R/W			

P0D.09	**Label**	Homing Mode			**Valid mode(s)**	-	-	-	-	-	F
	Range	0~1	**Default**	0	**Unit**	-					
	Valid	Immediate	**Index**	0x27A5	**SubIndex**	0x0B	**Attribute**	R/W			

P0D.10	**Label**	Alignment Mode			**Valid mode(s)**	-	-	-	-	-	F
	Range	0~4	**Default**	0	**Unit**	-					
	Valid	Immediate	**Index**	0x27A5	**SubIndex**	0x0C	**Attribute**	R/W			
Offset value must be less than 1/4 of a rotation. If greater than 1/4, alarm A1B will be triggered. IO-triggered operation: Slave axis remains stationary, master axis moves the offset distance. Currently only effective in torque command synchronization mode.											

P0D.11	Label	Gantry Origin Offset			Valid mode(s)	-	-	-	-	-	-	
	Range	-2^31 ~2^31-1	Default	0	Unit	-						
	Valid	Re-enable	Index	0x27A5	SubIndex	0x0D	Attribute	R/W				

5.2.11 [Class 11] Driver parameters

P11.00	Label	MCU 1 Version			Valid mode(s)	-	-	-	-	-	F	
	Range	0x0~0xFF	Default	0	Unit	-						
	Valid	Immediate	Index	0x27A9	SubIndex	0x01	Attribute	R/W				

P11.01	Label	MCU 2 Version			Valid mode(s)	-	-	-	-	-	F	
	Range	0x0~0xFF	Default	0	Unit	-						
	Valid	Immediate	Index	0x27A9	SubIndex	0x02	Attribute	R/W				

P11.02	Label	FPGA Version			Valid mode(s)	-	-	-	-	-	F	
	Range	0x0~0xFF	Default	0	Unit	-						
	Valid	Immediate	Index	0x27A9	SubIndex	0x03	Attribute	R/W				

P11.12	Label	Death Zone Compensation Factor 1			Valid mode(s)	-	-	-	-	-	F	
	Range	0x0~0xFF	Default	0	Unit	-						
	Valid	Immediate	Index	0x27A9	SubIndex	0x0D	Attribute	R/W				

P11.13	Label	Death Zone Compensation Factor 2			Valid mode(s)	-	-	-	-	-	F	
	Range	0x0~0xFF	Default	0	Unit	-						
	Valid	Immediate	Index	0x27A9	SubIndex	0x11	Attribute	R/W				

P11.16	Label	Analog 1 Zero Drift			Valid mode(s)	-	-	-	-	-	-	
	Range	0x0~0xFF	Default	0	Unit	-						
	Valid	Immediate	Index	0x27A9	SubIndex	0x12	Attribute	R/W				
Set the zero drift compensation value for analog input 1 voltage — this is the zero drift calibration function.												

P11.17	Label	Analog 2 Zero Drift			Valid mode(s)	-	-	-	-	-	-	
	Range	0x0~0xFF	Default	0	Unit	-						

	Valid	Immediate	**Index**	0x27A9	SubIndex	0x12	**Attribute**	R/W
Set the zero drift compensation value for analog input 2 voltage — this is the zero drift calibration function.								

P11.18	**Label**	Analog 3 Zero Drift			**Valid mode(s)**	-	-	-	-	-	-
	Range	0x0~0xFF	**Default**	0	**Unit**	-					
	Valid	Immediate	**Index**	0x27A9	SubIndex	0x13	**Attribute**	R/W			
Set the zero drift compensation value for analog input 3 voltage — this is the zero drift calibration function.											

P11.31	**Label**	Regenerative Vent Control Mode			**Valid mode(s)**	-	-	-	-	-	-
	Range	0x0~0xFF	**Default**	0	**Unit**	-					
	Valid	Restart	**Index**	0x27A9	SubIndex	0	**Attribute**	R/W			
Discharge Mode Setting For motors 400W and below, regenerative resistors are not included by default											

Power	Default value	Description
100/400	1	Regenerative energy is absorbed only by the internal bus capacitors of the driver.
750 and above	0	Regenerative energy can also be discharged through an external regenerative resistor if available.

5.3 402 Observer

- Parameter Valid mode Description
  CSP: Valid in cyclic synchronous position mode
  CSV: Valid in cyclic synchronous velocity mode
  CST: Valid in cyclic synchronous torque mode
  HM: Valid in homing mode
  PP: Valid in profile position mode
  PV: Valid in profile velocity mode
  PT: Valid in profile torque mode
  F: Valid in all modes

Index 603Fh	**Label**	Error code			**Unit**	**-**	**Structure**	VAR	**Type**	Uint 16
	Access	RO	**Mapping**	TPDO	**Mode**	F	**Range**	0x0~0xFFFF	**Default**	0X0
Please refer to Chapter 9 for more details on error codes.										

Index 6040h	**Label**	Control word			**Unit**	**-**	**Structure**	VAR	**Type**	Uint 16
	Access	RW	**Mapping**	RPDO	**Mode**	F	**Range**	0x0-0xFFFF	**Default**	0X0

Bit	Label	Description
0	Start	1 - valid, 0 - invalid
1	Main circuit power on	1 - valid, 0 - invalid
2	Quick stop	0 - valid,1 - invalid
3	Servo running	1 - valid, 0 - invalid
4-6	Running mode related	Related to each servo running mode
7	Fault reset	Reset resettable fault alarm. Rising edge of Bit7 is valid, bit7 remains at 1, and all other instructions are invalid
8	Pause	For more information on how to pause in each mode, refer to Object Dictionary 605Dh
9	No definition	Undefined
10	Reserved	Undefined
11-15	Reserved	Undefined

Index 6041h	**Label**	Status word			**Unit**	**-**	**Structure**	VAR	**Type**	Uint 16
	Access	RO	**Mapping**	TPDO	**Mode**	ALL	**Range**	0x0~0xFFFF	**Default**	0x0

Bit	Label	Description
0	Servo ready	1 - valid, 0 - invalid
1	Start	1 - valid, 0 - invalid
2	Servo running	1 - valid, 0 - invalid
3	Fault	1 - valid, 0 - invalid
4	Main circuit power on	1 - valid, 0 - invalid
5	Quick stop	0- valid, 1 - invalid
6	Servo cannot run	1 - valid, 0 - invalid
7	Warning	1 - valid, 0 - invalid
8	Reserved	Reserved
9	Remote control	1 - valid, 0 - invalid
10	Arrived at position	1 - valid, 0 - invalid
11	Internal limit valid	1 - valid, 0 - invalid
12-13	Mode related	Related to each servo operation mode
14	Reserved	Reserved
15	Origin found	1 - valid, 0 - invalid

Index 605Ah	Label	Quick stop option code		Unit	-	Structure	VAR	Type	INT 16
	Access	RW	Mapping	-	Mode	ALL	Range	0~7	Default	2

Motor stops when quick stop command is given.

PP, CSP, CSV, PV
0 ： To stop motor through P05.06. Status: Switch on disable, axis disabled.
1 ： Motor decelerates and stops through 6084h. Status: Switch on disable, axis disabled.
2 ： Motor decelerates and stops through 6085h. Status: Switch on disable, axis disabled.
3 ： Motor decelerates and stops through 60C6h. Status: Switch on disable, axis disabled.
5 ： Motor decelerates and stops through 6084h. Status: Quick stop
6 ： Motor decelerates and stops through 6085h. Status: Quick stop
7 ： Motor decelerates and stops through 60C6h. Status: Quick stop
HM
0 ： To stop motor through P05.06. Status: Switch on disable, axis disabled.
1 ： Motor decelerates and stops through 609Ah. Status: Switch on disable, axis disabled.
2 ： Motor decelerates and stops through 6085h. Status: Switch on disable, axis disabled.
3 ： Motor decelerates and stops through 60C6h. Status: Switch on disable, axis disabled.
5 ： Motor decelerates and stops through 609Ah. Status: Quick stop
6 ： Motor decelerates and stops through 6085h. Status: Quick stop
7 ： Motor decelerates and stops through 60C6h. Status: Quick stop
CST, PT
0 ： To stop motor through P05.06. Status: Switch on disable, axis disabled.
1, 2 ： Motor decelerates and stops through 6087h. Status: Switch on disable, axis disabled.
3 ： Motor decelerates and stops through torque = 0. Status: Switch on disable, axis disabled.
5, 6 ： Motor decelerates and stops through 6087h. Status: Quick stop
7 ： Motor decelerates and stops through torque = 0. Status: Quick stop

Index 605Bh	Label	Shutdown option code		Mode						F
	Range	RW	Unit	-	Range	0~1	Default	0		

PP, CSP, CSV, PV 0 ： To stop motor through P05.06, P05.06 = 0(Emergency stop), P05.06=1(Free stop) 1 ： Motor decelerates and stops through 6084h HM 0 ： To stop motor through P05.06, P05.06 = 0(Emergency stop), P05.06=1(Free stop) 1 ： Motor decelerates and stops through 609Ah CST, PT 0 ： To stop motor through P05.06, P05.06 = 0(Emergency stop), P05.06=1(Free stop) 1 ： Motor decelerates and stops through 6087h

Index 605Ch	**Label**	Disable operation option code			**Mode**							F
	Range	RW	**Unit**	-	**Range**	0~1	**Default**	0				

PP, CSP, CSV, PV
0 ： To stop motor through P05.06, P05.06 = 0(Emergency stop), P05.06=1(Free stop)
1 ： Motor decelerates and stops through 6084h
HM
0 ： To stop motor through P05.06, P05.06 = 0(Emergency stop), P05.06=1(Free stop)
1 ： Motor decelerates and stops through 609Ah
CST, PT
0 ： To stop motor through P05.06, P05.06 = 0(Emergency stop), P05.06=1(Free stop)
1 ： Motor decelerates and stops through 6087h

Index 605Dh	**Label**	Halt option code		**Unit**	**-**	**Structure**	VAR	**Type**	INT 16
	Access	RW	**Mapping**	-	**Mode**	F	**Range**	1~3	**Defaul t**	1

For deceleration mode settings during mode switching
PP, CSP, CSV, PV
1 ： Motor decelerates and stops through 6084h. Status: Operation enabled, axis enabled.
2 ： Motor decelerates and stops through 6085h. Status: Operation enabled, axis enabled.
3 ： Motor decelerates and stops through 60C6h. Status: Operation enabled, axis enabled.
HM
1 ： Motor decelerates and stops through 609Ah. Status: Operation enabled, axis enabled.
2 ： Motor decelerates and stops through 6085h. Status: Operation enabled, axis enabled.
3 ： Motor decelerates and stops through 60C6h. Status: Operation enabled, axis enabled.
CST, PT
1, 2 ： Motor decelerates and stops through 6087h. Status: Operation enabled, axis enabled.
3 ： Motor decelerates and stops through torque = 0. Status: Operation enabled, axis enabled.

Index 605Eh	**Label**	Fault reaction option code			**Unit**	**-**	**Structure**	VAR	**Type**	INT 16
	Access	RW	**Mapping**	-	**Mode**	F	**Range**	0~2	**Default**	0

Select stopping mode when servo alarm (Err 8xx) occurs.

PP, CSP, CSV, PV
0 ： Select motor stopping mode according to alarm properties. Status: Fault, axis disabled.
1 ： Motor decelerates and stops through 6084h. Status: Fault, axis disabled.
2 ： Motor decelerates and stops through 6085h. Status: Fault, axis disabled.
HM
0 ： Select motor stop by the alarm attribute for emergency stop, the fault state and disable
1 ： After the 609Ah motor is decelerated and stopped,, the fault state and disable
2 ： After the 6085h motor is decelerated and stopped, the fault state and disable
CST, PT
0, 1 ： Select motor stop by the alarm attribute for emergency stop, the fault state and disable
2 ： After the 6087 motor is decelerated and stopped, the fault state and disable
When other alarms, i.e. drive-side alarms:
Select motor stop by the alarm attribute for emergency stop, the fault state and disable

Index 6060h	**Label**	Mode of operation			**Unit**	**-**	**Structure**	VAR	**Type**	Int 8
	Access	RW	**Mapping**	RPDO	**Mode**	F	**Range**	1~11	**Default**	8

No.	Mode	Abbr.
1	Profile position mode	PP
3	Profile velocity mode	PV
4	profile Torque mode	PT
6	Homing mode	HM
8	Cyclic synchronous position mode	CSP
9	Cyclic synchronous velocity mode	CSV
10	Cyclic synchronous torque mode	CST

Index 6061h	**Label**	Mode of operation display			**Unit**	**-**	**Structure**	VAR	**Type**	Int 8
	Access	RW	**Mapping**	RPDO	**Mode**	F	**Range**	1~11	**Default**	8

No.	Mode	Abbr.
1	Profile position mode	PP
3	Profile velocity mode	PV
4	profile Torque mode	PT
6	Homing mode	HM
8	Cyclic synchronous position mode	CSP
9	Cyclic synchronous velocity mode	CSV
10	Cyclic synchronous torque mode	CST

Index 6062h	Label	Position demand value			Unit	Command unit	Structure	VAR	Type	Int 32
	Access	R0	Mapping	TPDO	Mode	PP/CSP/HM	Range	-2147483648~2147483647	Default	0
	Reflects position command when servo driver is enabled.									

Index 6063h	Label	Position actual internal value			Unit	Encoder unit	Structure	VAR	Type	Int 32
	Access	R0	Mapping	TPDO	Mode	F	Range	-2147483648~2147483647	Default	0
	Reflects motor absolute position (Encoder unit)									

Index 6064h	Label	Position actual value			Unit	Command unit	Structure	VAR	Type	Int 32
	Access	R0	Mapping	TPDO	Mode	F	Range	-2147483648~2147483647	Default	0
	Reflects user's real time absolute position 6064h*Gear ratio = 6063h									

Index 6065h	Label	Follow error window			Unit	Command unit	Structure	VAR	Type	UInt 32
	Access	R0	Mapping	TPDO	Mode	PP/CSP/HM	Range	0~2147483647	Default	0
	To set an acceptable deviation for requested position. When actual position exceed position deviation window, error might occur.									

Index 6066h	Label	Follow error time out			Unit	ms	Structure	VAR	Type	UInt 16
	Access	R0	Mapping	TPDO	Mode	PP/CSP/HM	Range	0~65535	Default	0
	To set position deviation detection time									

Index 6067h	Label	Position window			Unit	Command unit/s	Structure	VAR	Type	UInt 32
	Access	R0	Mapping	TPDO	Mode	PP/CSP/HM	Range	0~2147483647	Default	0
	To set an acceptable extent of arrival position									

Index 6068h	**Label**	Position window time			**Unit**	Command unit/s	**Structure**	VAR	**Type**	UInt 16
	Access	R0	**Mapping**	TPDO	**Mode**	PP/CSP/HM	**Range**	0~65535	**Default**	0
To set the time between arrival to the output of INP (In position) signal.										

Index 606Bh	**Label**	Velocity demand value			**Unit**	Command unit/s	**Structure**	VAR	**Type**	Int 32
	Access	R0	**Mapping**	TPDO	**Mode**	ALL	**Range**	-2147483648~2147483647	**Default**	0
To set the time between arrival to the output of INP (In position) signal.										

Index 606Ch	**Label**	Velocity actual value			**Unit**	Command unit/s	**Structure**	VAR	**Type**	Int 32
	Access	R0	**Mapping**	TPDO	**Mode**	CSV/PP	**Range**	-2147483648~2147483647	**Default**	0
Reflects user's internal command velocity feedback value										

Index 606Dh	**Label**	Velocity window			**Unit**	Command unit/s	**Structure**	VAR	**Type**	UInt 16
	Access	R0	**Mapping**	RPDO	**Mode**	PV/CSV	**Range**	0~65535	**Default**	10
Set the range of velocity										

Index 606Eh	**Label**	Velocity window time			**Unit**	ms	**Structure**	VAR	**Type**	UInt 16
	Access	R0	**Mapping**	RPDO	**Mode**	PV/CSV	**Range**	0~65535	**Default**	0
To set the time between velocity reached and status word set to TargetReached.										

Index 606Fh	**Label**	Velocity threshold			**Unit**	Command unit/s	**Structure**	VAR	**Type**	UInt 16
	Access	R0	**Mapping**	RPDO	**Mode**	PV/CSV	**Range**	0~65535	**Default**	10
To set to zero-speed threshold.										

Index 6070h	**Label**	Velocity threshold time			**Unit**	ms	**Structure**	VAR	**Type**	UInt 16
	Access	R0	**Mapping**	RPDO	**Mode**	PV/CSV	**Range**	0~65535	**Default**	100
	To set the time until status word – zero speed detection is canceled.									

Index 6071h	**Label**	Target torque			**Unit**	0.1%	**Structure**	VAR	**Type**	UInt 16
	Access	RW	**Mapping**	RPDO	**Mode**	PT/CST	**Range**	-32768~32767	**Default**	0
	To set target torque for protocol and cyclic torque mode.									

Index 6072h	**Label**	Maximum torque			**Unit**	0.1%	**Structure**	VAR	**Type**	UInt 16
	Access	RW	**Mapping**	RPDO	**Mode**	F	**Range**	0~65535	**Default**	3000
	To set max. torque for servo driver. Limited by motor max. torque.									

Index 6073h	**Label**	Maximum current			**Unit**	0.1%	**Structure**	VAR	**Type**	UInt 16
	Access	R0	**Mapping**	TPDO	**Mode**	F	**Range**	0~65535	**Default**	3000
	To set max. current for servo driver.									

Index 6074h	**Label**	Torque demand			**Unit**	0.1%	**Structure**	VAR	**Type**	Int 16
	Access	R0	**Mapping**	TPDO	**Mode**	F	**Range**	-32768~32767	**Default**	0
	Internal command torque									

Index 6075h	**Label**	Motor rated current			**Unit**	mA	**Structure**	VAR	**Type**	Int 32
	Access	R0	**Mapping**	TPDO	**Mode**	F	**Range**	0~2147483647	**Default**	3000
	Shows motor rated current.									

Index 6077h	**Label**	Torque actual value			**Unit**	0.1%	**Structure**	VAR	**Type**	Int 16
	Access	R0	**Mapping**	TPDO	**Mode**	F	**Range**	-32768~32767	**Default**	0
	Shows servo driver actual torque feedback									

Index 6079h	**Label**	DC link circuit voltage			**Unit**	mV	**Structure**	VAR	**Type**	UInt 32
	Access	R0	**Mapping**	TPDO	**Mode**	F	**Range**	0~2147483647	**Default**	0
	Shows DC bus voltage across P, N terminals									

Index 607Ah	Label	Target position		Unit	Command unit	Structure	VAR	Type	Int 32
	Access	RW	Mapping	TPDO	Mode	PP/CSP	Range	-2147483647~2147483647	Default	0
	To set the target position under protocol and cyclic position mode.									

Index 607Ch	Label	Home offset		Unit	Command unit	Structure	VAR	Type	Int 32
	Access	RW	Mapping	TPDO	Mode	HM	Range	-2147483647~2147483647	Default	0
	To set position offset to compensate for the deviation of mechanical origin from motor origin under homing									

Index 607Dh-01	Label	Min. position limit		Unit	Command unit	Structure	VAR	Type	Int 32
	Access	RW	Mapping	TPDO	Mode	HM	Range	-2147483647~2147483647	Default	0
	To set lower limit with calculated position and actual position using absolute position after homing.									

Index 607Dh-02	Label	Max. position limit		Unit	Command unit	Structure	VAR	Type	Int 32
	Access	RW	Mapping	TPDO	Mode	HM	Range	-2147483647~2147483647	Default	0
	To set upper limit with calculated position and actual position using absolute position after homing.									

Index 607Eh	Label	Polarity		Unit	-	Structure	VAR	Type	UInt 8
	Access	RW	Mapping	RPDO	Mode	HM	Range	0x0 – 0xFF	Default	0x0

Mode		Value
Position mode	PP	0：Rotate in the same direction as the position command 128：Rotate in the opposite direction to the position command
	HM	
	CSP	
Velocity mode	PV	0：Rotate in the same direction as the position command 64：Rotate in the opposite direction to the position command
	CSV	
Torque mode	PT	0：Rotate in the same direction as the position command 32：Rotate in the opposite direction to the position command
	CST	
ALL mode		0：Rotate in the same direction as the position command 224：Rotate in the opposite direction to the position command

Sets the input polarity of the command.

Index 607Fh	Label	Maximum profile velocity			Unit	Command unit/s	Structure	VAR	Type	UInt 32
	Access	RW	Mapping	RPDO	Mode	PP/HM/PV/CST	Range	0~2147483647	Default	2147483647
	To set maximum allowable velocity. Limited by 6080.									

Index 6080h	Label	Maximum motor speed			Unit	R/min	Structure	VAR	Type	UInt 32
	Access	RW	Mapping	RPDO	Mode	F	Range	0~2147483647	Default	6000
	To set the maximum allowable motor speed.									

Index 6081h	Label	Profile velocity			Unit	Command unit/s	Structure	VAR	Type	UInt 32
	Access	RW	Mapping	RPDO	Mode	PP	Range	0~2147483647	Default	10000
	To set target velocity. Limited by 607Fh.									

Index 6083h	Label	Profile acceleration			Unit	Command unit/s²	Structure	VAR	Type	UInt 32
	Access	RW	Mapping	RPDO	Mode	PP/PV	Range	1~2147483647	Default	10000
	To set motor acceleration									

<table>
<tr><td rowspan="2">Index 6084h</td><td>Label</td><td colspan="3">Profile deceleration</td><td>Unit</td><td>Command unit/s²</td><td>Structure</td><td>VAR</td><td>Type</td><td>UInt 32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Mode</td><td>CSP/CSV/PP/PV/HM</td><td>Range</td><td>1~2147483647</td><td>Default</td><td>10000000</td></tr>
<tr><td></td><td colspan="10">To set motor deceleration</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 6085h</td><td>Label</td><td colspan="3">Quick stop deceleration</td><td>Unit</td><td>Command unit/s²</td><td>Structure</td><td>VAR</td><td>Type</td><td>UInt 32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Mode</td><td>PP/PV</td><td>Range</td><td>1~2147483647</td><td>Default</td><td>10000</td></tr>
<tr><td></td><td colspan="10">To set the deceleration during an emergency stop</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 6087h</td><td>Label</td><td colspan="3">Torque slope</td><td>Unit</td><td>%1/s</td><td>Structure</td><td>VAR</td><td>Type</td><td>UInt 32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Mode</td><td>PT</td><td>Range</td><td>1~2147483647</td><td>Default</td><td>5000</td></tr>
<tr><td></td><td colspan="10">To set values for tendency torque command</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 608Fh-01</td><td>Label</td><td colspan="3">Encoder increments</td><td>Unit</td><td>Encoder unit</td><td>Structure</td><td>VAR</td><td>Type</td><td>UInt 32</td></tr>
<tr><td>Access</td><td>RO</td><td>Mapping</td><td>TPDO</td><td>Mode</td><td>F</td><td>Range</td><td>1~2147483647</td><td>Default</td><td>0</td></tr>
<tr><td></td><td colspan="10">To set encoder resolution</td></tr>
</table>

<table>
<tr><td rowspan="2">Index 6091h-01</td><td>Label</td><td colspan="3">Electronic gear ratio numerator</td><td>Unit</td><td>r</td><td>Structure</td><td>VAR</td><td>Type</td><td>Dint 32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Mode</td><td>F</td><td>Range</td><td>1-2147483647</td><td>Default</td><td>1</td></tr>
<tr><td></td><td colspan="10">To set electronic gear ratio numerator</td></tr>
<tr><td rowspan="2">Index 6091h-02</td><td>Label</td><td colspan="3">Electronic gear ratio denominator</td><td>Unit</td><td>r</td><td>Structure</td><td>VAR</td><td>Type</td><td>Dint 32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Mode</td><td>F</td><td>Range</td><td>1-2147483647</td><td>Default</td><td>1</td></tr>
<tr><td></td><td colspan="10">To set electronic gear ratio denominator</td></tr>
<tr><td rowspan="2">Index 6092h-01</td><td>Label</td><td colspan="3">Number of pulses per rotation</td><td>Unit</td><td>Command unit/r</td><td>Structure</td><td>VAR</td><td>Type</td><td>UInt 32</td></tr>
<tr><td>Access</td><td>RW</td><td>Mapping</td><td>RPDO</td><td>Mode</td><td>F</td><td>Range</td><td>1~2147483647</td><td>Default</td><td>10000</td></tr>
<tr><td></td><td colspan="10">If 6092h-01(Feed constant) is not equal to 608Fh(Position encoder resolution), then:
Electronic gear ratio = Encoder resolution / 6092h-01

If 6092h-01(Feed constant) is equal to 608Fh(Position encoder resolution), then:
Electronic gear ratio = 6091-01 / 6092h-01</td></tr>
</table>

Index 6098h	Label	Homing method			Unit	-	Structure	VAR	Type	UInt 8
	Access	RW	Mapping	RPDO	Mode	F	Range	-6-37	Default	19

The table below describes the velocity, direction and stopping conditions of each homing methods.

Value	Description			
	Velocity	*Direction*	*Stop*	
-6	Low	Negative	When torque reached	
-5	Low	Positive	When torque reached	
-4	High	Negative	Inversed when torque reached, after torque is gone	
-3	High	Positive	Inversed when torque reached, after torque is gone	
-2	High	Negative	Inversed when torque reached, received 1st Z-signal after torque is gone	
-1	High	Positive	Inversed when torque reached, received 1st Z-signal after torque is gone	
	Direction	*Deceleration point*	*Home*	*Before Z-signal*
1	Negative	Negative limit switch	Motor Z-signal	Negative limit switch falling edge
2	Positive	Positive limit switch	Motor Z-signal	Positive limit switch falling edge
3	Positive	Homing switch	Motor Z-signal	Falling edge on same side of homing switch
4	Positive	Homing switch	Motor Z-signal	Rising edge on same side of homing switch
5	Negative	Homing switch	Motor Z-signal	Falling edge on same side of homing switch
6	Negative	Homing switch	Motor Z-signal	Rising edge on same side of homing switch
7	Positive	Homing switch	Motor Z-signal	Falling edge on same side of homing switch
8	Positive	Homing switch	Motor Z-signal	Rising edge on same side of homing switch
9	Positive	Homing switch	Motor Z-signal	Rising edge on same side of homing switch
10	Positive	Homing switch	Motor Z-signal	Falling edge on same side of homing switch
11	Negative	Homing switch	Motor Z-signal	Failling edge on same side of homing switch
12	Negative	Homing switch	Motor Z-signal	Rising edge on same side of homing switch
13	Negative	Homing switch	Motor Z-signal on other side of homing switch	Rising edge on other side of homing switch
14	Negative	Homing switch	Motor Z-signal on other side of homing switch	Falling edge on other side of homing switch
15				
16				
17-32	Similar with 1-14, but deceleration point = homing point			
33	Home in negative direction, Homing point = motor Z-signal			
34	Home in positive direction, Homing point = motor Z-signal			
35-37	Set current position as homing point			

Index 6099h-01	Label	Speed during search for switch			Unit	Command unit/s	Structure	VAR	Type	UInt 32
	Access	RW	Mapping	RPDO	Mode	HM	Range	0~2147483647	Default	10000
	To set the speed used in homing									

Index 6099h-02	Label	Speed during search for zero			Unit	Command unit/s	Structure	VAR	Type	UInt 32
	Access	RW	Mapping	RPDO	Mode	HM	Range	0~2147483647	Default	5000
	To set the speed used in homing									

Index 609Ah	Label	Homing acceleration /deceleration			Unit	Command unit/s²	Structure	VAR	Type	UInt 32
	Access	R0	Mapping	TPDO	Mode	HM	Range	1~2147483647	Default	500000
	To set acceleration and deceleration used in homing									

Index 60B0h	Label	Position offset			Unit	Command unit	Structure	VAR	Type	Int 32
	Access	R0	Mapping	TPDO	Mode	HM	Range	-2147483647~2147483647	Default	0
	To set servo driver position command offset value under CSP mode（Position feedforward） Servo target position=607A+60B0									
Index 60B1h	Label	Velocity offset			Unit	Command unit/s	Structure	VAR	Type	Int 32
	Access	R0	Mapping	TPDO	Mode	CSP/CSV/PP/PV/HM	Range	-2147483647~2147483647	Default	0
	To deviate velocity command									
Index 60B2h	Label	Torque offset			Unit	0.1%	Structure	VAR	Type	Int 16
	Access	RW	Mapping	RPDO	Mode	CSP/CSV/PP/PV/HM	Range	0x0~0xFFFF	Default	0x0
	To add or deviate torque command									

Index 60B8h	Label	Probe function		Unit	-	Structure	VAR	Type	UInt 16
	Access	RW	Mapping	RPDO	Mode	F	Range	0x0-0xFFFF	Default	0x0

Bit	Description	Details
0	Probe 1	0--Disable 1--Enable
1	Probe 1 trigger mode	0--Single trigger, triggered only when trigger signal is valid 1—Continuous trigger
2	Probe 1 trigger signal selection	0—Probe 1 captured 1--Z signal
3	Reserved	-
4	Probe 1 rising edge enabled	0--Disable 1--Enable
5	Probe 1 falling edge enabled	0--Disable 1--Enable
6-7	Reserved	-
8	Probe 2	0--Disable 1--Enable
9	Probe 2 trigger mode	0--Single trigger, triggered only when trigger signal is valid 1—Continuous trigger
10	Probe 2 trigger signal selection	0—Probe 2 captured 1--Z signal
11	Reserved	-
12	Probe 2 rising edge enabled	0—Rising edge not latched 1—Rising edge latched
13	Probe 2 falling edge enabled	0—Falling edge not latched 1—Falling edge latched
14-15	Reserved	-

Index 60B9h	Label	Probe status		Unit	-	Structure	VAR	Type	UInt 16
	Access	R0	Mapping	TPDO	Mode	F	Range	00x-0xFFFF	Default	0x0

Bit	Definition	Details
0	Probe 1	0--Disable 1--Enable
1	Probe 1 rising edge latching	0—Rising edge not latched 1—Rising edge latched
2	Probe 1 falling edge latching	0—Falling edge not latched 1—Falling edge latched
3-5	-	-
6-7	-	-
8	Probe 2	0--Disable 1--Enable
9	Probe 2 rising edge latching	0—Rising edge not latched 1—Rising edge latched
10	Probe 2 falling edge latching	0—Falling edge not latched 1—Falling edge latched
11-13	-	-
14-15	-	-

Index 60BAh	**Label**	Probe 1 positive position			**Unit**	Command unit	**Structure**	VAR	**Type**	Int 32
	Access	R0	**Mapping**	TPDO	**Mode**	F	**Range**	-2147483647~2147483647	**Default**	0
	Shows position feedback at rising edge of probe 1 signal									
Index 60BBh	**Label**	Probe 1 negative position			**Unit**	Command unit	**Structure**	VAR	**Type**	Int 32
	Access	R0	**Mapping**	TPDO	**Mode**	F	**Range**	-2147483647~2147483647	**Default**	0
	Shows position feedback at falling edge of probe 1 signal									
Index 60BCh	**Label**	Probe 2 positive position			**Unit**	Command unit	**Structure**	VAR	**Type**	Int 32
	Access	R0	**Mapping**	TPDO	**Mode**	F	**Range**	-2147483647~2147483647	**Default**	0
	Shows position feedback at rising edge of probe 2 signal									
Index 60BDh	**Label**	Probe 2 negative position			**Unit**	Command unit	**Structure**	VAR	**Type**	Int 32
	Access	R0	**Mapping**	TPDO	**Mode**	F	**Range**	-2147483647~2147483647	**Default**	0
	Shows position feedback at falling edge of probe 2 signal									

Index 60C5h	**Label**	Maximum acceleration			**Unit**	Command unit/s²	**Structure**	VAR	**Type**	UInt 32
	Access	RW	**Mapping**	RPDO	**Mode**	F	**Range**	1~2147483647	**Default**	100000000
	To set upper limit of acceleration.									

Index 60C6h	**Label**	Maximum deceleration			**Unit**	Command unit/s²	**Structure**	VAR	**Type**	UInt 32
	Access	RW	**Mapping**	RPDO	**Mode**	F	**Range**	1~2147483647	**Default**	100000000
	To set lower limit of acceleration.									

Index 60D5h	**Label**	Probe 1 positive edge counter			**Unit**	-	**Structure**	VAR	**Type**	UInt 16
	Access	R0	**Mapping**	TPDO	**Mode**	F	**Range**	0~65535	**Default**	0

Shows the number of times probe 1 rising edge latched.

Index 60D6h	**Label**	Probe 1 negative edge counter			**Unit**	-	**Structure**	VAR	**Type**	UInt 16
	Access	R0	**Mapping**	TPDO	**Mode**	F	**Range**	0~65535	**Default**	0
	Shows the number of times probe 1 falling edge latched.									

Index 60D7h	**Label**	Probe 2 positive edge counter			**Unit**	-	**Structure**	VAR	**Type**	UInt 16
	Access	R0	**Mapping**	TPDO	**Mode**	F	**Range**	0~65535	**Default**	0
	Shows the number of times probe 2 rising edge latched.									

Index 60D8h	**Label**	Probe 2 negative edge counter			**Unit**	-	**Structure**	VAR	**Type**	UInt 16
	Access	R0	**Mapping**	TPDO	**Mode**	F	**Range**	0~65535	**Default**	0
	Shows the number of times probe 2 falling edge latched.									

Index 60E0h	**Label**	Positive torque limit			**Unit**	0.1 %	**Structure**	VAR	**Type**	UInt 16
	Access	RW	**Mapping**	RPDO	**Mode**	F	**Range**	0~65535	**Default**	3000
	To set the maximum torque of servo driver in positive direction									

Index 60E1h	**Label**	Negative torque limit			**Unit**	0.1%	**Structure**	VAR	**Type**	UInt 16
	Access	RW	**Mapping**	RPDO	**Mode**	F	**Range**	0~65535	**Default**	3000
	To set the maximum torque of servo driver in negative direction									
Index 60F4h	**Label**	Actual following error			**Unit**	Command unit	**Structure**	VAR	**Type**	Int 32
	Access	R0	**Mapping**	TPDO	**Mode**	CSP/PP/HM	**Range**	-2147483647~2147483647	**Default**	0
	Shows position following error									

Index 60FAh	**Label**	Control effort			**Unit**	Command unit/s	**Structure**	VAR	**Type**	Int 32
	Access	R0	**Mapping**	TPDO	**Mode**	CSP/PP/HM	**Range**	-2147483647~2147483647	**Default**	0

Shows internal command velocity (Position loop output)

Index 60FCh	Label	Position demand value			Unit	Encoder unit	Structure	VAR	Type	Int 32
	Access	R0	Mapping	TPDO	Mode	CSP/PP/HM	Range	-2147483647~2147483647	Default	0
	Shows internal command position of servo driver.									

Index 60FDh	Label	Digital Input status			Unit	-	Structure	VAR	Type	UINT 32
	Access	R0	Mapping	TPDO	Mode	CSP/PP/HM	Range	-2147483648~2147483647	Default	0
	The bits of 60FDh object are functionally defined as follow:									

Bit31	Bit30	Bit29	Bit28	Bit27	Bit26	Bit25	Bit24
Z signal	Reserved	Reserved	Reserved	Probe 2	Probe 1	BRAKE	INP/V-COIN /TLC
Bit23	**Bit22**	**Bit21**	**Bit20**	**Bit19**	**Bit18**	**Bit17**	**Bit16**
E-STOP	Reserved	Reserved	Reserved	Reserved	Reserved	DI14	DI13
Bit15	**Bit14**	**Bit13**	**Bit12**	**Bit11**	**Bit10**	**Bit9**	**Bit8**
DI12	DI11	DI10	DI9	DI8	DI7	DI6	DI5
Bit7	**Bit6**	**Bit5**	**Bit4**	**Bit3**	**Bit2**	**Bit1**	**Bit0**
DI4	DI3	DI2	DI1	Reserved	HOME	POT	NOT

Index 60FEh-01	Label	Physical outputs			Unit	-	Structure	VAR	Type	UInt 32
	Access	RW	Mapping	RPDO	Mode	F	Range	0x0~0x7FFFFFFF	Default	0x0
	The bits of 60FEh object are functionally defined as follow:									

Bit / Sub-index	31~21	21	20	19	18	17	16	15~0
01h	Reserved	DO6 valid	DO5 valid	DO4 valid	DO3 valid	DO2 valid	DO1 valid	Reserved

Index 60FEh-02	Label	Bit mask			Unit	-	Structure	VAR	Type	UInt 32
	Access	RW	Mapping	RPDO	Mode	F	Range	0x0~0x7FFFFFFF	Default	0xFFFF0000
	The bits of a 60FEh object are functionally defined as follow:									

Bit / Sub-index	31~21	21	20	19	18	17	16	15~0
02h	Reserved	DO6 enabled	DO5 enabled	DO4 enabled	DO3 enabled	DO2 enable	DO1 enabled	Reserved

							d		

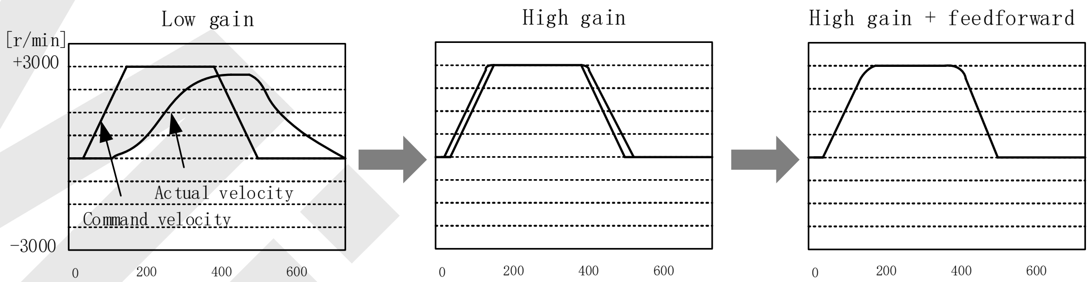
Index 60FFh	**Label**	Target velocity			**Unit**	Command unit	**Structure**	VAR	**Type**	Int 32
	Access	RW	**Mapping**	RPDO	**Mode**	CSV/PV	**Range**	-2147483647~2147483647	**Default**	0
	Shows set target velocity. Limited by 6080h									

Index 6502h	**Label**	Supported operation modes			**Unit**	-	**Structure**	VAR	**Type**	UInt 32
	Access	R0	**Mapping**	TPDO	**Mode**	F	**Range**	0x0~0x7FFFFFFF	**Default**	0x0
	Shows the control modes supported by the servo driver.									

Chapter 6 Adjustment and Application

6.1 Gain Adjustment

In order for servo driver to execute commands from master device without delay and to optimize machine performance, gain adjustment has to be done beforehand.

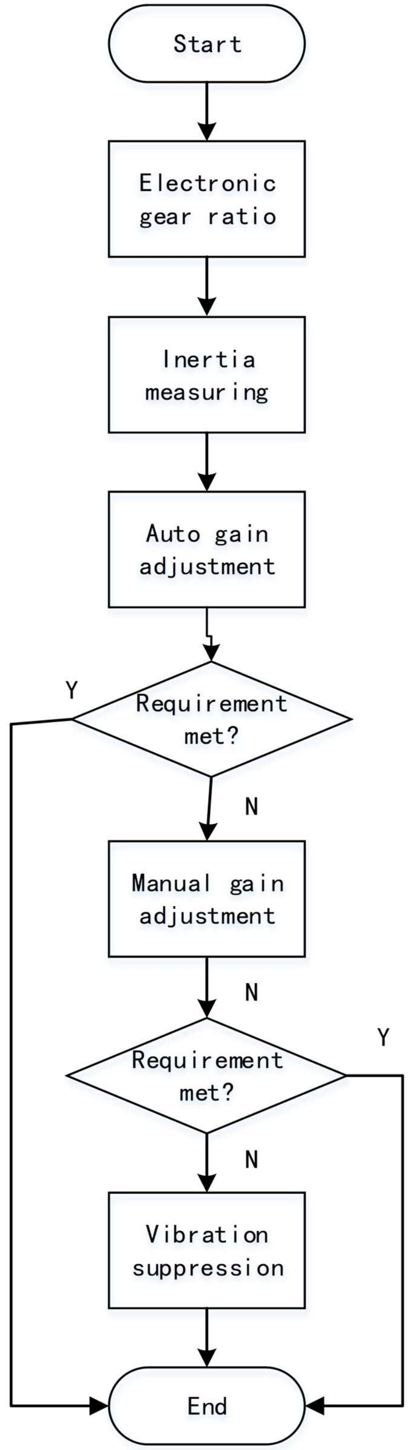


Position loop gain: 320 (0.1/s)
Velocity loop gain: 180 (0.1Hz)
Velocity loop integral time constant: 31ms

Position loop gain: 900 (0.1/s)
Velocity loop gain: 500 (0.1Hz)
Velocity loop integral time constant: 31ms

Position loop gain: 900 (0.1/s)
Velocity loop gain: 500 (0.1Hz)
Velocity loop integral time constant: 31ms

Servo driver gain adjustment is done in combination with a few other parameters (Inertia ratio, Position loop gain, Velocity loop gain and Filters settings). These parameters will have an effect on each other so it always advisable to tune each parameter accordingly in order to achieve optimal machine performance. Please refer to the steps below.



Gain adjustment flow

Steps	Functions	Explanation
Inertia ratio identification	Online	Motor moves with command from controller, servo driver will automatically calculate load-inertia ratio
	Offline	Using servo driver inertia determining function, servo driver can automatically calculate load-inertia ratio
Auto gain adjustment	Auto gain adjustment	Real time determining of mechanical load, gain value is set accordingly. 1. One-click tuning (Can be realized using MISUMI EDrive. Auto tuning of gain and inertia according to actual data) 2. Real time auto adjustment (Set by selecting mechanical rigidity level, related gain parameters will be automatically adjusted accordingly)
Manual gain adjustment	Basic gain	On top of auto gain adjustment, manually adjust related parameters so that machine can have better responsiveness and following
	Basic steps	1. Gain related parameters tuning under position mode 2. Gain related parameters tuning under velocity mode 3. Gain related parameters tuning under torque mode
	Gain switching	• Gain switching through internal data or external signal. Lower vibration at stop, shorten tuning time, improve command following.
	Model following control	• Improve responsiveness, shorten positioning time (Only available in position mode)
	Command pulse filter	Set filter for position, velocity and torque command pulse.
	Gain feedforward	Enable feedforward function to improve following behavior
	Friction compensation	Reduce the effect of mechanical friction
	3rd gain switching	Base on usual gain switching function. Can be set to switch gain at stopping and reduce positioning time.
Vibration suppression	Mechanical resonance	Using notch filtering function to suppress mechanical resonance.
	End vibration suppression	To suppress low frequency vibration of mechanical end

6.2 Inertia ratio identification

$$\text{Inertia ratio} = \frac{\text{Total mechanical load rotational inertia}}{\text{Electronic gear rotational inertia}}$$

Inertia ratio is an important parameter. Setting a suitable value can help with the precise tuning of the servo system. Inertia ratio can be set manually and also be determined automatically through servo driver

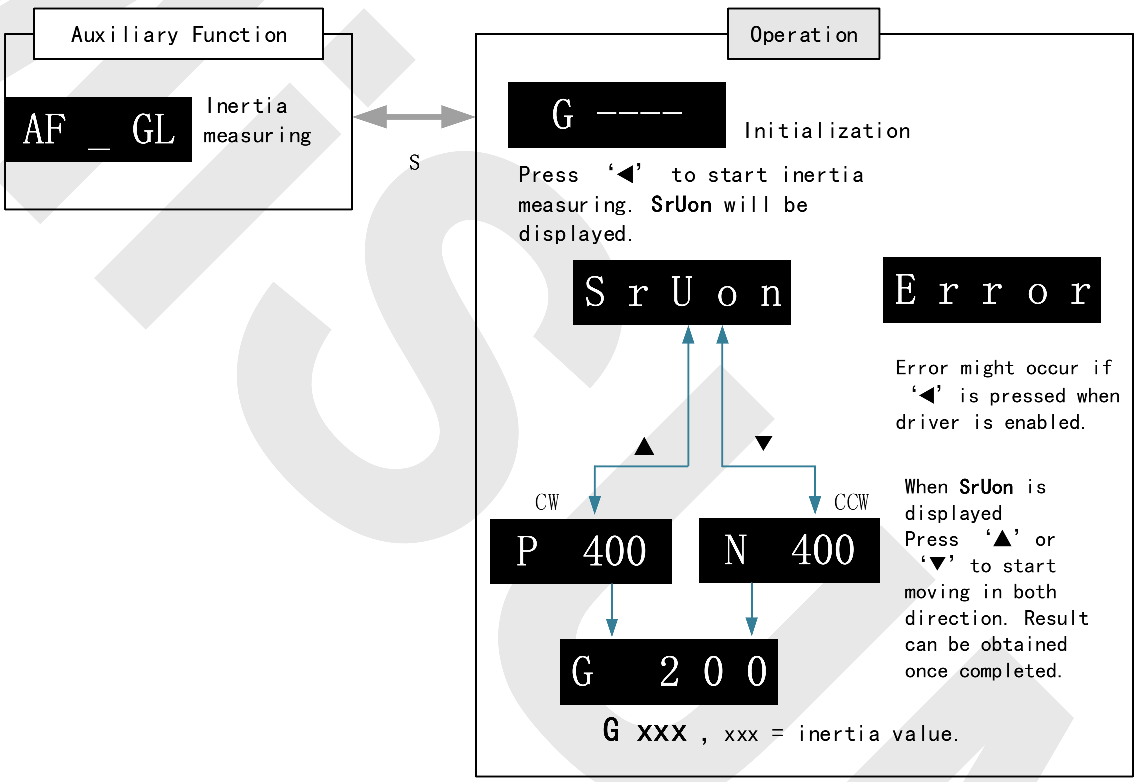
6.2.1 Online inertia determination

Enable motor using controller. Run motor at the speed above 400rpm, make sure there are acceleration, constant velocity and deceleration phase during the whole run. Cycle through 2-3 times to calculate load-inertia ratio. Result can be found on the front panel d16 or through MISUMI EDrive system monitoring window. Enter the calculated value into P00.04 and save the parameter.

6.2.2 Offline inertia determination

Can be achieved through driver front panel or on MISUMI EDrive
Please make sure:
1. Servo driver is disabled
2. Axis is within safe and allowed range and limit switch is not triggered to prevent axis from over travelling.

Auxiliary function to determine inertia on front panel



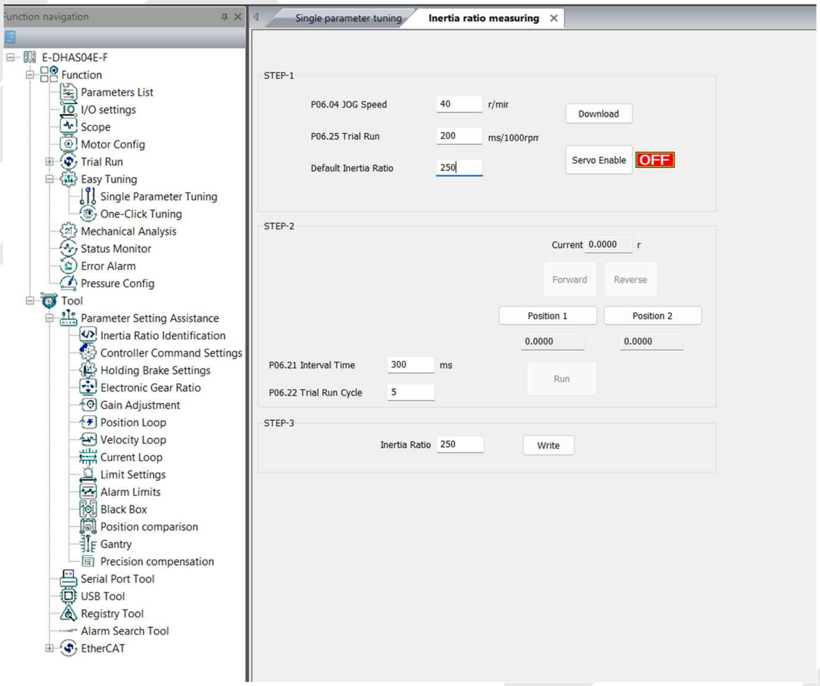
- When performing an inertia test, pay attention to the test run speed and acceleration to prevent collisions.
- After the inertia test is completed, the key returns to the selected state and the internal enable is turned off.

Steps:
1) Set the trial run velocity **P06.04**. Value set shouldn't be too large, please keep it at around **400 r/min**.
2) Enter **AF_GL** for auxiliary function – Inertia ratio determination into front panel
3) Press S once to enter. "**G---**" will be displayed on the front panel.
4) Press ◀ once to display "**StUon**"
5) Press ▲ or ▼ once to start to calculate the inertia.
6) After the calculation is done, G **xxx** will be displayed and **xxx** is the value of inertia calculated.
7) Write the corresponding value into P00.04. Please refer to parameter saving on

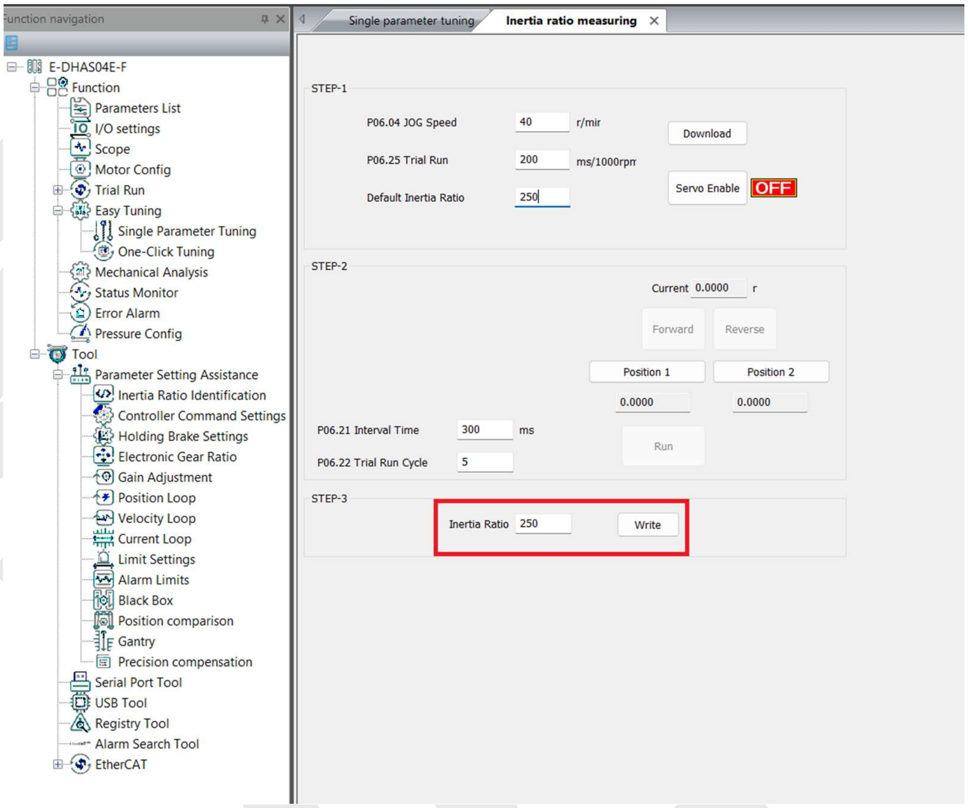
servo driver.

Inertia measuring using MISUMI EDrive

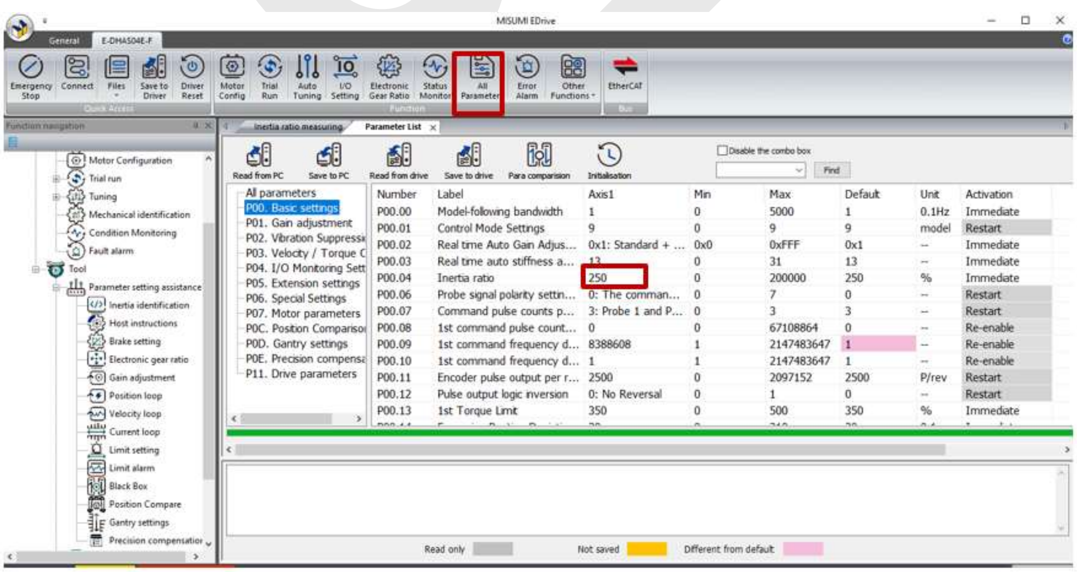
1) 1 Open the inertia identification page, set jog speed (P06.04) and acceleration time (P06.25), then click **Download**.
2) Enable "Disable external enable", click **Servo Enable** to turn ON.
3) Use **Forward** and **Reverse** to move motor; click **Position 1** and **Position 2** to record two positions.
4) Set wait time (P06.21) and cycle count (P06.22), then click **Run** to execute movement.



5. After completion, the system auto-calculates inertia ratio. Click **Write** to store.



6. Open **Parameter Management**, confirm value saved to P00.04, then click **Save to Drive**



Please take note:

1. Trial run velocity and distance should be optimal to prevent any axis from bumping into objects.

2. It is recommended to move only in 1 direction for vertically mounted axis. Take precaution before moving the axis.

3. For applications with higher frictional drag, please set a minimal travel distance.

P00.04	Name	Inertia ratio			Mode			F
	Range	0~20000	Unit	%	Default	250	Index	2004h
	Activation	Immediate						

P00.04=(load inertia/motor rotational inertia)×100%

Notice:
Set inertia ratio according to actual load inertia. When both are uniform, actual motor velocity loop responsiveness and gain settings will be consistent. If inertia ratio is greater than actual value, velocity loop gain settings will be higher and vice versa.

Common issues

Error	Cause	Solution
Inertia ratio identification failure	Loose load connection	Check for mechanical failure
	Measuring distance is too short	Increase measuring distance
	Belt load	Please pre-set an inertia ratio when using a belt to prevent jolt due to low inertia.

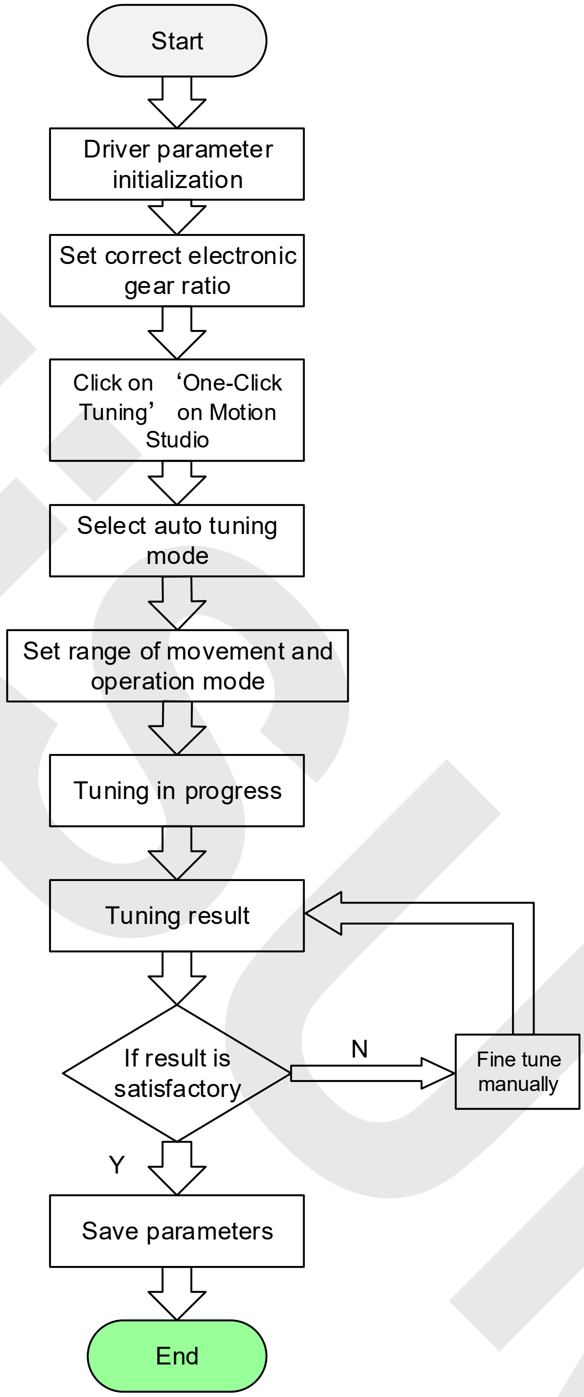
6.3 Easy Tuning

6.3.1 One-click Tuning

This function is able to automatically tune the most optimal gain parameters for the specific applications after the axis is in operation and learning. Corresponding paths and responsiveness level need to be set before using this function. Please refer to the flow chart below. Parameter will be saved to parameters file and can be used on similar axes. Recommended for applications where inertia changes is minute.

	Recommended application scenarios
Control mode	Suitable in position mode or EtherCAT mode (Not applicable in other modes)
Others	• Make sure servo driver can't be enabled externally or any external command that can rotate the motor. Set range of movement, velocity and acceleration/deceleration time for one-click tuning. • Prohibit external command. Make sure there is no obstacle within the range of movement of the axis and motor can rotate freely.

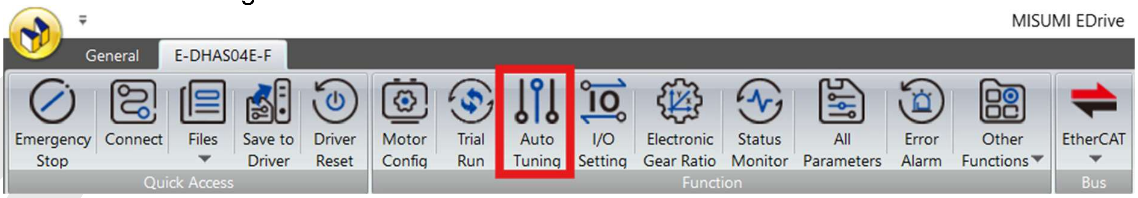
	Factors affecting one-click tuning
Load inertia	• External load smaller or 30 times larger than rotor inertia • Drastic changes in load inertia during motion. *Under heavy load (more than 30 times inertia), please make sure of safety*
Load	• Mechanical load is loosely connected. • Existence of gear backlash or any other non-linear factors • Complicated mechanical load structure
Motion	• Range of movement is too short or too long which cost the time to be overdue. • Not smaller than 0.5R



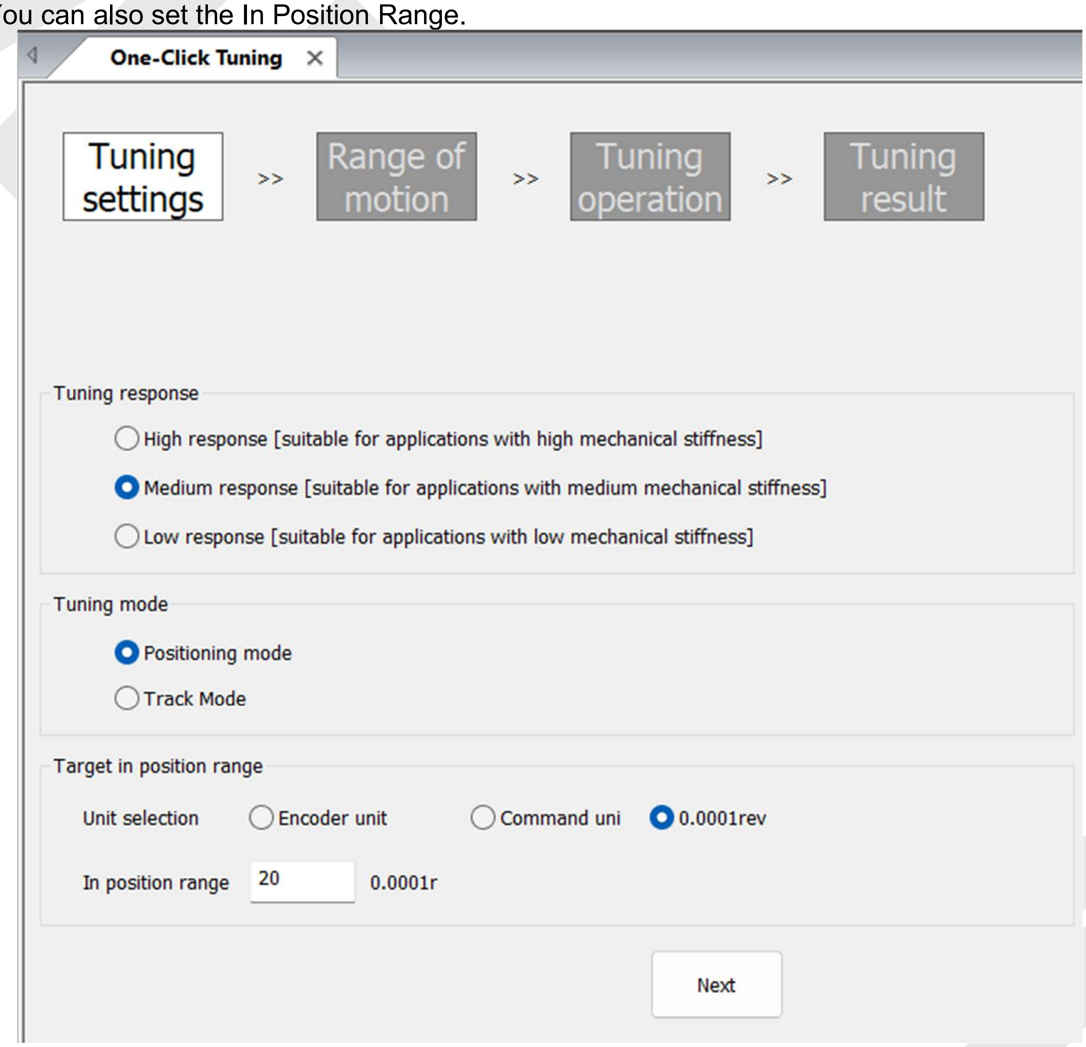
One-click Tuning flow chart

Operation Steps

1. Click ‘Auto Tuning’.



2. The first interface is for Tuning settings, which is mainly used to set the execution criteria for the auto-tuning process.
Tuning response: There are three types. Choose based on the actual mechanical conditions.
Tuning Mode: Two options are available — Positioning Mode and Track Mode.
You can also set the In Position Range.

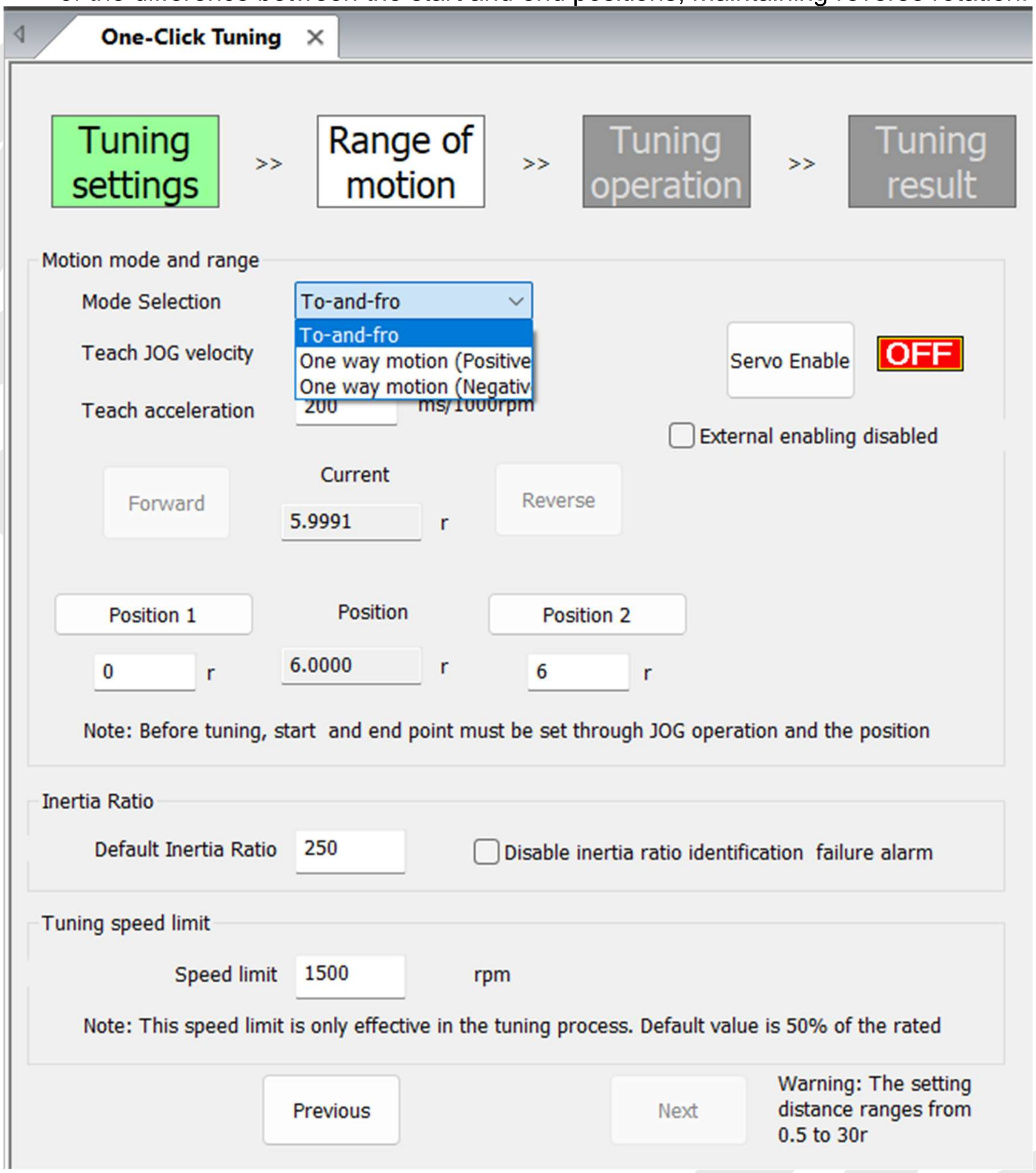


3. Clicking ‘Next’ go to the Range of motion interface, and define the motion range for auto-tuning.

1) There are three mode selection. Choose based on the allowable movement direction of the actual machine.

- To and fro: The motor moves back and forth between the start and end positions.
- One way motion (Positive): The motor moves a distance equal to the absolute value of the difference between the start and end positions, maintaining forward rotation.

- One way motion (Negative): The motor moves a distance equal to the absolute value of the difference between the start and end positions, maintaining reverse rotation.



2) There are two methods to set the start and end positions:

- After Servo Enable, use the forward/reverse buttons to adjust the position. Click the "Position 1/2" button to complete the setup.

Note:

- *During motion range setting, jog speed should be between 0–200 rpm. Acceleration time should not be too short to avoid collisions. After setting speed properties, disable external enable signals. Before enabling the servo, ensure no commands are being sent to avoid unintended movement. Then click servo enable.*

- Directly input the start and end positions. After entering the values, press Enter to apply the changes. (In reciprocating motion, the motor will first move to the set start position before beginning the reciprocating motion. When manually entering positions, ensure there is no risk of collision.)

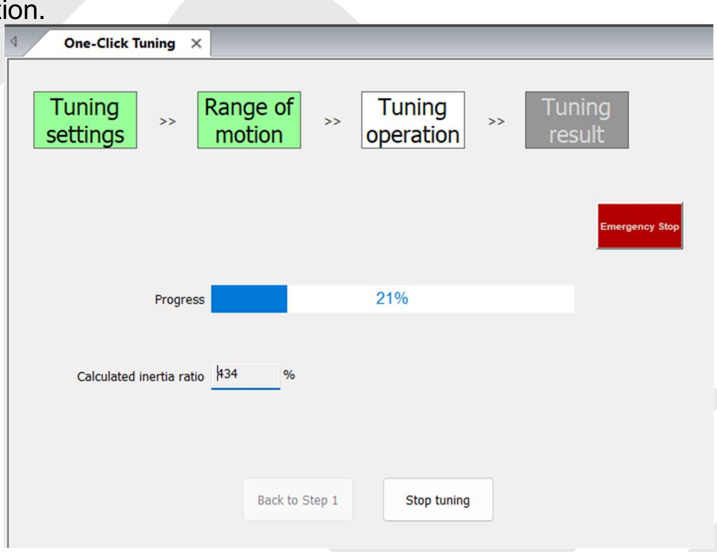
Note:

- *The difference between start and end positions must be greater than 0.5 revolutions. The closer the start/end points match the actual application stroke, the better the tuning adaptability. However, tuning time may increase accordingly.*

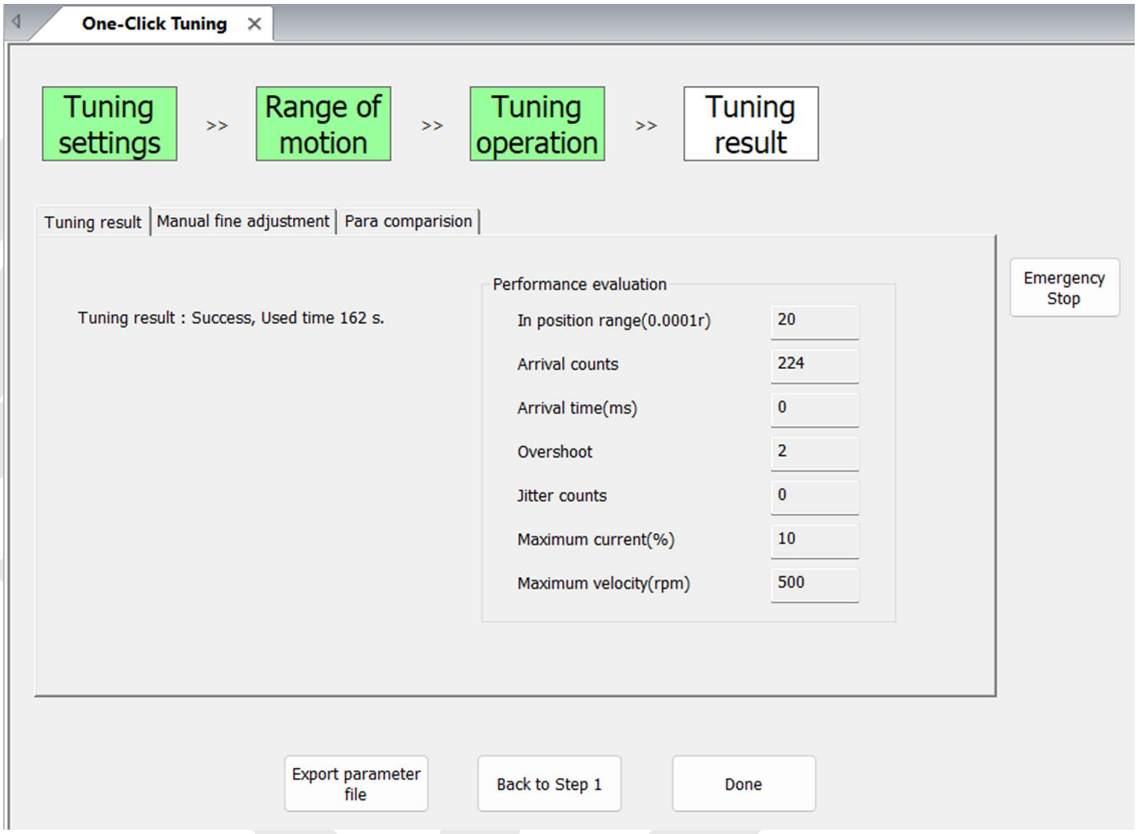
3) Inertia Ratio:
Can choose to ignore inertia identification failures to prevent tuning failure due to unsuccessful identification.
The inertia ratio can be manually entered or preset to a suitable value. This helps avoid shaking in belt-driven systems caused by low inertia.

4) Tuning Speed Limit:
The speed during tuning must be no less than 400 rpm.

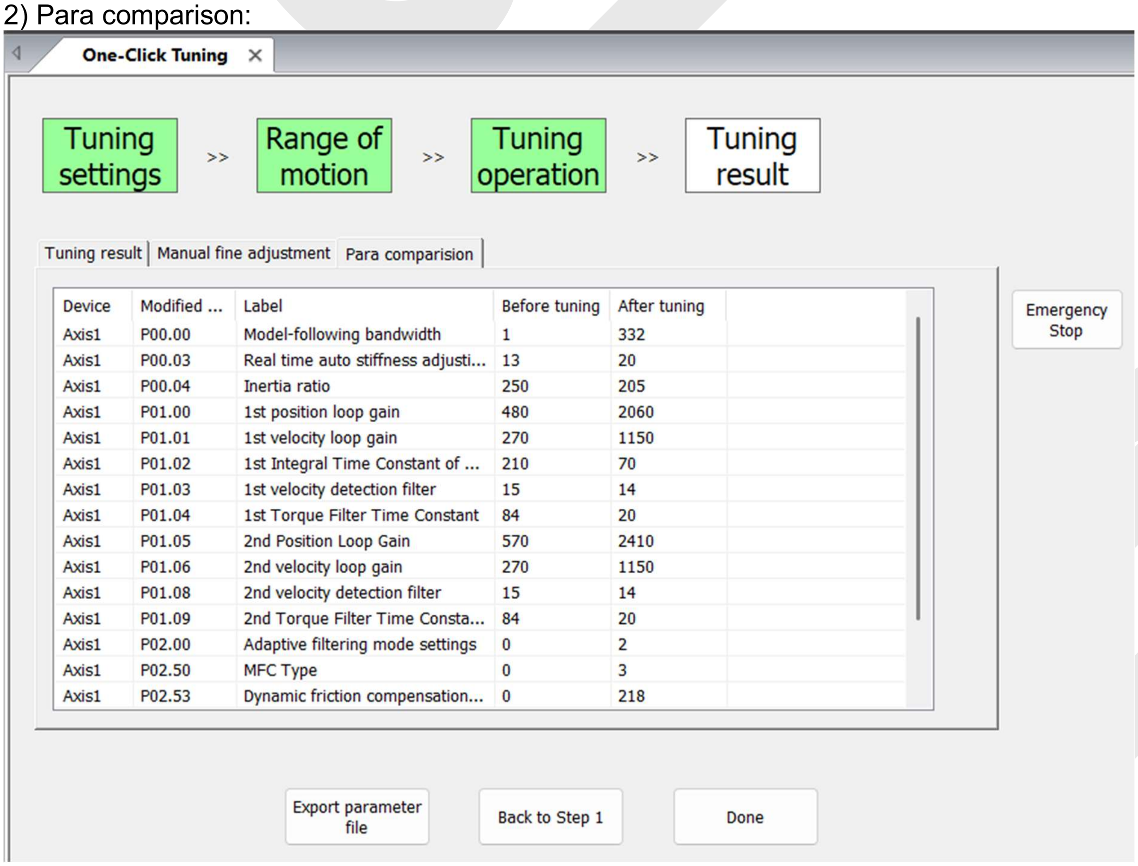
4. Click 'Next' and confirm that the motion is safe to enter the Tuning Operation interface. The tuning process will begin, with progress display and an emergency stop button available during the operation.



5. After tuning is complete, the system will transition to the Tuning Results interface, shows the tuning results and parameters comparison before and after tuning.
1) Tuning result:

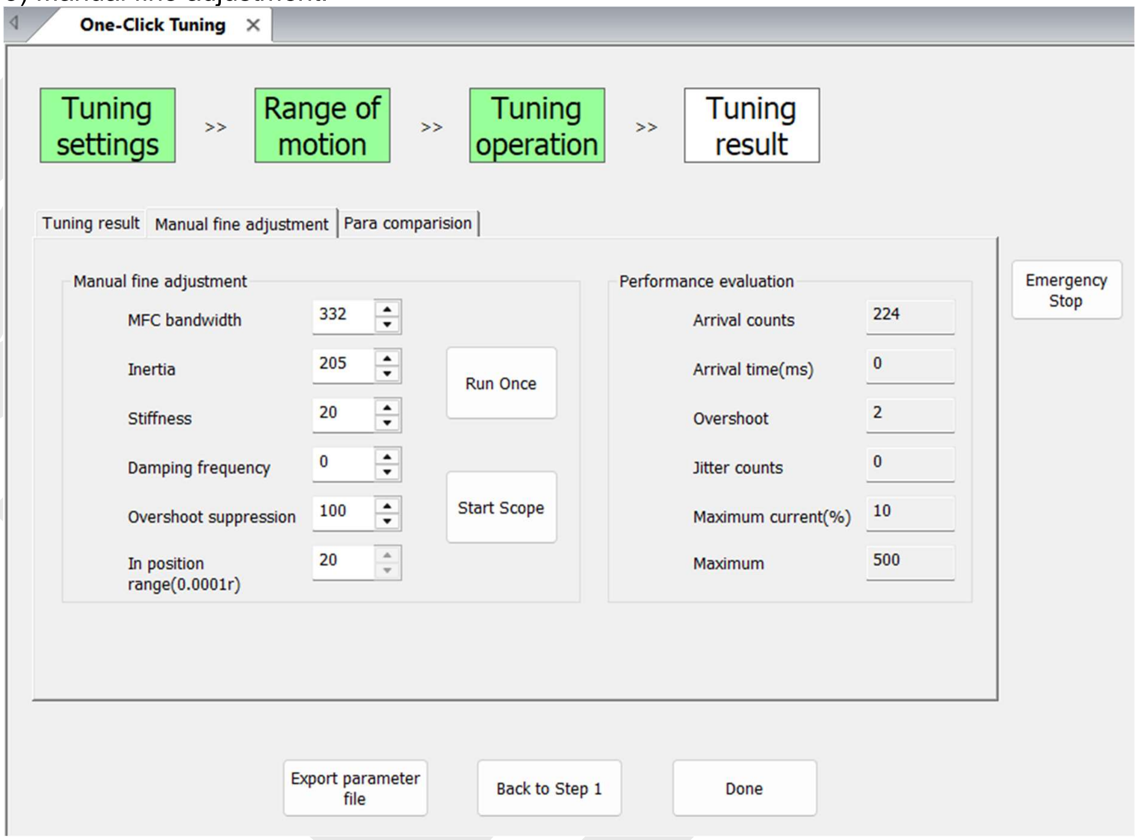


2) Para comparison:

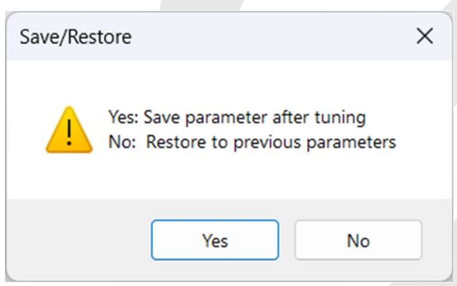


Device	Modified ...	Label	Before tuning	After tuning
Axis1	P00.00	Model-following bandwidth	1	332
Axis1	P00.03	Real time auto stiffness adjusti...	13	20
Axis1	P00.04	Inertia ratio	250	205
Axis1	P01.00	1st position loop gain	480	2060
Axis1	P01.01	1st velocity loop gain	270	1150
Axis1	P01.02	1st Integral Time Constant of ...	210	70
Axis1	P01.03	1st velocity detection filter	15	14
Axis1	P01.04	1st Torque Filter Time Constant	84	20
Axis1	P01.05	2nd Position Loop Gain	570	2410
Axis1	P01.06	2nd velocity loop gain	270	1150
Axis1	P01.08	2nd velocity detection filter	15	14
Axis1	P01.09	2nd Torque Filter Time Consta...	84	20
Axis1	P02.00	Adaptive filtering mode settings	0	2
Axis1	P02.50	MFC Type	0	3
Axis1	P02.53	Dynamic friction compensation...	0	218

If fine-tun is needed, can enter Manual fine adjustment to modify the gain.
3) Manual fine adjustment:



After modifying parameters, run the motor again to evaluate performance or use the oscilloscope to check if the results meet actual requirements.
If satisfied with the tuning results, click ‘Done’, and a prompt will appear asking whether to save the parameters.



Click ‘Yes’ to save the tuned parameters. Click ‘No’ to revert to the parameters before tuning.
Note:

- *Regardless of whether you click Yes or No, clicking ‘Done’ will exit the One-Key Auto Tuning Interface.*

Precautions

- Vertical Axis Applications: Ensure anti-drop measures are in place before executing any actions.
- Belt Applications: Pre-setting a moderate inertia ratio can prevent shaking caused by low inertia at the start of auto-tuning.
- Ball Screw Applications: If tuning takes too long, consider shortening the stroke.

Common Tuning Failures

Issue	Cause	Solution
Inertia Identification Failure	Lose mechanical connections	Inspect and fix mechanical issues
	Stroke too short, inertia identification fails	Increase stroke appropriately
	Belt-driven load	Pre-set a suitable inertia ratio to avoid low inertia causes shaking and identification failure

If the tuning results are not satisfactory, you can switch to Single parameter tuning for more advanced adjustments to achieve optimal gain settings.

6.3.2 Single Parameter Tuning

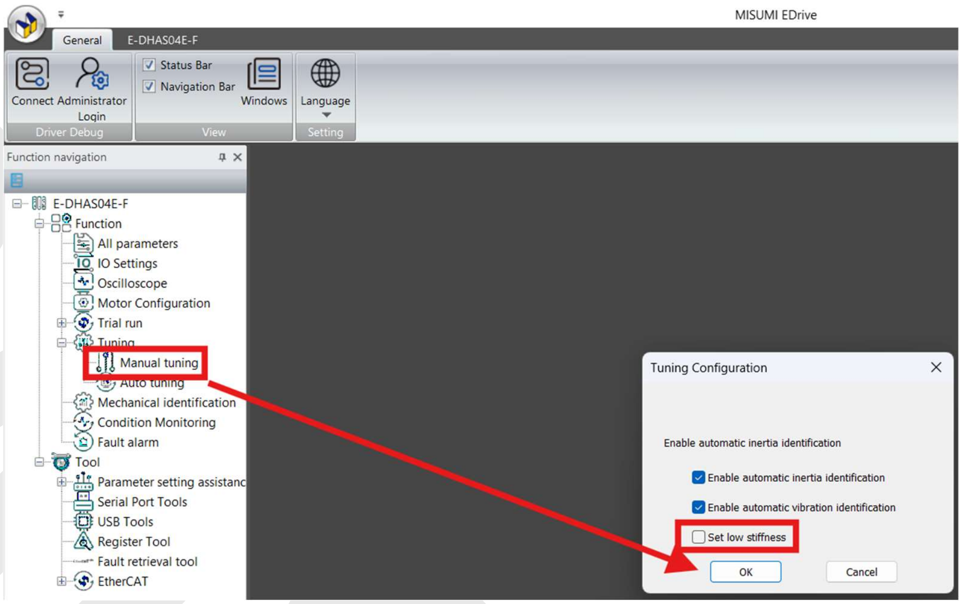
Set a mechanical rigidity level and the driver will automatically tune the parameters accordingly, including inertia measuring and vibration suppression to fulfill responsiveness and stability needs. At same time, more advanced functions can be applied, for example: Command pulse filter, low frequency vibration suppression, etc.
Recommended for applications where inertia changes is minute. Single parameter tuning is more complicated to set up compared to one-click tuning. Use single parameter tuning when one-click tuning doesn't meet the performance needs.

	Recommended application scenarios
Control mode	Suitable in position mode or EtherCAT mode (Not applicable in other modes)
Others	• Servo ON (SRV-ON) status • Set suitable position/torque limit so that motor can run normally • Use trial run or any external controller to make sure no clash of axes

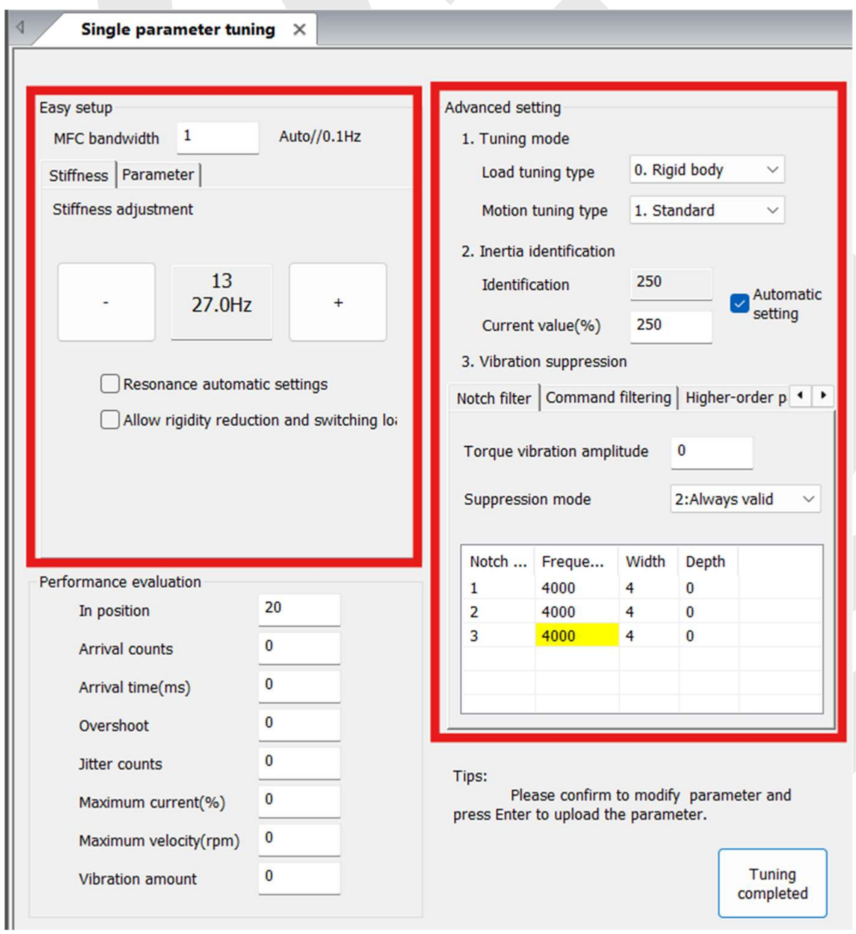
	Factors affecting single parameter tuning
Load inertia	• External load smaller or 30 times larger than rotor inertia • Inertia measuring might fail upon changes in load inertia • Load torque changes drastically
Load	• Mechanical rigidity is too low • Existence of gear backlash or any other non-linear factors • Complicated mechanical load structure
Motion	• Low speed, no more than 300[r/min]. • Acceleration/deceleration time too long, more than = 600ms • Speed > 300r/min, acceleration/deceleration time < 600ms but travelling time duration < 50ms.

Operation Steps

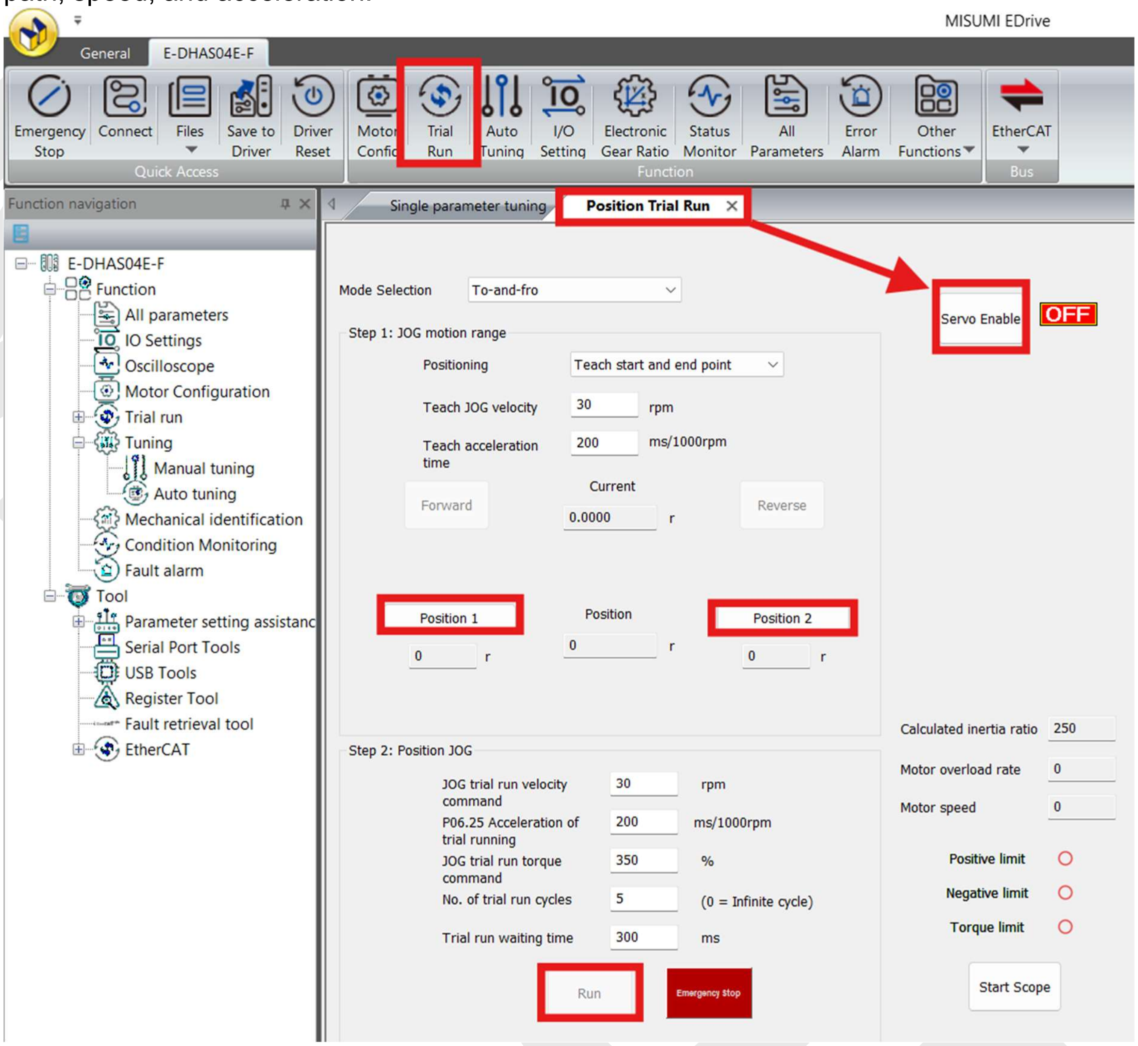
1. Open the wizard. Select the Manual Tuning function. The interface will appear as shown, with Inertia Auto Identification and Vibration Auto Identification enabled by default.
If rigidity parameter P00.03 is greater than 11, and low rigidity is selected, the initial rigidity will be set to 11 upon entering manual tuning.



2. Manual tuning interface. In Simple Settings, set MFC Bandwidth to 1 for automatic model-following bandwidth adjustment. You can also manually set other values.
If no advanced parameters need adjustment, you can use the Trial Run function or send commands from the host to rotate the motor.



3. Manual tuning requires motor movement. Use the Trial Run function to configure motion path, speed, and acceleration.

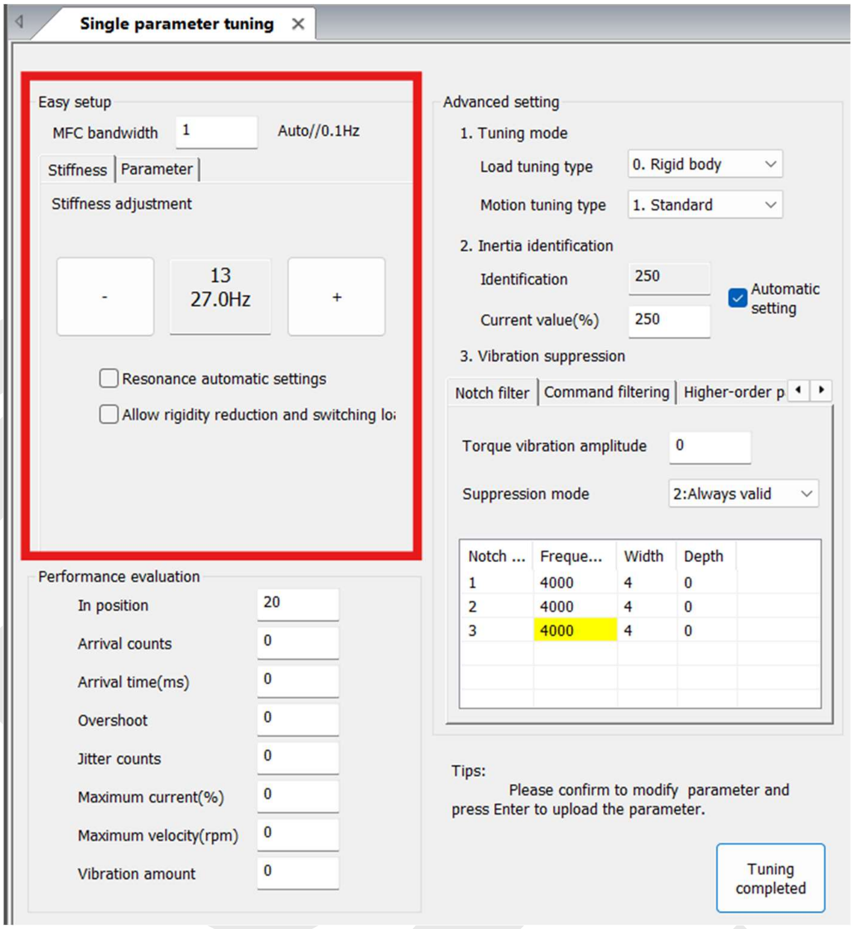


For E-DHASxxP, there are three methods to teach the motion range:

1) Teach Start and End Point: After enabling the servo, use forward/reverse buttons to adjust position. Click “Position 1/2” to complete setup.
2) Input Start and End Point: Directly input positions in the fields. The motor will move to the start point and then perform reciprocating motion.
3) Input distance: Input the travel distance in the position difference field. The motor will perform reciprocating motion from the current position.

Note: Teaching speed should not be too fast to avoid collisions!
After setting the motion range, configure JOG motion properties:
Jog trial run velocity command: >300 rpm during manual tuning.
Acceleration of trial running: <600 ms/1000rpm during manual tuning.
No. of trial run cycles: Set an appropriate number of runs to assist manual tuning.

4. Automatic parameter setting.
Manual Tuning includes Easy Setup and Advanced Setting:
1) Easy Setup: Adjust rigidity simply to achieve auto-tuning. Inertia identification is enabled by default and will auto-set the inertia ratio.



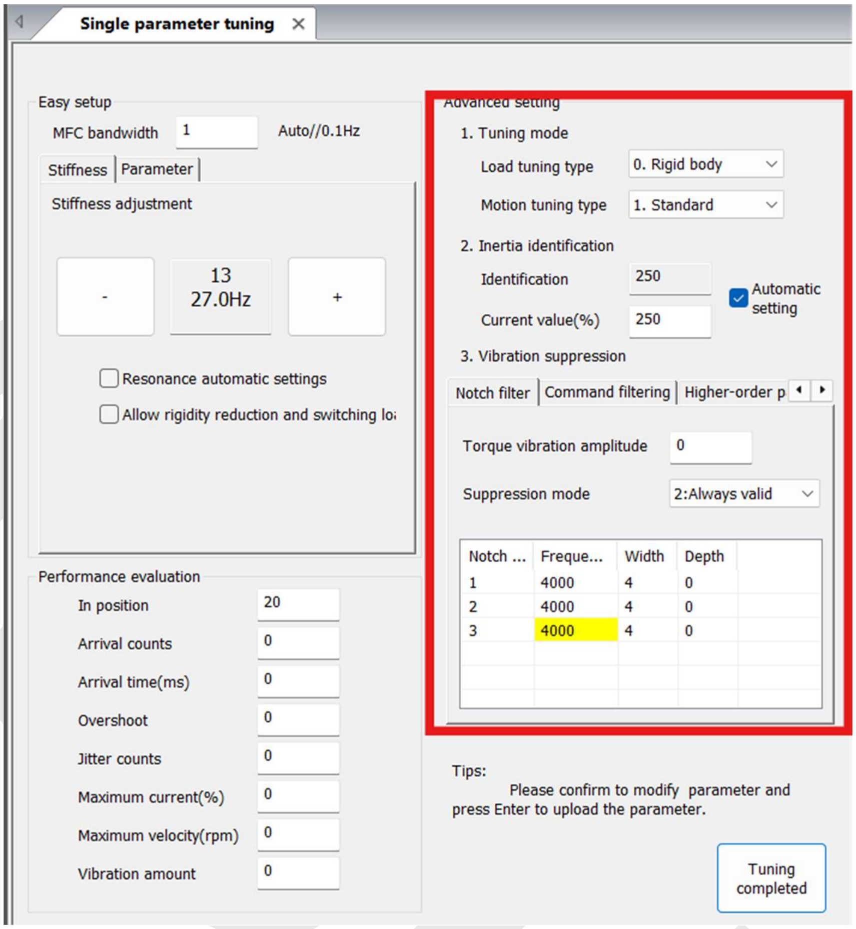
Easy Setup content:
MFC Bandwidth: Sets the model following bandwidth. MFC, also known as model following control, is used in position loop control to improve command response, accelerate positioning time, and reduce tracking error.

MFC Function	Description
0	Disable MFC
1	Auto-adjust MFC bandwidth
2 ~ 9	Invalid
10 ~ 2000	Manual setting (recommended 30–100 for belt applications)

Stiffness Adjustment:
Range: 0–31. Press '+' to increase stiffness, press '-' to decrease stiffness.
Higher values increase speed response but may cause vibration.
Set based on mechanical structure strength. If vibration count exceeds 10, reduce rigidity by 2 levels to prevent loosening of fasteners.
For belts or long rods prone to deformation, reduce rigidity and apply vibration suppression.

Resonance Automatic Settings:
If checked: cyclic vibration detection under current rigidity; resets to default if no vibration is detected.

2) Advanced Setting



<1> Tuning mode

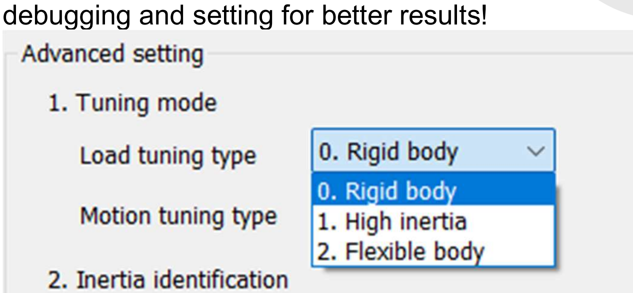
Load Tuning Type: The default is Rigid body, Standard. If vibration occurs during operation, it will automatically change to adapt to different transmission methods.

0: Rigid body (e.g., ball screw)

1: High inertia (load inertia >30–40× motor inertia)

2: Flexible body (e.g., belt drive)

Set the correct load setting type according to the actual situation and then perform debugging and setting for better results!



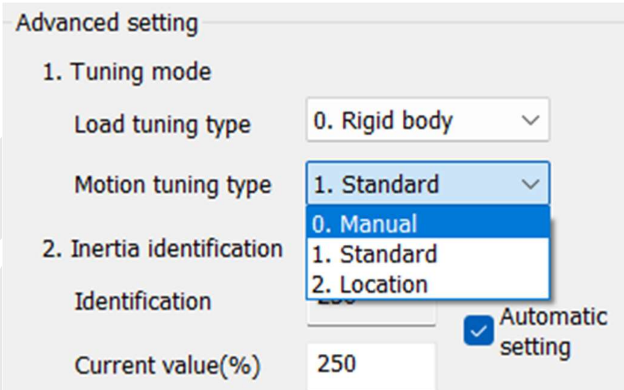
Motion Tuning Type:

0: Manual (disables real-time auto adjustment)

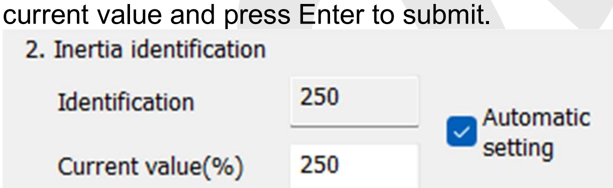
1: Standard (stable mode, no gain switching)

2: Location (for variable loads, e.g., horizontal axis)

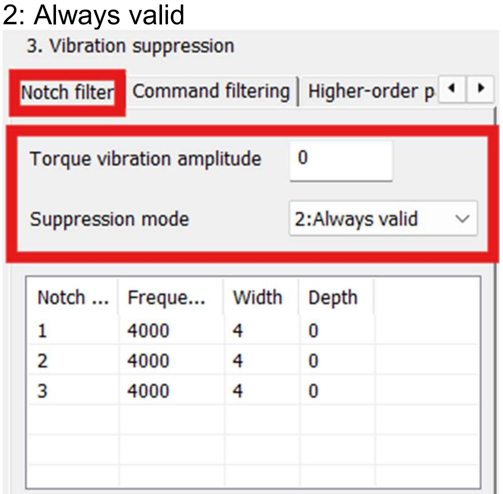
The main difference between standard and positioning is that there is no gain switching in standard mode.



<2> Inertia identification:
Enabled by default.
Identified %: flashes yellow when successful
Current Value %: syncs with identified value if auto-set is checked; otherwise, manual input is allowed
If 'Automatic setting' is unchecked, the identification value will not be synchronized. You can manually set the current inertia ratio and press Enter to submit.
When 'Automatic setting' is checked, P00.04 is filled in based on the actual inertia identification value.
Unchecking 'Automatic setting' allows you to manually enter the inertia ratio based on the current value and press Enter to submit.



<3> Vibration suppression:
Notch Filter:
Torque Vibration Amplitude, 0 = sensitive, 100% = no detection. Adjust the value based on on-site judgment to determine whether it is vibration.
Suppression Mode, range from 0 to 2:
0: Close
1: Valid once
2: Always valid

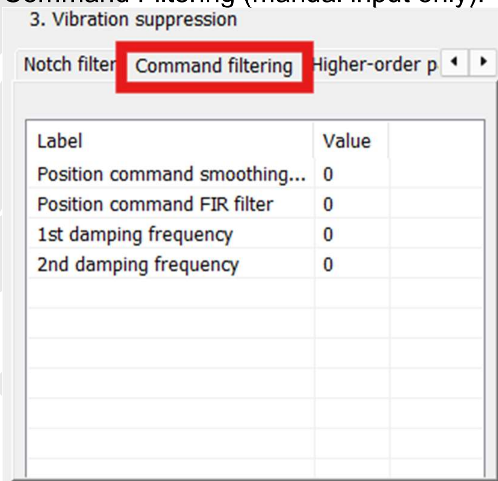


- Notch Filters: 1st, 2nd, 3rd

- Frequency: 50–2000
- Width: 0–20
- Depth: 0–99

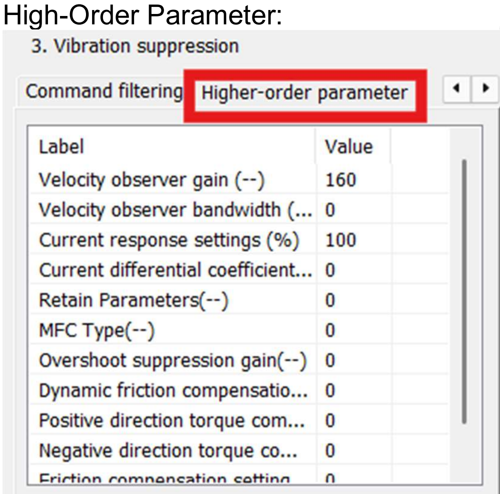
Frequency changes flash yellow.

Command Filtering (manual input only):



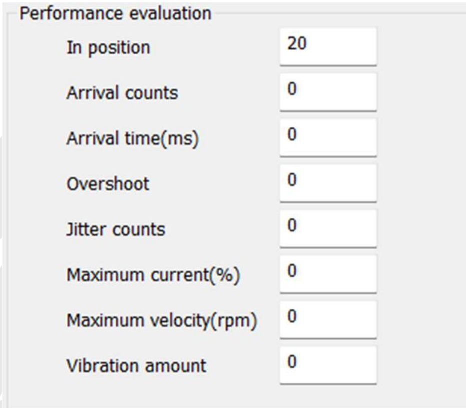
Position Command Smoothing Filter: 0–32767 (unit: 0.1 ms). Setting this parameter too high may prolong the setting time.
Position Command FIR Filter: 0–10000 (unit: 0.1 ms). Setting this parameter too high may prolong the setting time.
1st Damping Frequency: 10–2000 (unit: 0.1 Hz). Set the damping frequency to suppress end vibration.
2nd Damping Frequency: 10–2000 (unit: 0.1 Hz). Set the damping frequency to suppress end vibration.

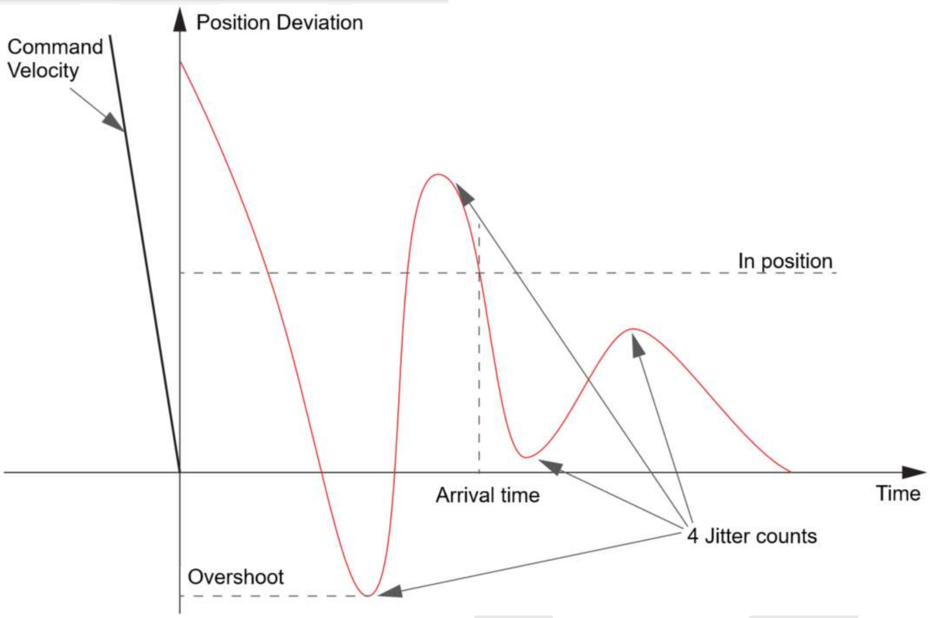
High-Order Parameter:



Velocity Observer Gain: The default stable gain, set to 1 to disable the observer.
Velocity Observer Bandwidth: The default is stable filtering, set to 1 to turns off the observer.
Current Response Settings: Ratio of effective values of driver current loop related parameters, range 50~100, unit %

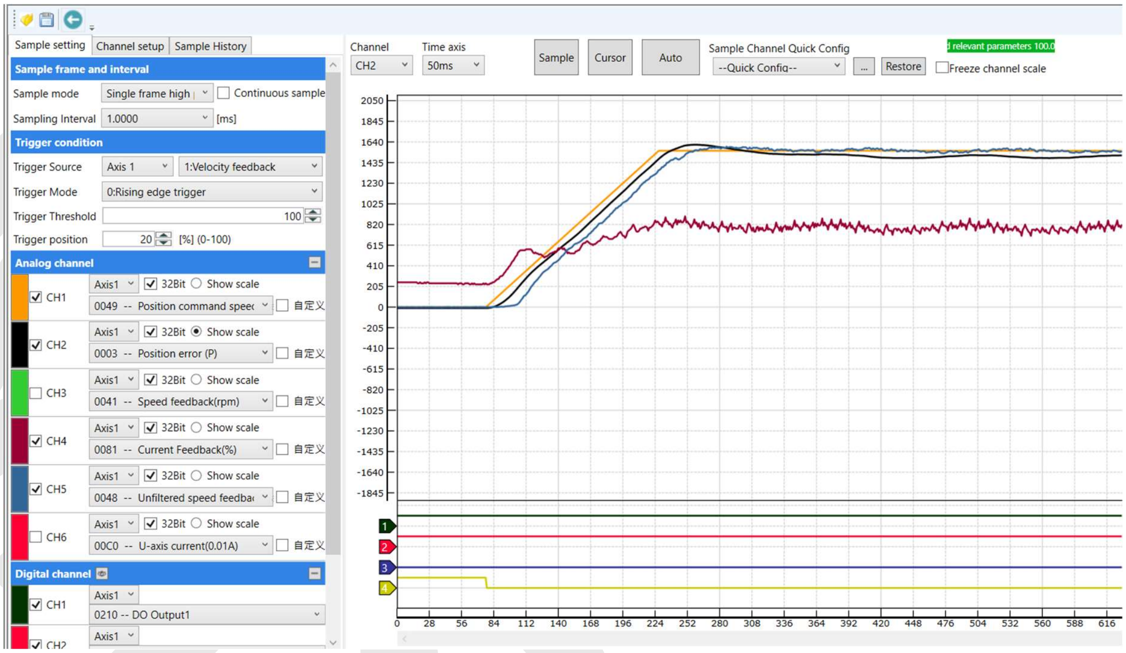
5. Performance Evaluation
Check overshoot and jitter count:



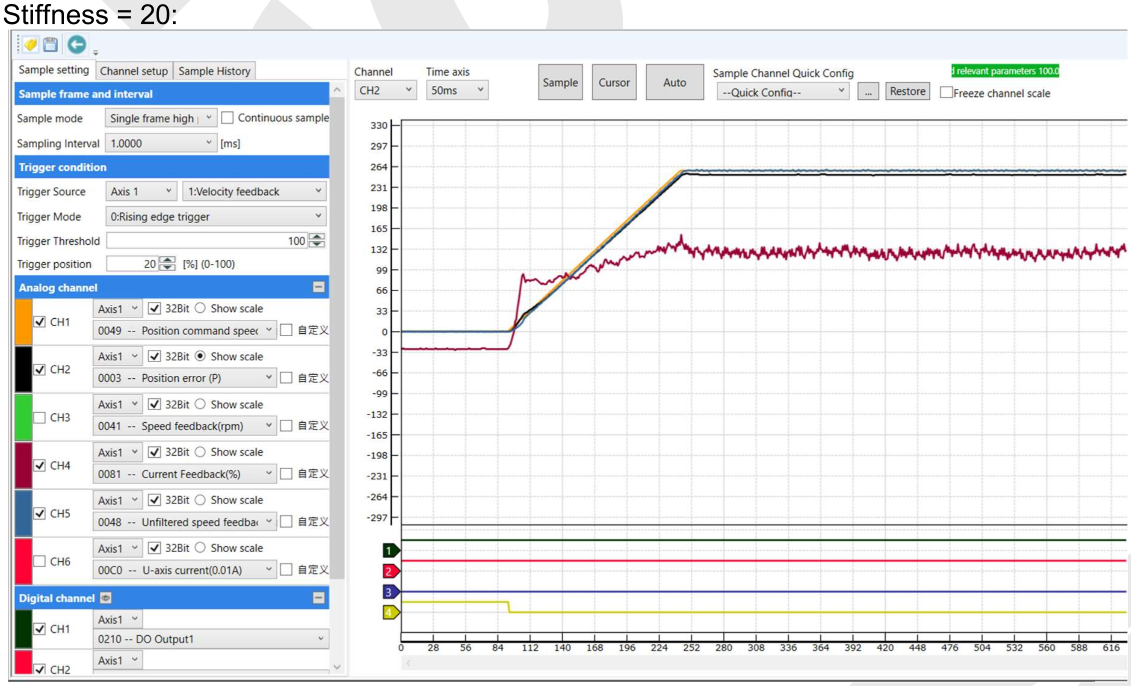


In position: allowable deviation between target and actual speed.
Aval counts: number of times target is reached.
Overshoot: overshoot between the target value and the actual measured value. <10% is displayed in white, 10% ~ 100% is displayed in yellow, >100% is displayed in red.
Jitter counts: the number of vibrations detected. If the number of vibrations = 1, the color turns yellow; if the number of vibrations > 1, the color turns red. The default color is white.
Maximum current: percentage of maximum current.
Increase stiffness and gain, use simple or advanced settings, and observe waveform to achieve optimal results.

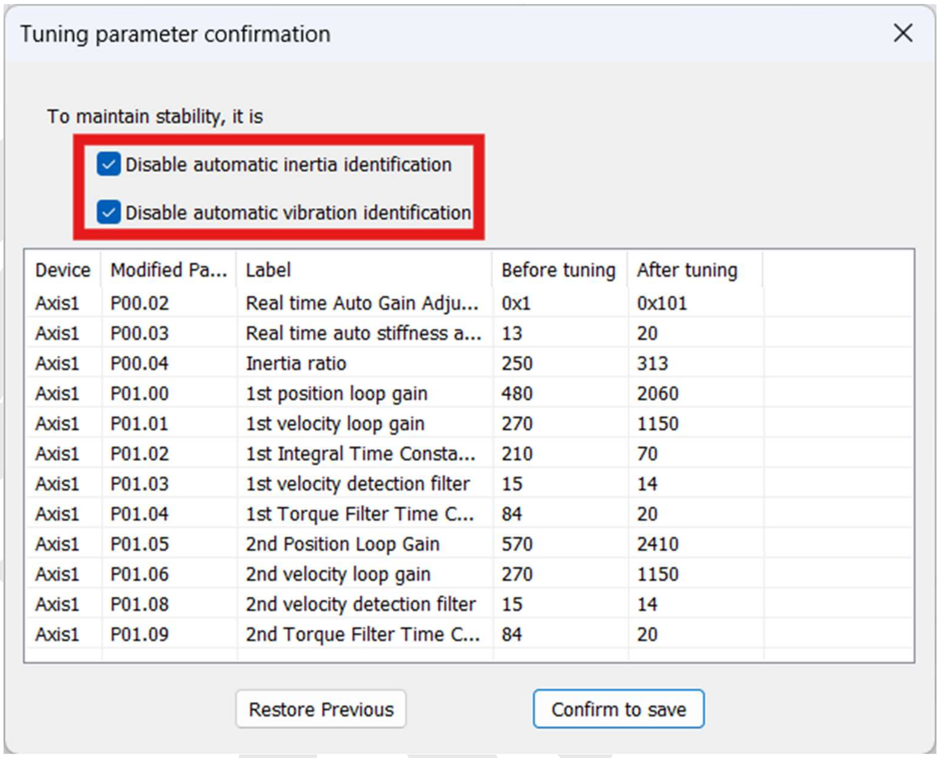
Stiffness = 11:



Stiffness = 20:



6. After Tuning Completion



Disable automatic inertia identification: After automatic parameter tuning, turn off automatic inertia identification.
Disable automatic vibration identification: After automatic parameter tuning, turn off automatic vibration identification.
Restore Previous: Do not save the parameters after automatic tuning
Confirm to save: Save the parameters after automatic tuning

6.4 Auto gain adjustment (rigidity level selection)

6.4.1 Overview

After setting the appropriate inertia ratio, estimate the machine's load characteristics in real time. This automatically adjusts the rigidity parameter value (P00.03) in real time, and sets the corresponding basic rigidity gain based on the result.

This function will measure real time mechanical properties and set gain values in accordance to mechanical rigidity. Can be used in any control mode.

Conditions to implement	
Control mode	Please refer to P00.02 for detailed explanations. Auto gain adjustment is different for each control mode.
Other	・Servo driver needs to be enabled ・Set up input signals such as deviation counter clearing and command input; Torque limit and other motion control parameters to enable motor to move normally without obstacles.

When the real-time auto-tuning function is enabled, the estimated values may become abnormal due to external interference or other factors. Therefore, if stable operation after power-on cannot be guaranteed, it is recommended to disable real-time auto-tuning.

Under certain conditions, external factors might affect automatic gain adjustment functions. If the conditions listed exist or are unfavorable, please disable the automatic gain adjustment function.

Affecting conditions	
Load inertia	• If inertia is less than 3 times or over 20 times of rotor inertia. • Changes in load inertia
Load	• Very low mechanical rigidity • If gear backlash is a non-linear property
Motion	• Velocity less than 100r/min or continuously in low velocity mode • Acc-/deceleration to 2000r/min within 1s. 。 • Acc-/deceleration torque lower than eccentric load, frictional torque. • Velocity < 100r/min, acc-/deceleration to 2000r/min within 1s but not longer than 50ms

6.4.2 How to operate

To enable automatic gain adjustment:

- Disable the servo driver. The inertia ratio must be set correctly; otherwise, the debugging results will be affected.
- Set P00.02 = 0x01/0x11 or 0x02/0x12. Then, set P00.03.
- Servo enabled. Run motion as normal to start measuring load properties. Related parameters will be automatically set. [See the table below for details]
- Increase motor responsiveness by increasing P00.03. Please check if there is any vibration before setting P00.03 to max. value.
- Save the parameters write them to the EEPROM.

Please take note:

- Please stop the motor before modifying any parameter. P00.02 only takes effect after saving modified parameter values into EEPROM and restarting the driver.
- After enabling the servo driver for the first time or when increasing P00.03, mechanical noise or vibration might occur for the first run, it is normal. If it persists, please set P00.03 to lower value.

The servo driver provides two automatic gain adjustment modes:

■ Standard mode (P00.02 = 0x_ _1): Basic mode, a mode that emphasizes stability. It does not use gain switching. In standard mode, in real-time automatic gain adjustment, the following basic gain setting parameters are updated based on P00.03.

Parameters that change in accordance to real time gain adjustment

Parameters	Label	Remarks
P01.00	1st position loop gain	When rigidity setting is changed, parameters will be updated to match rigidity value
P01.01	1st velocity loop gain	
P01.02	1st velocity integral time constant	
P01.03	1st velocity detection filter	
P01.04	1st torque filter	

Standard mode fixed parameters

Parameter	Parameter Value	Remarks
P01.10	300 (0.1%)	When rigidity setting is changed, these parameters will not change.
P01.11	0.50ms	
P01.12	0	
P01.13	0	

When real-time automatic adjustment is enabled, the automatically adjusted parameters cannot be modified. When P00.02 = 0x00 or 0x10 is set to manual adjustment mode, gain parameters can be manually modified one by one.

■ Positioning mode (P00.02=0x2): This mode emphasizes positioning. When there is no variable load on the horizontal axis, the position loop gain of the second gain parameter should be about one rigidity level higher than the first gain parameter.
The positioning mode in real-time automatic gain adjustment updates the following basic gain setting parameters based on P00.03.

Parameters that change in accordance to real time gain adjustment.

Parameters	Label	Remarks
P01.00	1st position loop gain	When rigidity setting is valid, parameters will be updated to match rigidity value
P01.01	1st velocity loop gain	
P01.02	1st velocity integral time constant	
P01.03	1st velocity detection filter	
P01.04	1st torque filter	
P01.05	2nd position loop gain	
P01.06	2nd velocity loop gain	
P01.08	2nd velocity detection filter	
P01.09	2nd torque filter	

Fixed parameters

Parameter	Label	Parameter Value
P01.07	2nd velocity integral time constant	1000ms
P01.10	Velocity feedforward gain constant	30%
P01.11	Velocity feedforward filter time constant	0.50ms
P01.12	Torque feedforward gain	0
P01.13	Torque feedforward filter time constant	0
P01.15	Position control gain switching mode	10
P01.17	Position control switching level	50
P01.18	Position control switching hysteresis	33
P01.19	Position gain switching time	33ms

Types of mechanical load
Please select mechanical load according to load-inertia ratio and mechanical structures:

Load types	Description
0x00 : Rigid structure	When load is **rigid** with relatively **low inertia**. Gain adjustments prioritize **system responsiveness**. Structures including high precision reducer, lead screws, mechanical gears, etc.
0x01 : High inertia	**High load inertia** (10 times or above). Gain adjustments prioritize **operation stability and responsiveness**. Recommended mechanical rigidity level **not more than 15**.
0x02 : Flexible structure	When load is **flexible** with relatively **high inertia**. Gain adjustments prioritize **operation stability**. Structures including long transportation belt or chain.

Structures with high inertia can have better performance if inertia ratio is set accurately.

P00.02	Name	Real time Auto Gain Adjusting			Valid Mode							F
	Range	0x0~0xFFF	Unit	—	Default	0x001	Index	2002h				
	Activation	Immediate										

Set up the mode of the real time auto gain adjusting.

Data bits	Category	Settings	Application
0x00_	Motion setting mode	Used to set motion setting mode, which can be selected according to the motion characteristics or setting requirements. Generally, it is recommended to select mode 1 with good generality when there is no special requirement, mode 2 when rapid positioning is needed If mode 1 and mode 2 cannot meet the requirements, please choose mode 0.	
		0: Manual	P00.03 invalid. Gain value must be adjusted manually and accordingly.
		1: Standard	P00.03 valid. Quick gain adjusting can be achieved by changing P00.03 rigidity value. Gain switching is not used in this mode, suitable for applications with requirements for stability.
		2: Positioning	P00.03 valid. Quick gain adjusting can be achieved by changing P00.03 rigidity value. This mode is suitable for applications requiring quick positioning. Not recommended for load mounted vertical to ground, or please compensate for the load using P06.07
0x0_0	Load type setting	Used to select the load type, choose according to load-inertia ratio and mechanical structure.	
		0: Rigid structure	This mode prioritizes system responsiveness. Use this mode when there is a relatively rigid structure with low load inertia. Typical application including directly connected high-precision gearbox, lead screw, gears, etc.
		1: High inertia	For applications with higher load inertia (10 times or above), gain settings take into account both machine stability and responsiveness. Not recommended to set rigidity above 15 for high load inertia.
		2: Flexible structure	This mode prioritizes system stability. Use this mode when there is low rigidity structure with high load inertia. Typical applications included belts and chains.
0x_00	reserved		

The setting type combination is a hexadecimal standard, as follows:

Setting type combination	Application type
0X000	Rigid structure Manual
0X001	Rigid structure +Standard
0X002	Rigid structure +Positioning
0X010	High inertia + Manual
0X011	High inertia + Standard
0X012	High inertia + Positioning
0X020	Flexible structure + Manual
0X021	Flexible structure +Standard
0X022	Flexible structure +Positioning

P00.03	Name	Real time auto rigidity	Mode							F

	adjusting						
Range	00 ~ 31	Unit	—	Default	11	Index	2003h
Activation	Immediate						

The mechanical rigidity setting is low when the real-time automatic gain adjustment is valid.

Low → Mechanical stiffness → High

Low → Servo gain → High

0.1 ...... 11.12.13 ...... 30.31

Low → Responsiveness → High

Lower values ensure better system responsiveness and mechanical rigidity, but machine vibration might occur, please set accordingly.

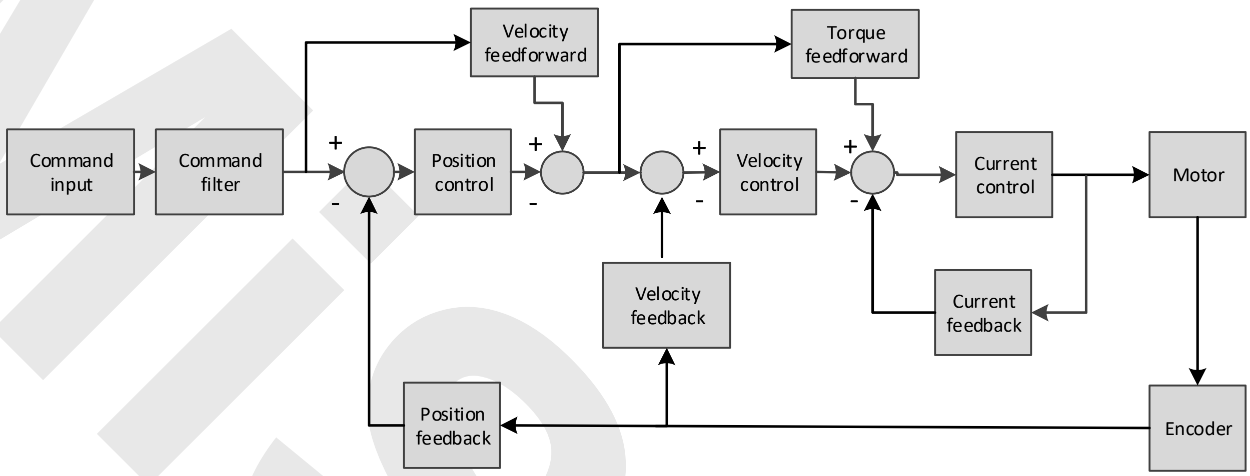
Gain parameters settings table

Rigidity	1st gain				2nd gain			
	P01.00	P01.01	P01.02	P01.04	P01.05	P01.06	P01.07	P01.09
	Position loop gain (0.1/s)	Velocity loop gain (Hz)	Velocity loop integral time constant （0.1ms）	Torque filter (0.01ms)	Position loop gain (0.1/s)	Velocity loop gain (Hz)	Velocity loop integral time constant （0.1ms）	Torque filter (0.01ms)
0	20	15	3700	1500	25	15	10000	1500
1	25	20	2800	1100	30	20	10000	1100
2	30	25	2200	900	40	25	10000	900
3	40	30	1900	800	45	30	10000	800
4	45	35	1600	600	55	35	10000	600
5	55	45	1200	500	70	45	10000	500
6	75	60	900	400	95	60	10000	400
7	95	75	700	300	120	75	10000	300
8	115	90	600	300	140	90	10000	300
9	140	110	500	200	175	110	10000	200
10	175	140	400	200	220	140	10000	200
11	320	180	310	126	380	180	10000	126
12	390	220	250	103	460	220	10000	103
13	480	270	210	84	570	270	10000	84
14	630	350	160	65	730	350	10000	65
15	720	400	140	57	840	400	10000	57
16	900	500	120	45	1050	500	10000	45
17	1080	600	110	38	1260	600	10000	38
18	1350	750	90	30	1570	750	10000	30
19	1620	900	80	25	1880	900	10000	25
20	2060	1150	70	20	2410	1150	10000	20
21	2510	1400	60	16	2930	1400	10000	16
22	3050	1700	50	13	3560	1700	10000	13
23	3770	2100	40	11	4400	2100	10000	11
24	4490	2500	40	9	5240	2500	10000	9
25	5000	2800	35	8	5900	2800	10000	8
26	5600	3100	30	7	6500	3100	10000	7
27	6100	3400	30	7	7100	3400	10000	7
28	6600	3700	25	6	7700	3700	10000	6
29	7200	4000	25	6	8400	4000	10000	6
30	8100	4500	20	5	9400	4500	10000	5
31	9000	5000	20	5	10500	5000	10000	5

6.5 Manual gain adjustment (Basic)

6.5.1 Overview

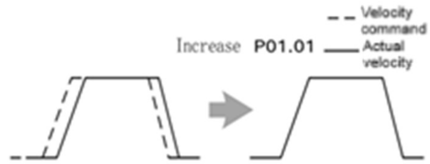
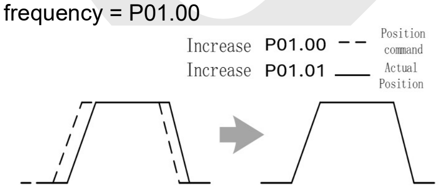
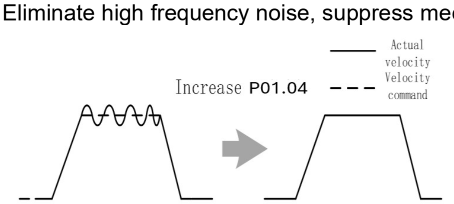
Due to limitation of load conditions, automatic gain adjustment might not achieve expected performance. Control can be improved through manual gain adjustment
The servo system is made up of 3 control loops. From outer to inner: position loop, velocity loop, current loop as shown in the diagram below.



Inner control loop demands higher responsiveness. To avoid system instability, please tune in accordance with this principle. Current loops gain usually satisfies the responsiveness demand without tuning. When gain adjustment is done under position control mode, to keep the system stabile, position and velocity loop gain have to be increased at the same time to make sure the responsiveness of the position loop is lower than velocity loop.

Steps to tuning (Position and velocity control)
For servo gain, if any one of the parameters is changed, please modify other gain related parameters accordingly. Make sure to change at around 5% and follow the rules as below.

- Increase responsiveness
- Reduce torque command filter time
- Increase velocity loop gain
- Decrease velocity loop integral time
- Increase position loop gain
- Decrease responsiveness, prevent vibration and overshoot
- Reduce position loop gain
- Increase velocity loop integral time
- Reduce velocity loop gain
- Increase torque filter time

Step	Parameter	Label	Tuning method
1	P01.01	Velocity Loop Gain	Determines the maximum frequency of the speed command that the speed loop can follow. When the inertia ratio P00.04 is set correctly, the maximum following frequency of the speed loop = P01.01.  Increasing this parameter within the range where no noise or vibration occurs can speed up positioning time and bring better speed stability and followability. If noise occurs, reduce the parameter setting value. If mechanical vibration occurs, use the mechanical resonance suppression function.
2	P01.02	Velocity loop integral time constant	To eliminate velocity loop deviation  Velocity loop integral time constant (ms) = 4000 /（2*π*Velocity loop gain(Hz)） Reduce P01.02 to reduce positioning time. Mechanical vibration might occur if set value is too low; Velocity loop deviation can't be zeroed if set value is too high. Reduce P01.02 to increase systemic stiffness, reduce deviation, provided that there is no resonance or noise in the system. If load-inertia ratio is high or resonance exists in mechanical system, increase P01.02.
3	P01.00	Position loop gain	Determine if position loop is able to follow the changes in position command at highest frequency. Position loop highest following frequency = P01.00  Increase P01.00 to reduce position following deviation, reduce positioning time provided that there is no resonance or noise in the system. If P01.00 is set too high, it might cause trembling in the mechanical system or positioning overshoot
		1st torque filter time constant	Eliminate high frequency noise, suppress mechanical resonance.  System response improves with lower set value but there is

4	P01.04		mechanical limitations；High frequency resonance suppression improves with higher set value but it might cause reduction in response bandwidth and phase margin, resulting in system turbulence. Torque filtering frequency is 4 times higher than velocity loop max following frequency: $1000000/(2\pi\times P01.04)\geq P01.01\times 4$ For example, when P01.01=180（0.1 Hz）， P01.04 should satisfy： P01.01≤221（0.01ms）

1. If vibration occurs with increasing P01.01, please modify P01.04 to suppress vibration.
2. If the parameters are set too high, it might cause current loop response to reduce.
3. To suppress vibration at stop, increase P01.01 and decrease P01.04.
4. Decrease P01.04 if motor vibrates too much at rest.
5. P01.04 cannot be set to overly high value as it might cause control system instability because the torque loop response is much higher than velocity loop.

For servo gain, if any one of the parameters is changed, please modify other gain related parameters accordingly. Make sure to the change at around 5% and follow the rules as below.

1. Increase responsiveness
   - Reduce torque command filter time
   - Increase velocity loop gain
   - Decrease velocity loop integral time
   - Increase position loop gain

2. Decrease responsiveness, prevent vibration and over shoot
   - Reduce position loop gain
   - Increase velocity loop integral time
   - Reduce velocity loop gain
   - Increase torque filter time

6.5.2 Parameters adjustment under different control modes

Under different control modes, parameters adjustment has to be adjusted in this order: "Inertia measuring" -> "Auto gain adjustment"->" Manual gain adjustments"

Position control mode

Set load-inertia ratio P00.04 after inertia determination.

No.	Parameter	Label
1	P01.00	1st position loop gain
2	P01.01	1st velocity loop gain
3	P01.02	1st velocity integral time constant
4	P01.03	1st velocity detection filter
5	P01.04	1st torque filter time constant
6	P01.05	2nd position loop gain
7	P01.06	2nd velocity loop gain
8	P01.07	2nd velocity integral time constant
9	P01.08	2nd velocity detection filter
10	P01.09	2nd torque filter time constant
11	P01.10	Velocity feedforward gain constant
12	P01.11	Velocity feedforward filter time constant
13	P01.12	Torque feedforward gain
14	P01.13	Torque feedforward filter time constant
15	P01.15	Position control gain switching mode
16	P01.17	Position control switching level
17	P01.18	Position control switching hysteresis
18	P01.19	Position gain switching time

1st and 2nd gain initial values are obtained by automatic gain adjustment

No.	Parameter	Label
1	P01.00	1st position loop gain
2	P01.01	1st velocity loop gain
3	P01.02	1st velocity integral time constant
4	P01.03	1st velocity detection filter
5	P01.04	1st torque filter time constant
6	P01.05	2nd position loop gain
7	P01.06	2nd velocity loop gain
8	P01.07	2nd velocity integral time constant
9	P01.08	2nd velocity detection filter
10	P01.09	2nd torque filter time constant

Manually adjusted gain parameters

No.	Parameter	Label
1	P01.00	1st position loop gain
2	P01.01	1st velocity loop gain
3	P01.02	1st velocity integral time constant
4	P01.04	1st torque filter time constant
5	P01.10	Velocity feedforward gain constant
6	P01.11	Velocity feedforward filter time constant

Velocity control mode

Velocity control mode parameters adjustment is pretty similar to position control mode. Except for position loop gain P01.00 and P01.05, velocity feedforward gain (P01.10)

Torque control mode

Parameters adjustment for torque control mode must be differentiate into 2 conditions:

1. When actual velocity reaches velocity limit, adjustment will be as per velocity control mode. Motor will switch from torque control to velocity limit as velocity control.
2. When actual velocity doesn't reach velocity limit yet, Except for position loop gain, velocity loop gain and feedforward gain, parameter adjustments as per velocity control mode.

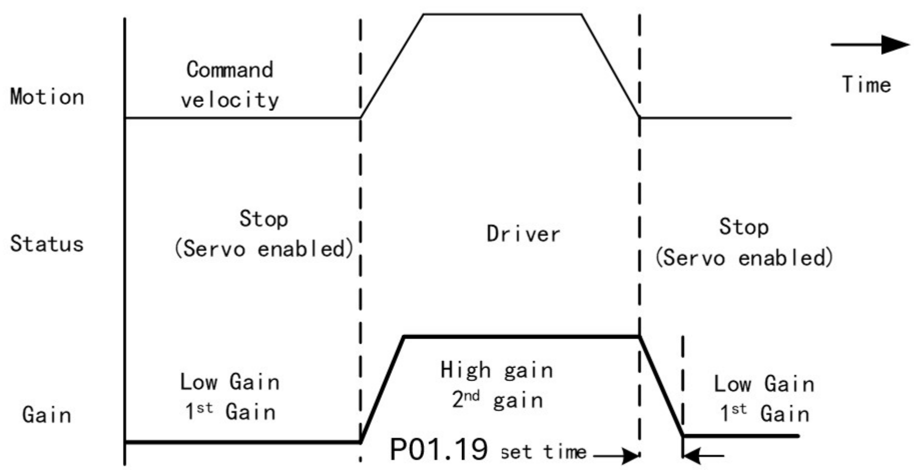
If there is no velocity limit and control is through torque command, please deactivate torque and notch filter, set velocity limit to max. value and increase velocity loop gain to as high as possible.

6.5.3 Gain switching

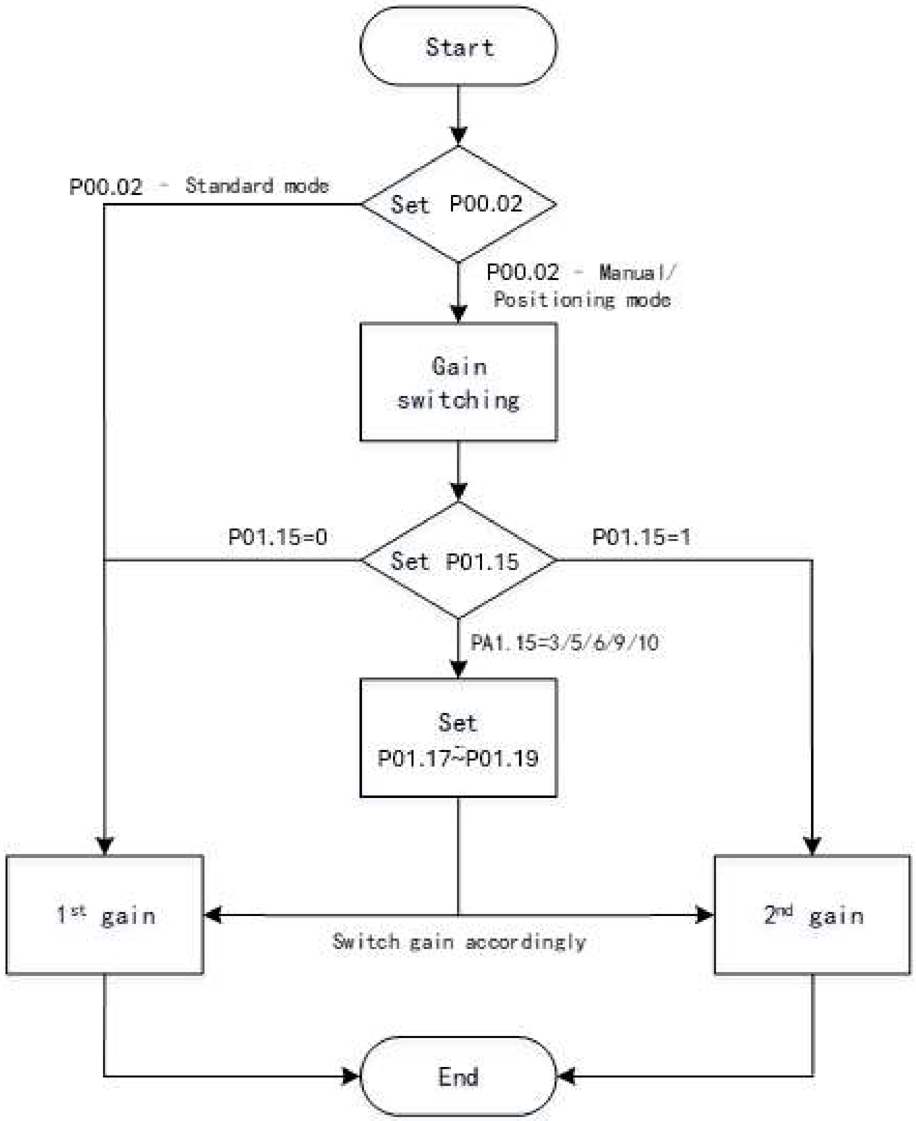
Gain switching function can be triggered internally in servo driver. Only valid under position or velocity control mode. The following effects can be realized by gain switching:

- Switch to lower gain when motor stops to suppress vibration
- Switch to higher gain when motor is moving at a low velocity to shorten positioning time
- Switch to higher gain when motor is moving at a high velocity to improve command following behavior.

The diagram below shows gain switching when motor stops.



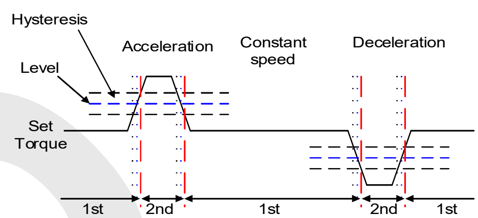
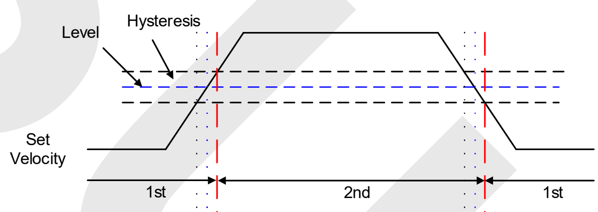
1st gain (P01.00-P01.04) and 2nd gain (P01.05-P01.09) switching can be realized through manual and positioning mode. Switching condition is set through P01.15. Gain switching is invalid under standard mode.

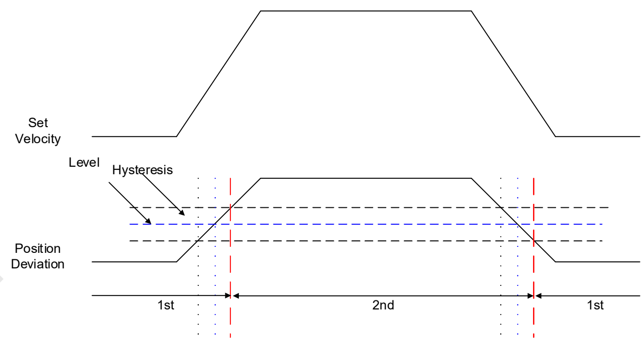
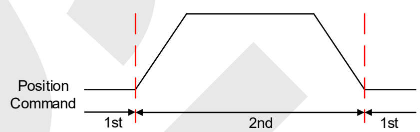
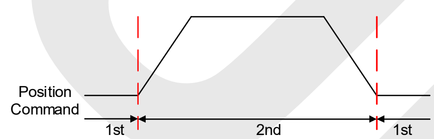


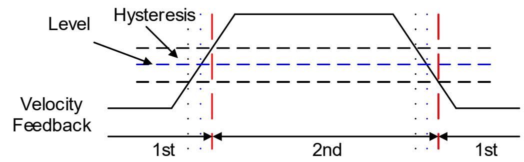
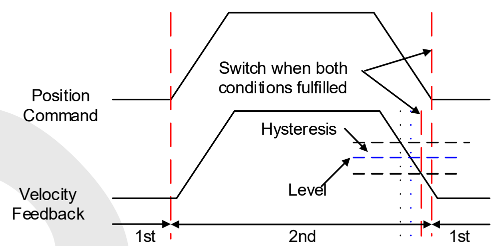
Related parameters on gain switching

No.	Parameter	Label	Remarks
1	P01.15	Position control gain switching mode	In position control, set P01.15=3、5、6、9、10. In velocity control, set P01.15=3、5、9
2	P01.17	Position control level switching	Please set P01.17≥P01.18
3	P01.18	Position control hysteresis switching	If P01.17＜P01.18, driver will set P01.17＝P01.18
4	P01.19	Position gain time switching	

P01.15	Name	Position control gain switching mode		Mode						F
	Range	0~11	Unit	—	Default	0	Index	2115h		
	Activation	Immediate								

Set Value	Condition	Gain switching condition
0	1st gain fixed	Fixed on using 1st gain(P01.00-P01.04)
1	2nd gain fixed	Fixed on using 2nd gain (P01.05-P01.09)
2	Reserved	
3	High set torque	Switch to 2nd gain when set torque command absolute value larger than (level + hysteresis)[%] Switch to 1st gain when set torque command absolute value smaller than (level + hysteresis)[%] 
4	Reserved	Reserved
5	High set velocity	 Valid for position and velocity control. Switch to 2nd gain when set velocity command absolute value larger than (level + hysteresis)[r/min] Switch to 1st gain when set velocity command absolute value smaller than (level-hysteresis)[r/min]

6	Large position deviation	Valid for position control. Switch to 2nd gain when position deviation absolute value larger than (level + hysteresis)[pulse] Switch to 1st gain when position deviation absolute value smaller than (level-hysteresis)[pulse] 
7	Pending position command	Valid for position control. Switch to 2nd gain if position command ≠ 0 Switch to 1st gain if position command **remains = 0** throughout the duration of delay time. 
8	Not yet in position	Valid for position control. Switch to 2nd gain if position command is not completed. Switch to 1st gain if position command **remains uncompleted** throughout the duration of delay time. 
9	High actual velocity	Valid for position control. Switch to 2nd gain when actual velocity absolute value larger than (level + hysteresis)[r/min] Switch to 1st gain when actual velocity absolute value remains smaller throughout the duration of delay time than (level-hysteresis)[r/min]

		
10	Pending position command +actual velocity	Valid for position control. Switch to 2nd gain if position command ≠ 0 Switch to 1st gain if positional command = 0 throughout the duration of delay time and absolute value of actual velocity remains smaller than (level - hysteresis) (r/min) 

For position control mode, set P01.15=3,5,6,9,10;

For velocity control mode, set P01.15=3,5,9;

*** Above 'level' and 'hysteresis' are in correspondence to P01.17 Position control gain switching level and P01.18 Hysteresis at position control switching.*

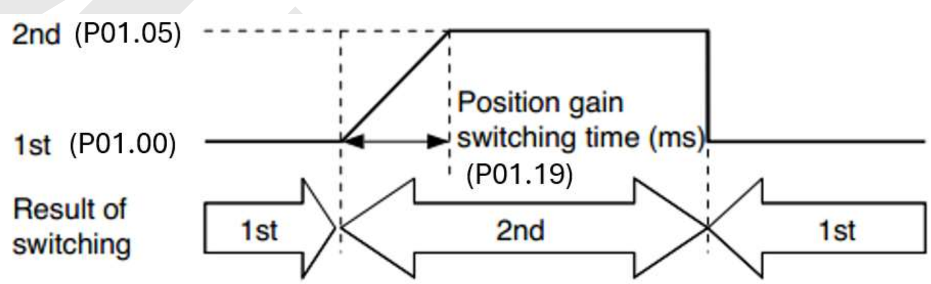
P01.17	Name	Position control gain switching level			Mode							**F**
	Range	0~20000	Unit	Mode dependent	Default	50	Index		2117h			
	Activation	Immediate										

Set threshold value for gain switching to occur.
Unit is mode dependent.

Switching condition	**Unit**
Position	Encoder pulse count
Velocity	RPM
Torque	%

Please set level ≥ hysteresis

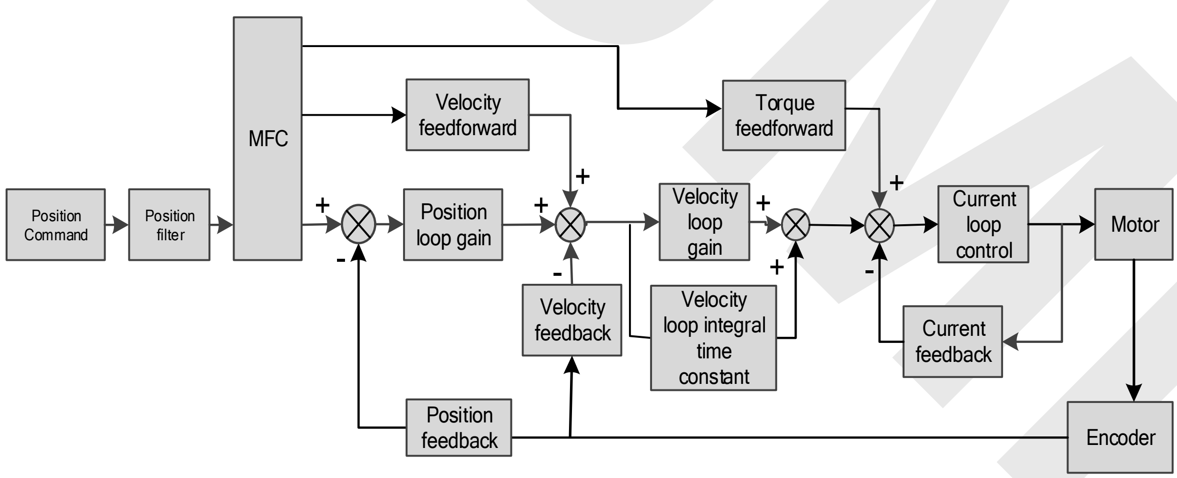
P01.18	Name	Hysteresis at position control switching			Mode							**F**
	Range	0~20000	Unit	Mode dependent	Default	33	Index		2118h			
	Activation	Immediate										

	To eliminate the instability of gain switching. Used in combination with P01.17 using the same unit. If level< hysteresis, driver will set internally hysteresis = level.							
P01.19	Name	Position gain switching time			Mode			F
	Range	0~10000	Unit	0.1ms	Default	33	Index	2119h
	Activation	Immediate						
	During position control, to ease torque changes and vibration due to rapid changes in position loop gain, set suitable P01.19 value For example: 1st (P01.00) <-> 2nd (P01.05)  							

6.6 Manual Gain Adjustment Function (Application)

6.6.1 Model following control (MFC)

Model following control is a type of closed loop control system. First, an ideal model is constructed and acts as a reference for actual model in a closed loop control. Model following control can be treated as a control mode with 2 flexibilities: Model reference can be used to improve command responsiveness and closed loop control used to increase responsiveness of the system towards interference. They don't affect each other.
Model following control can be used in position loop control to increase responsiveness to commands, reduce positioning time and following error. This function is only available in position control mode.



To adjust model following control

1. Automatic adjustment

Set model following bandwidth P00.00 = 1 for automatic adjustment. Now, P00.00 = P01.01, model following bandwidth is adjusted automatically according to different velocity loop gain.

2. Manual adjustment

Please use manual adjustment if

- Automatic adjustment is not satisfactory.
- Responsiveness needs further improvement in comparison with automatic adjustment.
- There is a need to set servo gain or model following control parameters manually.

Steps to manually adjust

Step	Content
1	Set up vibration suppression.
2	Set up the right inertia ratio.
3	Manually adjust gain.
4	Increase P00.00 if there is no overshoot and vibration. Usually, P00.00 ≥ P01.01 is recommended.

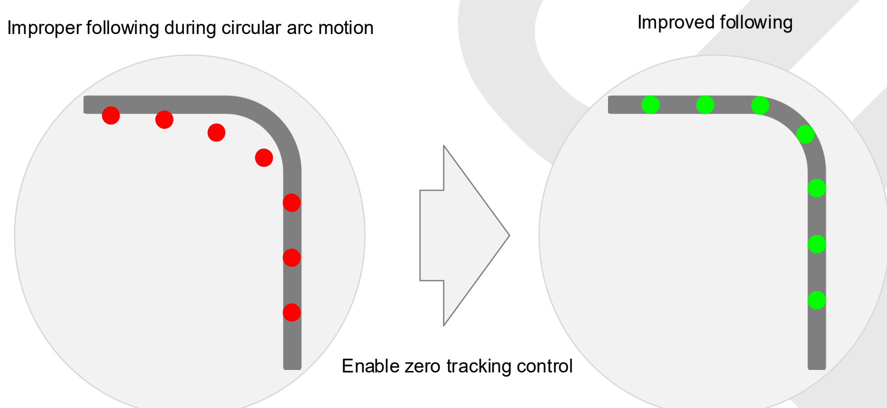
Model following bandwidth determines the responsiveness of the servo system. Increasing the value set will increase responsiveness and reduce positioning time. Overshoot can be prevented if it is set at a lower value, but responsiveness will be lowered. Model following bandwidth shouldn't be too large for mechanical structure with lower rigidity, excessive position deviation alarm might occur under high velocity.

6.6.2 Zero tracking control

Zero tracking control (ZTC) is able to realize a zero position deviation during acceleration/deceleration. This function increase multi axis precision and master-slave following.

Recommended application:

1. Multi axis



2. Master-slave following

Used when driving axis sends frequency divider signal to lead following axis to improve the following control.

- ZTC only available under position control mode.
- ZTC can only be enabled when P00.00 is valid.
- Model following control (MFC) and Zero Tracking Control (ZTC) cannot be used together at the same time.

Zero tracking control can achieve better performance with the following limiting factors.

	Limiting factors
Electronic gear ratio	Electronic gear ratio should be lower to prevent current noise.
Mechanical structure	Better structural rigidity to prevent vibration.
Motion	1. Command acceleration should be continuously low to prevent deviation change during drastic changes in acceleration. 2. Callback or overtravel might exist in positioning; sigmoid signal command might improve the problem.

Related parameters

Parameter	Label	Description
P02.50	Model following control (MFC)	0：Model following control - Default 1：Zero tracking control
P02.53	Dynamic friction compensation coefficient	Range: 0-1000, unit: 0.1% Unit：Changes in torque with the effect of friction on rotational speed. Only valid when MFC is activated
P00.00	Model following bandwidth	If P00.00 = 0, MFC and ZTC is deactivated. When P02.50 = 1 (Zero tracking control), higher bandwidth will improve following performance but noise will be higher.
Set the following parameters to default		
P02.51	Velocity feedforward compensation coefficient	Default value = 0 for zero tracking control.
P02.52	Torque feedforward compensation coefficient	
P02.54	Overtravel time constant	
P02.55	Overtravel suppression gain	

6.6.3 Feedforward gain

In position control, velocity feedforward is calculated by comparing the velocity control command calculated internally and velocity command calculated from position feedback. Comparing to control only using feedback, this will reduce position deviation and increase responsiveness. Furthermore, by comparing the torque needed during motion from velocity control command in comparison with velocity feedback, torque feedback can be calculated to improve system responsiveness.

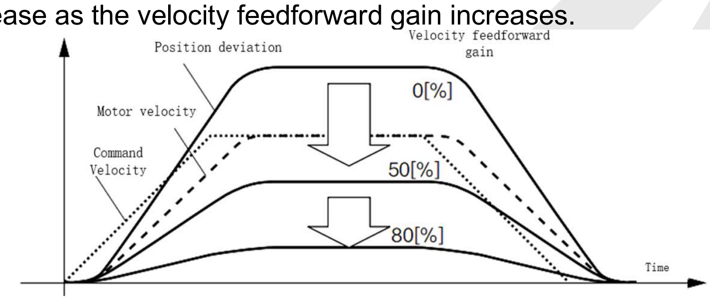
Velocity feedforward

Velocity feedforward can be used in position control mode. When the function is enabled, it can increase velocity responsiveness, reduce position deviation during constant velocity.

P01.10	Name	Velocity feedforward gain			Mode	**PP**			**HM**	**CSP**	
	Range	0~1000	Unit	0.10%	Default	300	Index		2110h		
	Activation	Immediate									
	Used for decreasing following error caused by low responsiveness of velocity loop. It might cause overshoot or increase in noise if the set value is too high.										
P01.11	Name	Velocity feed forward filter time constant			Mode	**PP**			**HM**	**CSP**	
	Range	0~6400	Unit	0.01ms	Default	50	Index		2111h		
	Activation	Immediate									
	Set velocity feed forward low pass filter to eliminate high or abnormal frequencies in velocity feed forward command. Often used when position command with low resolution or high electronic gear ration to smoothen velocity feed forward. Position deviation under constant velocity can be lowered with higher velocity feed forward gain. Please refer to the equation below. Position deviation [Uint]= $\frac{Set\ velocity[\frac{Uint}{s}]}{Position\ loop\ gain[Hz]} x \frac{100 - Velocity\ feed\ foward\ gain[\%]}{100}$										

Velocity feedforward application

Set P01.11 to around 50 (0.5ms), then tune P01.10 from 0 to bigger values until the velocity feedforward achieves better performance. Under constant velocity, the position deviation in a motion will decrease as the velocity feedforward gain increases.



Steps to tuning:

1. Increase P01.10 to increase responsiveness but velocity overshoot might occur during acc-/deceleration.
2. By reducing P01.11, velocity feedforward would be more effective and vice versa. P01.10 and P01.11 need to be tuned to a balance.

3. If mechanical noise exists under normal working conditions, please increase P01.11 or use position command filter (1 time delay/ FIR smoothing filter)

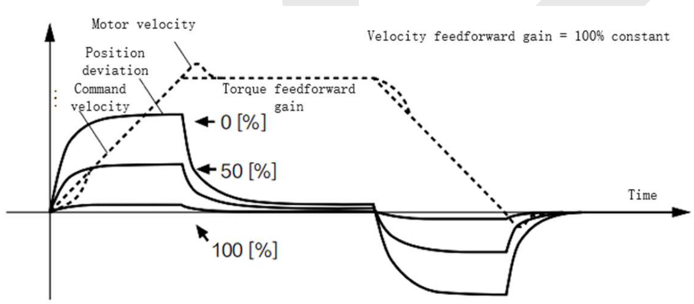
Torque feedforward

Position control mode: Torque feedforward can increase the responsiveness of torque command, decrease position deviation during constant acc-/deceleration.
Velocity control mode: Torque feedforward can increase the responsiveness of torque command, decrease velocity deviation during constant velocity.

P01.12	Name	Torque feed forward gain			Mode	PP	PV	HM	CSP	CSV	
	Range	0~1000	Unit	0.1%	Default	0	Index		2112h		
	Activation	Immediate									
	Before using torque feed forward, please set correct inertia ratio. By increasing torque feed forward gain, position deviation on constant acceleration/deceleration can be reduced to close to 0. Under ideal condition and trapezoidal speed profile, position deviation of the whole motion can be reduced to close to 0. In reality, perturbation torque will always exist, hence position deviation can never be 0.										
P01.13	Name	Torque feed forward filter time constant			Mode	PP	PV	HM	CSP	CSV	
	Range	0~6400	Unit	0.01ms	Default	0	Index		2113h		
	Activation	Immediate									
	Low pass filter to eliminate abnormal or high frequencies in torque feed forward command. Usually used when encoder has lower resolution or precision. Noise reduces if torque feed forward filter time constant is set higher but position deviation will increase at acceleration varied points.										

Torque feedforward application

Set P01.13 to around 50 (0.5ms), then tune P01.10 from 0 to bigger values until torque feedforward achieves better performance. Under constant acc-/deceleration, the position deviation in a motion will decrease as the velocity feedforward gain increase.



Steps to tuning:

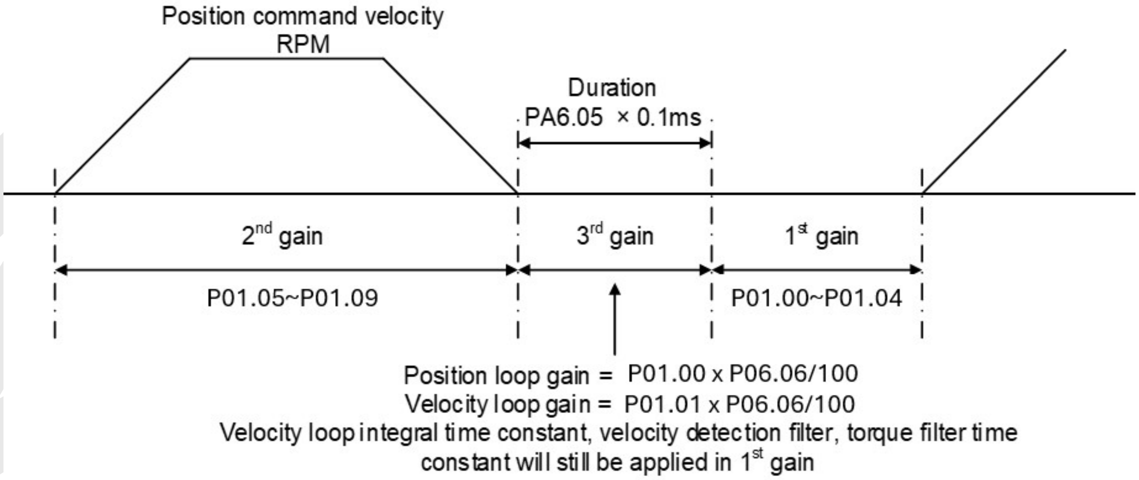
3. Increase P01.12 to increase responsiveness but velocity overshoot might occur during acc-/deceleration.

By reducing P01.13, torque feedforward would be more effective and vice versa. P01.12 and P01.13 need to be tuned to a balance and reduce noise.

6.6.4 3rd Gain Switching

Besides switching between 1st and 2nd gain, a 3rd gain switching is added to set gain at the moment of stopping to reduce positioning time.
Only available under position mode and P06.05 ≠ 0, set P06.06 for 3rd gain value. When 2nd gain switches to 1st gain, it has to go through 3rd gain, switching time is set in P01.19.

Diagram below shows when P01.15 = 7.


Position command velocity
RPM
Duration
PA6.05 × 0.1ms
2nd gain
3rd gain
1st gain
P01.05~P01.09
P01.00~P01.04
Position loop gain = P01.00 x P06.06/100
Velocity loop gain = P01.01 x P06.06/100
Velocity loop integral time constant, velocity detection filter, torque filter time constant will still be applied in 1st gain

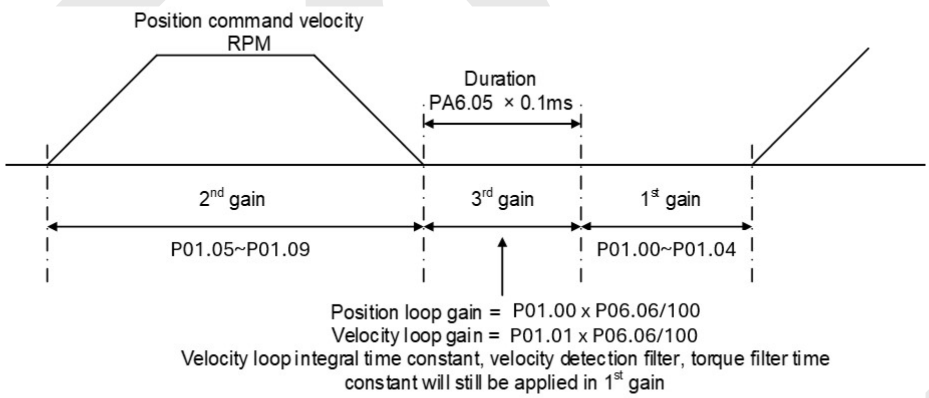
Related parameters

P06.05	Label	Position 3^{rd} gain valid time			Mode	**PP**		**HM**	**CSP**		
	Range	0~10000	Unit	0.1ms	Default	0	Index		2605h		
	Activation	Immediate									
	To set time for 3^{rd} gain to be valid When not in use, set P06.05=0, P06.06=100										
P06.06	Label	Position 3^{rd} gain scale factor			Mode	**PP**		**HM**	**CSP**		
	Range	0~1000	Unit	100%	Default	100	Index		2606h		
	Activation	Immediate									

Set up the 3^{rd} gain by multiplying factor of the 1^{st} gain

3^{rd} gain= 1^{st} gain * P06.06/100

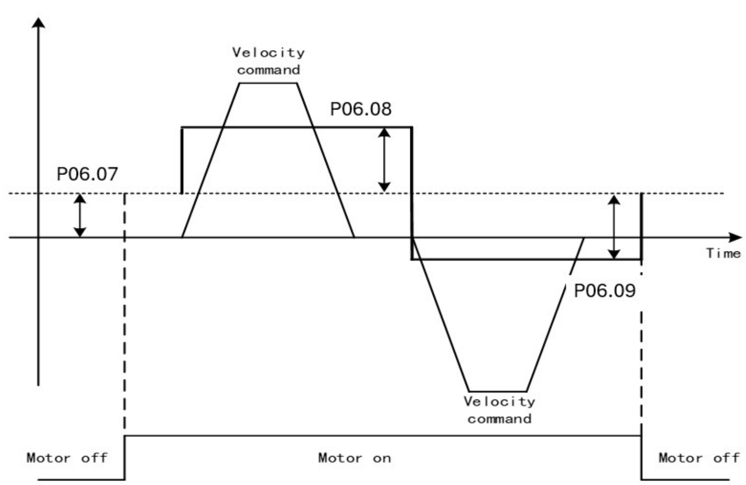
Only effective under position control mode, set P06.05≠0, 3^{rd} gain function activated, set 3^{rd} gain value in P06.06. When 2^{nd} gain switches to 1^{st} gain, will go through 3^{rd}, switching time value set in P01.19.



Above diagram is illustrated using P01.15 = 7.

6.6.5 Friction compensation function

This function is to compensate for changes in load to reduce the effect of friction in motion. The compensation value is directional.



Vertically loaded axis: A constant eccentric load torque is applied on the motor. By adjusting P06.07, positioning deviation due to different motional direction can be reduced.
Belt-drivern axis: Due to large radial load with dynamic frictional torque. Positioning time delay and deviation can be reduced by adjusting P06.08 and P06.09.

P06.07	Name	Torque command additional value			Mode			F
	Range	-100~100	Unit	%	Default	0	Index	2607h
	Activation	Immediate						
	To set torque forward feed additional value of vertical axis. Applicable for loaded vertical axis, compensate constant torque. Application: When load move along vertical axis, pick any point from the whole motion and stop the load at that particular point with motor enabled but not rotating. Record output torque value from d04, use that value as torque command additional value (compensation value)							
P06.08	Name	Positive direction torque compensation value			Mode			F
	Range	-100~100	Unit	%	Default	0	Index	2608h
	Activation	Immediate						
P06.09	Name	Negative direction torque compensation value			Mode			F
	Range	-100~100	Unit	%	Default	0	Index	2609h
	Activation	Immediate						
	To reduce the effect of mechanical friction in the movement(s) of the axis. Compensation values can be set according to needs for both rotational directions. Applications: 1. When motor is at constant speed, d04 will deliver torque values. Torque value in positive direction = T1; Torque value in negative direction = T2 P06.08/P06.09 = $T_f = \frac{\lvert T1-T2 \rvert}{2}$							

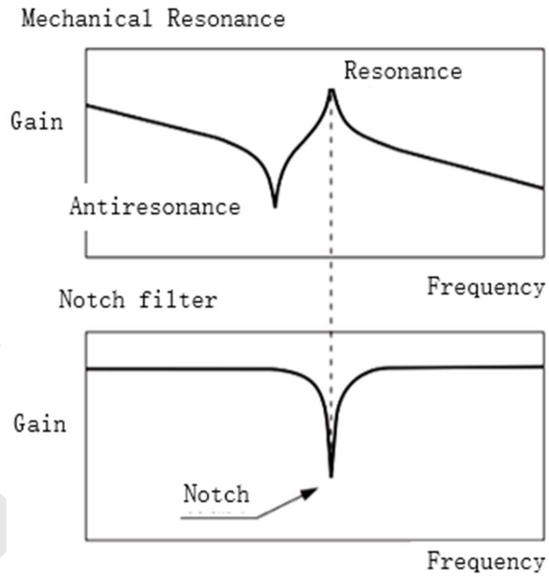
6.7 Vibration Suppression

6.7.1 Mechanical resonance suppression

Mechanical system has certain resonance frequencies. When servo gain is increased, resonance might occur at around mechanical resonant frequencies, preventing gain value from increasing. In such situation, notch filter can be used to suppress resonance to set higher gains or lower vibration.
To suppress mechanical resonance:

1. Torque command filter time constant
    - Set filter time constant to reduce gain at around resonant frequencies
   - Torque command filter blocked frequencies（Hz） $fc = \frac{1}{2\pi \times P01.04(0.01ms) \times 0.00001}$
2. Notch filter
   - Notch filter suppress mechanical resonance by reducing gain at certain frequencies.

   When notch filter is correctly set, resonance can be suppressed and servo gain can be increased.

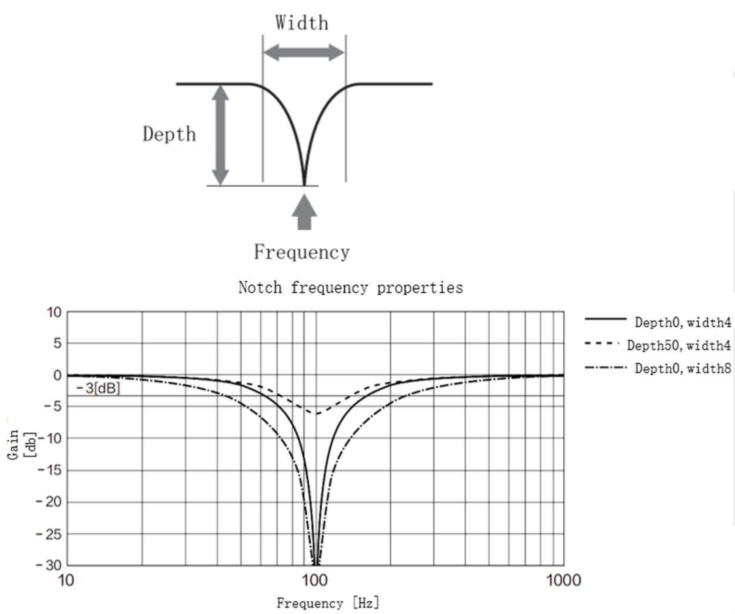


Notch filter bandwidth

- Center frequency of the notch filter, frequency bandwidth with reduction of -3dB.

Notch filter depth

- The ratio between input and output of center frequency.
- When depth = 0, center frequency output is totally off and when depth = 100,
- Hence when notch filter depth is set at lower value, the depth is higher and better at suppressing mechanical resonance but it might cause system instability.



If the notch filter from mechanical properties analysis tool doesn't show any obvious peak but vibration did occur, it might not be due to mechanical resonance, it may be that servo gain has reached its limit. This kind of vibration can't be suppressed by using notch filter, only by reducing gain and torque command filter time.

To use notch filter

Automatic notch filter

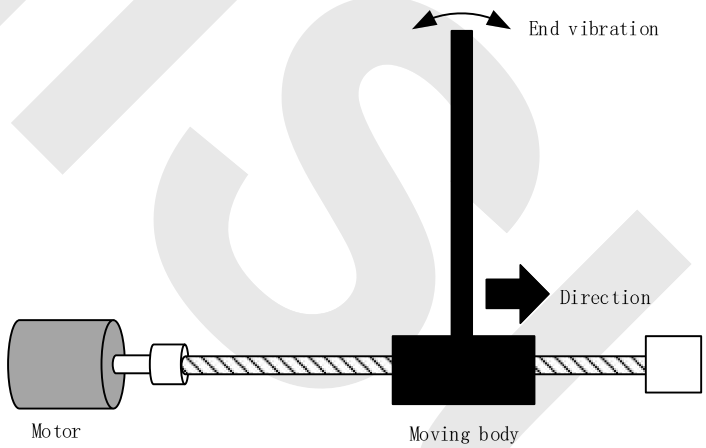
1. Set P02.00 = 1 for auto notch filter adjustment
2. If P00.03 rigidity increases, 3rd group of notch filter (P02.07/P02.08/P02.09) updates automatically when driver is enabled. P02.00 = 0, auto adjustments stop.
   - If resonance is suppressed, it means self-adjusting notch filter is working. If resonance occurs when mechanical rigidity increases, please use manual notch filter, set filter frequency to actual resonant frequency.

Manual notch filter

There are 2 ways to use manual notch filter.

1. After enabling self-adjusting notch filter, set the values from 3rd group of filters to 1st group of notch filter (P02.01/P02.02/P02.03), see if resonance is suppressed. If there is other resonance, set P02.00 = 1, then set the values from 3rd group of filters to 2nd group of notch filter (P02.04/P02.05/P02.06)
2. Get resonant frequency, notch filter bandwidth and depth and set it into the corresponding parameters through MISUMI EDrive.

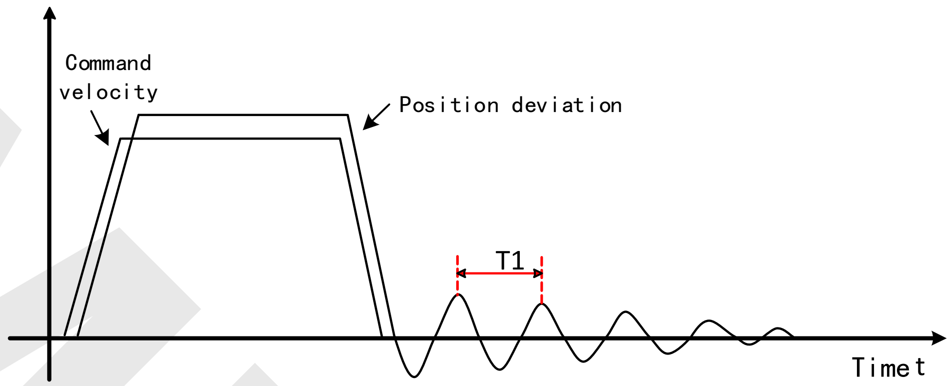
6.7.2 End vibration suppression



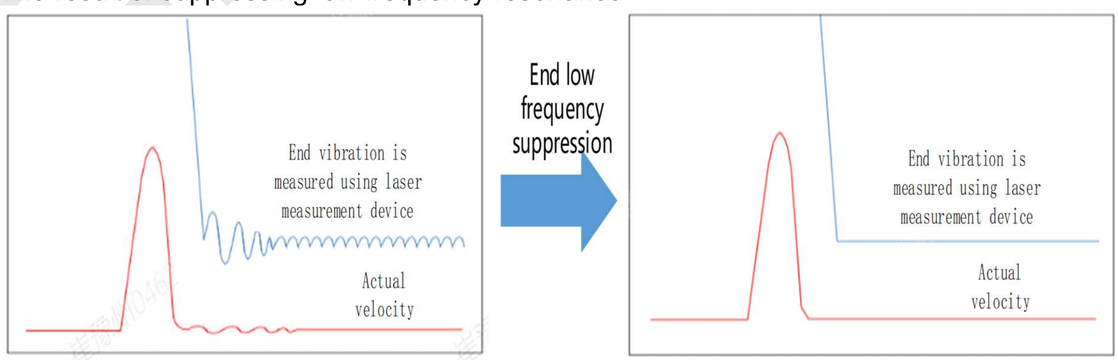
If the mechanical has an end that is long and heavy, it might cause end vibration at emergency stop and affect the positioning. Usually happens on long armed axis with loose end. The frequency is usually within 100Hz which is lower than mechanical resonant frequencies. It is called low-frequency resonance which can be prevented by applying low frequency suppression function.

To apply low frequency suppression

1. Trace current/ position deviation waveform when motion stops.
2. Measure the vibration cycle T1 of current waveform.
3. Convert T1 into low frequency resonance by F1 = 1/T1
4. Write F1 into P02.14
5. If some other low frequency resonance occurs, please repeat step 1-3 and write F2 into P02.16.



The result of suppressing low frequency resonance



6.7.3 Mechanical properties analysis

This function is available on MISUMI EDrive. Mechanical properties analysis is used to determine mechanical resonance and to use filter to suppress the resonance.
To avoid excessive vibration during testing, set the excitation amplitude to a low value for the first test. If the excitation is too low, the analyzed waveform may be distorted to some extent. If vibration occurs during testing and reducing the excitation current does not resolve the issue, possible causes and solutions include: The gain is too high; please reduce the speed gain or set a notch filter based on the resonance point identified by the mechanical characteristics; the inertia is too high; please set the correct inertia.

6.8 Multiturn absolute encoder

Multiturn absolute encoder records the position, and the revolution counts of the motor. When the driver is powered-off, multiturn absolute encoder will back up the data using battery and after powering on, the data will be used to calculate absolute mechanical position and there is no need for a mechanical homing process. Use widely in robotic arms and CNC machines.

If it is the first time using the encoder, please home the mechanical axis and initialize the absolute position of the encoder to zero. Set up a homing point and only home when there is an alarm. Please stop the axis before reading any position data to prevent inaccuracy.

6.8.1 Parameters setting

P00.15	Name	Absolute Encoder settings	Mode	**PP**			**HM**	**CSP**		
	Range	0~32767	Unit	-	Default	0	Index	2015h		
	Activation	Immediate								

0: Incremental mode:
Used as an incremental encoder. Doesn't retain position data on power off. Unlimited travel distance.
1: Multiturn linear mode:
Used as a multiturn absolute encoder. Retrain position data on power off. For applications with fixed travel distance and no multiturn data overflow.
2: Multiturn rotary mode:
Used as a multiturn absolute encoder. Retrain position data on power off. Actual data feedback in between 0-(P06.63). Unlimited travel distance.
3: Single turn absolute mode:
Used when travel distance is within 1 revolution of the encoder. Data overflow will trigger alarm.
5: Clear multiturn alarm and activate multiturn absolute function. Will switch to multiturn mode once alarm cleared, if remains at 5 after 3s, please solve according to Er153.
9: Clear multiturn position, reset multiturn alarm and activate multiturn absolute function. Will switch to multiturn mode once alarm cleared, if remains at 9 after 3s, please solve according to Er153. Please disable axis before setting to 9 and home the axis before using.

6.8.2 Read absolute position

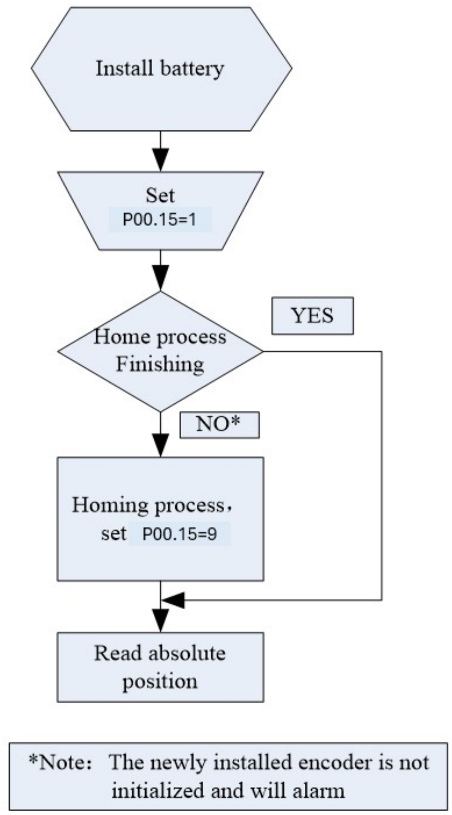
1. Steps：

1) First, select a motor with multiturn absolute encoder, install battery and confirm whether the driver version supports the specific motor.

2) Set P00.15 = 1. If it is the first time installation, Err153 will occur because battery is newly installed, and position data is invalid. Please home the axis and initialize the absolute position of the encoder to zero.

3) When absolute homing point is set and there is no fault with the battery, the alarm will be cleared

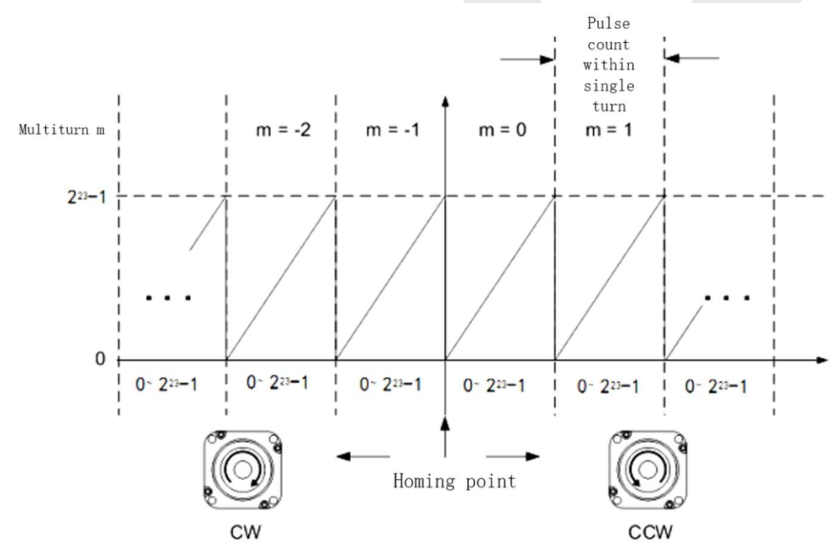
4) Finally, the user can read the absolute position. Position won't be lost even if the driver is powered off.



2、Read absolute position

When the rotor turns in clockwise direction, the revolution count will be negative; turns in counterclockwise direction, the count will be positive. No. of revolutions will be from -32767 to +32767. If the count number reaches +32767 in counterclockwise direction, the count will revert back to -32768, -32767 and vice versa for clockwise direction.

As for position data, it depends on the precision of the encoder. For 17 bit = 0-131071, 23 bit = 0-8388607



Read data from 6064h object dictionary

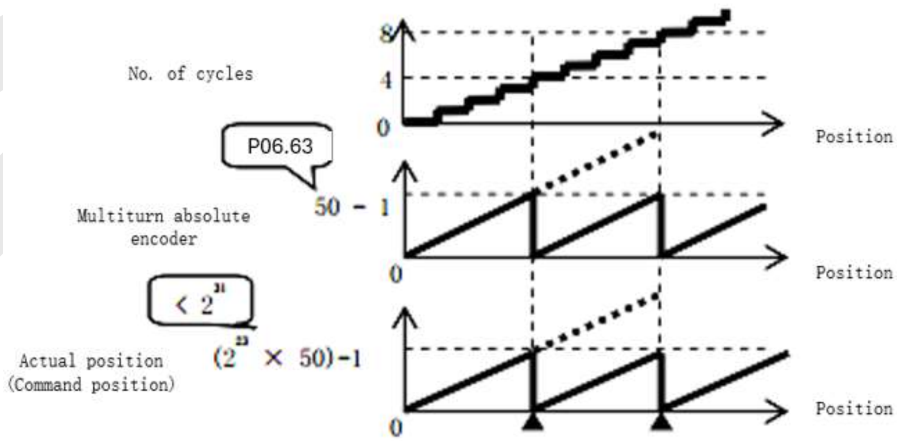
Please read data only when the motor is fully stopped or it might cause calculation errors. Please repeat this step at least twice to make sure the result is uniform.

Multiturn linear mode(P00.15 = 1)

Multiturn absolute with memory of position at power off. Use this mode when travel distance is constant, encoder multiturn data would not overflow.
In this mode, encoder data ranges from -32768~32767. If the value either of the limits, Er157 might occur. Set 9 in P00.15 to clear multiturn data and home the axis.

Multiturn rotational mode

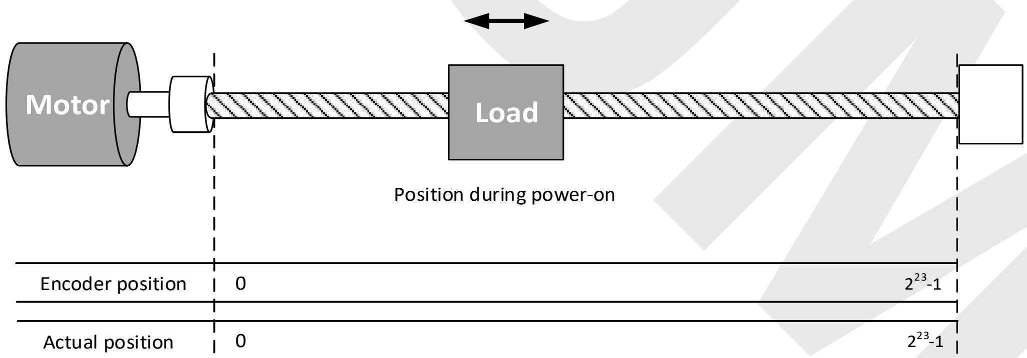
For absolute encoder, multiturn rotational mode (P00.15 = 2, P06.63 set to multiturn upper limit) is added on top of incremental mode and multiturn linear mode. Actual feedback multiturn data is always between 0 – [P06.63 + 1], regardless of the direction of rotation. There is no limit to no. of rotation and no data overflow.



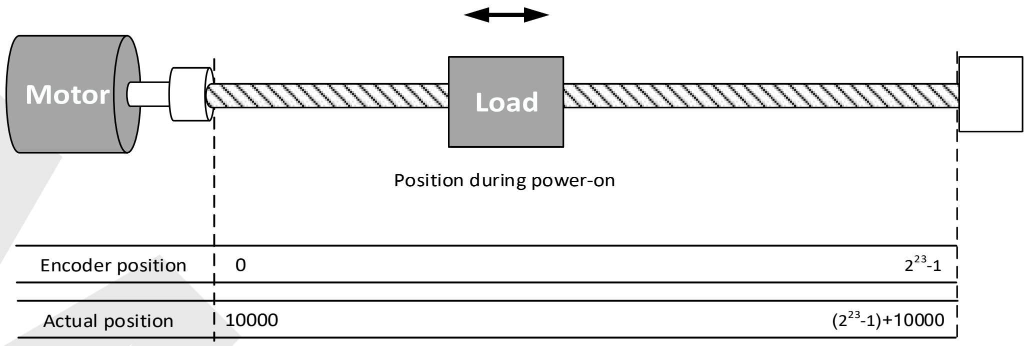
Single turn absolute mode

Use this mode when the travel distance of the axis is within a single turn of the rotor.
1. Target position input range – EtherCAT
When using 23-bit absolute encoder, under single turn absolute mode, electronic gear ratio =1:1
Homing point offset 607Ch = 0, target position range = 0 – [2^{23}-1]
Axis is homed, target position range = 607Ch – [2^{23}-1+607Ch]

When electronic gear ratio = 1:1, 607Ch = 0:



When electronic gear ratio = 1:1, 607Ch = 10000:



3、Clear multiturn position

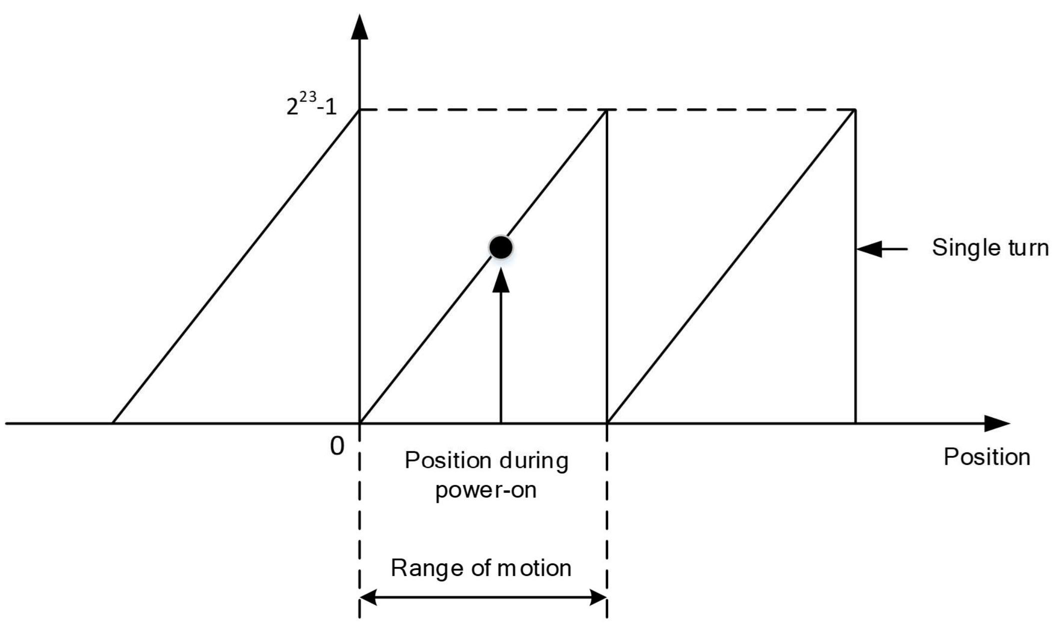
Before clearing multiturn position, the axis needs to be homed. After clearing multiturn position, revolution count = 0 but absolute position remains unchanged and Err153 alarm will be cleared.

Please make sure the homing point is within the range of 1 revolution of the rotor. Installation and setup of the homing point can be set with the use of auxiliary function D21 on the front panel.

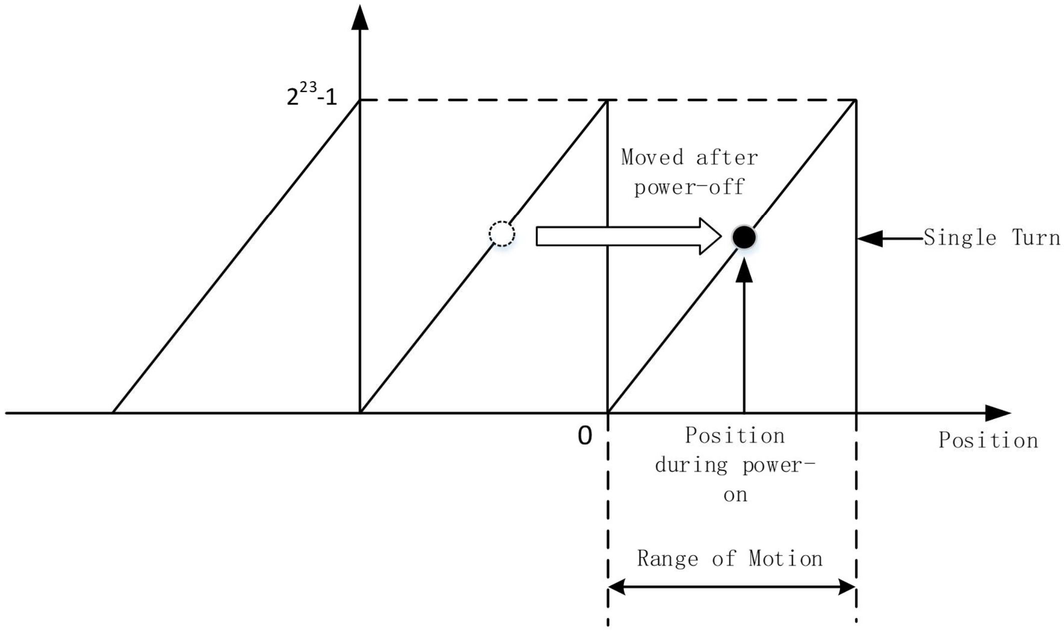
By setting P00.15 to 9, multiturn position will be cleared.

Please take notice of motor position during power on. Range of motion of a motor depends on the position of the motor during power on (23-bit absolute encoder as example).

If the motor position is as shown below during power on. The range of motion of the motor is within the range of a single turn of the motor from motor position during power on.



If power is turned off at position as shown below and power on when motor reaches the position below. Motor range of motion changes as shown below.



Multi-turn Position Zeroing

Before performing a multi-turn position zeroing, the machine must return to its origin. After performing the multi-turn position zeroing, the multi-turn position becomes 0, the single-turn position remains unchanged, and the encoder absolute value alarm is cleared.

The range of the machine's home position is one motor revolution. Within this range, the single-turn zero point of that revolution is used as the absolute origin. Therefore, the deviation range of the mechanical origin installation must be within the range of a single motor revolution. During home-returning, the position can be adjusted in conjunction with the "D21 Single-turn Value" setting on the driver panel.

Multi-turn position zeroing is achieved by setting parameter P00.15 to 9. This can be performed via the panel or bus communication.

6.8.3 Absolute Encoder Related Alarm

The alarm can determine if the absolute value encoder is valid. If battery power is low, not a motor with absolute encoder, encoder error etc. occurs, users can find out about the error from alarm output or on the front panel. The controller will stop any operation until the alarm is cleared.

Alarm output:

Err153 will be shown on front panel or by I/O ALM signal and from the controller.

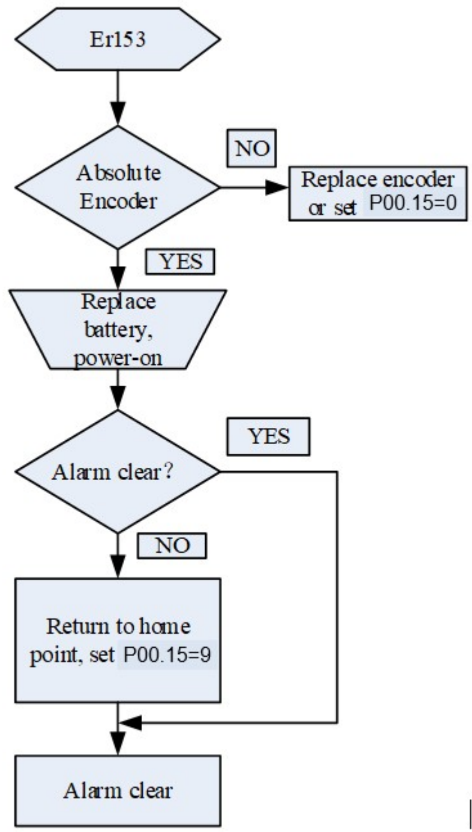
Err153 might occur,

（1）If absolute encoder is used for the first time and due to installation of new batteries Axis needs to be homed and multiturn data needs to be cleared.

（2）If battery voltage is lower than 3.2v. Replace the battery and restart the motor.

（3）If battery voltage is lower than 2.5v or battery power was cut off. Replacing the battery won’t clear the alarm. Axis needs to be homed and multiturn data needs to be cleared.

4、Alarm processing flow chart



6.8.4 Battery kit

In multiturn absolute mode, Er153 might occur upon first time installation. P00.15 needs to be set to 0 to reset errors and clear multiturn data.
When battery supply voltage < 3.0V, ArA03 might occur. Change battery as per steps below:

1) Power on driver (Make sure axis is disabled)
2) Change battery. Servo driver will reset warning automatically.
3) After the driver automatically resets ArA03 (encoder battery warning), there are no other abnormal warnings, and it can operate normally.

6.9 Probe

Motor feedback position latching function can be realized through input signal with probe function. E-DHASxxE supports up to 2 inputs with probe function and can be used simultaneously, to record the position information corresponding to probe signal rising and falling edge. Probe 1 signal comes from CN1 terminal pin 1 and 5 differential signals. Probe 2 signal comes from CN1 terminal pin 2-6 differential signal.

P00.07	Name	Probe signal polarity settings/Command pulse input mode settings			Mode			F
	Range	0 ~ 3	Unit	—	Default	3	Index	2007h
	Activation	After restart						

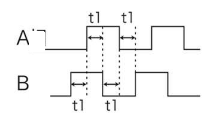
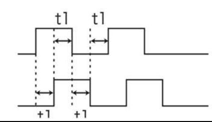
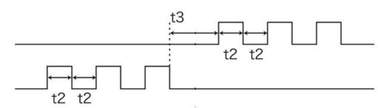
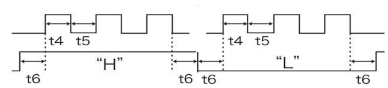
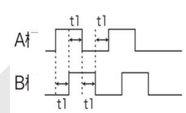
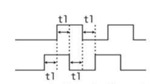
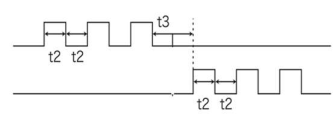
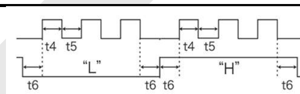
Probe signal polarity settings take effect when P00.01 = 9

Set value	Details
0	Probe 1 & 2 polarity inversion
1	Probe 2 polarity inversion

2	Probe 1 polarity inversion
3	No polarity inversion for probe 1 & 2

If P00.01 ≠ 9, P00.07 = Command pulse input mode settings.

Command pulse input

Command Polarity inversion (P00.06)	Command pulse input mode settings (P00.07)	Command Pulse Mode	Positive signal	Negative signal
【0】	0 *or* 2	90°phase difference 2 phase pulse （Phase A+ Phase B）		
	1	CW pulse sequence ＋ CCW pulse sequence		
	【3】	Pulse sequence ＋ Directional symbol		
1	0 *or* 2	90°phase difference 2 phase pulse （Phase A＋Phase B）		
	1	CW pulse sequence ＋ CCW pulse sequence		
	3	Pulse sequence ＋ Directional symbol		

Command pulse input signal max. frequency and min. duration needed

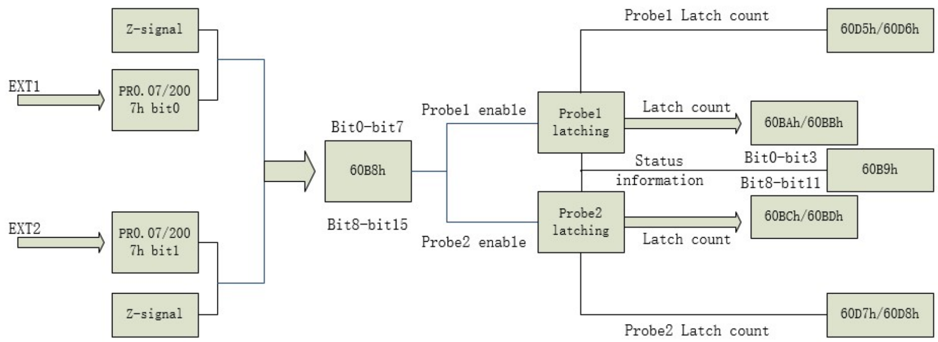
Command pulse input interface		Max. Frequency	Min. duration needed（μs）					
			t1	t2	t3	t4	t5	t6
Pulse sequence interface	Differential driver	500 kHz	2	1	1	1	1	1
	Open collector	200 kHz	5	2.5	2.5	2.5	2.5	2.5

Please set >0.1μs for the duration between rising and falling edge of command pulse input signal.

1 revolution with 2500 pulses 2-phase pulse input when P00.07=0 or 2, P00.08 = 10000;

1 revolution with 10000 pulses 1-phase pulse input when P00.07=1 or 3, P00.08 = 10000

6.9.1 Probe function



When using EXT1 or EXT2 as probe, please set as following:

- Set polarity of EXT 1 or EXT 2 as probe. Set the level polarity of the probes using 0x2007 / P00.07. Bit 0 for EXT1 signal, bit 1 for EXT2 signal
- Probe function is set through 0x60B8 (Bit 0-7 is for probe 1, bit8-15 is for probe 2). Functions including activation trigger signal selection, triggering mode and triggering signal edge.

Please take note:

- Triggering mode: Single trigger, rising signal edge = valid; triggering mode: Continuous trigger, rising and falling edge = valid
- After activation, trigger signal selection, triggering signal edge settings, counter will be reset and 0x60B9 status will change as well.
- Probe signal level is shown in 60FD: EXT1 -> bit 26, EXT2 -> bit 27.

6.9.2 Related Objects

Index	Sub Index	Label	Access	Data Type	Units	Range	Default
2007h	00h	Probe 1 polarity setting	RW	Uint16		0~0xFFFF	1
2007h	01h	Probe 2 polarity setting	RW	Uint16		0~0xFFFF	1
60BAh	00h	Probe 1or Z-signal rising edge latching position	RO	int32	Command unit	-2147483648 ~2147483647	0
60BBh	00h	Probe 1 or Z-signal falling edge latching position	RO	int32	Command unit	-2147483648 ~2147483647	0
60BCh	00h	Probe 2 or Z-signal rising edge latching position	RO	int32	Command unit	-2147483648 ~2147483647	0
60BDh	00h	Probe 2 or Z-signal falling edge latching position	RO	int32	Command unit	-2147483648 ~2147483647	0
60D5h	00h	Probe 1 or Z-signal rising edge counter	RO	Uint32		0~4294967296	0
60D6h	00h	Probe 1 or Z-signal falling edge counter	RO	Uint32		0~4294967296	0
60D7h	00h	Probe 2 or Z-signal rising edge counter	RO	Uint32		0~4294967296	0
60D8h	00h	Probe 2 or Z-signal falling edge counter	RO	Uint32		0~4294967296	0

6.9.3 Signal Input of EXT1 and EXT2

EXT1：Pin1 and Pin5 of CN1 terminal

EXT2：Pin2 and Pin6 of CN1 terminal

The probe function reuses DI5/DI6. When DI5 and DI6 have no assigned function, they are used as probes.

6.9.4 Probe Control Word 60B8h

Bit	Definition	Details
0	Probe 1 enable	0--Disable 1--Enable
1	Probe 1 mode	0--Single trigger mode 1--Continuous trigger mode
2	Probe 1 trigger signal selection	0—EXT1 signal 1--Z signal
3	Reserved	-
4	Probe 1 rising edge trigger	0--Disable 1--Enable
5	Probe 1 falling edge trigger	0--Disable 1--Enable
6-7	Reserved	-
8	Probe 2 enable	0--Disable 1--Enable
9	Probe 2 mode	0--Single trigger mode 1--Continuous trigger mode
10	Probe 2 trigger signal selection	0—EXT2 signal 1--Z signal
11	Reserved	-
12	Probe 2 rising edge trigger	0--Disable 1--Enable
13	Probe 2 falling edge trigger	0--Disable 1--Enable
14-15	Reserved	-

6.9.5 Probe Status Word 60B9h

Bit	Definition	Details
0	Probe 1 enable	0--Disable 1--Enable
1	Probe 1 or Z-signal rising edge trigger	0-- not executed 1-- executed
2	Probe 1 or Z-signal falling edge trigger	0-- not executed 1-- executed
3-5	Reserved	-
6-7	Reserved	-
8	Probe 2 enable	0--Disable 1--Enable
9	Probe 2 or Z-signal rising edge trigger	0-- not executed 1-- executed
10	Probe 2 or Z-signal falling edge trigger	0-- not executed 1-- executed
11-13	Reserved	-
14-15	Reserved	-

6.9.6 Latch Position Register

Index	Details

60BAh	Probe 1 or Z-signal rising edge latch position
60BBh	Probe 1 or Z-signal falling edge latch position
60BCh	Probe 2 or Z-signal rising edge latch position
60BDh	Probe 2 or Z-signal falling edge latch position

6.9.7 Latch Counter Register

Index	Details
60D5h	Probe 1 or Z-signal rising edge counter
60D6h	Probe 1 or Z-signal falling edge counter
60D7h	Probe 2 or Z-signal rising edge counter
60D8h	Probe 2 or Z-signal falling edge counter

6.9.8 Probe operation

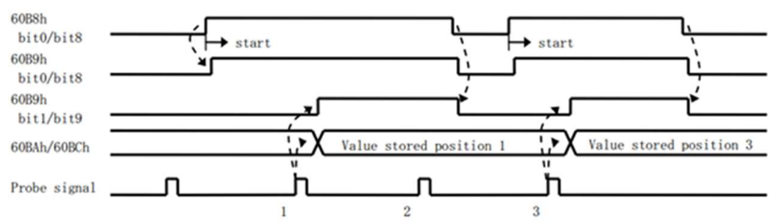
When bit 0/bit 8 of probe function control parameter 60B8h changes from "0 (stop)" to "1 (start)", various setting conditions (bits 1 to 7/bits 9 to 15 of 60B8h) are acquired and probe operation is started.
To make changes to these setting conditions effective, return bit 0/bit 8 to "0 (stop)" and then to "1 (start)" again.

6.9.9 Probe mode

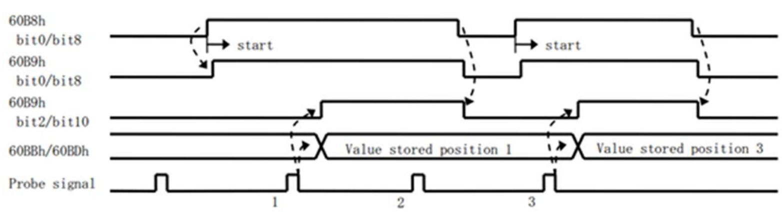
Set bit1/bit9 of 60B8h (Probe mode), 0 = Single trigger mode, 1 = Continuous trigger mode.

（1）Single trigger mode

Triggers only when the trigger signal is valid for the first time. In order to latch the position, users need to set bit0/bit8 of 60B8h to 0, then set bit0/bit8 of 60B8h to 1. The sequence diagram is as shown below:



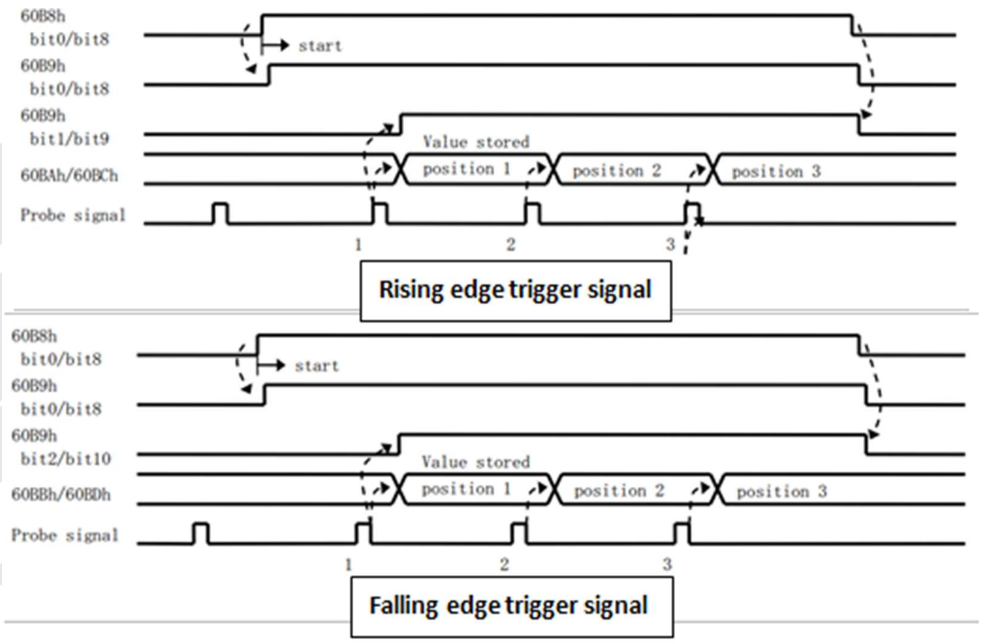
Rising edge trigger signal



Falling edge trigger signal

（2）Continuous trigger mode

The data saved from signal triggering will be saved until the next trigger signal. Enabling the probe again is not needed. Sequence diagram as shown below:



6.10 Safety Functions

6.10.1 Velocity limit function

P05.13 sets the motor's overspeed alarm threshold. If the motor speed exceeds this threshold, an Er1A0 alarm will occur.

P05.13	Name	Overspeed level settings			Mode						F
	Range	0~10000	Unit	RPM	Default	0	Index			2513h	
	Activation	Immediate									
	If motor speed exceeds P05.13, Er1A0 might occur. When P05.13 = 0, overspeed level = max. motor speed x 1.2										

6.10.2 Servo stop mode

This parameter can be used to set the stop mode.
This parameter can be used to set the servo alarm stop mode.

Pr5.06	Label	Servo-off mode			Mode						F
	Range	0~5	Unit	—	Default	0	Index			2506h	
	Activation	After restart									
	To set servo driver disable mode and status.										

Set value	Explanation	
	Mode	*Status*
0	Servo braking	Dynamic braking
1	Free stopping	Dynamic braking
2	Dynamic braking	Dynamic braking
3	Servo braking	Free-run
4	Free stopping	Free-run
5	Dynamic braking	Free-run

Pr5.10	Label	Servo-off due to alarm mode			Mode			F
	Range	0~2	Unit	-	Default	0	Index	2510h
	Activation	After restart						

To set servo driver disable mode and status if alarm is triggered.

Alarm type 2:

Set value	Explanation	
	Mode	*Status*
0	Servo braking	Dynamic braking
1	Free stopping	Dynamic braking
2	Dynamic braking	Dynamic braking
3	Servo braking	Free-run
4	Free stopping	Free-run
5	Dynamic braking	Free-run

Alarm type 1:

Set value	Explanation	
	Mode	*Status*
0	Dynamic braking	Dynamic braking
1		
2		
3	Servo braking	Free-run
4	Free stopping	Free-run
5	Dynamic braking	Free-run

6.10.3 Max. time to stop after disabling

This parameter sets the maximum stopping time after the enable is disconnected. If the motor speed remains greater than the speed set in P04.39 after this time, the driver's brake signal BRK turns OFF (brake operation begins). If the brake is not in place, a forced stop is initiated based on whether dynamic braking is enabled.

Pr6.14	Label	Max. time to stop after disabling			Mode			F
	Range	0~3000	Unit	ms	Default	500	Index	2614h
	Activation	Immediate						

To set the max. time allowed for the axis to stop on emergency stop or normal axis disabling.
After disabling axis, if motor speed is still higher than Pr4.39 but the time set in Pr6.14 is reached, BRK_ON given and holding brake activated.
BRK_ON given time is determined by Pr6.14 or when motor speed goes below Pr4.39, whichever comes first.

Applications:
1. After disabling axis, if motor speed is still higher than Pr4.39 but the time set in Pr6.14 is reached, BRK_ON given and holding brake activated.
2. After disabling axis, if motor speed is already lower than Pr4.39 but the time set in Pr6.14 is not yet reached, BRK_ON given and holding brake activated.

6.10.4 External brake deactivation output signal BRK-OFF

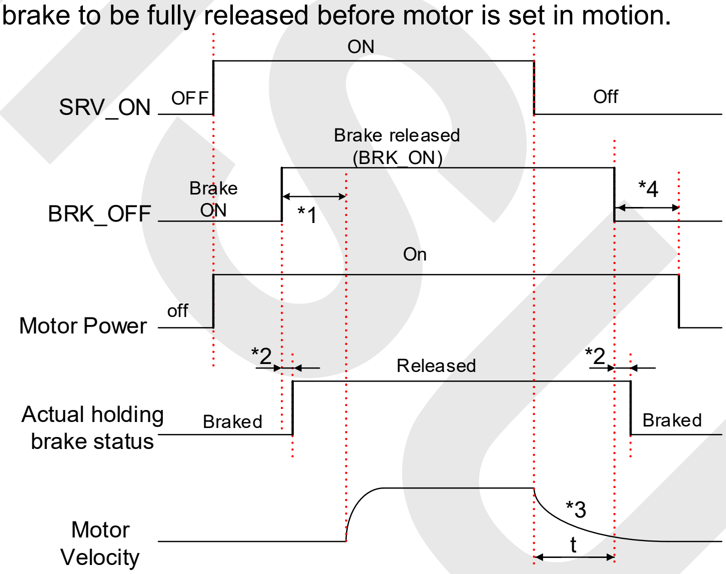
Please refer to P04.11 to set up the I/O output function parameters. When enabled and timing conditions are fulfilled, the set I/O output will deliver ON signal.

P04.37	Name	Motor power-off delay time			Mode			F
	Range	0~3000	Unit	1ms	Default	100	Index	2437h
	Activation	Immediate						

To set delay time for holding brake to be activated after motor power off to prevent axis from sliding.

P04.38	Name	Delay time for holding brake release			Mode			F
	Range	0~3000	Unit	1ms	Default	0	Index	2438h
	Activation	Immediate						

To set delay time for holding brake to be released after motor power on. Motor will remain at current position and input command is masked to allow holding brake to be fully released before motor is set in motion.



*1: Delay time set in P04.38
*2: Delay time from the moment BRK_OFF signal is given until actual holding brake is released or BRK_ON signal is given until actual holding brake is activated. It is dependent on the holding brake of the motor.
*3: Deceleration time is determined by P06.14 or if motor speed goes below P04.39, whichever comes first. BRK_OFF given after deceleration time.
*4: P04.37 set time value.

Delay time from the moment SRV_ON is given until BRK_OFF switch to BRK_ON, is less than 500ms.

P04.39	Name	Holding brake activation speed			Mode			F
	Range	30~3000	Unit	RPM	Default	30	Index	2439h
	Activation	Immediate						

To set the activation speed for which holding brake will be activated.

When SRV-OFF signal is given, motor decelerates, after it reaches below P04.39 and P06.14 is not yet reached, BRK_OFF is given. BRK_OFF signal is determined by P06.14 or if motor speed goes below P04.39, whichever comes first. Application: 1. After disabling axis, P06.14 has been reached but motor speed is still above P04.39, BRK_OFF signal given. 2. After disabling axis, P06.14 has not been reached but motor speed is below P04.39, BRK_OFF signal given.

6.10.5 Emergency stop function

The emergency stop function is used when an alarm occurs or a servo prohibition signal is received when servo driver is enabled.

Method 1: Set up P04.43 to enable the function

P04.43	Name	Emergency stop function			Mode				F
	Range	0~1	Unit	-	Default	0	Index	2443h	
	Activation	Immediate							
	0：Emergency stop is valid, servo driver will be forced to STOP and alarm occurs. 1：Emergency stop is invalid, servo driver will not be forced to STOP.								

P05.04	Name	Driver prohibition input settings			Mode				F
	Range	0~2	Unit	—	Default	0	Index	2504h	
	Activation	Immediate							

To set driver prohibition input (POT/NOT): If set to 1, no effect on homing mode.

Set value	Explanation
0	POT → Positive direction driver prohibited NOT → Negative direction driver prohibited
1	POT and NOT invalid
2	Any single sided input from POT or NOT might cause Er260

In homing mode, POT/NOT invalid, please set object dictionary 5012-04 bit0=1

Method 2: Using 605Ah object dictionary through master device to activate this function.

P05.11	Name	Servo braking torque setting			Mode				F
	Range	0~500	Unit	%	Default	0	Index	2511h	
	Activation	Immediate							
	To set torque limit for servo braking mode. If P05.11 = 0, use torque limit as under normal situation. Between max. torque 6072 and P05.11, actual torque limit will take smaller value.								

6.11 Position comparison

The E-DHASxxE series drives support a position comparison function. Position comparison is achieved by using instantaneous position data in comparison with the preset position in position parameters. When the condition(s) is met, a pulse width configurable DO signal or ABZ/OCZ signal through frequency divider will be delivered. This function is operated in CPLD, without communication delay between processors hence it is suitable for application where high velocity motion is required.

Position comparison		Description
Output trigger	Output	6 DO or frequency divider ABZ/OCZ signal
	Logic	DO output valid as set in P04.10-P04.15
		ABZ/OCZ output valid as set in P05.42
		Output mode：Pulse / Flip
	Pulse width	P0C.02 set pulse width
	Delay compensation	PA5.72 compensate for hardware delay
Comparison source	Motor enclosed	Supported
	Closed loop ABZ encoder	Supported
Comparison value	Points of comparison	42 points
Comparison attribute	Comparison method	Comparison ON/OFF for positive/negative crossover
		Set comparison output

Please assign DO as CMP-OUT or ABZ-signal as position comparison output.

Related parameters

P0C.00	Label	Enable position comparison			Mode		F
	Range	0~1	Unit	%	Default	0	Index 27A4-01
	Activation	Immediate					

Set Value	Description
【0】	Disable
1	Enable （Rising edge）

P0C.01	Label	Position comparison mode			Mode		F
	Range	0~255	Unit	-	Default	0	Index 27A4-02
	Activation	Immediate					

Set value	Description
【0】	Sequential comparison mode
128	Reciprocating comparison mode

Detailed explanations are available in Chapter 6 Application under Position Comparison section

P0C.02	Label	Position comparison pulse output width			Mode						F
	Range	0~4095	Unit	ms	Default	0.1ms		Index		27A4-03	
	Activation	Immediate									
To set output signal pulse width of position comparison											

P0C.03	Label	Position comparison output delay time compensation			Mode						F
	Range	-10000~10000	Unit	0.1μs	Default	0		Index		27A4-04	
	Activation	After restart									
To set delay time compensation for delay due to DO/ frequency divider											

P0C.04	Label	Position comparison starting point			Mode						F
	Range	1~42	Unit	-	Default	1		Index		27A4-05	
	Activation	Immediate									
To set the starting point of position comparison.											

P0C.05	Label	Position comparison end point			Mode						F
	Range	1~42	Unit	-	Default	1		Index		27A4-06	
	Activation	Immediate									
To set the end point of position comparison.											

P0C.06	Label	No. of cycle for N cycles comparison			Mode						F
	Range	1~50000	Unit	-	Default	1		Index		27A4-07	
	Activation	Immediate									
To set the number of cycles for N cycles comparison in position comparison.											

P0C.07	Label	Position comparison – set current position as origin			Mode						F
	Range	0~50000	Unit	-	Default	0		Index		27A4-08	
	Activation	Immediate									

Set Value	Description
【0】	Disable
1	Enable （Rising edge）

Set origin for position comparison, set current position as origin at rising edge.

P0C.08	Label	Position comparison – Offset to origin			Mode			F
	Range	1~50000	Unit	-	Default	0	Index	27A4-09
	Activation	Immediate						
To set offset value of position in comparison to origin set in P0C.07								

To set target position and its attributes for position comparison.

P0C.20 – P0C.61	Label	Position comparison 1-42 target value			Mode			F
	Range	$-2^{31} \sim 2^{31}$	Unit	Command unit	Default	0	Index	27A4-15~ 27A4-3E
	Activation	Immediate						
When the target position(value) is reached, position comparison output will be depended on the position comparison properties value set.								
P0C.70	Label	Position comparison 1 & 2 attributes value			Mode			F
	Range	$-2^{31} \sim 2^{31}-1$	Unit	Command unit	Default	0	Index	27A4-47
	Activation	Immediate						

Bit	Position comparison 1
0	Positive traversal comparison. 0=OFF,1=ON
1	Negative traversal comparison. 0=OFF,1=ON
2~5	Reserved
6	Output property settings： =0：Pulse mode =1：Flipping mode
7	DO1
8	DO2
9	DO3
10~12	Reserved
13	Frequency divider Phase A output
14	Frequency divider Phase B output
15	Frequency divider Phase Z output

Bit	Position comparison 2
16	Positive traversal comparison. 0=OFF,1=ON
17	Negative traversal comparison. 0=OFF,1=ON
18~21	Reserved
22	Output property settings： =0：Pulse mode =1：Flipping mode
23	DO1
24	DO2
25	DO3

	26~28	Reserved	
	29	Frequency divider Phase A output	
	30	Frequency divider Phase B output	
	31	Frequency divider Phase Z output	

Working principle

- Enable position comparison P0C.00
  Position comparison function enabled when P0C.00 is set to 1. Comparison status will be updated as position comparison starting point. When P0C.00 is set to 0, position comparison ends and status clears.

- Sequential Comparison Mode
  In sequential comparison mode, when the end comparison point is compared, the comparison enable is automatically turned off, and the current comparison value is reset to zero. The comparison function is only re-enabled when the comparison enable switch is detected again. Real-time position feedback in sequential comparison mode is absolute. After each comparison point is completed, the real-time position feedback (P0C.10) is linearly accumulated based on the previous comparison point and is not automatically cleared.

- Reciprocating Comparison Mode
  In reciprocating comparison mode, when the end comparison point is compared, the comparison enable is not turned off, and the current comparison value is reset to the starting comparison point. After each comparison point is compared, the real-time position feedback (P0C.10) is cleared and the count is restarted, continuing the reciprocating comparison. In reciprocating comparison mode, the target position is always incremental. After the previous comparison point is compared, the real-time position feedback is automatically reset and the count restarts to compare with the new target point.

- Position comparison output width P0C.02
  When position comparison conditions are met, output can be delivered through DO or frequency divider ABZ/OCZ signal. Signal pulse width can be set in P0C.02. Please make sure the output signal width is less than the travel between 2 target positions.

- Position comparison target position
  42 target positions. Target position value and its corresponding attributes can be set in P0C.20~P03.94.

- Position comparison starting point P0C.04
  Indicates the first comparison point. For example, if P0C.04 is set to 5, position comparison will start from 5th target position.

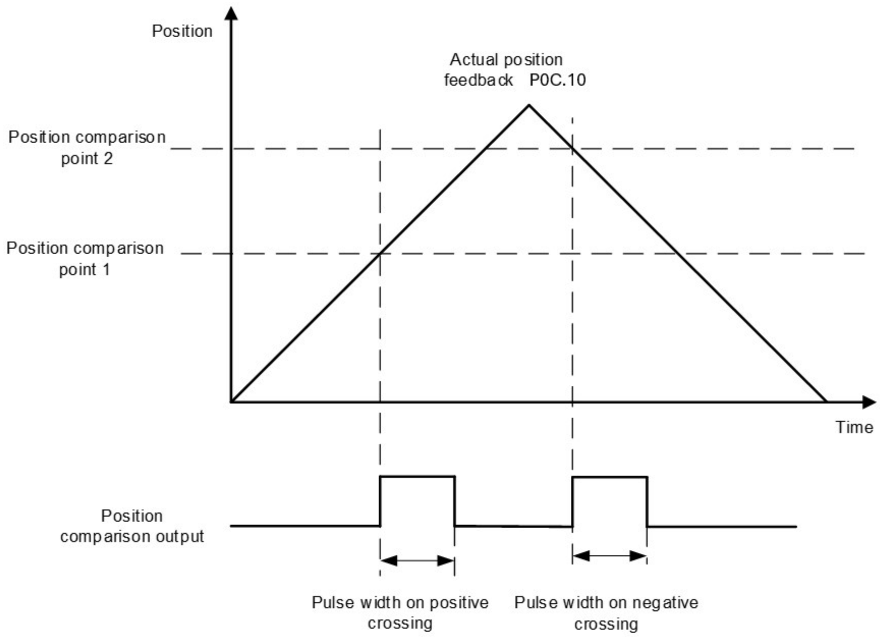
- Position comparison end point P0C.05
  Indicates the last comparison point. For example, if P0C.05 is set to 7, position comparison will stop at 7th target position.
- Position comparison – Offset to origin P0C.08
  When P0C.07 is triggered, P05.80 actual position will automatically be set as P0C.08 offset value.

Applying position comparison

Output pulse width is set in P0C.02. Output pulse will be sent once the position comparison point is crossed and attributes conditions is fulfilled.

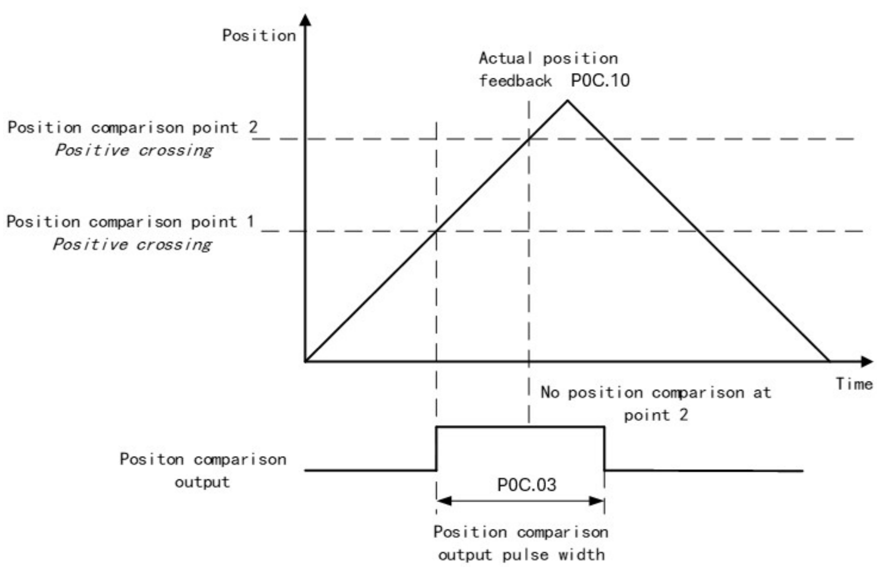
When the attribute of position comparison is set to positive crossing, position feedback becomes larger, position comparison will be enabled; if position feedback becomes smaller, it indicates negative crossing and position comparison will be disabled.

The diagram below shows position comparison point 1 as positive crossing and position comparison point 2 as negative crossing. When position comparison point 2 is positively crossed, position comparison will be disabled.

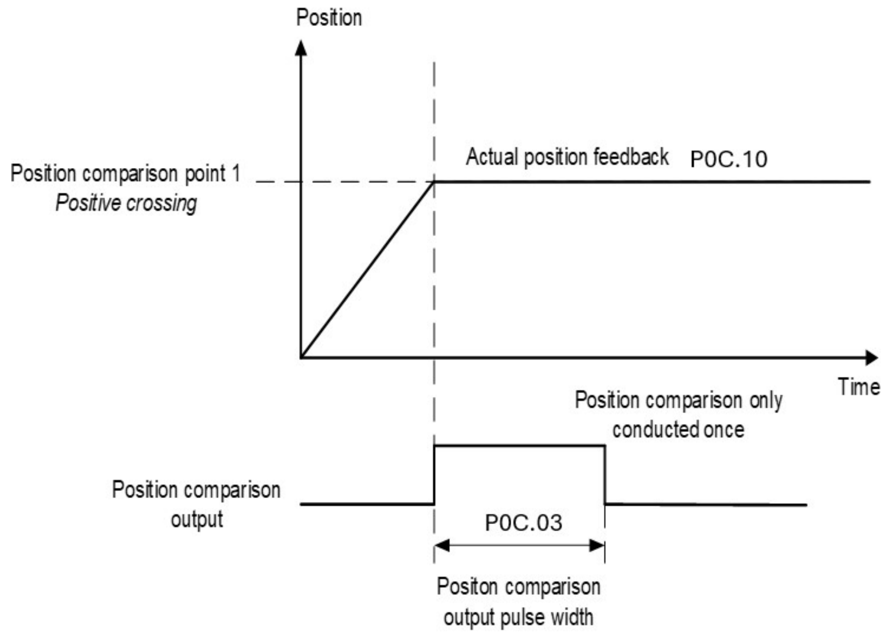


When multiple position comparison points are set, make sure the travel time between 2 comparison points are larger than the output pulse width as position comparison will be temporarily disabled during output.

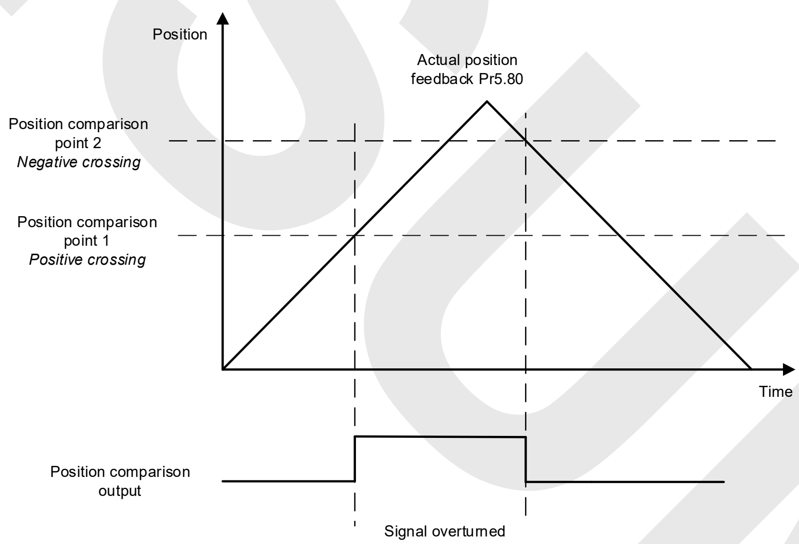
Diagram below shows travel time between 2 points is smaller than output pulse width.



When stopping at position comparison point, there will only be 1 pulse output as with crossing a comparison point.



In overturn mode, output pulse width will be overturned as the position comparison point is crossed.



6.12 Full closed loop control

Full closed loop control utilizes external position sensor (i.e. grading ruler) to get actual position feedback to implement position control. This control can compensate for lead screw tolerance and any changes due to temperature.
Parameters setting needs to make sure a smooth axis motion profile. No overtravel or abnormal noise at stopping.

1. **Set external encoder**
   External encoder type can be set accordingly in P00.31. At the moment, only ABZ incremental encoder is supported.

Parameter	Label	Range	Description
P00.31	External encoder type	0~3	=0：ABZ incremental encoder =1：Communication incremental encoder =2：Communication absolute incremental encoder (Tamagawa protocol) =3：BISS-C

2. **Set direction of external encoder**
   Please make sure the direction of the external encoder is the same as the motor encoder to prevent motor runaway.
   a) Enter position JOG mode. Jog the motor in the same direction at low velocity. Monitor if the feedback value of d21 absolute encoder single turn position and d21_1 external encoder are changing in the same trend. If they are not the same, inverse the setting of P00.32.
   b) The feedback value of d21 and d21_1 can be verified by pushing the axis and monitoring the trend of the changes. Please make sure the servo axis is disabled.
   c) Use trial run to set up a reciprocating motion. Max velocity > 200rpm. If d49 = 1 after several cycles of motion, set P00.32 to 1; d48 External encoder feedback pulse count per revolution.
3. **Set external encoder feedback pulse count**
   When P00.37 = 0, set external encoder feedback pulse count per revolution in P00.36. If the lead size of lead screw and encoder accuracy are known, please calculate using the formula below and enter the result into P00.36.

$$\mathrm{P00.36} = \frac{\text{Lead size of lead screw (mm)}}{\text{Encoder accuracy } (\frac{\mu\mathrm{m}}{\mathrm{pulse}})}$$

23-bit encoder resolution = 8388608 pulses

Please make sure the parameters are set correctly to avoid excessive position deviation especially after long range motion. This may trigger excessive hybrid control deviation error alarm.

Parameter	Label	Range	Description
P00.35	External encoder frequency divider numerator	$0\sim2^{23}$	To set external encoder frequency divider numerator When P00.35 = 0, numerator = resolution of encoder
P00.36	External encoder frequency divider denominator	$1\sim2^{23}$	To set external encoder frequency divider denominator
P00.37	External encoder feedback pulse count per revolution	0~2147483648	When P00.37 = 0, P00.36 set value = external encoder feedback pulse count per revolution.

4. **Set alarm threshold**
   - Excessive hybrid deviation (P00.33)
     To set alarm threshold value for the position deviation between motor actual position and external encoder actual position. Er191 might occur if position deviation exceeds alarm threshold value.
   - Clear hybrid control deviation (P00.34)
     Use to set the condition to clear hybrid control deviation (Only in full closed loop control mode)

Set value	Description
【0】	OFF
1~100	Revolution count to clear hybrid control deviation

5. **Set encoder feedback mode**
   Set P00.30 = 1 to enable external encoder feedback, this is to activate full closed loop control. P00.01 needs to be set to 1 to enable this function. Please restart driver after modifying this parameter.

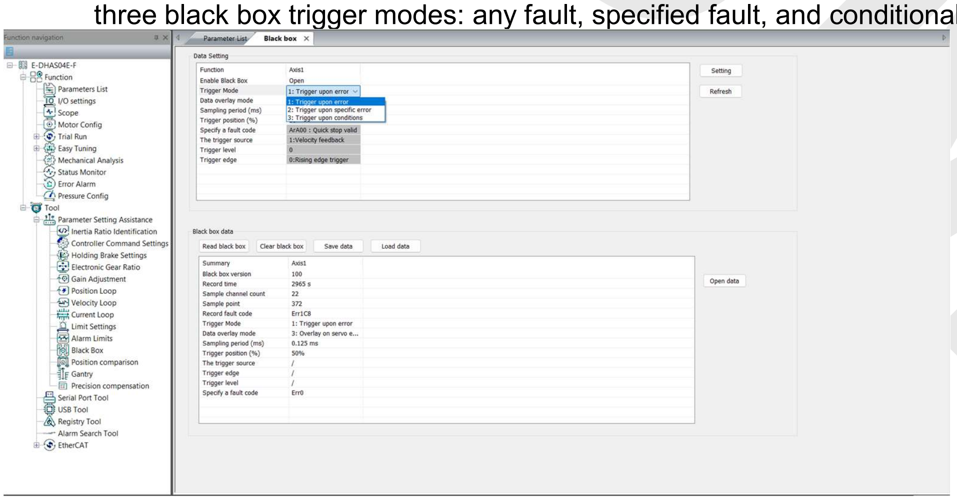
Parameter	Label	Range	Description
P00.30	Encoder feedback mode	0~2	=0：Motor encoder =1：External encoder (Full closed loop control) =2：Reserved

6.13 Black box

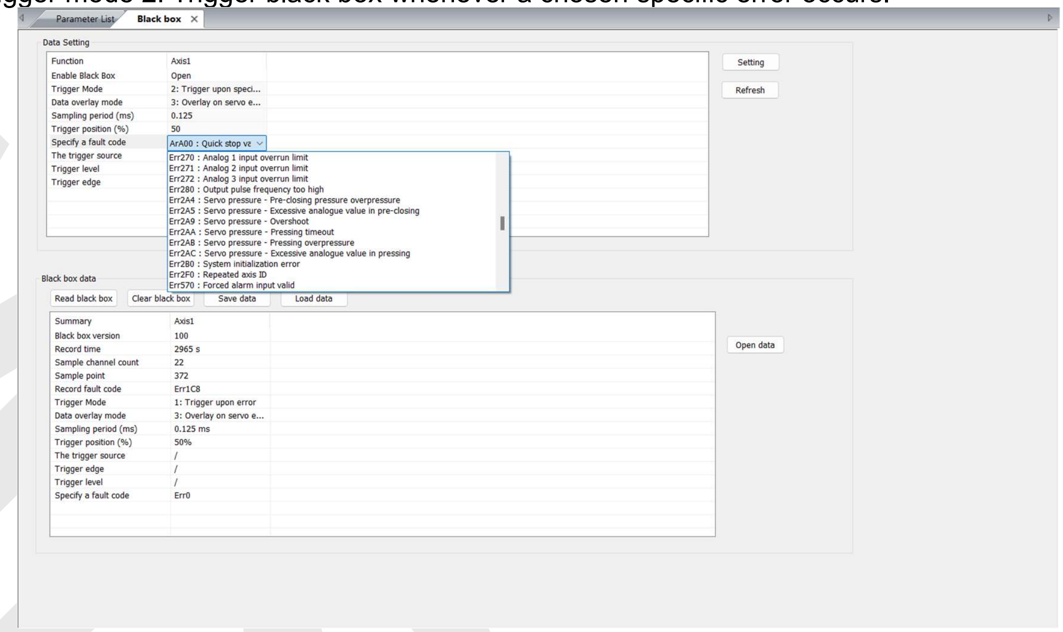
Black box is a function which allows users to set conditions or data to be captured whenever error occurs. The data will be recorded by black box at the moment of error occurrence and automatically saved. Thus, through MISUMI EDrive, users can analyze the cause of the problem with the aid of black box data.
Black box is deactivated by default. It is user configurable to choose whether to overwrite current data or when to overwrite the data in black box.

Setting Up Black Box

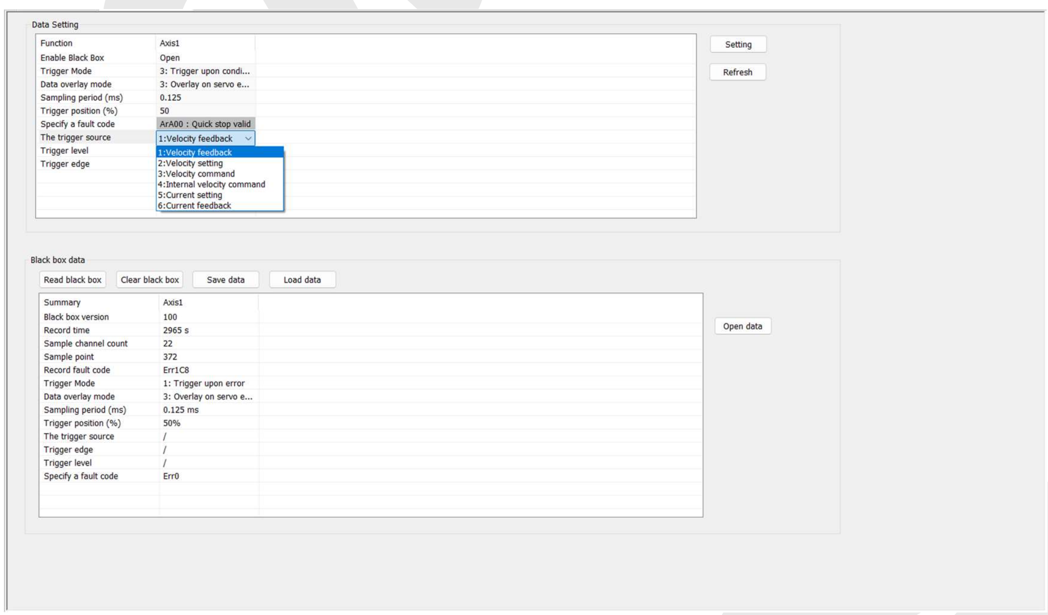
1. Click on “Black Box” in the “Function navigation” to enter Black box setup. There are three black box trigger modes: any fault, specified fault, and conditional trigger.



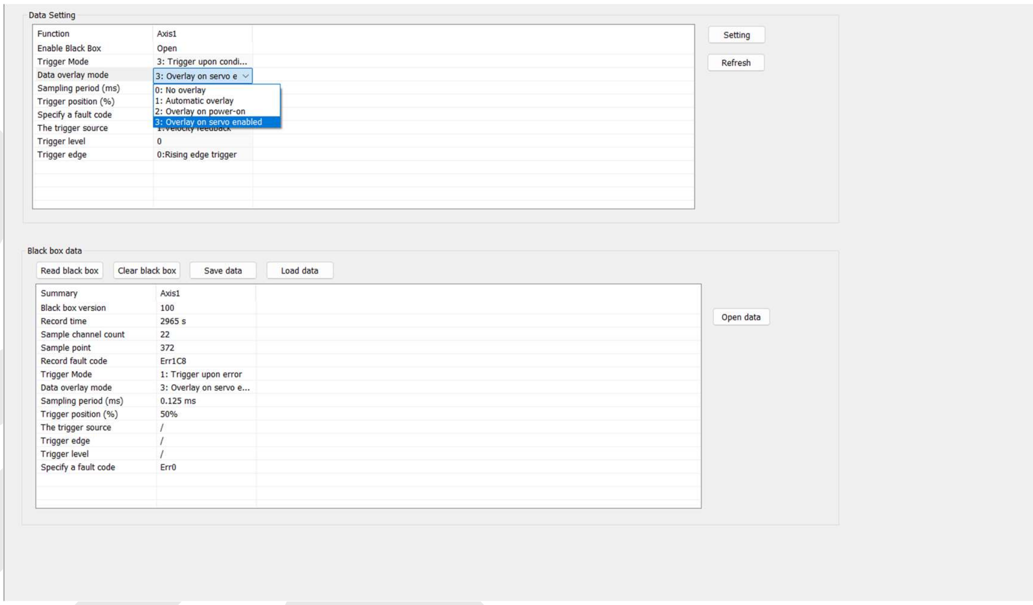
2. Trigger mode 2: Trigger black box whenever a chosen specific error occurs.



3. Trigger mode 3: Conditions for black box functions to be triggered can set. Set the source, level and edge of the trigger as shown below.



4. Data overlay mode: To select how and when black box data is overlaid. 0: Do not overlay data (Black box will only preserve the data of the first trigger). 1: Always overlay (Black box data will be overlaid every time). 2: Overlay upon powered on (Data overlaid occurs when servo driver is powered on) 3: Overlay when enabled (Data overlaid occurs when servo driver is enabled).



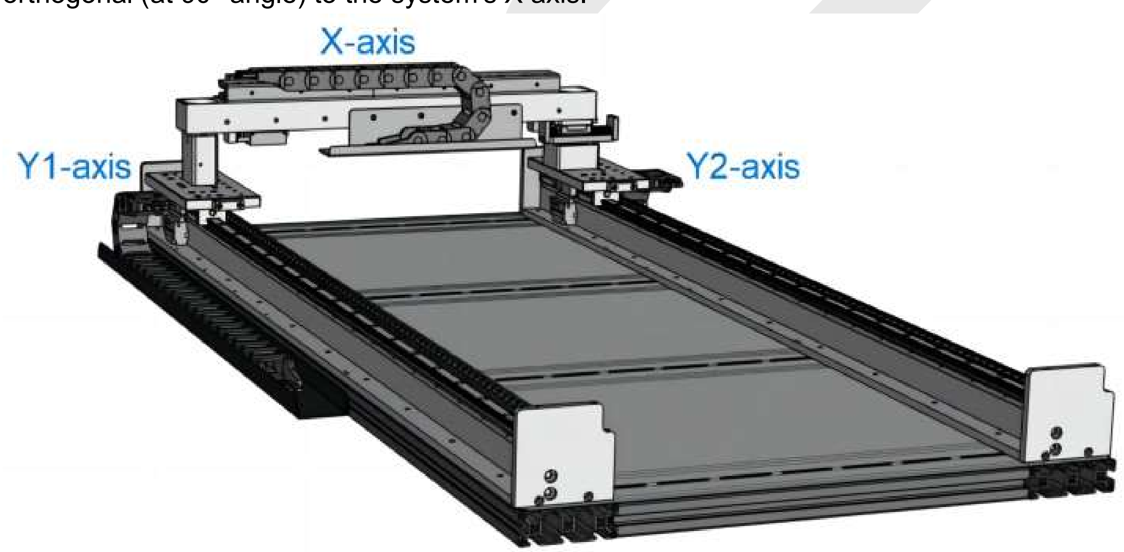
5. Sampling period (ms): The lower the set value, the more precise the samples are but sampling time will be shorter.
6. Trigger position (%): Set the position of trigger within the sampling period.
7. Click on “Setting” to save the settings to driver.

6.14 Gantry Function Application

6.14.1 Function Overview

The gantry function is used to achieve synchronization of two axes. Equipment with a gantry synchronization structure requires dual-side driving of two motors to ensure synchronization. To achieve this, the feedback from both sides is cross-referenced for comparison, ensuring synchronization on both sides.

The gantry system uses two parallel axes (Y1 and Y2) to control a single linear axis, which is orthogonal (at 90° angle) to the system's X axis.



To improve the synchronization of the two axes during operation, a synchronization mode must be used. The gantry synchronization control is entirely completed by the servo driver, while the upper computer only performs simple open-loop position control and logic control.

Gantry Function Purposes:

- Achieve alignment and synchronized tracking of two axes in the equipment. The drive will perform synchronization control independently, without the need for complex upper computer control.
- Issue a warning and stop system operation when the position deviation exceeds the set allowable value.
- Suitable for applications requiring two-axis synchronization, such as semiconductor, welding and cutting equipment, glass processing, and large planers.

6.14.2 Related parameters

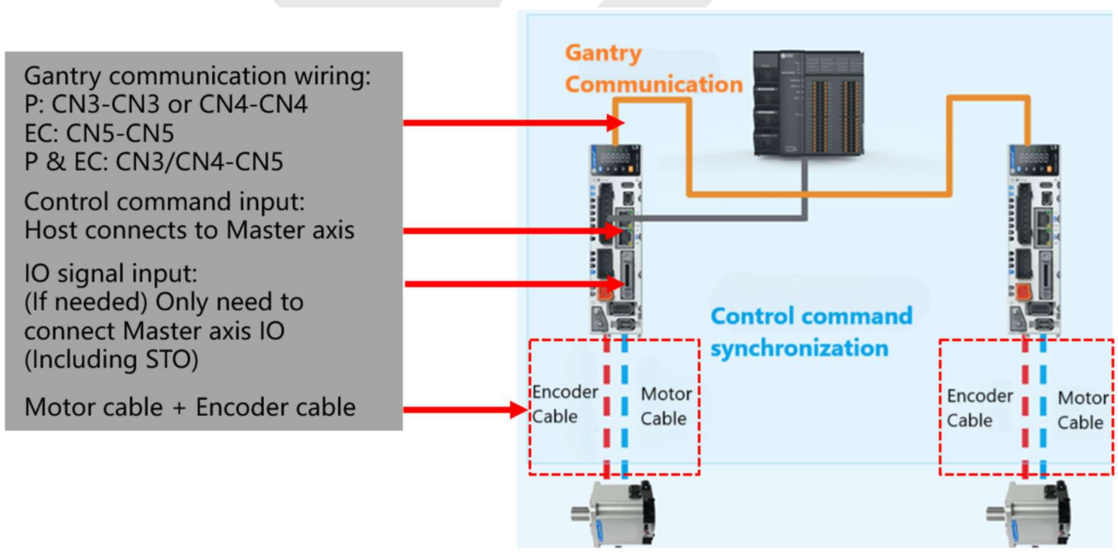
Parameter Number	Label	Description	Activation
Basic Settings			
P00.01	Control Mode Settings	Set control mode	Restart
P00.06	Command pulse input mode settings	Sets the motor's forward rotation direction. When the gantry function is enabled: **Main Axis**: Sets the command pulse input polarity, in conjunction with P00.07. **Slave Axis**: Sets the relationship between the forward rotation direction of the slave axis and the main axis. If set to 0, it is the same as the main axis's forward direction; if set to 1, it is opposite to the main axis's forward direction. **Note**: Incorrect setting of this parameter can cause gantry errors and even damage the mechanical structure!	Restart
Gantry Settings			
P0D.00	Gantry Configuration	Default is 0, which means the gantry function is not enabled. Bit0: Gantry function switch, 0 to disable, 1 to enable. Bit1: Master-slave axis switch, 0 for slave axis, 1 for master axis. Bit2: Synchronization of some parameters of the slave axis with the master axis control: 0 for not synchronization, 1 for synchronization.	Restart
P0D.01	Gantry Slave Axis Command Mode	0: Torque command synchronization 1: Position command synchronization	Re-Enable
P0D.02	Gantry Gain 1	Gantry synchronization feedback compensation gain setting. This is only effective in position command gantry mode. 0: Gain is 0, equivalent to center position feedback, with the smallest torque deviation and the largest position deviation. 100: Default value, gain is 100%, balancing torque and position deviation. 1-100: For rigid gantry, reducing the gain can decrease torque deviation during movement. 100-300: For flexible gantry, increasing the gain can decrease position deviation during movement.	Re-Enable
P0D.03	Gantry position synchronization deviation threshold	Unit: Pulse 0: Disable position synchronization deviation alarm	Immediate

P0D.04	Gantry torque deviation threshold	Unit: 0.1% 0: Disable torque synchronization deviation alarm	Immediate
P0D.05	Gantry Gain 2	This parameter of the synchronous controller suppresses the torque deviation between the two axes. It is only effective in position command synchronization mode. 0: Disable torque deviation suppression. 1-1000: The larger the value, the better the torque deviation suppression effect, but it will lead to a decrease in the speed loop's maximum gain. It is generally enabled in gantries with high mechanical rigidity. If a high speed loop gain is required, this value should not be set too high. It can be used in conjunction with P06.73 to suppress torque deviation.	Immediate
P0D.06	Gantry Position Gain	Set gantry position gain	Immediate
P0D.07	Gantry Velocity Gain	Set gantry velocity gain	Immediate
P0D.08	Gantry Velocity Integral	Set gantry velocity integral	Immediate

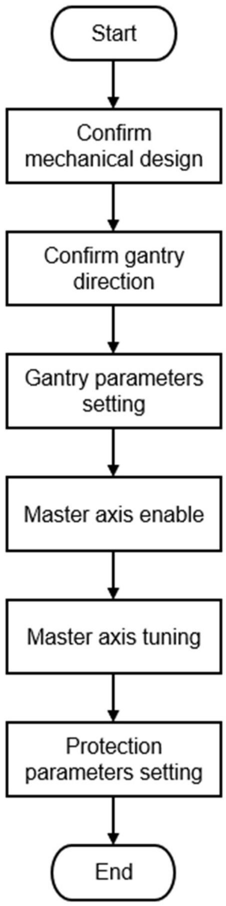
6.14.3 Implementation steps

Wiring

Y1 is gantry master axis, Y2 is gantry slave axis.



Debugging Workflow



Start

Identify whether the system is a rigid gantry or flexible gantry.

Check if the master and slave axes move in the same or opposite direction.

Configure parameters for each axis individually. Save and restart after setting.

Slave axis will follow automatically.

Tune MFC, rigidity, and inertia on the master axis.
Slave axis will auto-sync these settings.

Set based on synchronization position and torque deviation.

After setting, save the two-axis parameters and restart to make them effective.

Debugging Steps

1. Confirm mechanical design

Flexible Gantry: Set slave command mode P0D.01 = 1

Rigid Gantry: Set slave command mode P0D.01 = 0

2. Confirm gantry direction

Method	Description
Manual Push (for small systems)	Connect upper computer to master axis and collect “unfiltered speed feedback”. Push gantry in one direction. Repeat for slave axis. If speed signs match → same direction. If signs differ → opposite direction.
Test Run (for large systems)	Disconnect one axis power cable and disable DB state. Perform jog test run and collect “unfiltered speed feedback”. Repeat for both axes. If speed signs match → same direction. If signs differ → opposite direction.

3. Gantry parameters setting

Configure the master axis and slave axis motor parameters separately.

Function Code	Parameter Name	Master Axis	Slave Axis	Activation
P00.06	Command Pulse Polarity	Based on user's requirement	0: Same 1: Opposite	Restart
P0D.00	Gantry Configuration	3: The slave axis parameters partially synchronize the main axis control bit	1: No sync 5: Partial sync	Restart
P0D.01	Gantry Slave Axis Command Mode	Rigid Gantry: Set to 0 Flexible Gantry: Set to 1	Same as master	Re-enable
P0D.03	Gantry Position Synchronization Deviation Threshold	Default, not too large or zero	Same as master	Immediate
P0D.04	Gantry Torque Deviation Threshold	Default, not too large or zero	Same as master	Immediate

4. Master axis enable
Slave axis will auto-enable after enabling master axis.
5. Master axis tuning
Use trial run mode for synchronized motion. Tuning method same as single-axis.
6. Protection parameters setting
Set P0D.03 and P0D.04 according to the synchronization error and torque deviation during normal operation and control requirements.
Observe the maximum values of the "synchronous position error" and "synchronous torque error" of the oscilloscope channel during normal operation. It is recommended to set them to 2 times the maximum value.

Fault Codes & Monitoring Parameters

Fault Code	Description
Er250	Excessive gantry sync error
Er251	Gantry communication error after master enable
Er252	Slave axis not enabled
Er253	Excessive torque deviation
Er254	Gantry not in position control mode
Er255	Gantry alignment failed
Ar15	Slave not enabled within 2s of master enable
Ar16	Slave axis alarm
Ar17	Slave emergency stop active
Ar18	Slave limit active
Ar19	Slave PWM sync warning
Ar1A	Excessive gantry communication error
Ar1B	Incorrect gantry parameter settings

Monitoring Parameters

Oscilloscope Channel	Description
0x300	Slave feedback speed
0x301	Slave feedback position
0x302	Slave torque
0x303	Slave position error
0x304	Center position
0x305	Sync position error
0x306	Center speed
0x307	Sync torque error
0x308	Sync speed error

6.14.4 Precautions

Common problem solving

1: Motor Oscillation Due to Low Inertia Ratio

Solution: Manually increase inertia ratio

2: Axes Cannot Sync, Overload or Stall Fault

Solution:

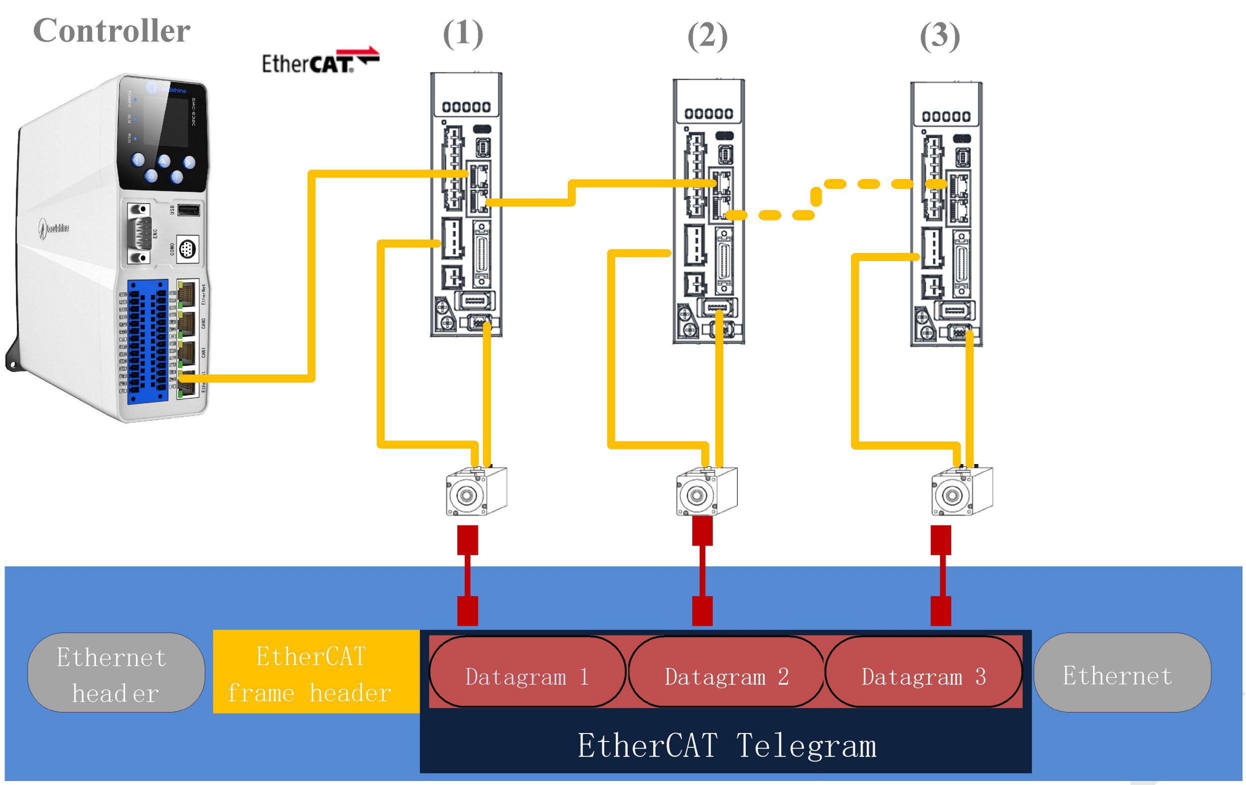
- Check if both axes run in the same direction

If master P00.06 = 1, slave P00.06 must be 0 (Slave inverts received command direction in sync mode)

Chapter 7 EtherCAT communication

7.1 EtherCAT principle function

In comparison to Ethernet protocol which requires huge bandwidth for packets to be moved between master and clients, EtherCAT communication protocol breaks through this systemic limitation of Ethernet which requires every client to receive the whole data package from the master.
The EtherCAT master sends a telegram that passes through each node. Each EtherCAT slave device reads the data addressed to it "on the fly", and inserts its data in the frame as the frame is moving downstream. The frame is delayed only by hardware propagation delay times. The last node in a segment (or drop line) detects an open port and sends the message back to the master using Ethernet technology's full duplex feature.
The telegram's maximum effective data rate increases to over 90 %, and due to the utilization of the full duplex feature, the theoretical effective data rate is even higher than 100 Mbit/s (> 90 % of two times 100 Mbit/s).
The EtherCAT master is the only node within a segment allowed to actively send an EtherCAT frame; all other nodes merely forward frames downstream. This concept prevents unpredictable delays and guarantees real-time capabilities.



EtherCAT in standard Ethernet frame

ID number setting of EtherCAT slave station

To set up EtherCAT slave station ID number, please set P00.24 = 1 and set required ID number to P00.23.

P00.23	Name	EtherCAT slave ID			Mode			F
	Range	0~32767	Unit	—	Default	2	Index	2023h
	Activation	After restart						
	Set ID number of the slave station under EtherCAT mode							
P00.24	Name	Source of slave ID			Mode			F

	Range	0~1	Unit	—	Default	1	Index	2024h
	Activation	After restart						
0: Master device automatically assigns a slave address. 1： The slave ID = P00.23								

7.2 Synchronous Mode

7.2.1 Free Running Mode

In free running mode, The Driver processes the process data sent by the master asynchronously. It only applies to asynchronous motion mode such as homing mode, protocol position mode, etc

7.2.2 Distributed clock synchronization mode

The E-DHASxx E Driver adopts the synchronous mode of distributed clock as shown in figure 6.2. When the master station sends process data to the slave station, the slave station immediately reads the process data, and then waits for the synchronization signal to trigger the process data to act on the driver.
The process data must arrive at the drive before the time of Sync0 signal T1. The E-DHASxx E Driver has completed the analysis of the process data and relevant control calculation before the arrival of Sync0 event. After receiving Sync0 event, E-DHASxx E Driver immediately implements the control action which has a high synchronization performance.

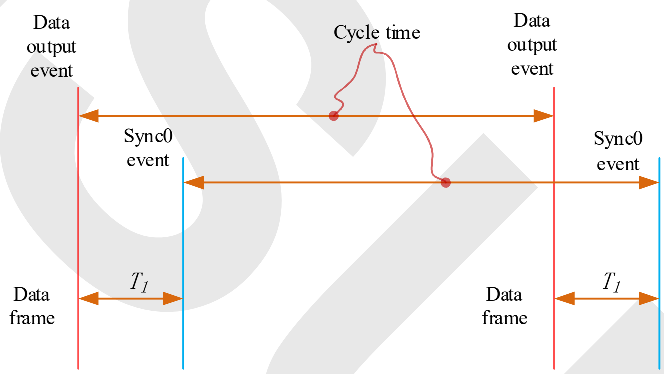


Figure 7.2 High performance synchronization mode

7.3 EtherCAT state machine

EtherCAT state machine, commonly known as "communication state machine ", is mainly used to manage communication between master and slave stations. The communication function mainly includes mailbox and process data communication. The EtherCAT state machine transition relationship is shown in figure 7.3

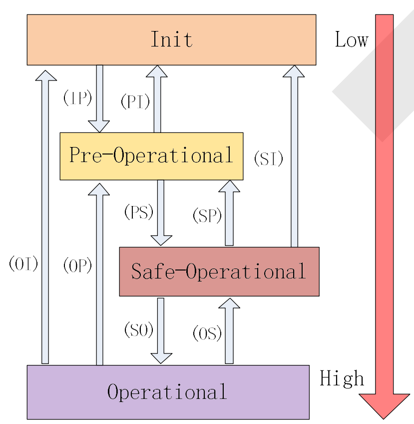


Figure 7.3 EtherCAT state machine transitions

EtherCAT state machine transitions have the following characteristics：

① From initialization to operational, the conversion must be carried out strictly in the order of initializing > pre-operational > safe operational > operational, from low to high, and no grade skipping is allowed
② When converting from high to low, grade skipping is allowed.
③ If state transition request to master station fails, slave station will send an error message to the master station.

EtherCAT 402 State Machine Communication function

State and transition	Communication function
Init	No mailbox or process data communication is possible.
Pre-Operational	Mailbox communication is effective, no process data communication, SDO function is valid
Safe-Operational	Mailbox communication and sending process data object is valid, SDO and TXPDO are valid
Operational	Mailbox communication, receive and send process data object valid, SDO、RXPDO and TXPDO valid

7.4 CANopen over EtherCAT (CoE)

7.4.1 Network structure of E-DHASxx E

The structure of E-DHASxx E Driver system network module is shown in figure 7.4

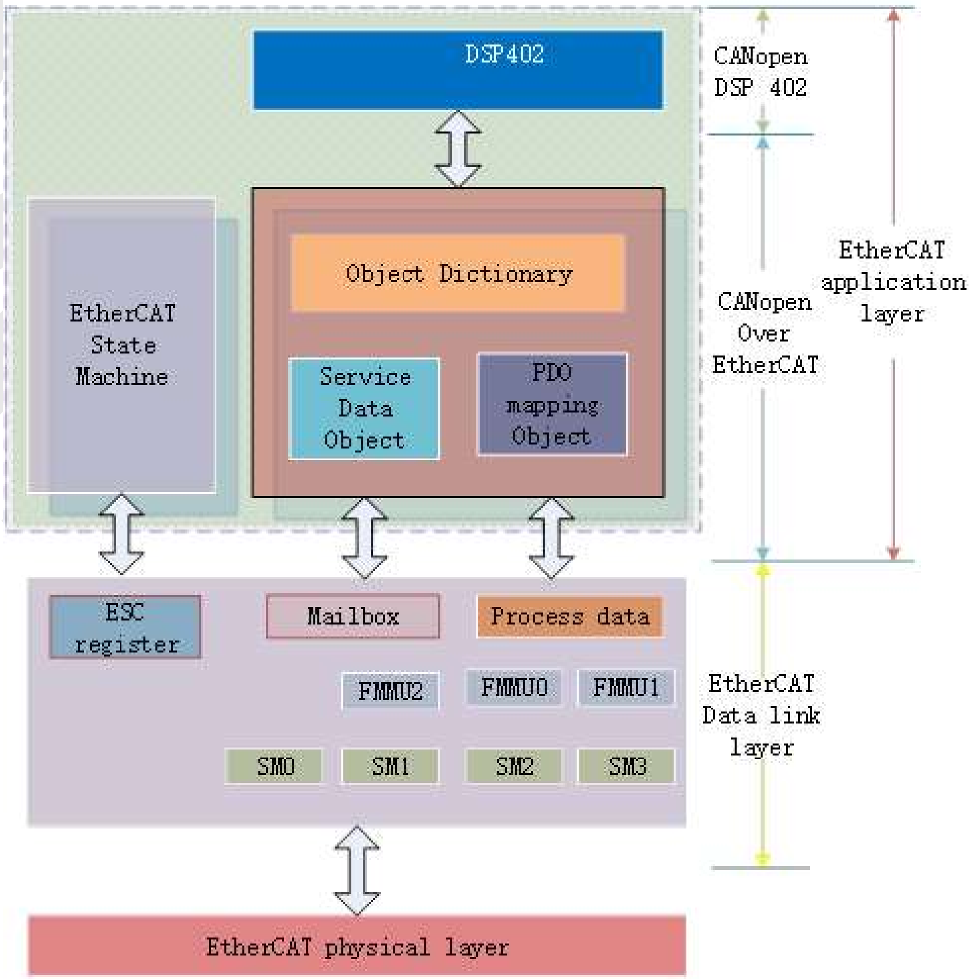


Figure 7.4 Structure of E-DHASxx E network module

The data link layer is mainly implemented by EtherCAT slave station controller (ESC). EtherCAT application layer protocol mainly includes application part (CANopen DSP402), object dictionary and communication function (red frame part), among which object dictionary and communication function can be jointly called CoE part.

Object dictionary——Bridge of communication function and application part.
Communication function——Implementation of communication rules (SDO, PDO, etc.)
Application part——Define the specific function of the device, such as the drive, IO module.

7.4.2 Object dictionary

EtherCAT master controls the E-DHASxx E drive by writing and reading device state /information. To do this, the drive defines read-write parameters and read-only state values. Object dictionary is the collection of these parameters and states.
The E-DHASxx E object dictionary contains all DSP402 and CoE related data objects in a standardized manner. It is a collection of E-DHASxx E parameter data structures.
The E-DHASxx E object dictionary is the interface with which the controller communicates. EtherCAT master implements E-DHASxx E motion control through the interface of object dictionary.

7.4.3 Service Data Object (SDO)

The E-DHASxx E series supports SDO services. EtherCAT master can configure, monitor and control E-DHASxx E servos by using SDO to read and write E-DHASxx E object dictionaries.
In conventional CANopen DS301 mode, SDO protocol CAN only transfer 8 bytes at a time to match the data length of CAN message. In COE enhancement mode, only the payload data is expanded without changing the protocol head; In this way, the SDO protocol uses mailboxes with larger data lengths, thus improving the transmission efficiency of big data.

7.4.4 Process Data Object (PDO)

PDO Introduction

PDO is generally used for real-time data updates. It is divided into receiving PDO (RXPDO) and sending PDO (TXPDO). The data stream direction of receiving PDO is from master station to slave station, while sending PDO is from slave station to master station
The PDO function of E-DHASxx E supports both synchronous cycle mode and non-periodic update mode. When distributed clock synchronization mode is selected on master station, PDO will update according to the synchronization cycle. If free moving mode is selected, PDO data updates aperiodic.

PDO mapping

Through PDO mapping, the real-time transmission of mapped objects can be realized.
E-DHASxx E supports simultaneous transmission of 2 sets of RXPDO and 2 sets of TXPDO. Each PDO object can map up to 8 object dictionary (maximum length 32 bytes). The format of PDO mapping content is shown in table 7.2

Table 7.2 Format of PDO mapping

Bit	31~16	15~8	7~0
Description	Index of mapped object	Subindex of mapped object	Bit length (Hex)
Example	6040h	00h	10h(16bit)

Default PDO mapping (consistent with the XML file) is shown in table 7.3

Table 7.3 Default PDO mapping

PDO Map object index	**PDO Map object Sub-index**	**Mapping content**	**Mapped Object**			**Description**
			Index	**Sub-index**	**Bit length**	
RXPDO1 (1600h)	01h	60400010h		00h	10h(16 bit)	01h
	02h	607A0020h		00h	10h(16 bit)	02h
	03h	60B80020h		00h		03h
RXPDO2 (1601h)	01h	60400010h	6040h	00h	10h(16 bit)	Control word
	02h	60FF0020h	60FFh	00h	20h(32 bit)	Target velocity
	03h	60B20010h	60B2h	00h	10h(16 bit)	Torque feedforward
RXPDO3 (1602h)	01h	60400010h	6040h	00h	10h(16 bit)	Control word
	02h	60710010h	6071h	00h	10h(16 bit)	Target torque
	03h	60870020h	6084h	00h	20h(32 bit)	Profile deceleration
RXPDO4 (1603h)	01h	60400010h	6040h	00h	10h(16 bit)	Control word
	02h	60980008h	6098h	00h	08h(8 bit)	Homing method

	03h	60990120h	6099h	01h	20h(32 bit)	High homing velocity
	04h	60990220h	6099h	02h	20h(32 bit)	Low homing velocity
	05h	609A0020h	609Ah	00h	20h(32 bit)	Homing acceleration
	06h	607C0020h	607Ch	00h	20h(32 bit)	Homing position offset
	07h	60600008h	6060h	00h	08h(8 bit)	Operation mode
TXPDO1 (1A00h)	01h	603F0000h				
	02h	60410000h				
	03h	60610000h				
	04h	60640000h				
	05h	60B90020h				
	06h	60BA0020h				
	07h	60FD0020h				
TXPDO2 (1A01h)	No default mapping					

PDO dynamic mapping

Different from CIA DS301, CoE uses PDO specified objects (1C12h/1C13h) to configure PDO mapped objects (1600h~1603h/1A00h~1A01h) to PDO SyncManager (SyncManager 2/3). PDO specified objects are defined in table 7.4

Table 7.4 PDO specifies object definitions

Index	Sub-index	Range	Data type	Access
RXPDO (1C12h)	00h	0~4	U8*1)	RO *2)
	01h	1600h~1603h	U16	RW
	02h		U16	RW
	03h		U16	RW
	04h		U16	RW
TXPDO (1C13h)	00h	0~2	U8	RO
	01h	1A00h~1A01h	U16	RW
	02h		U16	RW

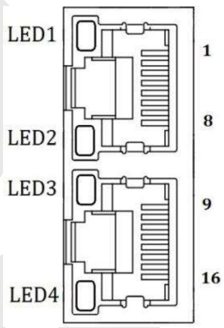
*** 1) U represents unsigned type, such as U8 for unsigned 8 bits and U16 for unsigned 16 bits*
2) Access: RO = Read Only, RW = Read and Write, WO = Write Only

PDO dynamic mapping setup procedure

1) Switch EtherCAT state machine to pre-operational, then PDO map can be configured using SDO.
2) Clear the PDO mapping object of the PDO specified object by setting 1C12-00h / 1C13-00h to 0.
3) Invalidate the PDO mapping object by assigning 0 to the subindex 0 of 1600h~1603h /1A00h~1A01h.
4) Reconfigure PDO mapping content and write the mapping object into the objects in the range of 1600-01h~1600-08h, 1601-01h~1601-08h, 1602-01h~1602-08h, 03-01h~1603-08h (RXPDO mapping content as from 1600h-01), 00-01h ~ 1A00-08h or 1A01-01h~1A01-08h (TXPDO mapping content as from 1A00h-01) according to Table 6.3
5) Set the total number of PDO mapping objects by writing the number of mapping objects into 1600-00h, 1601-00h, 1602-00h, 1603-00h, 1A00-00h or 1A01-00h. The total number of PDO mapping objects without mapping content will be set to 0.
6) Write valid PDO mapping object index to PDO specified object by writing valid RXPDO mapping object index 1600h~1603h into 1C12-01h ~ 1C12-04h and writing valid TXPDO mapping object index 1A00h, 1A01h into 1C13-01h, 1C13-02h.
7) Set the total number PDO specified objects by writing the number of mapped objects to 1C12-00h and 1C13-00h.
8) Switch EtherCAT state to Safe-Operational or above, the configured PDO mapping will be valid.

7.5 Network status display

The network connection status is determined by the LED light on CN3 and CN4 port.



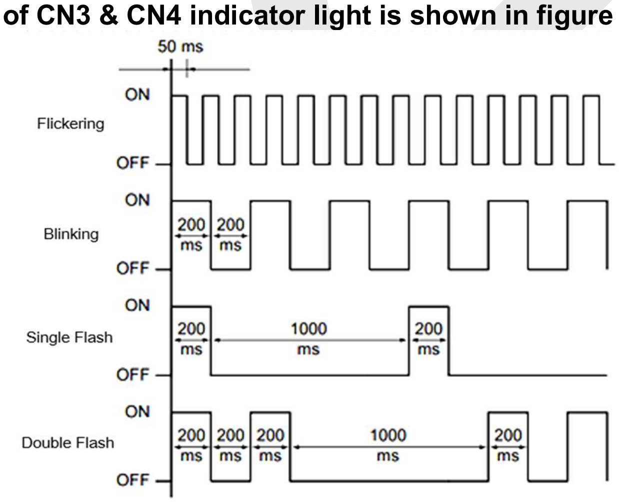
①LED1: Link/Activity IN status，Green.
②LED3: Link/Activity OUT status，Green.
③LED2: RUN status，Green. EtherCAT state machine.
④LED4: ERR statue，Red.

Figure 7.6 CN3 and CN4 port

Table 7.5 LED Indicator

Label	Color	Status	Description
RUN	Green	（OFF）	Init
		(Blinking)	Pre-Operational
		(Single flash)	Safe-Operational
		(ON)	Operational
ERR	Red	(OFF)	*Refer to chapter 4.3 for more details*
		(Blinking)	
		(Single flash)	
		(Double flash)	
		(Flickering)	
		(ON)	
L/A IN	Green	(OFF)	Physical layer link not established
		(ON)	Physical layer link established
		(Flickering)	Interactive data after link established
L/A OUT	Green	(OFF)	Physical layer link not established
		(ON)	Physical layer link established
		(Flickering)	Interactive data after link established

Status description of CN3 & CN4 indicator light is shown in figure 7.7



Chapter 8 Control Mode

8.1 E-DHASxxE Series Servo System Motion Control Instructions

1. EtherCAT master device sends "control word (6040h)" to initialize the drive.
2. Driver sends feedback "status word (6041h)" to the master device to indicate ready status (status word indication).
3. Master device sends enable command (control word switch).
4. The driver enables and sends feedback status to the master device.
5. The master station sends homing command to home the axis. (Homing parameter and control word switch)
6. Driver returns home and sends feedback home status to master device (status word indication)
7. The master station sends the position mode command for position movement (position motion parameters and control word switch) or sends the velocity command for velocity movement (velocity motion parameters and control word switch).
8. When the drive is finished executing the command (position command), E-DHASxxE feedback the position/velocity to the master device for monitoring during the motion.
9. The master device sends commands for the next motion.

8.2 CIA402 State Machine

The servo driver must be guided according to the process specified in the 402 protocol so that the servo driver can operate in the specified state.

State machine switchover diagram

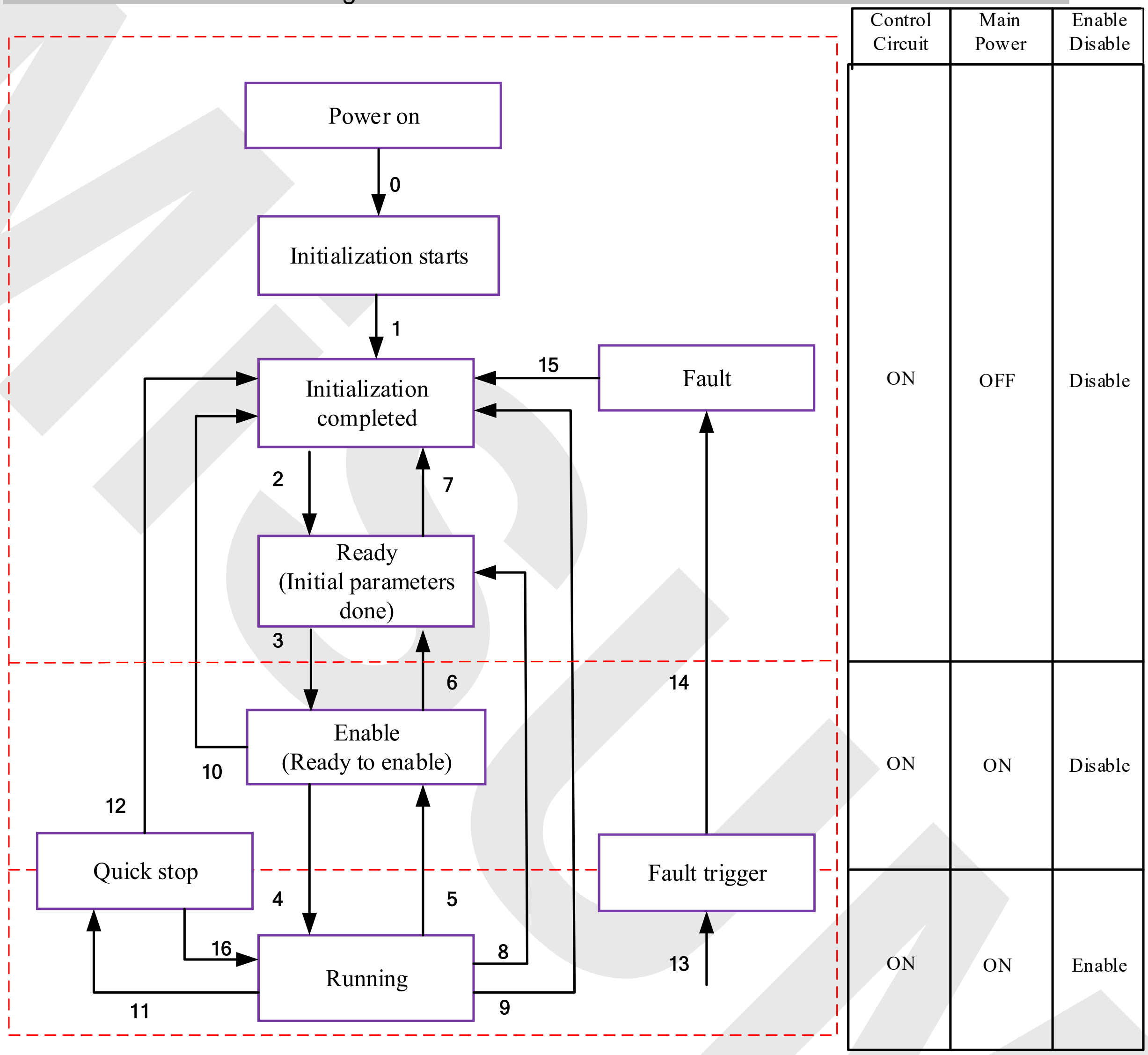


Figure 8.1 E-DHASxxE 402 State Machine switchover diagram

Table 8.1 Status description

Status	Description
Initialization starts	Driver powered on, initialization starts; Holding brake activated; Axis disabled
Initialization done	Initialization done; Parameters initialize, faultless; Axis disabled.
Ready	Parameter initialization done; Axis disabled.
Enable	Servo driver is ready to be enabled.
Running	Driver enabled, faultless
Quick stop	Quick stop activated
Fault triggered	Alarm not solved yet; Axis disabled.
Fault	Alarm solved. Waiting to switch from 402 state machine to Initialization starts; Axis disabled.

402 state machine switching is dependent on master device-controlled servo driver control word (6040h)

CiA402 status switching		Control word 6040h	Status word 6041h Bit1-Bit9
0	Power on -> Initialization	Transit automatically	0x0000
1	Initialization -> Faultless	Transit automatically, Enter 13 if fault occurs	0x0250
2	Faultless -> Ready	0x0006	0x0231
3	Servo ready--> Waiting to enable	0x0007	0x0233
4	Waiting to enable -> Running	0x000F	0x0237
5	Running -> Waiting to enable	0x0007	0x0233
6	Waiting to enable -> Ready	0x0006	0x0231
7	Ready -> Faultless	0x0000	0x0250
8	Running -> Ready	0x0006	0x0231
9	Running -> Faultless	0x0000	0x0250
10	Waiting to enable -> Faultless	0x0000	0x0250
11	Running -> Quick stop	0x0002	0x0217
12	Quick stop -> Faultless	Transit automatically	0x0250
13	Fault stop -> Fault	Transit automatically	0x021F
14	Fault stop -> Fault	Transit automatically	0x0218
15	Fault -> Faultless	0x80	0x0250
16	Quick stop -> Running	0x0F	0x0237

8.3 Driver Control Mode Setting

8.3.1 Supported control mode (6502h)

E-DHASxxE supports seven modes, as defined in 6502h.

Bit	31~10	9	8	7	6	5	4	3	2	1	0
Mode	Reserved	CST	CSV	CSP	Reserved	HM	Reserved	PT	PV	Reserved	PP
1:Supported	0	1	1	1	0	1	0	1	1	0	1

Description	Abbr.
Profile position mode	PP
Profile velocity mode	PV
Profile Torque mode	PT
Homing mode	HM
Cyclic synchronous position mode	CSP
Cyclic synchronous velocity mode	CSV
Cyclic synchronous torque mode	CST

8.3.2 Operational mode setting (6060h) and Operational mode display (6061h)

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

Bit	Description	Abbr.
1	Profile position mode	PP
3	Profile velocity mode	PV
4	Profile Torque mode	PT
6	Homing mode	HM
8	Cyclic synchronous position mode	CSP
9	Cyclic synchronous velocity mode	CSV
10	Cyclic synchronous torque mode	CST

8.4 Common Functions for All Modes

8.4.1 Digital input/ output setting and status display

Please refer to chapter 5 for more details on digital I/O input and polarity settings.60FDh object complies with IEC61800-200 standard input I/O status mapping object. 60FDh is set according to function as the table below shows.

Bit31	**Bit30**	**Bit29**	**Bit28**	**Bit27**	**Bit26**	**Bit25**	**Bit24**
Z signal	Reserved	Reserved	Reserved	Touch Probe 2	Touch Probe 1	BRAKE	INP/V-COIN /TLC
Bit23	**Bit22**	**Bit21**	**Bit20**	**Bit19**	**Bit18**	**Bit17**	**Bit16**
E-STOP	Reserved	Reserved	Reserved	Reserved	Reserved	DI14	DI13
Bit15	**Bit14**	**Bit13**	**Bit12**	**Bit11**	**Bit10**	**Bit9**	**Bit8**
DI12	DI11	DI10	DI9	DI8	DI7	DI6	DI5
Bit7	**Bit6**	**Bit5**	**Bit4**	**Bit3**	**Bit2**	**Bit1**	**Bit0**
DI4	DI3	DI2	DI1	Reserved	HOME	POT	NOT

In addition to the internal operation of the servo system, E-DHASxxE also provides a function for the master device to operate digital I/O output of the servo driver.
If I/O output function is set up as master device control, master device can control servo driver digital I/O output through 60FEh object

Bit / Sub-index	31~21	21	20	19	18	17	16	15~0
01h	Reserved	DO6 valid	DO5 valid	DO4 valid	DO3 valid	DO2 valid	DO1 valid	Reserved
02h		DO6 enabled	DO5 enabled	DO4 enabled	DO3 enabled	DO2 enabled	DO1 enabled	

8.4.2 Motor Rotational Direction

Rotational direction is defined in 607Eh.

Mode		Set value
Position Mode	PP / HM / CSP	0：Rotate in the same direction as the position command 128：Rotate in the opposite direction to the position command
Velocity Mode	PV / CSV	0：Rotate in the same direction as the position command 64：Rotate in the opposite direction to the position command
Torque Mode	PT / CST	0：Rotate in the same direction as the position command 32：Rotate in the opposite direction to the position command
ALL Modes		0：Rotate in the same direction as the position command 224：Rotate in the opposite direction to the position command

8.4.3 Stop Settings

E-DHASxxE provides quick stop function. Stopping is different under different modes. Controlled by using object dictionary 605A.

Index 605Ah	**Name**	Quick stop option code		**Unit**	-	**Structure**	VAR	**Type**	INT 16
	Access	RW	**Mapping**	-	**Mode**	ALL	**Range**	0~7	**Default**	2

Motor stops when quick stop command is given.

PP, CSP, CSV, PV
0 : To stop motor through P05.06. Status: Switch on disable, axis disabled.
1 : Motor decelerates and stops through 6084h. Status: Switch on disable, axis disabled.
2 : Motor decelerates and stops through 6085h. Status: Switch on disable, axis disabled.
3 : Motor decelerates and stops through 60C6h. Status: Switch on disable, axis disabled.
5 : Motor decelerates and stops through 6084h. Status: Quick stop

6 : Motor decelerates and stops through 6085h. Status: Quick stop 7 : Motor decelerates and stops through 60C6h. Status: Quick stop HM 0 : To stop motor through P05.06. Status: Switch on disable, axis disabled. 1 : Motor decelerates and stops through 609Ah. Status: Switch on disable, axis disabled. 2 : Motor decelerates and stops through 6085h. Status: Switch on disable, axis disabled. 3 : Motor decelerates and stops through 60C6h. Status: Switch on disable, axis disabled. 5 : Motor decelerates and stops through 609Ah. Status: Quick stop 6 : Motor decelerates and stops through 6085h. Status: Quick stop 7 : Motor decelerates and stops through 60C6h. Status: Quick stop CST 0 : To stop motor through P05.06. Status: Switch on disable, axis disabled. 1, 2: Motor decelerates and stops through 6087h. Status: Switch on disable, axis disabled. 3 : Motor decelerates and stops through torque = 0. Status: Switch on disable, axis disabled. 5, 6: Motor decelerates and stops through 6087h. Status: Quick stop 7 : Motor decelerates and stops through torque = 0. Status: Quick stop

When 402 state machine is disabled, the motor will stop freely.
When bit8(Halt) of 6040h is 1, the motor will stop with deceleration set in 6083h/6084h.

8.4.4 Position mode – Electronic Gear

E-DHASxxE position mode consists of cyclic synchronous position mode (CSP), protocol position mode (PP) and homing mode (HM), only in these three modes is the electronic gear valid.
Electronic gear ratio range is 0.001~8000(23-bit encoder), otherwise ErA00 might occur if over range (the warning is not saved, after modification to a reasonable range, alarm on operational panel will automatically disappear, but the 402 state will still be in the "error" state, write 0x80 into 6040h).

Method 1:
Electronic gear ratio setting is defined by 608Fh (Position encoder resolution). 6091h (Gear ratio), 6092h (Feed constant) to change the motor position. Only valid under pre-operational mode.
608Fh (Position encoder resolution) is the resolution of the encoder, which is read internally without additional setting. 6092h_01 represents the number of pulses that can be set for each revolution of the motor. 6091h_01/6091h_02 is real-time update effective.

Electronic gear subdivision method can be determined by modifying 6092h_01 (Feed constant)
1. If 6092h_01 (Feed constant) is not equal to 608Fh (Position Encoder resolution), then:

Electronic gear ratio = encoder resolution / 6092h_01

2. If 6092h_01(Feed constant) is equal to 608Fh(Position encoder resolution), then:

Electronic gear ratio = 6091_01/6092h_01

Electronic gear ratio range is 0.001~8000(23 bit encoder), 0.001~125(17 bit encoder)

Command pulse count per motor revolution needs to be ≥ Encoder Pulse Count per Revolution / 8000.

Method 2:
Electronic gear can be set through P00.08. If P00.08 ≠ 0, P00.08 is valid. If P00.08 = 0, object dictionary 6092-01 is valid.

Note: *when the setting value exceeds this range, the error will be reported and automatically reset to the default value. The default values of 6091_01, 6091_02 and 6092_01 are 1, 1 and 10000.*

8.4.5 Position Limits

The hardware limit is valid in all operational modes, and the software limit is valid only in the absolute operational mode of cyclic synchronous position mode (CSP) and profile position mode (PP)
The limit of the software is defined by 607Dh. The maximum position in the negative direction is defined in 607d-01h and the maximum position in the positive direction is defined in 607d-02h, the unit is consistent with the command unit.
The setting of object dictionary 0x5012-04 not only affects the homing offset of 607C, but also affects the software limit, 607D needs to be modified before the operational state.

5012-04		Actual Positive Position Limit	Actual Negative Position Limit
Bit2	**Bit3**		
0	0	607D-02 + 607C	607D-01 + 607C
0	1	607D-02 - 607C	607D-01 - 607C
1	X	607D-02	607D-01

E-DHASxxE Software position limits valid conditions:
1. It can only be set in the pre-operational state of ESM. It is recommended to configure it by SDO when the system starts.
2. Only in the absolute mode of CSP and PP, in CSP mode, it is recommended to use the software limit function of the master station to achieve the fastest performance limit.
3. The incremental encoder motor is not effective until the homing process is completed.
4. The setting rule is 607d-01h < 607d-02h, that is, the negative position limit value is less than the positive position limit value.

8.4.6 CiA DSP402 Control Word

Bit definition of Control Word 6040h.

Bit	15~11	10~9	8	7	6~4	3	2	1	0
Definition	-	-	Halt	Fault reset	Related to modes	Operation enable	Quick stop	Voltage output	Switch on

Command	Bit7 and Bit0 to Bit3					6040 Value	402 State machine *1)
	7：Fault reset	3：Operation enable	2：Quick stop	1：Voltage output	0：Start		
Power off	0	×	1	1	0	0006h	2;6;8
Switch on	0	0	1	1	1	0007h	3*
Switch on	0	1	1	1	1	000Fh	3**
No voltage output	0	×	×	0	×	0000h	7;9;10;12
Quick stop	0	×	0	1	×	0002h	7;10;11
Operation enable	0	0	1	1	1	0007h	5
enable	0	1	1	1	1	000Fh	4;16
Fault reset	Rising edge	×	×	×	×	0080h	15

× is not affected by this bit state
* indicates that this transition is performed in the device start state
** indicates that it has no effect on the start state and remains in the start state
*1) The state machine switch corresponds to figure 7.1
Definition of bit 8 and bit 6~4 in different operation modes are shown in the following table

Bit	Operation Mode						
	Profile Position (PP)	Profile Velocity (PV)	Profile Torque (PT)	Homing (HM)	Cyclic Sync Position (CSP)	Cyclic Sync Velocity (CSV)	Cyclic Sync Torque (CST)
8	Stop with deceleration	Stop with deceleration	Stop with deceleration	Stop with deceleration	-	-	-
6	Absolute/ Increment	-	-	-	-	-	-
5	Immediately trigger	-	-	-	-	-	-
4	New Position	-	-	Start	-	-	-

8.4.7 Status Word

Bit definition of Status Word 6041h.

Bit	Definition
15~14	Reserved
13~12	Related to modes
11	Position limit valid
10	Position arrival
9	Distance
8	Related to modes
7	Reserved
6	Not switch on

5	Quick stop
4	Voltage output
3	Fault
2	Operation enable
1	Switch on
0	Ready to switch on

Bit 11 is valid when the software or hardware limit is in effect.
The combination of bit 6 and bit 3~0 represents the device state shown in following table

Combination of bit 6 and bit 3~0	Description
××××,××××,×0××,0000	Not ready to switch on
××××,××××,×1××,0000	Switch on disabled
××××,××××,×01×,0001	Ready to switch on
××××,××××,×01×,0011	Switch on
××××,××××,×01×,0111	Operation enabled
××××,××××,×00×,0111	Quick stop active
××××,××××,×0××,1111	Fault reaction active
××××,××××,×0××,1000	Fault

× is not affected by this bit state
Definition of bit 8 and bit 13~12 in different operation modes are shown in the following table

Bit	Operation Mode						
	Profile Position (PP)	Profile Velocity (PV)	Profile Torque (PT)	Homing (HM)	Cyclic Sync Position (CSP)	Cyclic Sync Velocity (CSV)	Cyclic Sync Torque (CST)
13	Position error is too large	-	-	Homing Process error	-	-	-
12	-	Velocity is 0	-	Homing Process completed	Following valid	Following valid	Following valid
8	Abnormal stop	-	-	Abnormal stop	Abnormal stop	-	-

8.4.8 Synchronous cycle time setting

The default synchronous cycle time range of E-DHASxxE series is 250us – 10ms. Min value: 125us; Max value: 20ms. Please make sure the values set is the multiplier of 250us.
8.4.9 Driver Enabling

This section describes how to use control words 6040h/ status word 6041h command switching/status determination for E-DHASxxE controlled motor.
Steps:
1：Write 0 to the control word 6040h, and then AND 0x250 by bit, whether it is equal to 0x250
2：Write 6 to the control word 6040h, and then AND 0x231 by bit, whether it is equal to 0x231
3：Write 7 to the control word 6040h, and then AND 0x233 by bit, whether it is equal to 0x233
4：Write 15 to the control word 6040h, and then AND 0x237 by bit, whether it is equal to 0x237

8.5 Position Mode（CSP、PP、HM）

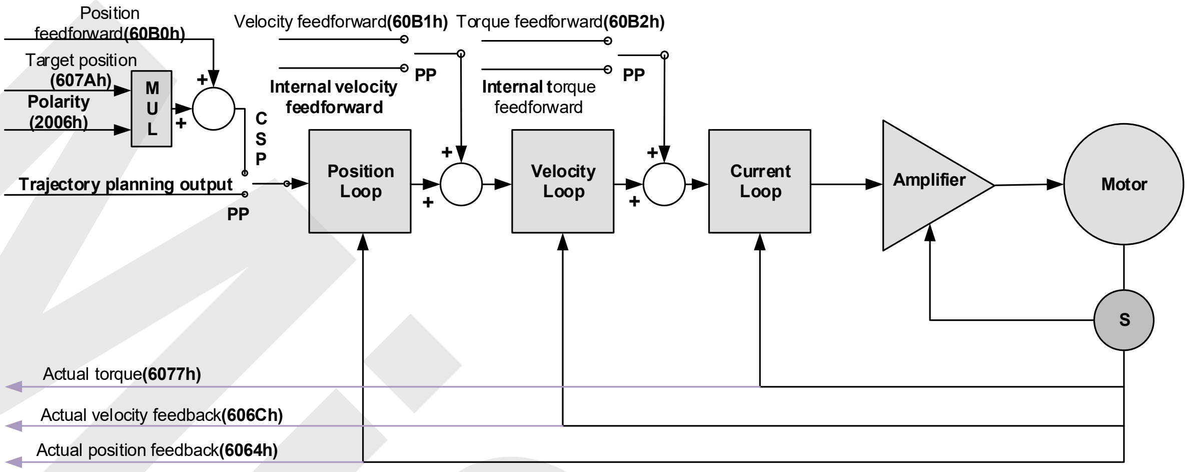
8.5.1 Common Functions of Position Mode

Index	Sub-Index	Label	Access	PDO	Mode		
					PP	CSP	HM
6040	0	Control word	RW	RxPDO	Yes	Yes	Yes
6072	0	Max torque	RW	RxPDO	Yes	Yes	Yes
607A	0	Target position	RW	RxPDO	Yes	Yes	/
607D	1	Min. software limit	RW	RxPDO	Yes	Yes	/
	2	Max. software limit	RW	RxPDO	Yes	Yes	/
607F	0	Maximum protocol velocity	RW	RxPDO	Yes	/	Yes
6080	0	Maximum motor velocity	RW	RxPDO	Yes	Yes	Yes
6081	0	Profile velocity	RW	RxPDO	Yes	/	/
6083	0	Profile acceleration	RW	RxPDO	Yes	/	/
6084	0	Profile deceleration	RW	RxPDO	Yes	/	/
60C5	0	Protocol maximum acceleration	RW	RxPDO	Yes	/	Yes
60C6	0	Protocol maximum deceleration	RW	RxPDO	Yes	/	Yes

Index	Sub-Index	Label	Access	PDO	Mode		
					PP	CSP	HM
6041	0	Status word	RO	TxPDO	Yes	Yes	Yes
6062	0	Position command	RO	TxPDO	Yes	Yes	Yes
6063	0	Actual internal position	RO	TxPDO	Yes	Yes	Yes
6064	0	Actual position feedback	RO	TxPDO	Yes	Yes	Yes
6065	0	Position deviation window	RW	RxPDO	Yes	Yes	/
6066	0	Position deviation detection time	RW	RxPDO	Yes	Yes	/
606C	0	Velocity feedback	RO	TxPDO	Yes	Yes	Yes
6074	0	Internal command torque	RO	TxPDO	Yes	Yes	Yes
6076	0	Rated torque	RO	TxPDO	Yes	Yes	Yes
6077	0	Actual torque	RO	TxPDO	Yes	Yes	Yes
60F4	0	Actual following error	RO	TxPDO	Yes	Yes	Yes
60FA	0	Position loop velocity output	RO	TxPDO	Yes	Yes	Yes
60FC	0	Internal command position	RO	TxPDO	Yes	Yes	Yes

8.5.2 Cyclic Synchronous Position Mode (CSP)

CSP Block Diagram



Related Objects

Basic object

PDO	Index+Sub-Index	Label	Data Type	Access	Unit	Notes
(RXPDO)	6040-00h	Control word	U16	RW	—	Required
	607A-00h	Target position	I32	RW	Uint	Required
	60B0-00h	Position feedforward	I32	RW	Uint	Optional
	60B1-00h	Velocity feedforward	I32	RW	Uint /S	Optional
	60B2-00h	Torque feedforward	I16	RW	0.1%	Optional
(TXPDO)	6041-00h	Status word	U16	RO	—	Required
	6064-00h	Actual feedback position	I32	RO	Uint	Required
	606C-00h	Actual feedback velocity	I32	RO	Uint /S	Optional
	60F4-00h	Actual following error	I32	RO	Uint	Optional
	6077-00h	Actual torque	I16	RO	0.1%	Optional

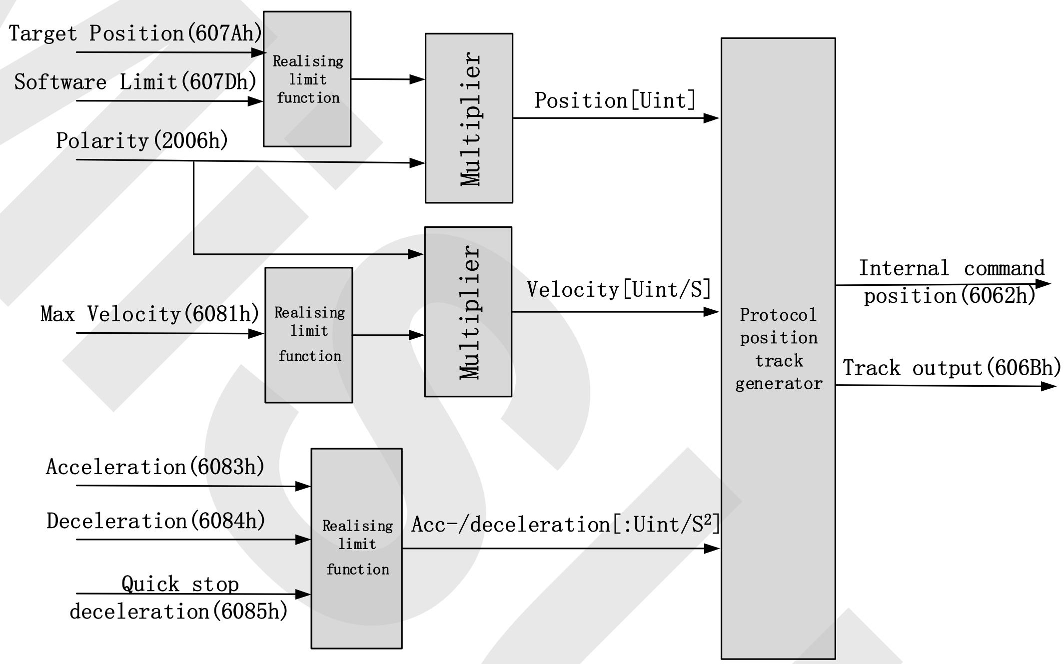
Extended object

Index+Sub-Index	Label	Data Type	Access	Unit
603F-00h	Error code	U16	RO	—
6060-00h	Operation mode	I8	RW	—
6061-00h	Displayed operation mode	I8	RO	—
6062-00h	Position demand value	I32	RO	Uint
606B-00h	Internal command speed	I32	RO	Uint
607D-01h	Min. software limit	I32	RO	Uint
607D-02h	Max. software limit	I32	RO	Uint
605A-00h	Quick stop option code	I16	RW	—
6085-00h	Emergency stop deceleration	U32	RW	Uint /S
608F-01h	Encoder resolution	U32	RO	P
608F-02h	Motor turns	U32	RO	—
6091-01h	Electronic gear ratio numerator	U32	RW	—
6091-02h	Electronic gear ratio denominator	U32	RW	—
6092-01h	Number of pulses per rotation	U32	RW	—
6092-02h	Number of physical axis turns	U32	RO	—

8.5.3 Protocol Position Mode (PP)

Under non-synchronous mode, master device is responsible for only sending parameters and control command; After receiving enable command from master device, servo driver will plan motion route according to parameters. Under non-synchronous mode, motor motion between each axis is asynchronous.

From the perspective of servo driver functions, the difference between PP and CSP mode is that PP mode requires track generator function.



Related Parameters

Basic object

PDO	Index+Sub-Index	Label	Data Type	Access	Unit	Notes
(RXPDO)	6040-00h	Control word	U16	RW	—	Required
	607A-00h	Target position	I32	RW	Unit	Required
	6081-00h	Max. velocity	U32	RW	Unit	Required
	6083-00h	Acceleration	I32	RW	Unit /S	Optional
(TXPDO)	6041-00h	Status word	U16	RO	—	Required
	603F-00h	Error code	U16	RO		Optional
	6064-00h	Actual position feedback	I32	RO	Unit	Required
	606C-00h	Actual velocity feedback	I32	RO	Unit /S	Optional
	60F4-00h	Actual following error	I32	RO	Unit	Optional
	6077-00h	Actual torque	I16	RO	0.1%	Optional

Extended object

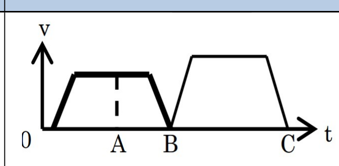
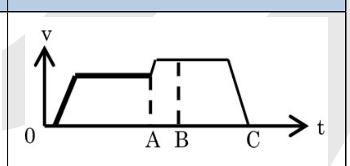
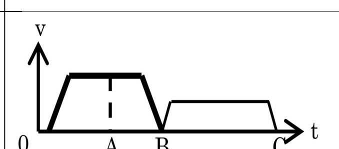
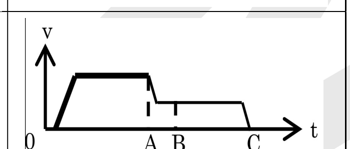
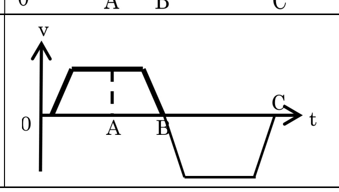
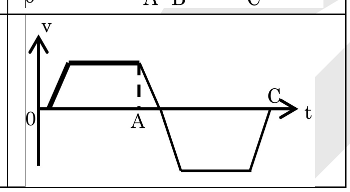
Index+Sub-Index	Label	Data Type	Access	Unit
603F-00h	Error code	U16	RO	—
6060-00h	Operation mode	I8	RW	—
6061-00h	Displayed operation mode	I8	RO	—
6062-00h	Position demand value	I32	RO	Unit
606B-00h	Internal command speed	I32	RO	Unit
607D-01h	Min. software limit	I32	RO	Unit
607D-02h	Max. software limit	I32	RO	Unit
605A-00h	Quick stop option code	I16	RW	—
6085-00h	Emergency stop deceleration	U32	RW	Unit/S^2
608F-01h	Encoder resolution	U32	RO	P
608F-02h	Motor turns	U32	RO	—
6091-01h	Electronic gear ratio numerator	U32	RW	—
6091-02h	Electronic gear ratio denominator	U32	RW	—
6092-01h	Number of pulses per rotation	U32	RW	—
6092-02h	Number of physical axis turns	U32	RO	—

Control and status words under PP mode

Control word bits 4~6 definition under PP mode

Bit	Value	Definition
4 (New position)	0—>1	Latest target position(607Ah)、Max. Velocity(6081h)、Acc-/deceleration(6083h/6084h) Starts
5 (Instant trigger)	0	Trigger new position command once current one is completed.
	1	Interrupted current position command and trigger new position command
6(Absolute/ relative)	0	Set target position(607Ah)as absolute position
	1	Set target position(607Ah) as relative position

5 motion structures under PP mode

Control words bit 5	0	1
Accelerates/ constant velocity toward target position		
Decelerates towards target position		
Target position in inversed direction		

A：Command switching time from master device
B：Arrival time before target position renewal
C：Arrival time after target position renewal
Thick line: Motion before command changed
Thin line ：Motion after command changed

Status word bits 12-15, 10, 8 definition under PP mode

Bit	Value	Definition
8(Abnormal Stoppage)	0	Normal motion
	1	Abnormal stoppage triggered, motor stopped *1)
10(Arrived at position)	0	Motion not completed
	1	Target position reached
12(New position)	0	Current motion completed/interruptible, able to execute new position command *2)
	1	Current motion not completed/interruptible, unable to execute new position command
14(Motion Parameter = 0)	0	Motion parameters valid, necessary parameters all not set to 0.
	1	Parameter = 0 under current motion. One of 3 parameters, Max. velocity (6081h), acceleration (6083h) and deceleration (6084h) = 0.
15(Trigger)	0	Current motion incomplete/uninterruptable, new target position cannot be renewed. *3)
	1	Current motion completed/interruptible, new target position can be renewed.

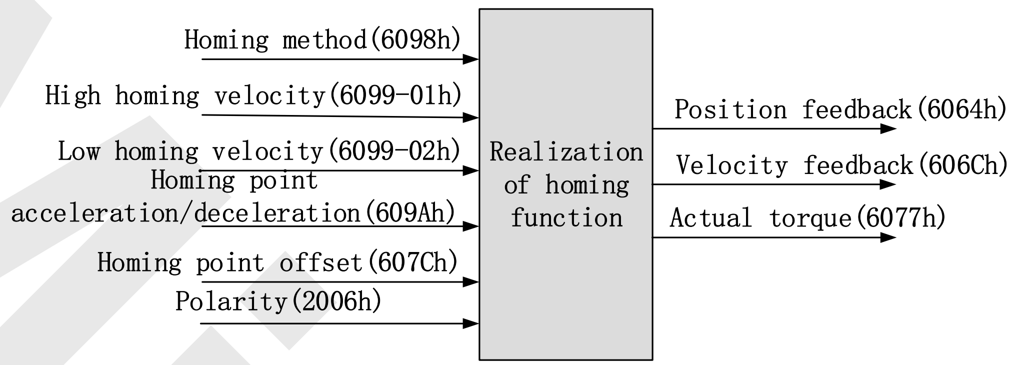
*1) Bit 8 abnormal stoppage usually valid when hardware limit, deceleration stoppage and quick stop are triggered.
*2) Bit 12 under control word(6040h)bit 5 valid and bit 4 invalid, motion interruptible.
*3) Bit 15 and bit 12 have inversed logic under PP mode.

<u>Application: Realization of relative position motion</u>

Step 1: 6060h = 1, determine if 6061h =1. Servo driver is now under PP mode.
Step 2: Write motion parameters: Target position 607Ah, Max. velocity 6081h, acceleration 6083h, deceleration 6084h
Step 3: Enable servo driver and switch bit 6 and 4 to realize relative position motion.

8.5.4 Homing mode (HM)

E-DHASxxE servo system supports every other homing method except for method 36. Output/input parameters of L7EC are as shown below.



Related Parameters

Basic object

PDO	Index+Sub-Index	Name	Data Type	Access	Unit	Notes
(RXPDO)	6040-00h	Control word	U16	RW	—	Required
	6098-00h	Homing mode	I8	RW	—	Optional
	6099-01h	High homing velocity	U32	RW	Unit/S	Optional
	6099-02h	Low homing velocity	U32	RW	Unit/S	Optional
	609A-00h	Homing point acceleration	U32	RW	Unit/S^2	Optional
	607C-00h	Homing point offset	I32	RW	Unit	Optional
(TXPDO)	60-00h	Status word	U16	RO	—	Required
	603F-00h	Error code	U16	RO		Optional
	6064-00h	Actual position feedback	I32	RO	Unit	Optional
	606C-00h	Actual velocity feedback	I32	RO	Unit/S	Optional
	60F4-00h	Actual following error	I32	RO	Unit	Optional
	6077-00h	Actual torque	I16	RO	0.1%	Optional

Extended object

Index+Sub-Index	Label	Data Type	Access	Unit
603F-00h	Error code	U16	RO	—
6060-00h	Operation mode	I8	RW	—
6061-00h	Displayed operation mode	I8	RO	—
6062-00h	Position demand value	I32	RO	Unit
606B-00h	Internal command speed	I32	RO	Unit
608F-01h	Encoder resolution	I32	RO	Unit
608F-02h	Motor revolution	I32	RO	Unit
6091-01h	Electronic gear ratio numerator	U32	RW	—
6091-02h	Electronic gear ratio denominator	U32	RW	—
6092-01h	Number of pulses per rotation	U32	RW	—
6092-02h	Number of physical axis turns	U32	RO	—

Control and status words under HM mode

Control word bit 4 definition under HM mode

Bit	Value	Definition
4(Homing motion starts/stops)	0—>1	Homing motion starts
	1 —>0	Homing motion stops, motor stops

Status word bits 12-15, 10, 8 definitions under PP mode

Bit	Value	Definition
8(Abnormal Stoppage)	0	Normal motion
	1	Abnormal stoppage triggered, motor stops *1)
10(Arrived at position)	0	Motion not completed
	1	Target position reached
12(Homing done)	0	Homing not done
	1	Homing done, valid after reaching position (bit 10) *2)
14(Motion Parameter = 0)	0	Motion parameters valid, necessary parameters all not set to 0.
	1	Parameter = 0 under current motion. One of 4 parameters, Homing mode (6098h), high homing velocity(6099h-01), low homing velocity (6099h-02) and homing point acc-/deceleration (609Ah) = 0.
15(Trigger)	0	Homing triggered/completed *3)
	1	Homing triggers

*1) Bit 8 abnormal stoppage is usually valid when hardware limit, deceleration stoppage and quick stop are triggered.
*2) Determine if homing is done, determine if bit 10/12 is occupied.
*3) Use to indicate if homing is able to trigger or already triggered.

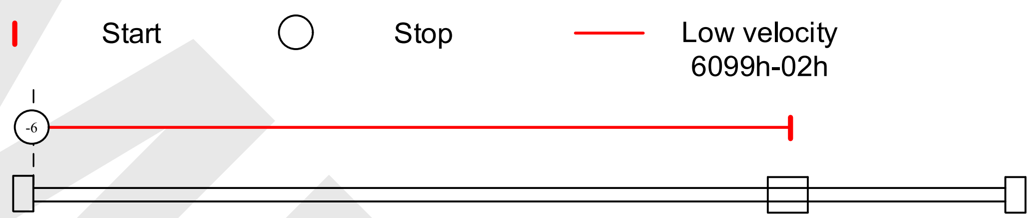
Incorrect position triggering conditions

Triggering condition	Remarks
Absolute encoder homing	Control words 6040h bit 4 from 0 to 1
2 limit switch signals detected	Positive and negative limit switches detected during homing
Negative limit valid when positive limit in used	Negative limit valid under 2,7-10,23-26 homing modes
Positive limit valid when negative limit in used	Positive limit valid under 1,11-14,27-30 homing modes
Limit switch valid when not in used	Limit switch valid under 3,4,19,20 homing modes
Limit switch/homing signal valid when only z-signal in used	Limit switch and homing sensor valid under 33,34 homing modes

Homing mode

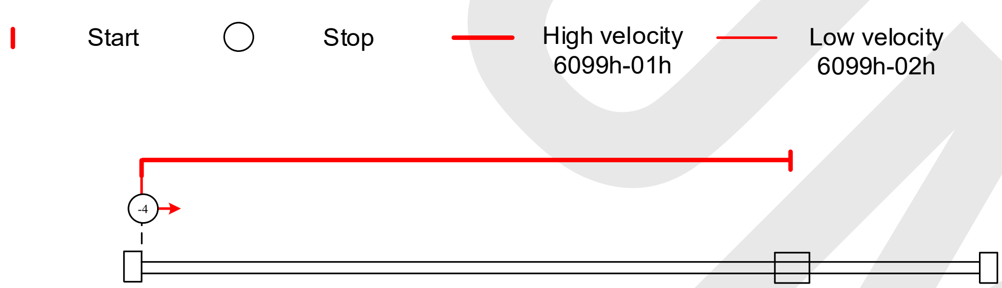
Torque limiting mode

Mode-6： Search for homing point in **negative direction** at **low velocity**. Stop after torque reaches the value set in P05.39 and homing done signal delivers after the time value set in P05.37

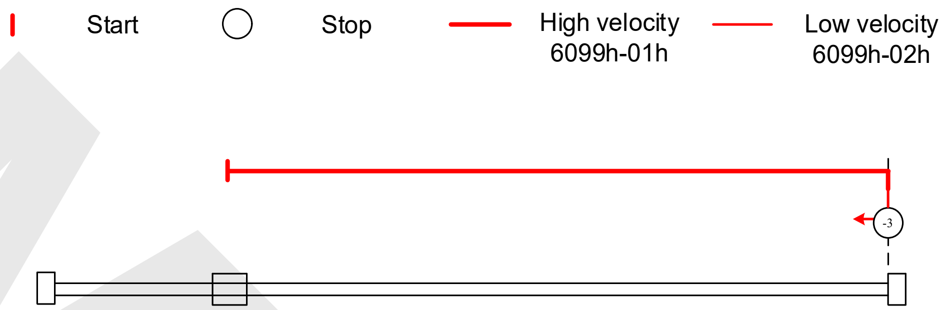


Mode -5： Search for homing point in **positive direction** at **low velocity**. Stop after torque reaches the value set in P05.39 and homing done signal delivers after the time value set in P05.37

Mode -4： Search for homing point in **negative direction** at **high velocity**. Move in **positive direction** after torque reaches the value set in P05.39, stop when torque is gone. Homing done signal delivers after the time value set in P05.37

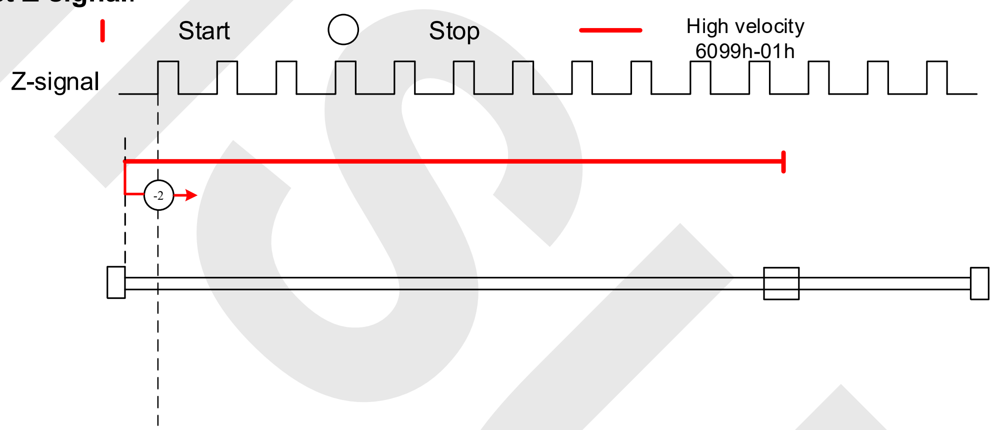


Mode -3： Search for homing point in **positive direction** at **high velocity**. Move in **negative direction** after torque reaches the value set in P05.39, stops when torque is gone. Homing done signal delivers after the time value set in P05.37

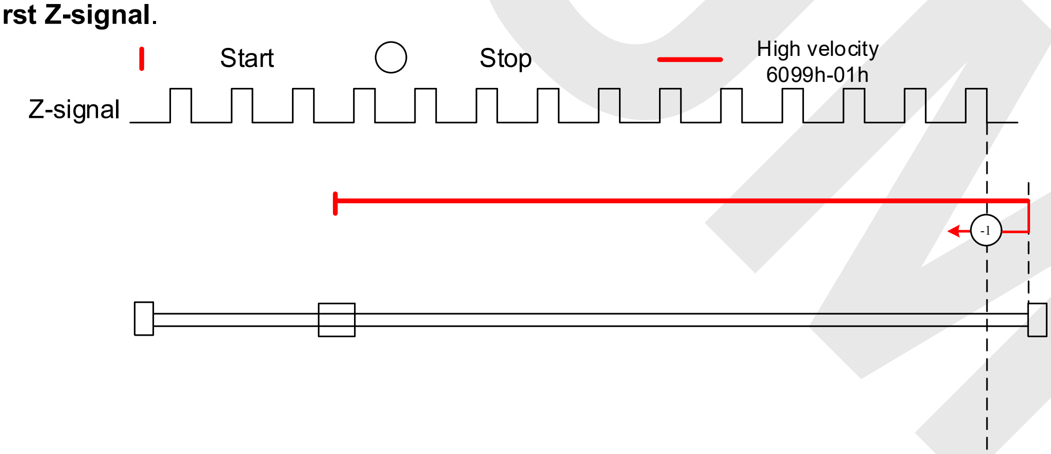


Torque limiting+Z-signal mode

Mode -2：Search for homing point in **negative direction** at **high velocity**. Move in **positive direction** after torque reaches the value set in P05.39, stops when torque is gone with the **first Z-signal**.



Mode -1：Search for homing point in **positive direction** at **high velocity**. Move in **negative direction** after torque reaches the value set in P05.39, stops when torque is gone with the **first Z-signal**.



Limit switch signal+Z-signal mode

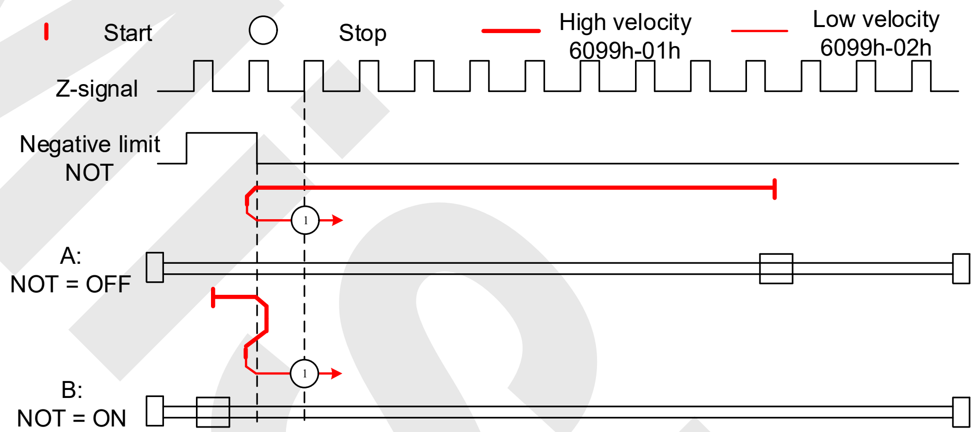
Mode 1:

Diagram A: *Negative limit switch = OFF*

1. Move in **negative direction** at **high velocity** until **negative limit switch valid.**
2. Move in **positive direction** at **low velocity** and stops **after negative limit switch** and **first encoder Z-signal valid**

Diagram B: *Negative limit switch = ON*
1. Start to move at **negative limit switch position** in **positive direction** at **high velocity** until **negative limit switch invalid.**
2. Move in **negative direction** at **high velocity** until **negative limit switch valid.**
3. Move in **positive direction** at **low velocity** and stops **after negative limit switch** and **first encoder Z-signal valid**

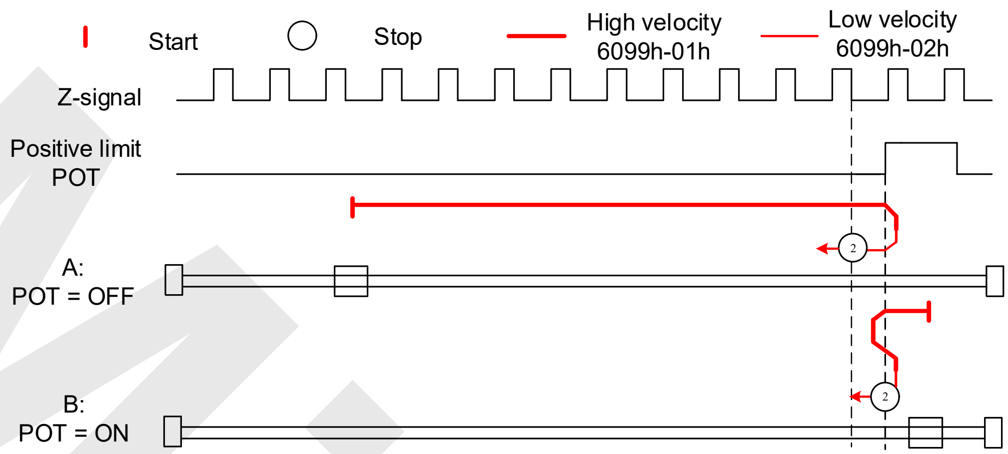
If the positive limit signal is valid during the homing process, the status word (6041h) bit 13 will be valid, indicating homing error and the motor will stop immediately.



Mode 2:
Diagram A: *Positive limit switch = OFF*
1. Move in **positive direction** at **high velocity** until **positive limit switch valid.**
2. Move in **negative direction** at **low velocity** and stops **after positive limit switch** and **first encoder Z-signal valid**

Diagram B: *Positive limit switch = ON*
1. Start to move at **positive limit switch position** in **negative direction** at **high velocity** until **positive limit switch invalid.**
2. Move in **positive direction** at **high velocity** until **positive limit switch valid.**
3. Move in **negative direction** at **low velocity** and stops **after positive limit switch** and **first encoder Z-signal valid**

If the negative limit signal is valid during the homing process, the status word (6041h) bit 13 will be valid, indicating homing error and the motor will stop immediately.



Homing switch signal+Z-signal mode

Mode 3:

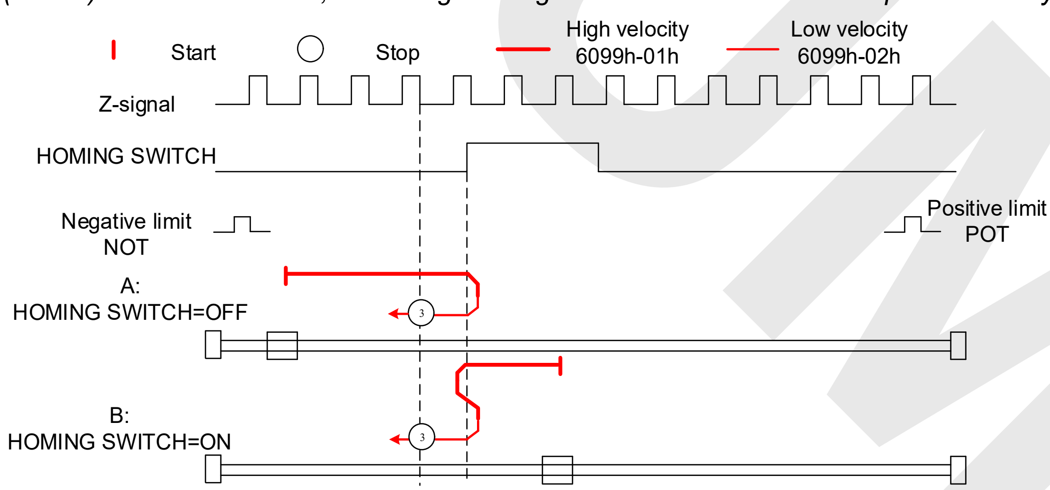
Diagram A: *Homing switch = OFF*

1. Move in **positive direction** at **high velocity** until **homing switch valid.**
2. Move in **negative direction** at **low velocity** and stops **after homing switch** and **first encoder Z-signal valid**

Diagram B: *Homing switch = ON*

1. Start to move at **homing switch position** in **negative direction** at **high velocity** until **after homing switch.**
2. Move in **positive direction** at **high velocity** until **homing switch valid.**
3. Move in **negative direction** at **low velocity** and stops **after homing switch** and **first encoder Z-signal valid**

If the positive/negative limit switch signal is valid during the homing process, the status word (6041h) bit 13 will be valid, indicating homing error and the motor will stop immediately.



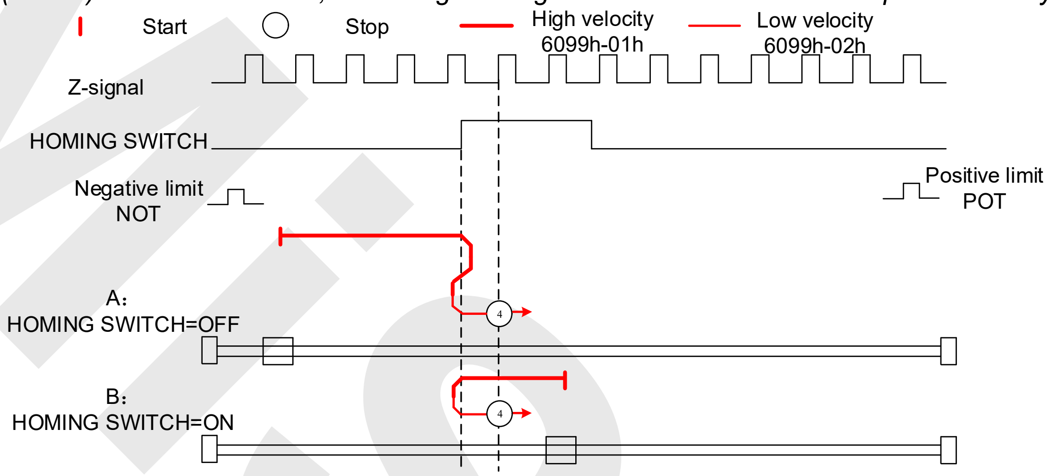
Mode 4:

Diagram A: *Homing switch = OFF*

1. Move in **positive direction** at **high velocity** until **homing switch valid.**
2. Move in **negative direction** at **high velocity** until **homing switch invalid.**
3. Move in **positive direction** at **low velocity** and stops after **homing switch valid** and **first encoder Z-signal valid**

Diagram B: *Homing switch = ON*
1. Start to move at **homing switch position** in **negative direction** at **high velocity** until **after homing switch.**
2. Move in **positive direction** at **low velocity** and stops after **homing switch valid** and **first encoder Z-signal valid**

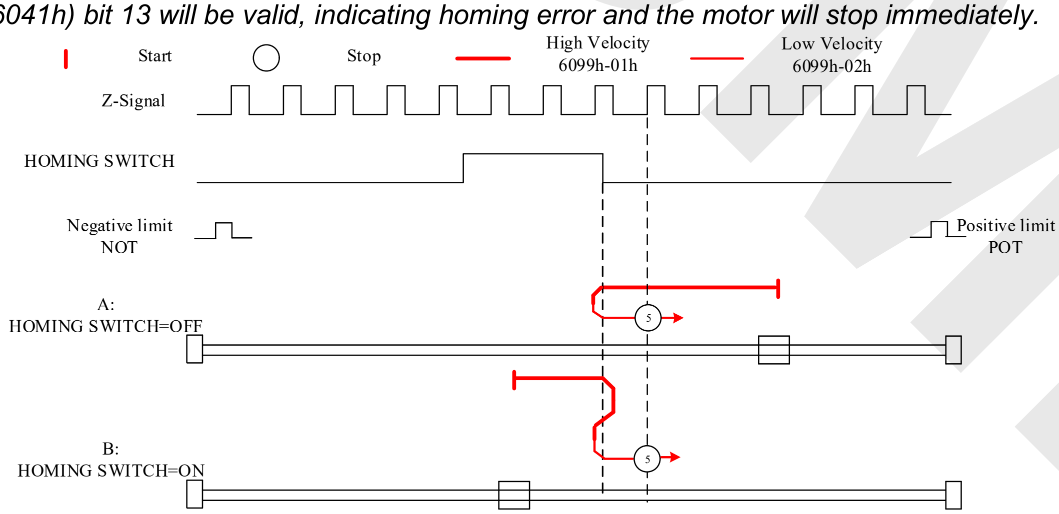
If the positive/negative limit switch signal is valid during the homing process, the status word (6041h) bit 13 will be valid, indicating homing error and the motor will stop immediately.



Mode 5:
Diagram A: *Homing switch = OFF*
1. Move in **negative direction** at **high velocity** until **homing switch valid.**
2. Move in **positive direction** at **low velocity** and stops **after homing switch** and **first encoder Z-signal valid**

Diagram B: *Homing switch = ON*
1. Start to move at **homing switch position** in **positive direction** at **high velocity** until **after homing switch.**
2. Move in **negative direction** at **high velocity** until **homing switch valid.**
3. Move in **positive direction** at **low velocity** and stops **after homing switch** and **first encoder Z-signal valid**

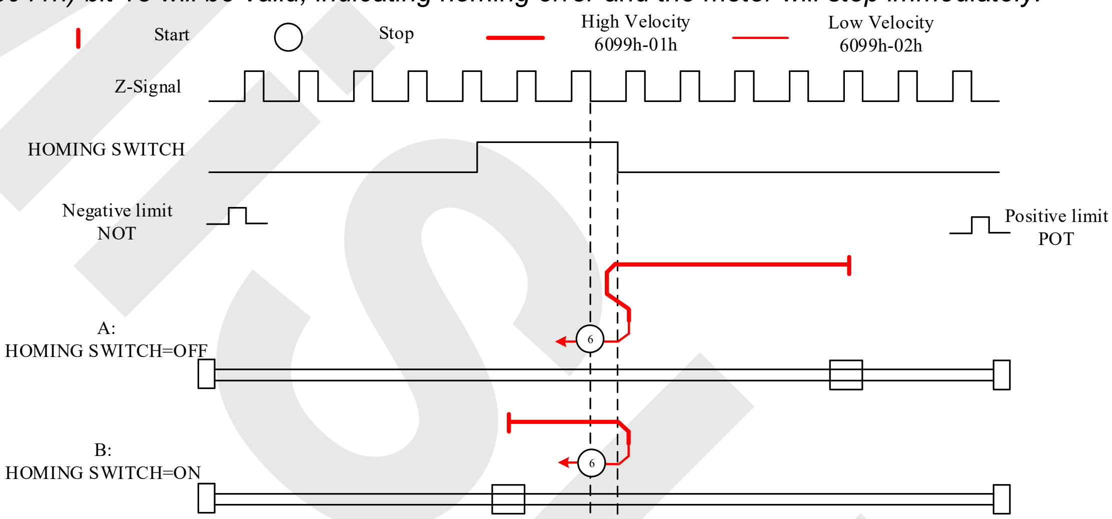
If the positive/negative limit switch signal is valid during the homing process, the status word (6041h) bit 13 will be valid, indicating homing error and the motor will stop immediately.



Mode 6:

Diagram A: *Homing switch = OFF*
1. Move in **negative direction** at **high velocity** until **homing switch valid.**
2. Move in **positive direction** at **high velocity** until **homing switch invalid.**
3. Move in **negative direction** at **low velocity** and stops after **homing switch valid** and **first encoder Z-signal valid**

Diagram B: *Homing switch = ON*
1. Start to move at **homing switch position** in **positive direction** at **high velocity** until **after homing switch.**
2. Move in **negative direction** at **low velocity** and stops after **homing switch valid** and **first encoder Z-signal valid**
If the positive/negative limit switch signal is valid during the homing process, the status word (6041h) bit 13 will be valid, indicating homing error and the motor will stop immediately.



Limit switch signal+homing switch signal+Z-signal mode

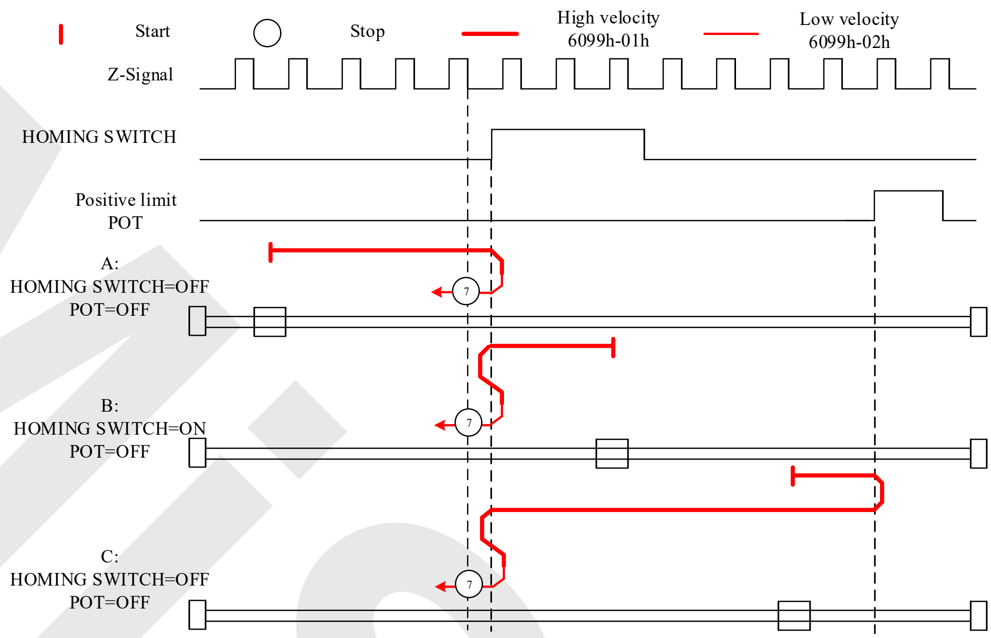
Mode 7

Diagram A: *Homing switch & positive limit switch = OFF*
1. Move in **positive direction** at **high velocity** until **homing switch valid.**
2. Move in **negative direction** at **low velocity** and stops after **homing switch** and **first encoder Z-signal valid.**

Diagram B: *Homing switch = ON, positive limit switch = OFF*
1. Start to move at **homing switch position** in **negative direction** at **high velocity** until **after homing switch.**
2. Move in **positive direction** at **high velocity** until **homing switch valid.**
3. Move in **negative direction** at **low velocity** and stops **after homing switch** and **first encoder Z-signal valid**

Diagram C: *Homing switch & positive limit switch = OFF*
1. Move in **positive direction** at **high velocity** until **positive limit switch valid**.
2. Move in **negative direction** at **high velocity** until **after homing switch**.
3. Move in **positive direction** at **high velocity** until **homing switch valid**.
4. Move in **negative direction** at **low velocity** and stops **after homing switch** and **first encoder Z signal valid**

If the negative limit switch signal is valid during the homing process, the status word (6041h) bit 13 will be valid, indicating homing error and the motor will stop immediately.



Mode 8

Diagram A: *Homing switch & positive limit switch = OFF*

1. Move in **positive direction** at **high velocity** until **homing switch valid.**
2. Move in **negative direction** at **high velocity** until **after homing switch.**
3. Move in **positive direction** at **low velocity** and stops after **homing switch valid** and **first encoder Z-signal valid.**

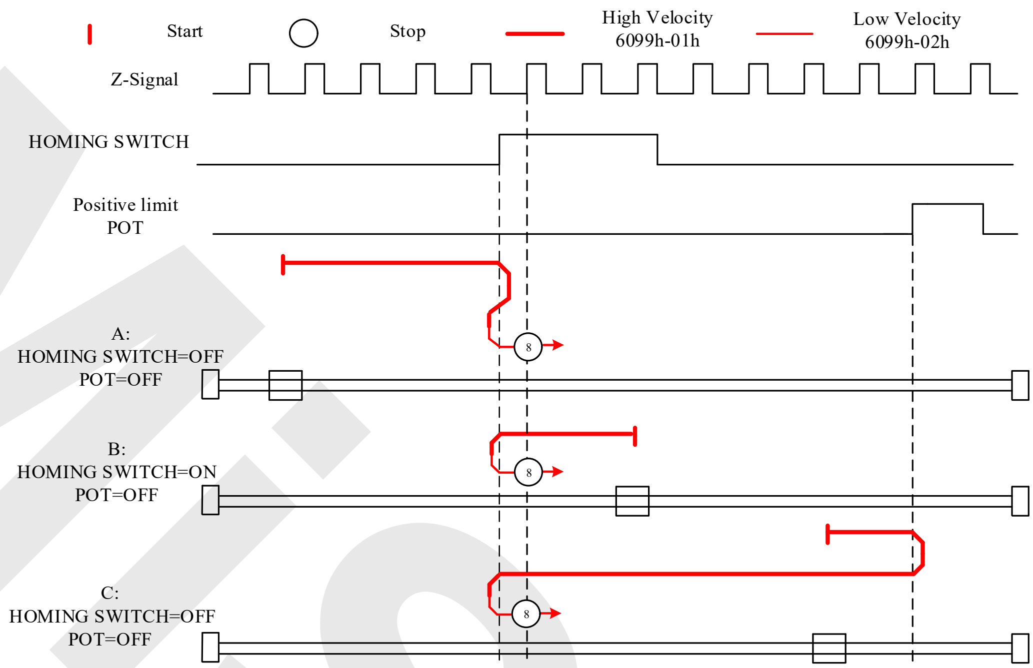
Diagram B: *Homing switch = ON, positive limit switch = OFF*

1. Start to move at **homing switch position** in **negative direction** at **high velocity** until **after homing switch.**
2. Move in **positive direction** at **low velocity** and stops after **homing switch valid** and **first encoder Z-signal valid**

Diagram C: *Homing switch & positive limit switch = OFF*

1. Move in **positive direction** at **high velocity** until **positive limit switch valid**.
2. Move in **negative direction** at **high velocity** until **after homing switch**.
3. Move in **positive direction** at **low velocity** and stops after **homing switch valid** and **first encoder Z-signal valid.**

If the negative limit switch signal is valid during the homing process, the status word (6041h) bit 13 will be valid, indicating homing error and the motor will stop immediately.



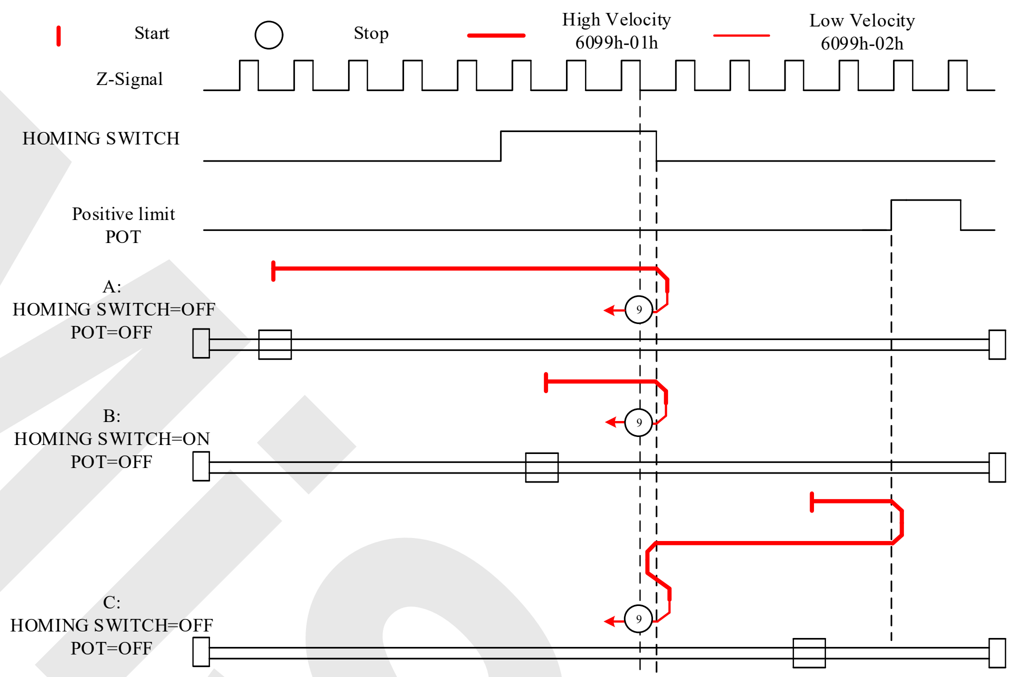
Mode 9

Diagram A: *Homing switch & positive limit switch = OFF*
1. Move in **positive direction** at **high velocity** until **after homing switch.**
2. Move in **negative direction** at **low velocity** and stops after **homing switch valid** and **first encoder Z-signal valid.**

Diagram B: *Homing switch = ON, positive limit switch = OFF*
1. Start to move at **homing switch position** in **positive direction** at **high velocity** until **homing switch invalid.**
2. Move in **negative direction** at **low velocity** and stops after **homing switch valid** and **first encoder Z-signal valid**

Diagram C: *Homing switch & positive limit switch = OFF*
1. Move in **positive direction** at **high velocity** until **positive limit switch valid**.
2. Move in **negative direction** at **high velocity** until **homing switch valid**.
3. Move in **positive direction** at **high velocity** until **after homing switch**.
4. Move in **negative direction** at **low velocity** and stops after **homing switch valid** and **first encoder Z signal valid**

If the negative limit switch signal is valid during the homing process, the status word (6041h) bit 13 will be valid, indicating homing error and the motor will stop immediately.



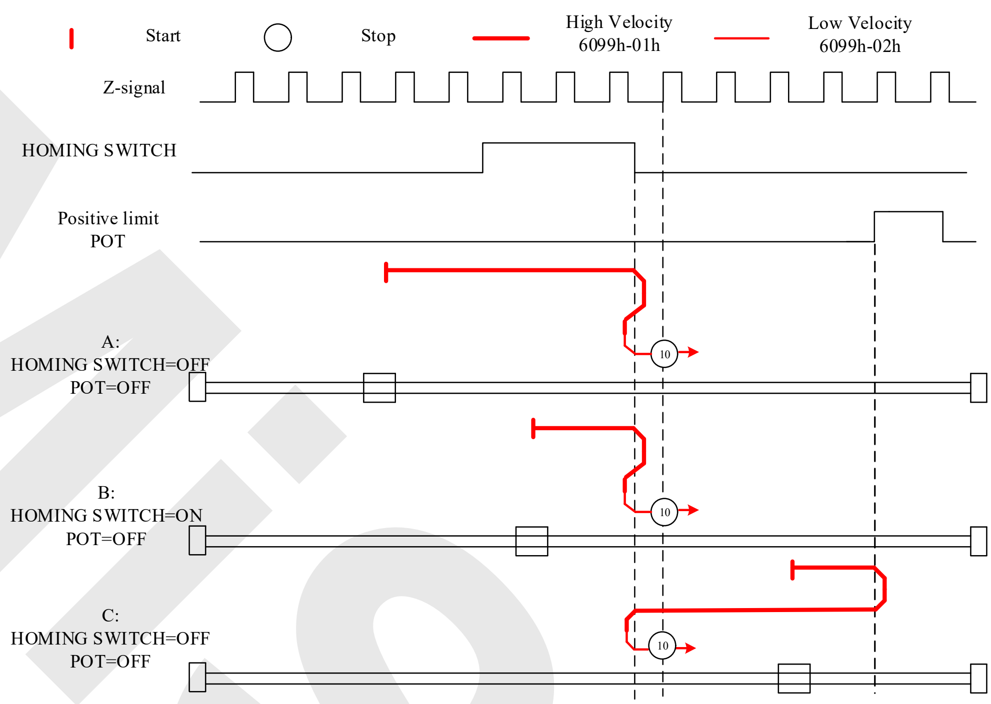
Mode 10

Diagram A: *Homing switch & positive limit switch = OFF*
1. Move in **positive direction** at **high velocity** until **after homing switch.**
2. Move in **negative direction** at **high velocity** until **homing switch valid.**
3. Move in **positive direction** at **low velocity** and stops **after homing switch** and **first encoder Z-signal valid.**

Diagram B: *Homing switch = ON, positive limit switch = OFF*
1. Start to move at **homing switch position** in **positive direction** at **high velocity** until **after homing switch.**
2. Move in **negative direction** at **high velocity** until **homing switch valid.**
3. Move in **positive direction** at **low velocity** and stops **after homing switch** and **first encoder Z-signal valid**

Diagram C: *Homing switch & positive limit switch = OFF*
1. Move in **positive direction** at **high velocity** until positive **limit switch valid**.
2. Move in **negative direction** at **high velocity** until **homing switch valid**.
3. Move in **positive direction** at **low velocity** and stops **after homing switch** and **first encoder Z signal valid**

If the negative limit switch signal is valid during the homing process, the status word (6041h) bit 13 will be valid, indicating homing error and the motor will stop immediately.



Mode 11

Diagram A: *Homing switch & negative limit switch = OFF*

1. Move in **negative direction** at **high velocity** until **homing switch valid.**
2. Move in **positive direction** at **low velocity** and stops **after homing switch** and **first encoder Z-signal valid**

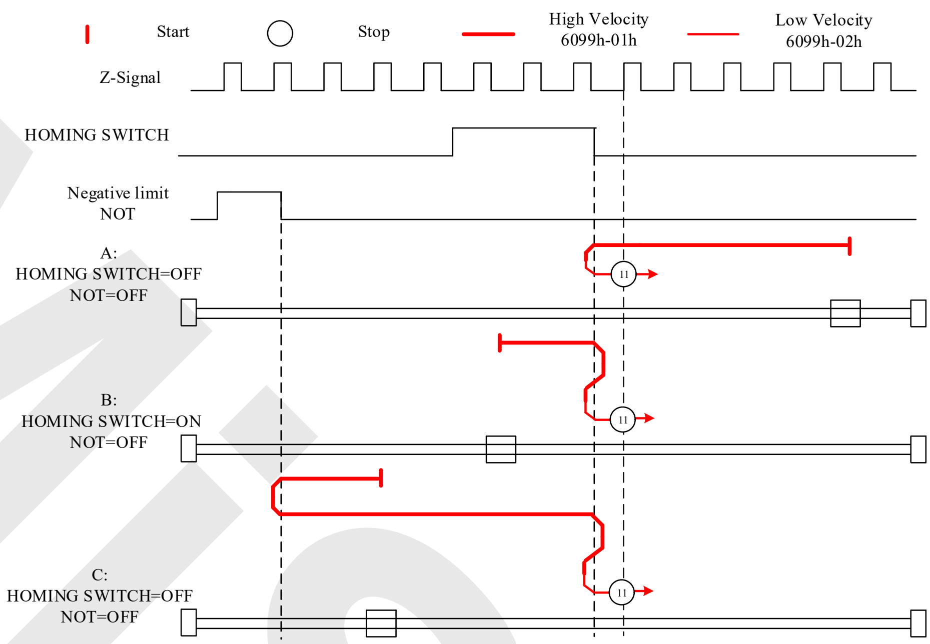
Diagram B: *Homing switch = ON, negative limit switch = OFF*

1. Start to move at **homing switch position** in **positive direction** at **high velocity** until **after homing switch.**
2. Move in **negative direction** at **high velocity** until **homing switch valid.**
3. Move in **positive direction** at **low velocity** and stops **after homing switch** and **first encoder Z-signal valid**

Diagram C: *Homing switch & negative limit switch = OFF*

1. Move in **negative direction** at **high velocity** until the **negative limit switch valid**.
2. Move in **positive direction** at **high velocity** until **homing switch invalid**.
3. Move in **negative direction** at **high velocity** until **homing switch valid**.
4. Move in **positive direction** at **low velocity** and stops **after homing switch** and **first encoder Z signal valid**

If the positive limit switch signal is valid during the homing process, the status word (6041h) bit 13 will be valid, indicating homing error and the motor will stop immediately.



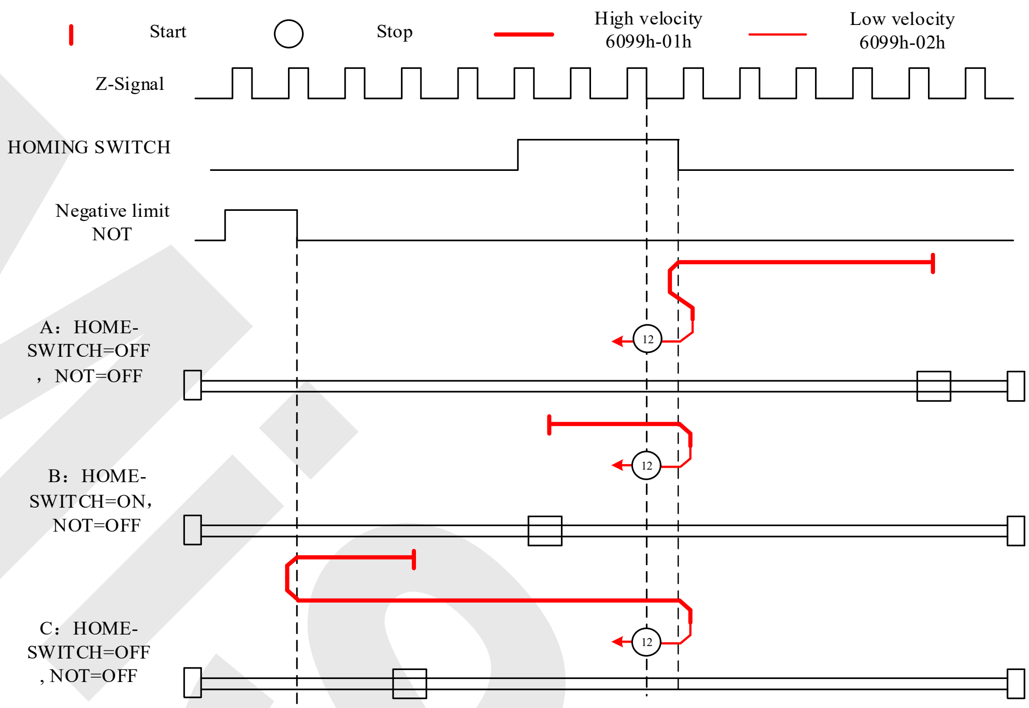
Mode 12

Diagram A: *Homing switch & negative limit switch = OFF*
1. Move in **negative direction** at **high velocity** until **homing switch valid.**
2. Move in **positive direction** at **high velocity** until **after homing switch.**
3. Move in **negative direction** at **low velocity** and stops after **homing switch valid** and **first encoder Z-signal valid**

Diagram B: *Homing switch = ON, negative limit switch = OFF*
1. Move at **homing switch position** in **negative direction** at **high velocity** until **after homing switch**.
2. Move in **positive direction** at **low velocity** and stops after **homing switch valid** and **first encoder Z-signal valid.**

Diagram C: *Homing switch & negative limit switch = OFF*
1. Move in **negative direction** at **high velocity** until **negative limit switch valid.**
2. Move in **positive direction** at **high velocity** until **after homing switch**.
3. Move in **negative direction** at **low velocity** and stops after **homing switch valid** and **first encoder Z-signal valid.**

If the positive limit switch signal is valid during the homing process, the status word (6041h) bit 13 will be valid, indicating homing error and the motor will stop immediately.

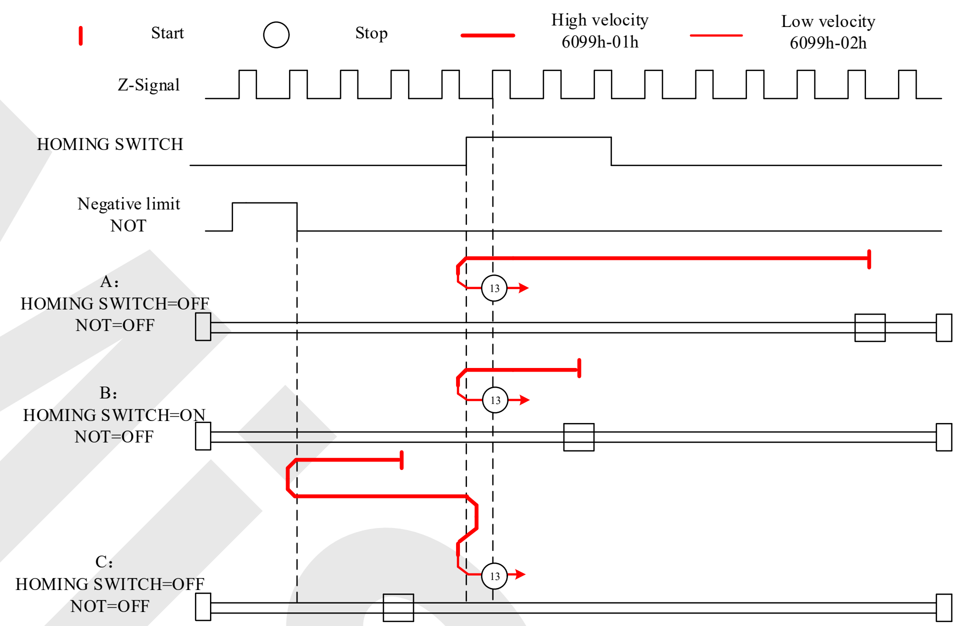


Mode 13
Diagram A: *Homing switch & negative limit switch = OFF*
1. Move in **negative direction** at **high velocity** until **after homing switch**.
2. Move in **positive direction** at **low velocity** and stops after **homing switch valid** and **first encoder Z-signal valid**.

Diagram B: *Homing switch = ON, negative limit switch = OFF*
1. Start to move at **homing switch position** in **negative direction** at **high velocity** until **after homing switch.**
2. Move in positive **direction** at **low velocity** and stops after **homing switch valid** and **first encoder Z-signal valid.**

Diagram C: *Homing switch & negative limit switch = OFF*
1. Move in **negative direction** at **high velocity** until **negative limit switch valid**.
2. Move in **positive direction** at **high velocity** until **homing switch valid.**
3. Move in **negative direction** at **high velocity** until **after homing switch**.
4. Move in **positive direction** at **low velocity** and stops after **homing switch valid** and **first encoder Z-signal valid.**

If the positive limit switch signal is valid during the homing process, the status word (6041h) bit 13 will be valid, indicating homing error and the motor will stop immediately.



Mode 14

Diagram A: *Homing switch & negative limit switch = OFF*

1. Move in **negative direction** at **high velocity** until **after homing switch**.
2. Move in **positive direction** at **high velocity** until **homing switch valid**.
3. Move in **negative direction** at **low velocity** and stops **after homing switch** and **first encoder Z-signal valid.**

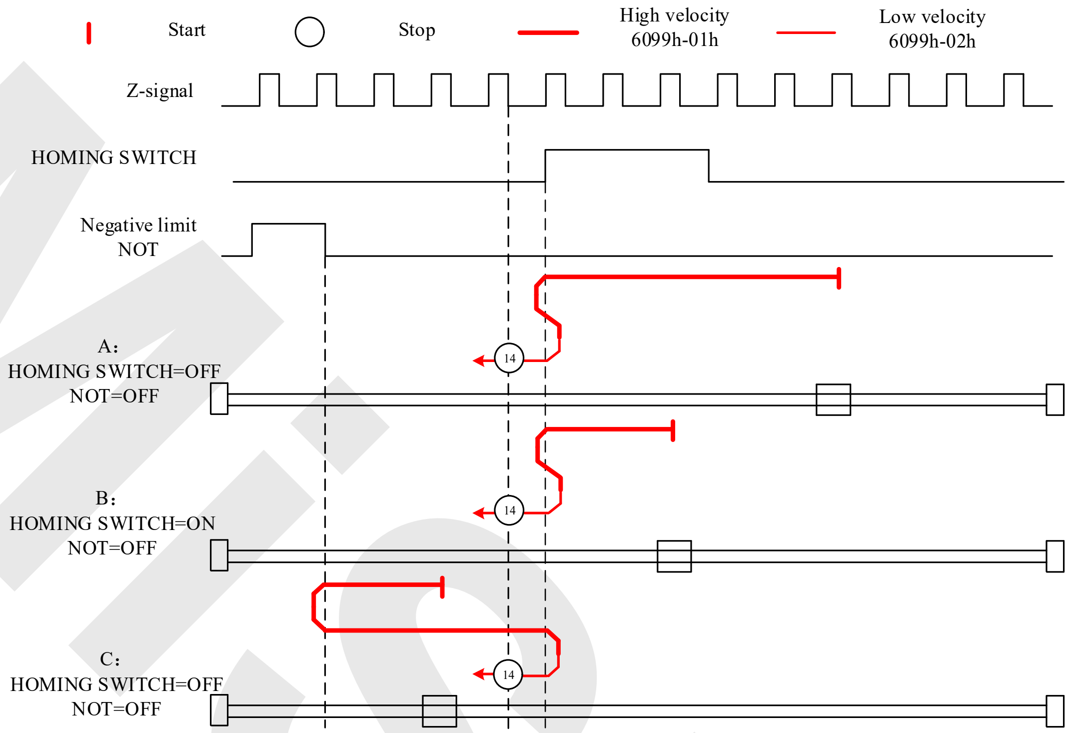
Diagram B: *Homing switch = ON, negative limit switch = OFF*

1. Start to move at **homing switch position** in **negative direction** at **high velocity** until **homing switch invalid**.
2. Move in **positive direction** until **homing switch valid**.
3. Move in **negative direction** at **low velocity** and stops **after homing switch** and **first encoder Z signal valid.**

Diagram C: *Homing switch & negative limit switch = OFF*

1. Move in **negative direction** at **high velocity** until **negative limit switch valid**.
2. Move in **positive direction** at **high velocity** until **homing switch valid**.
3. Move in **negative direction** at **low velocity** and stops **after homing switch** and **first encoder Z-signal valid.**

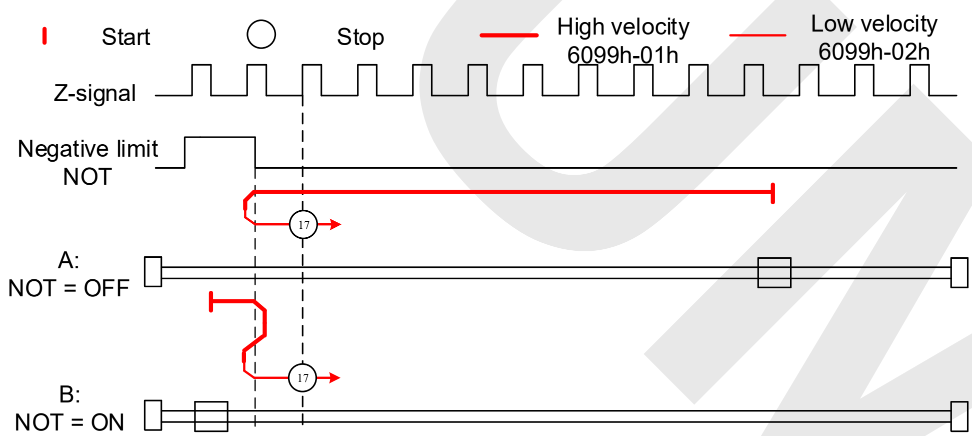
If the positive limit switch signal is valid during the homing process, the status word (6041h) bit 13 will be valid, indicating homing error and the motor will stop immediately.



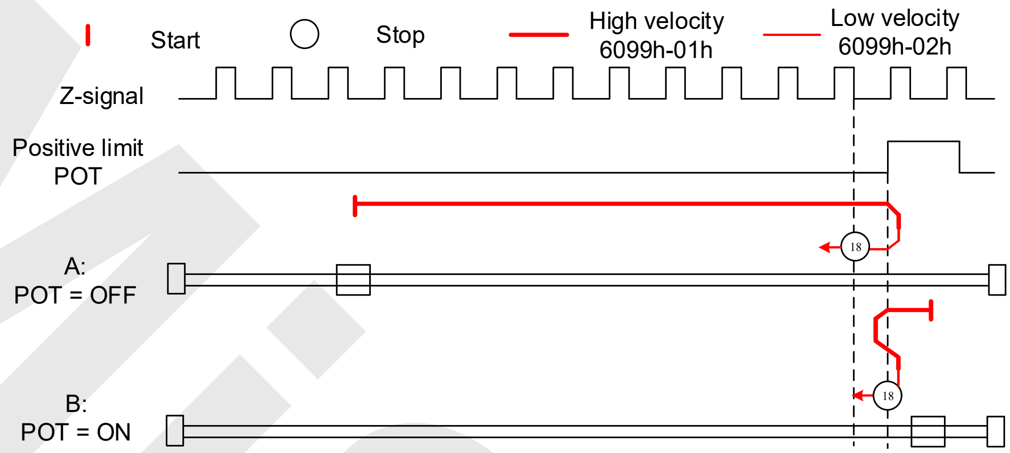
Limit switch signal triggering detection mode

Mode 17:

This mode is similar to mode 1. Only difference is that homing point detection is not through Z-signal but through triggering of negative limit switch signal

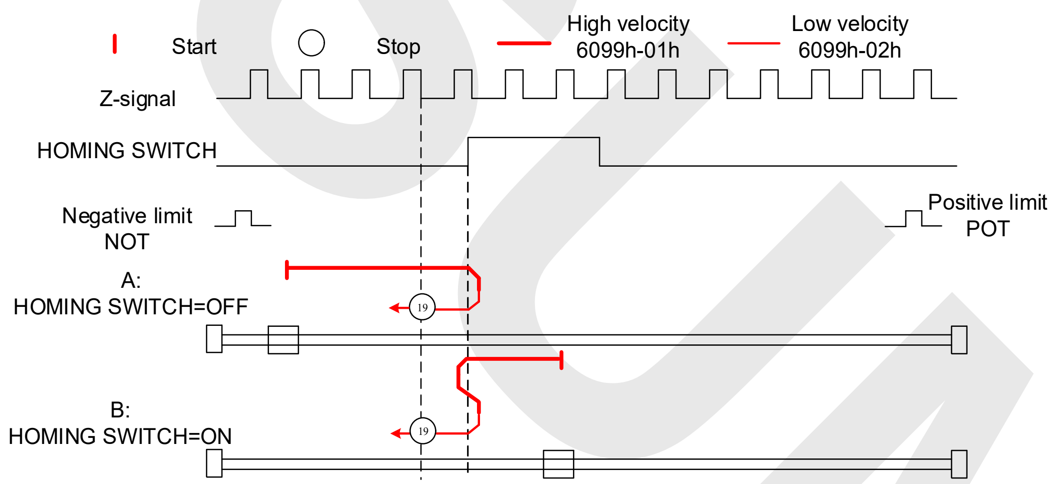


Mode 18:
This mode is similar to mode 2. Only difference is that homing point detection is not through Z-signal but through switching of positive limit switch signal



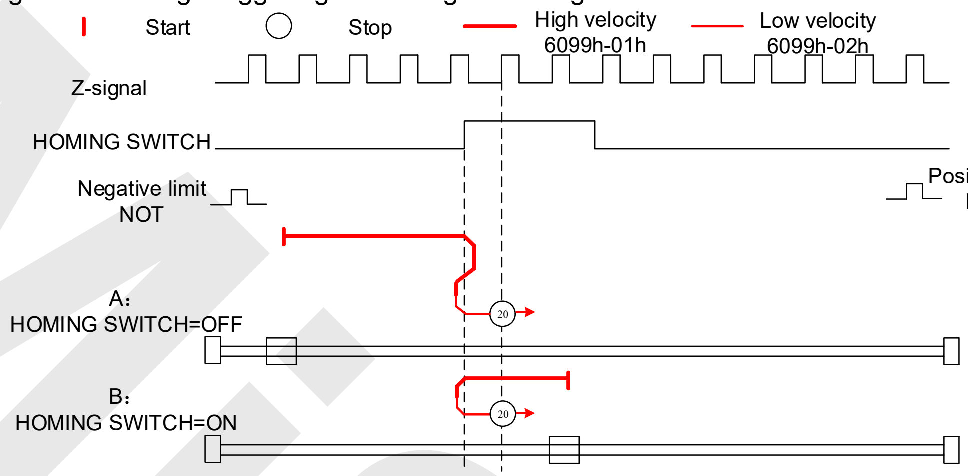
Homing switch signal triggering detection mode

Mode 19:
This mode is similar to mode 3. Only difference is that homing point detection is not through Z-signal but through triggering of homing switch signal



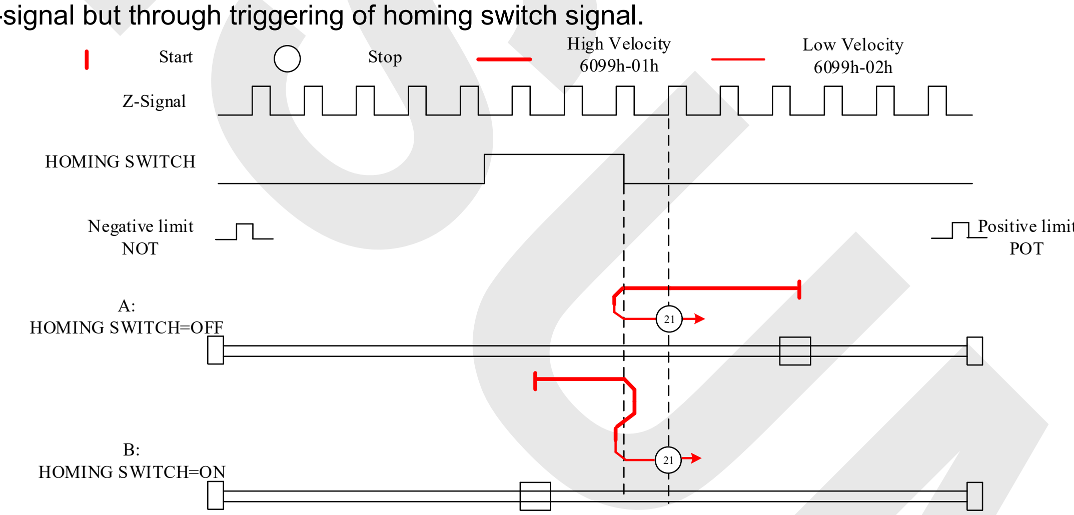
Mode 20:

This mode is similar to mode 4. Only difference is that homing point detection is not through Z-signal but through triggering of homing switch signal

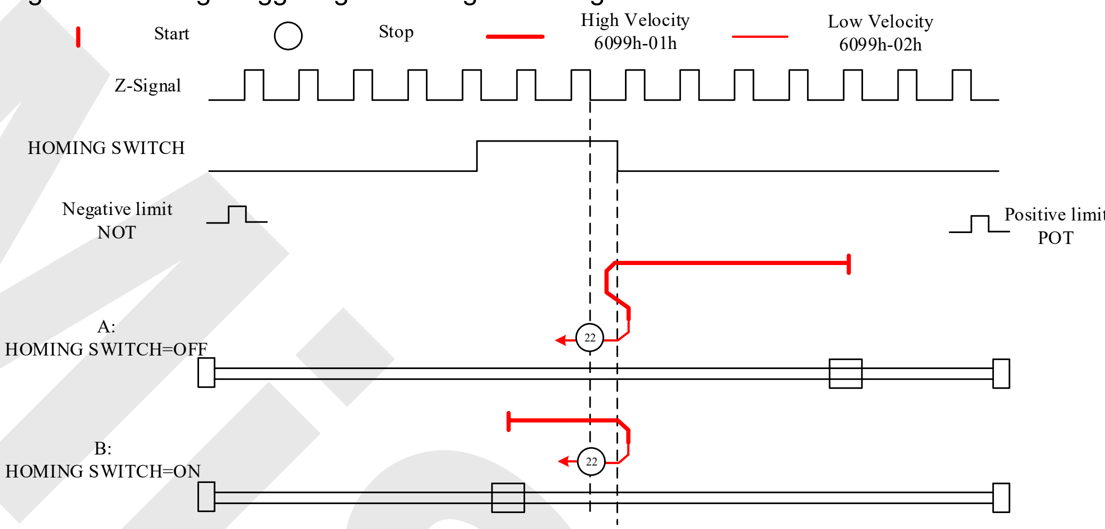


Mode 21:

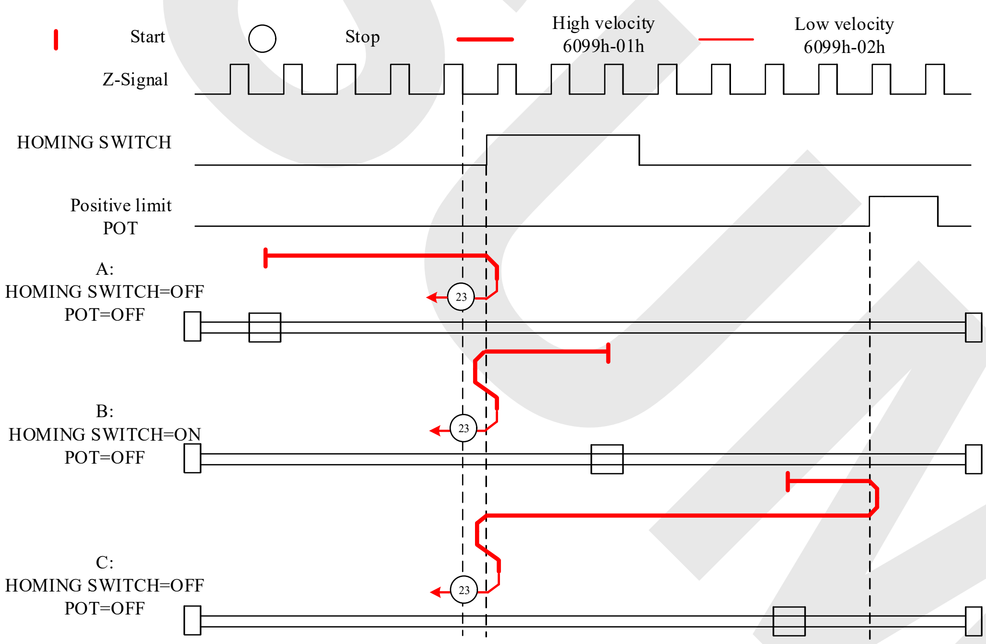
This mode is similar to mode 5. Only difference is that homing point detection is not through Z-signal but through triggering of homing switch signal.



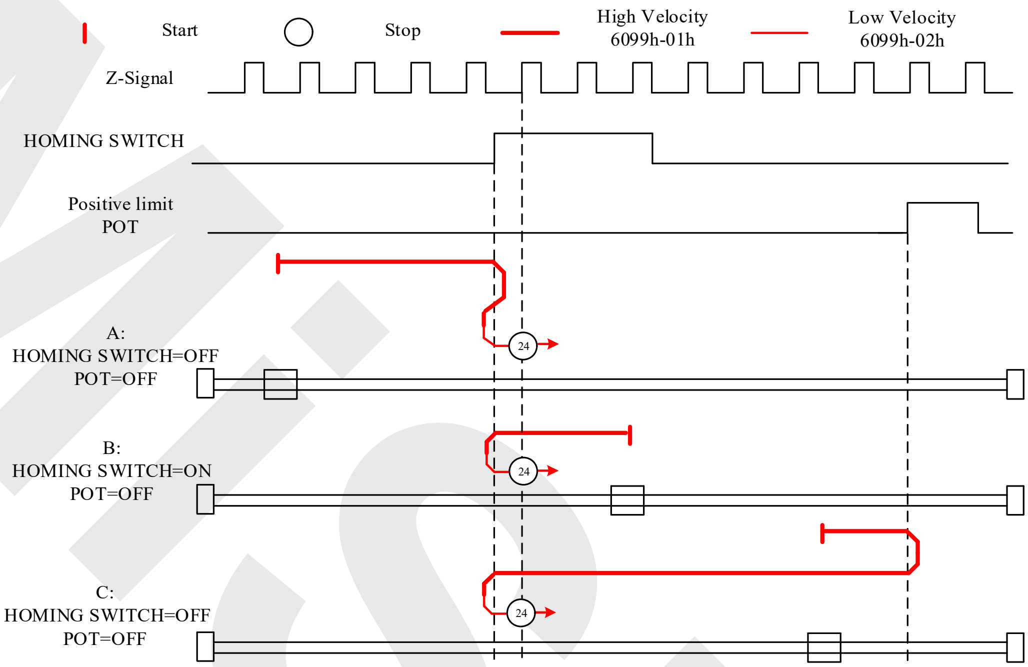
Mode 22:
This mode is similar to mode 6. Only difference is that homing point detection is not through Z-signal but through triggering of homing switch signal.



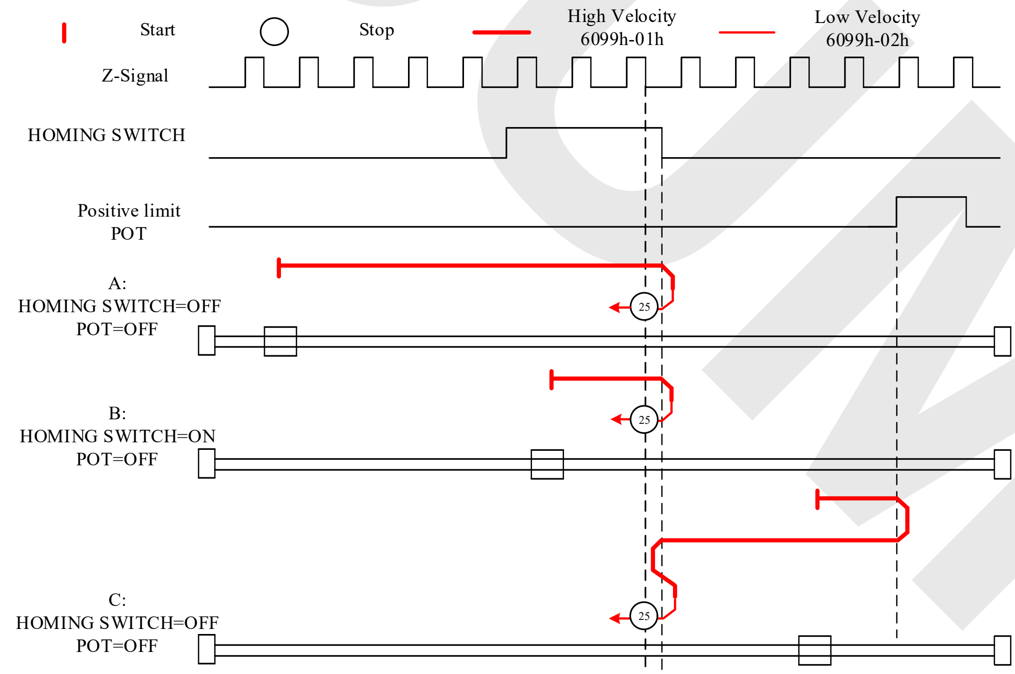
Mode 23:
This mode is similar to mode 7. Only difference is that homing point detection is not through Z-signal but through triggering of homing switch signal.



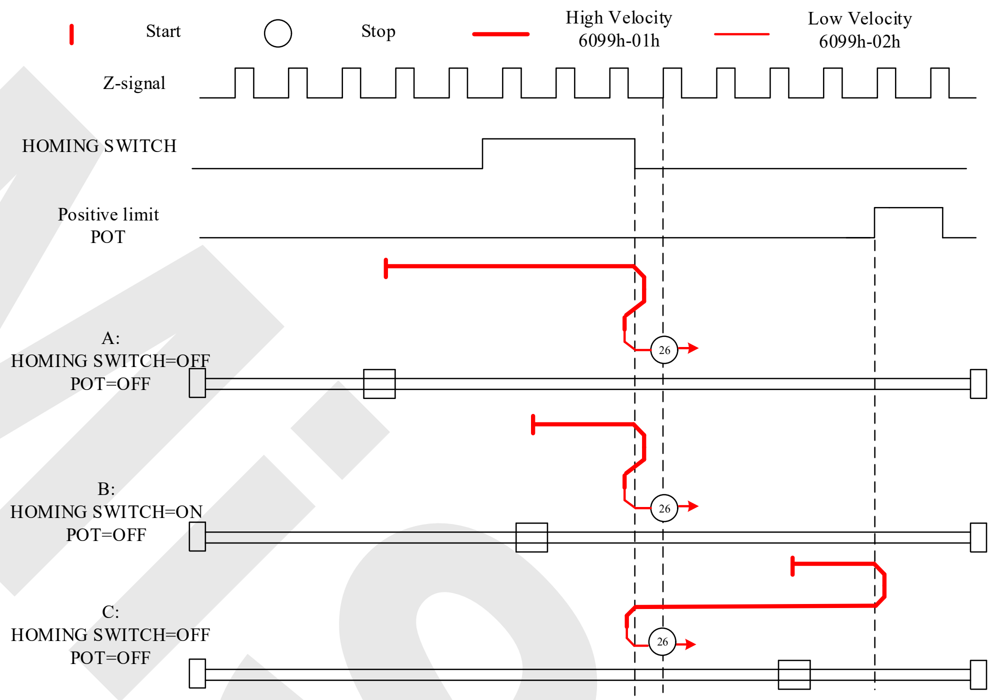
Mode 24:
This mode is similar to mode 8. Only difference is that homing point detection is not through Z-signal but through triggering of homing switch signal.



Mode 25:
This mode is similar to mode 9. Only difference is that homing point detection is not through Z-signal but through triggering of homing switch signal

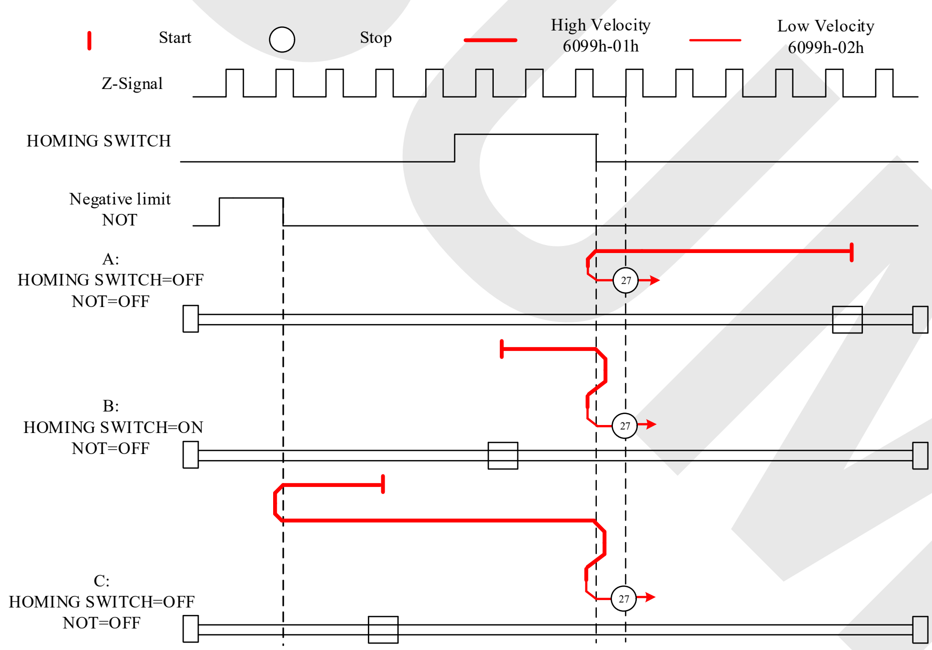


Mode 26:
This mode is similar to mode 10. Only difference is that homing point detection is not through Z-signal but through triggering of homing switch signal



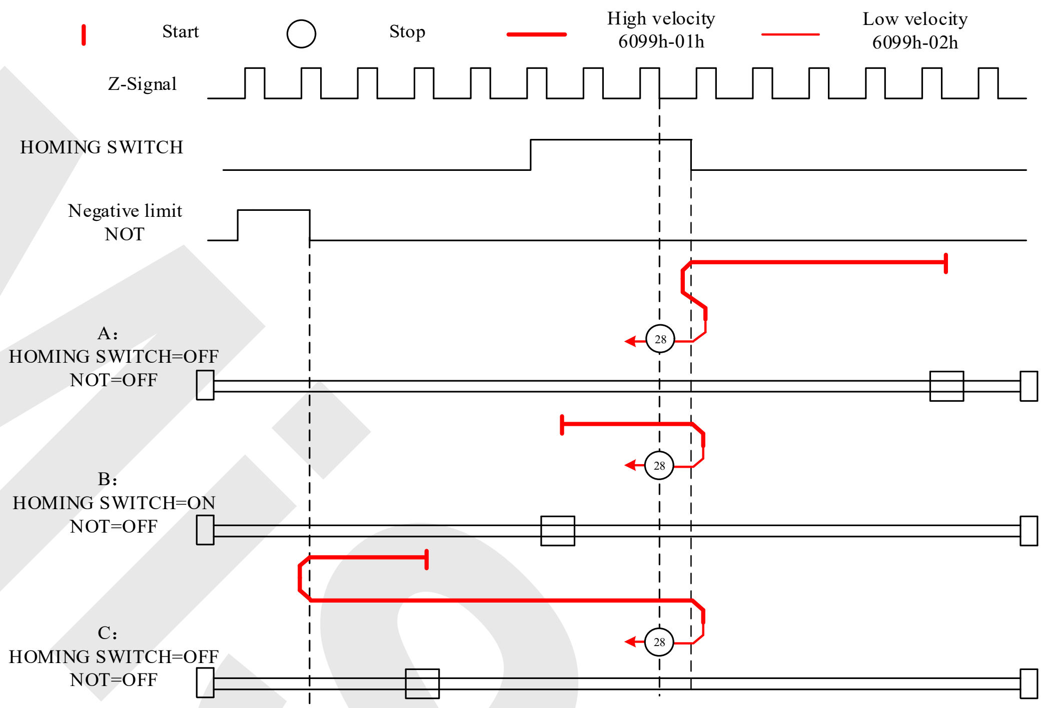
Mode 27：

This mode is similar to mode 11. Only difference is that homing point detection is not through Z-signal but through triggering of homing switch signal



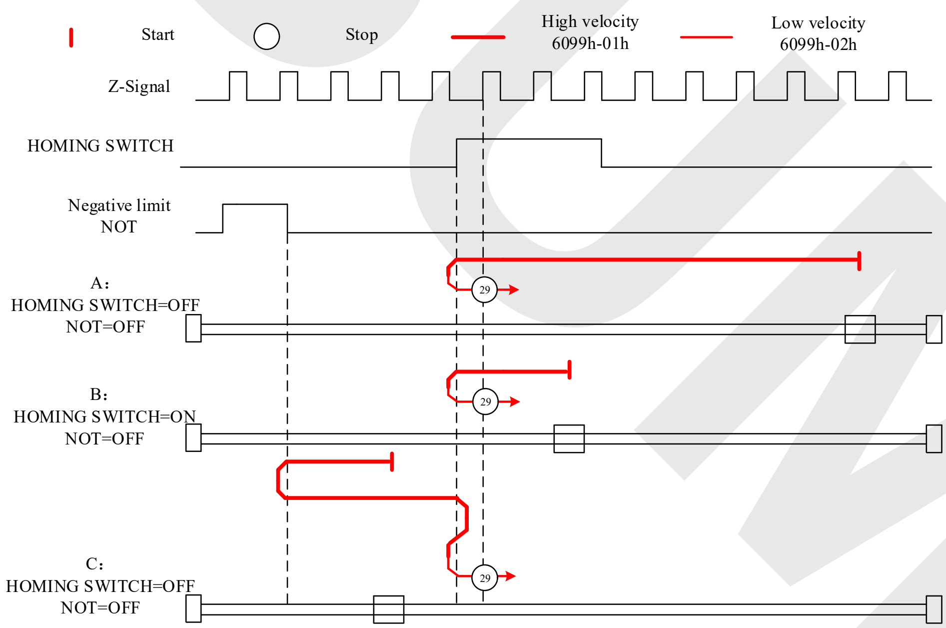
Mode 28：

This mode is similar to mode 12. Only difference is that homing point detection is not through Z-signal but through triggering of homing switch signal



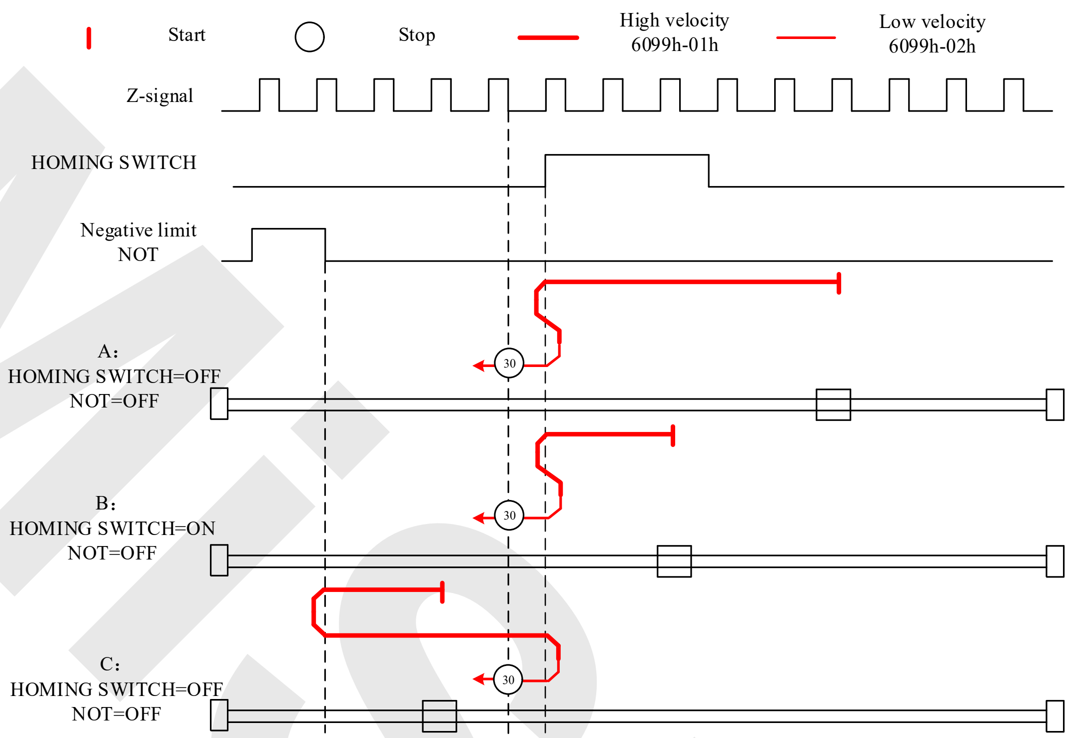
Mode 29：

This mode is similar to mode 13. Only difference is that homing point detection is not through Z-signal but through triggering of homing switch signal



Mode 30：

This mode is similar to mode 14. Only difference is that homing point detection is not through Z-signal but through triggering of homing switch signal

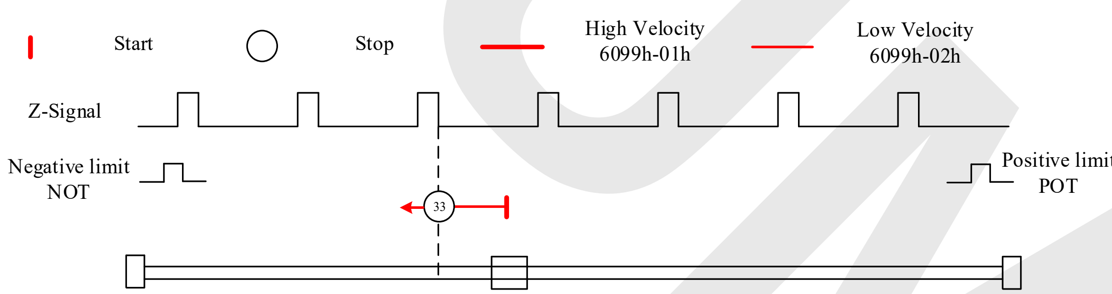


Other modes

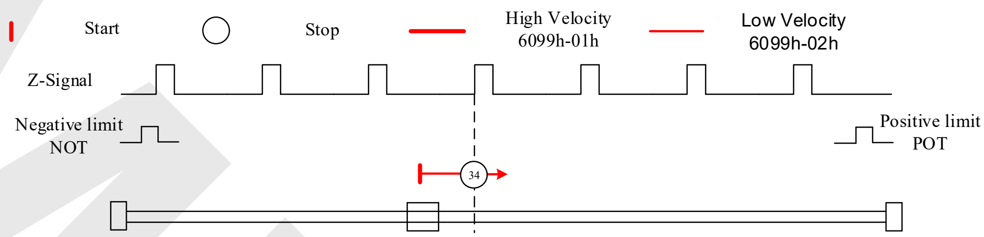
Mode 33:

The motor starts to move in **negative direction** and stops when the **Z-signal is valid**.

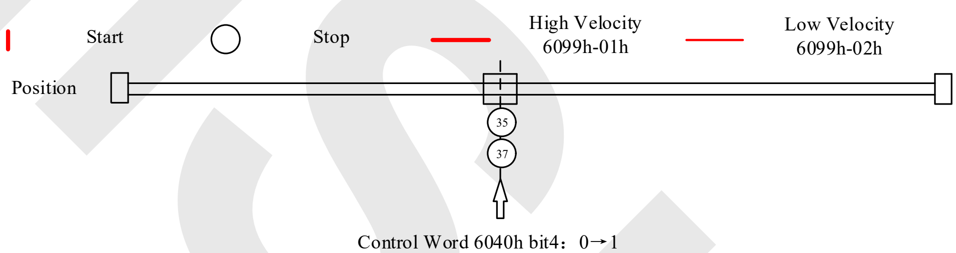
If the positive/negative limit switch signal or homing switch is valid during the homing process, the status word (6041h) bit 13 will be valid, indicating homing error and the motor will stop immediately.



Mode 34:
The motor starts to move in **positive direction** and stops when the **Z-signal is valid**.
If the positive/negative limit switch signal or homing switch is valid during the homing process, the status word (6041h) bit 13 will be valid, indicating homing error and the motor will stop immediately.



Mode 35/37:
Set the current position as homing point. Using this mode, motor doesn't have to be enabled. Set control word 6040h bit 4 from 0 to 1.



<u>Application: Realization of homing motion</u>
Step 1: 6060h = 6, determine if 6061h = 6. Servo driver is now under HM mode.
Step 2: Write motion parameters: Homing method 6098h, Homing velocity 6099h-01/6099h-02 and acceleration/deceleration 609Ah.
Step 3: Enable servo driver and switch bit 4 from 0 to 1 to start homing motion.

8.6 Velocity Control Mode（CSV、PV）

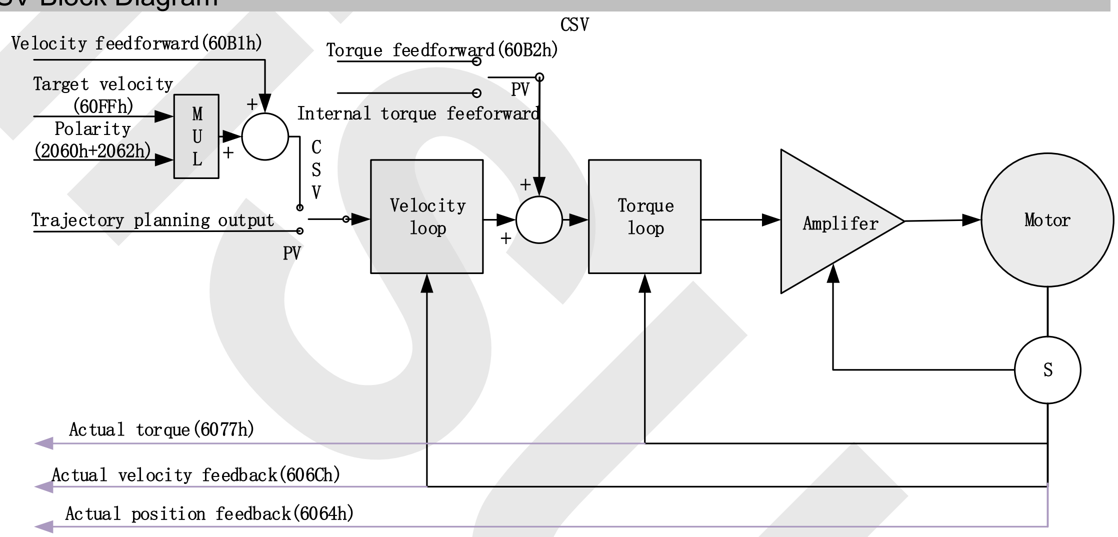
8.6.1 Common Functions of Velocity Control

Index	Sub Index	Name	Access	PDO	Mode	
					CSV	PV
6040	0	Control word	RW	RxPDO	Yes	Yes
6072	0	Max torque	RW	RxPDO	Yes	Yes
6080	0	Maximum motor velocity	RW	RxPDO	Yes	Yes
60B1	0	Velocity feedforward (Restricted by 6080)	RW	RxPDO	Yes	Yes
60B2	0	Torque feedforward	RW	RxPDO	Yes	Yes
60FF	0	Target velocity (Restricted by 6080)	RW	RxPDO	Yes	Yes

Index	Sub Index	Name	Access	PDO	Mode	
					CSV	PV
6041	0	Status word	RO	TxPDO	Yes	Yes
6063	0	Actual internal position	RO	TxPDO	Yes	Yes
6064	0	Actual feedback position	RO	TxPDO	Yes	Yes
606B	0	Internal command velocity	RO	TxPDO	Yes	Yes
606C	0	Actual feedback velocity	RO	TxPDO	Yes	Yes
6074	0	Internal torque command	RO	TxPDO	Yes	Yes
6076	0	Rated torque	RO	TxPDO	Yes	Yes
6077	0	Actual torque	RO	TxPDO	Yes	Yes

8.6.2 Cyclic Synchronous Velocity Mode (CSV)

CSV Block Diagram



Related Objects

Basic object

PDO	Index+Sub-Index	Name	Data Type	Access	Unit	Remarks
(RXPDO)	6040-00h	Control word	U16	RW	—	Required
	60FF-00h	Target velocity	I32	RW	Unit	Required
	60B1-00h	Velocity feedforward	I32	RW	Unit/S	Optional
	60B2-00h	Torque feedforward	I16	RW	0.1%	Optional
(TXPDO)	6041-00h	Status word	U16	RO	—	Required
	6064-00h	Actual position feedback	I32	RO	Unit	Optional
	606C-00h	Actual speed feedback	I32	RO	Unit/S	Optional
	60F4-00h	Actual following error	I32	RO	Unit	Optional
	6077-00h	Actual torque	I16	RO	0.1%	Optional

Extended object

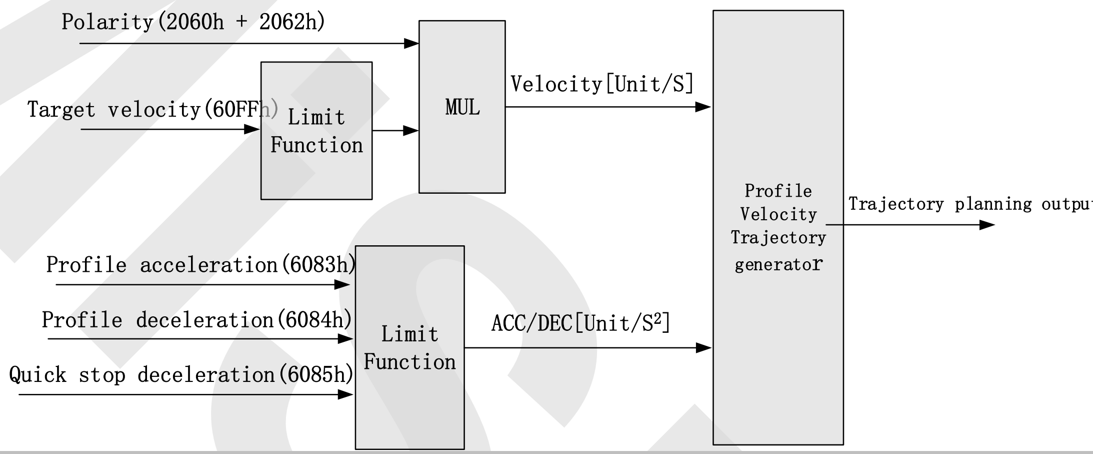
Index+Sub-Index	Name	Data Type	Access	Unit
603F-00h	Error code	U16	RO	—
6060-00h	Operation mode	I8	RW	—
6061-00h	Displayed operation mode	I8	RO	—
606B-00h	Internal command velocity	I32	RO	Unit
605A-00h	Quick stop option	I16	RW	—
6085-00h	Quick stop deceleration	U32	RW	Unit/S^2

8.6.3 Profile Velocity Mode (PV)

In asynchronous motion mode, master device is only responsible for sending motion parameters and control commands. E-DHASxxE servo driver will conduct trajectory planning according to the motion parameters sent by master device after receiving the motion start command from the master device. In asynchronous motion mode, the motion between each axes is asynchronous.

PV Block Diagram

The difference between PV and CSV mode is that PV needs E-DHASxxE to have the function of trajectory generator. The input and output structure of the trajectory generator is shown in figure 5.8



Related Objects

Basic object

PDO	Index+Sub-Index	Name	Data Type	Access	Unit	Notes
(RXPDO)	6040-00h	Control word	U16	RW	—	Required
	60FF-00h	Target velocity	I32	RW	Unit	Required
	6083-00h	Acceleration	I32	RW	Unit/S^2	Optional
(TXPDO)	6041-00h	Status word	U16	RO	—	Required
	6064-00h	Position feedback	I32	RO	Unit	Optional
	606C-00h	Velocity feedback	I32	RO	Unit/S	Optional
	60F4-00h	Actual following error	I32	RO	Unit	Optional
	6077-00h	Actual torque	I16	RO	0.1%	Optional

Extended object

Index+Sub-Index	Name	Data Type	Access	Unit
603F-00h	Error code	U16	RO	—
6060-00h	Operation mode	I8	RW	—
6061-00h	Displayed operation mode	I8	RO	—
605A-00h	Quick stop option	I16	RW	—
6084-00h	Deceleration	U32	RW	Unit/S^2
6085-00h	Quick stop deceleration	U32	RW	Unit/S^2

Control Word and Status Word for Profile Velocity Mode

The bit6~4 of control words (6040h) associated with the control mode in PV mode are invalid. The motion in PV mode can be triggered as long as the motion parameters (target velocity (60FFh) ACC/DEC (6083h/6084h)) are given after the axis is enabled.

Table7. Bit15~12、10、8 of Status word (6041h) for Profile Velocity Mode

Bit (Label)	Value	Details
8 (Quick stop)	0	Quick stop invalid
	1	Quick stop valid
10 (Velocity reached)	0	Velocity not yet reached
	1	Velocity reached
12 (Zero speed)	0	It's not zero speed. It's moving.
	1	Zero speed or it's going to slow down to zero speed *1)

*1) Zero speed of bit 12 is generally effective when deceleration stop and hardware limit valid.

<u>Application: Realization of profile velocity motion</u>

Step 1: 6060h = 3, determine if 6061h = 3. Servo driver is now under PV mode.

Step 2: Write motion parameters: Target velocity 60FFh, acceleration 6083h and deceleration 6084h.

8.7 Torque Mode（CST、PT）

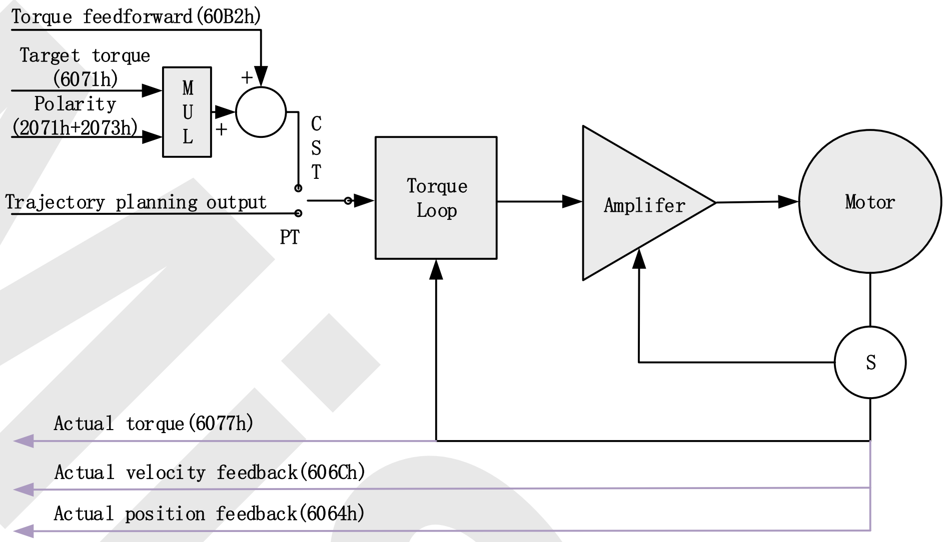
8.7.1 Common Functions of Torque Mode

Index	Sub Index	Label	Access	PDO	Mode	
					CST	PT
6040	0	Control word	RW	RxPDO	Yes	Yes
6071	0	Target torque	RW	RxPDO	Yes	Yes
6072	0	Max torque	RW	RxPDO	Yes	Yes
6080	0	Maximum motor speed	RW	RxPDO	Yes	Yes
6087	0	Torque change rate	RW	RxPDO	Yes	Yes
60B2	0	Torque feedforward	RW	RxPDO	Yes	Yes

Index	Sub Index	Label	Access	PDO	Mode	
					CST	PT
6041	0	Status word	RO	TxPDO	Yes	Yes
6063	0	Actual internal position	RO	TxPDO	Yes	Yes
6064	0	Actual feedback position	RO	TxPDO	Yes	Yes
606C	0	Actual feedback velocity	RO	TxPDO	Yes	Yes
6074	0	Internal torque command	RO	TxPDO	Yes	Yes
6075	0	Rated current	RO	No	Yes	Yes
6076	0	Rated torque	RO	No	Yes	Yes
6077	0	Actual torque	RO	TxPDO	Yes	Yes
6079	0	Bus voltage	RO	TxPDO	Yes	Yes

8.7.2 Cyclic Synchronous Torque Mode (CST)

CST Block Diagram



Related Objects

Basic object

PDO	Index+Sub-Index	Name	Data Type	Access	Unit	Remarks
(RXPDO)	6040-00h	Control word	U16	RW	—	Required
	6071-00h	Target torque	I16	RW	Unit	Required
	6087-00h	Torque feed-forward	U32	RW	0.1%/S	Optional
(TXPDO)	6041-00h	Status word	U16	RO	—	Required
	6064-00h	Actual position feedback	I32	RO	Unit	Optional
	606C-00h	Actual velocity feedback	I32	RO	Unit/S	Optional
	60F4-00h	Actual following error	I32	RO	Unit	Optional
	6077-00h	Actual torque	I16	RO	0.1%	Required

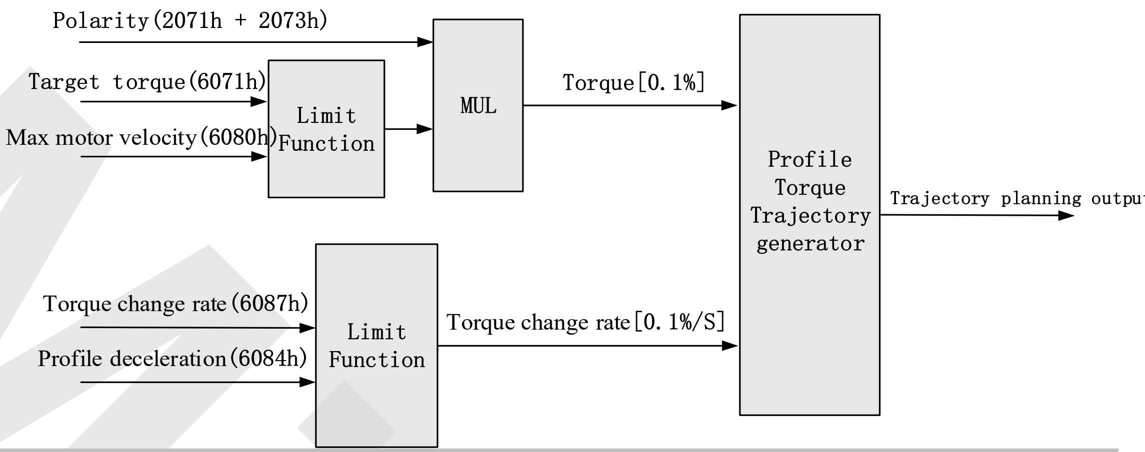
Extended object

Index+Sub-Index	Name	Data Type	Access	Unit
603F-00h	Error code	U16	RO	—
6060-00h	Operation mode	I8	RW	—
6061-00h	Displayed operation mode	I8	RO	—
6074-00h	Internal command torque	I16	RO	0.1%
605A-00h	Quick stop option	I16	RW	—
6080-00h	Maximum motor velocity	U32	RW	Unit/S
6085-00h	Quick stop deceleration	U32	RW	Unit/S^2
60B1-00h	Velocity feedforward	I32	RW	Unit/S
2077-00h	Velocity limit	I16	RW	RPM

8.7.3 Profile Torque Mode (PT)

In asynchronous motion mode, master device is only responsible for sending motion parameters and control commands. E-DHASxxE-F servo driver will conduct trajectory planning according to the motion parameters sent by master device after receiving the motion start command from the master device. In asynchronous motion mode, the motion between each axes is asynchronous.

PT Block Diagram



Related Objects

Basic object

PDO	Index+Sub-Index	Label	Data Type	Access	Unit	Notes
(RXPDO)	6040-00h	Control word	U16	RW	—	Required
	6071-00h	Target torque	I16	RW	0.1%	Required
	6087-00h	Torque change rate	U32	RW	0.1%/S	Optional
(TXPDO)	6041-00h	Status word	U16	RO	—	Required
	6064-00h	Actual feedback position value	I32	RO	Unit	Optional
	606C-00h	Actual feedback speed value	I32	RO	Unit/S	Optional
	60F4-00h	Actual following error	I32	RO	Unit	Optional
	6077-00h	Actual torque	I16	RO	0.1%	Optional

Extended object

Index+Sub-Index	Label	Data Type	Access	Unit
603F-00h	Error code	U16	RO	—
6060-00h	Operation mode	I8	RW	—
6061-00h	Displayed operation mode	I8	RO	—
6074-00h	Internal command torque	I16	RO	0.1%
6080-00h	Maximum motor velocity	U32	RW	Unit/S
605A-00h	Quick stop option	I16	RW	—
6085-00h	Quick stop deceleration	U32	RW	Unit/S^2
2077-00h	Velocity limit	I16	RW	RPM

Application: Realization of profile torque motion

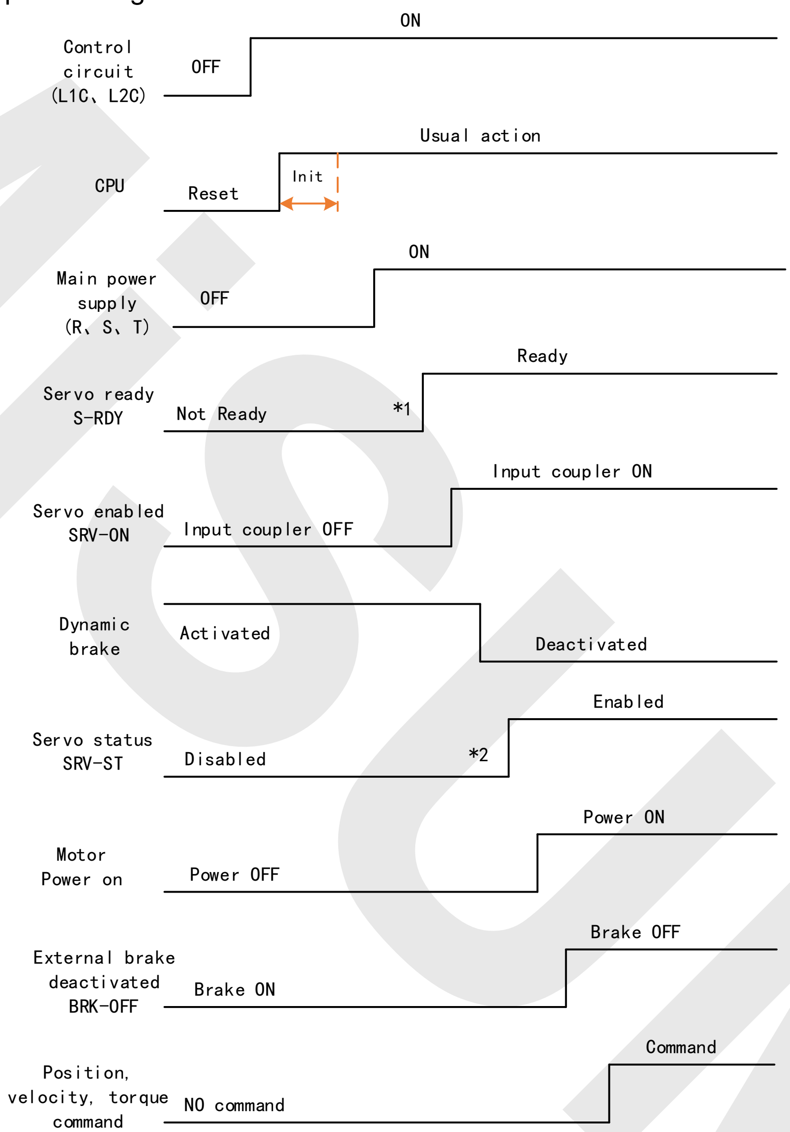
Step 1: 6060h = 4, determine if 6061h = 4. Servo driver is now under PT mode.

Step 2: Write motion parameters: Target torque 6071h, Torque change rate 6087h, and Max. velocity limit 6080h

Chapter 9 Timing Chart

9.1 Servo Enabled

Power on sequence diagram



Please enter servo status, position, velocity, torque command as sequence diagram above.
*1. S-RDY signal is given after CPU initialization and main power supply powered on.
* 2. SRV-ST signal is received when servo driver is enabled. Command input is not allowed yet.

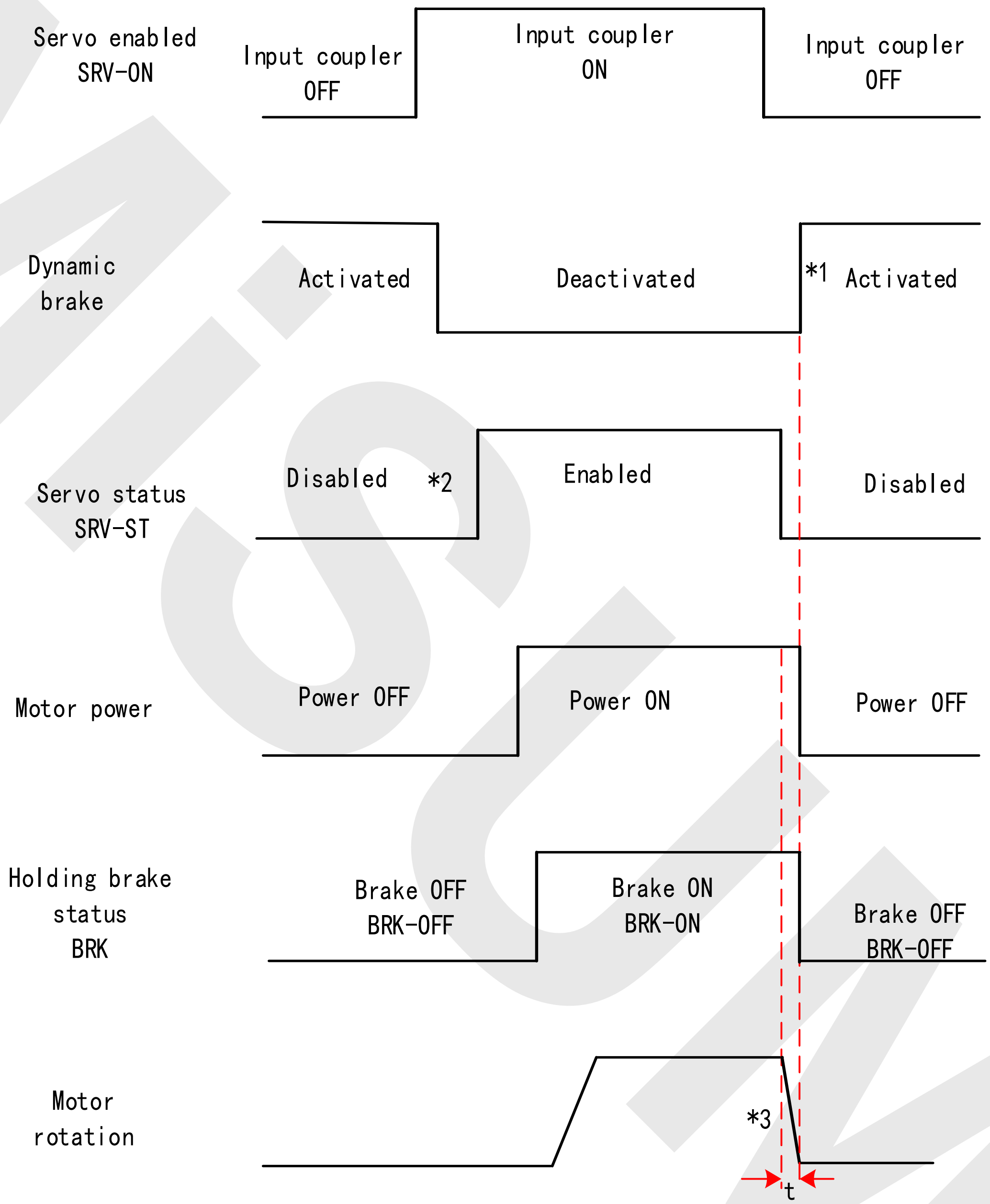
9.2 Servo Stop

Servo stopping are of 3 different methods: Servo braking method, free stopping method, dynamic braking method.

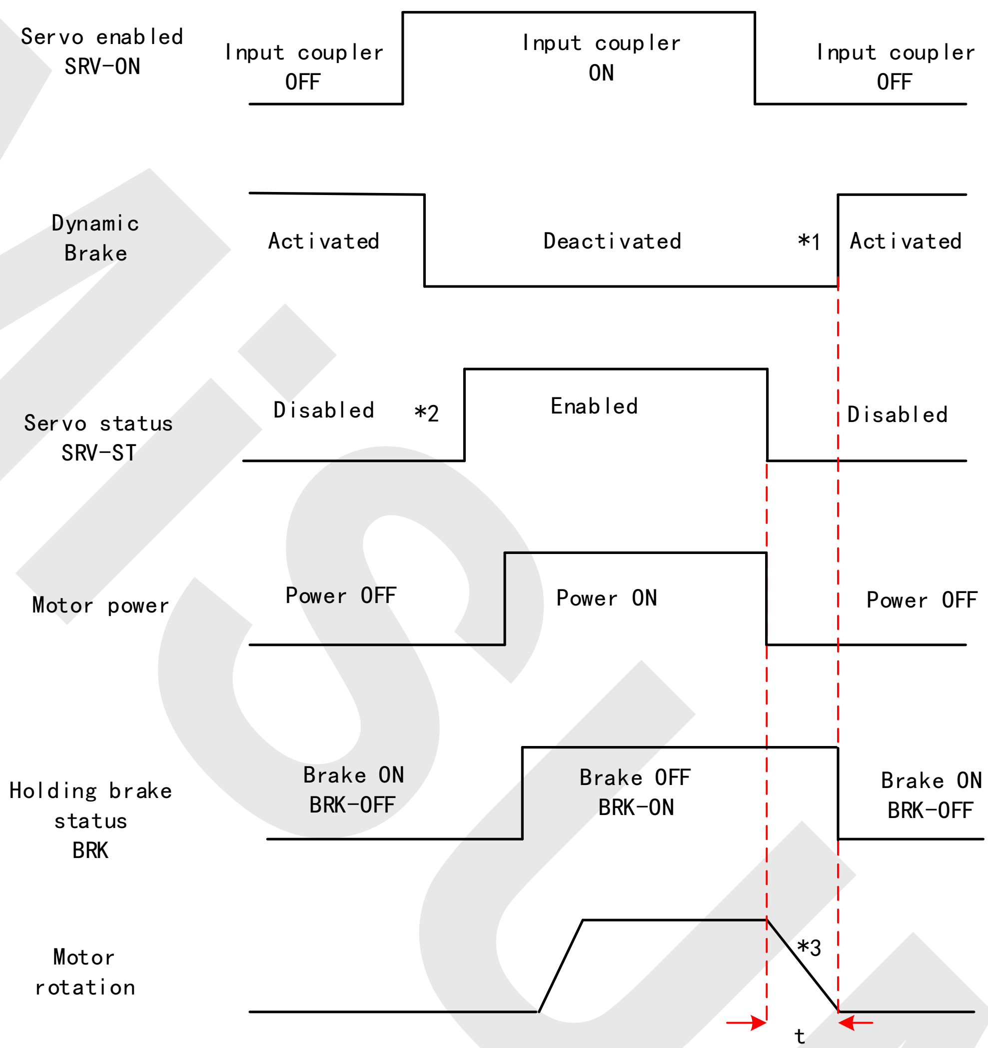
Stopping method	Description	Details
Servo braking	Servo driver delivers braking torque in opposite direction	Quick stopping but mechanical impact might exist
Free stopping	Motor power cut off. Free to move until velocity = 0. Affected inertia, friction and other factors	Smooth deceleration, low mechanical impact but slow stopping
Dynamic braking	Brake activated when in motion	Quick stopping but mechanical impact might exist

Stopping status	Status after stopped
Free running	Motor is powered off, rotor is free to rotate
Dynamic braking	Motor is powered off, rotor is not free to rotate
Holding brake stopping	Motor axis is locked, cannot rotate freely

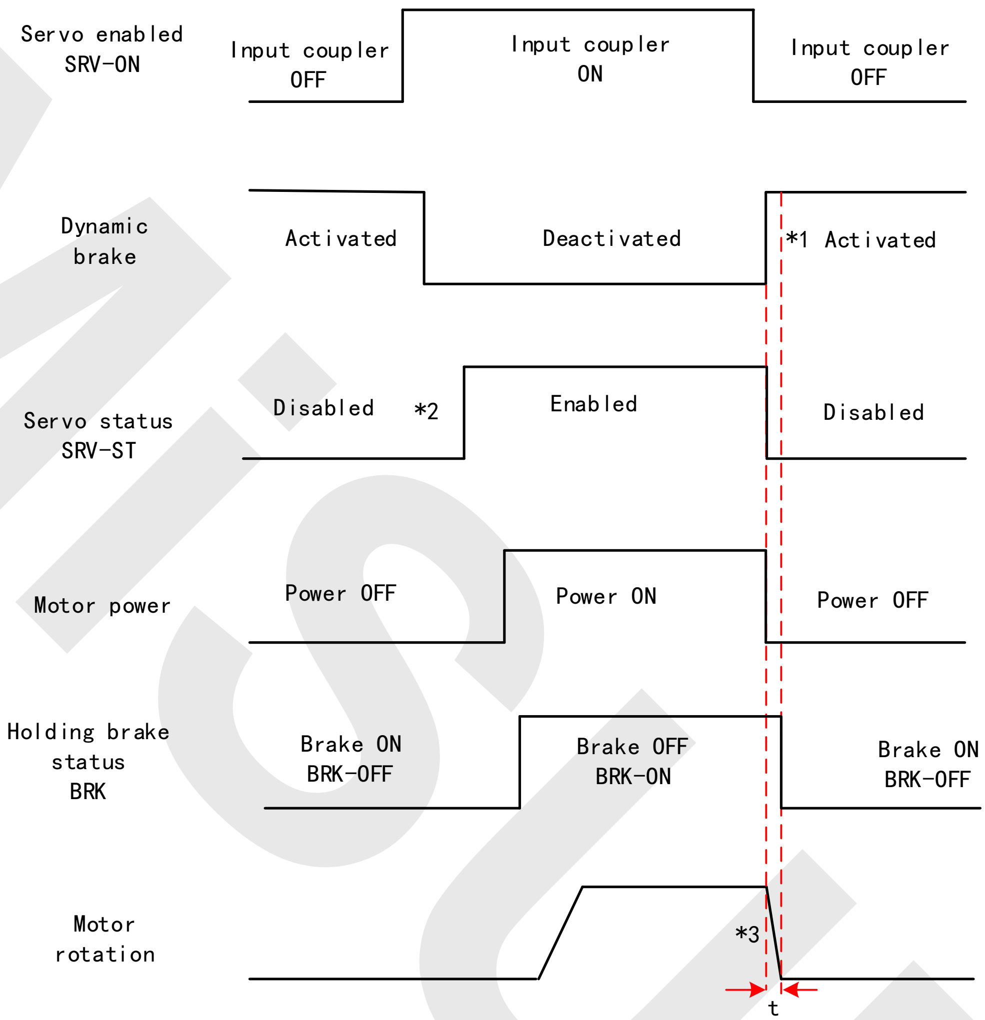
Motor stopping（Servo disabled）- Sequence Diagram
Servo braking method. Status after stopping: Dynamic braking (P05.06 = 1)



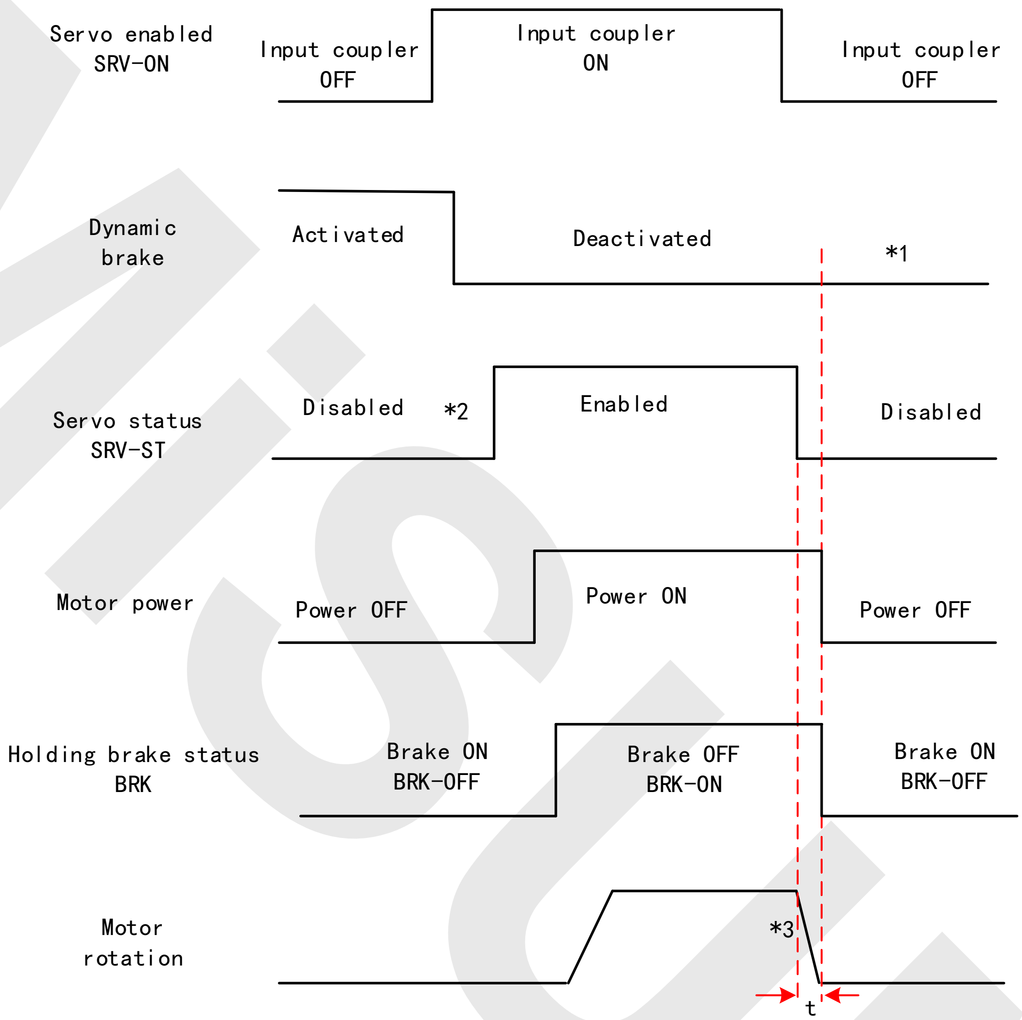
Free stopping method. Status after stopping: Dynamic braking (P05.06 = 1)



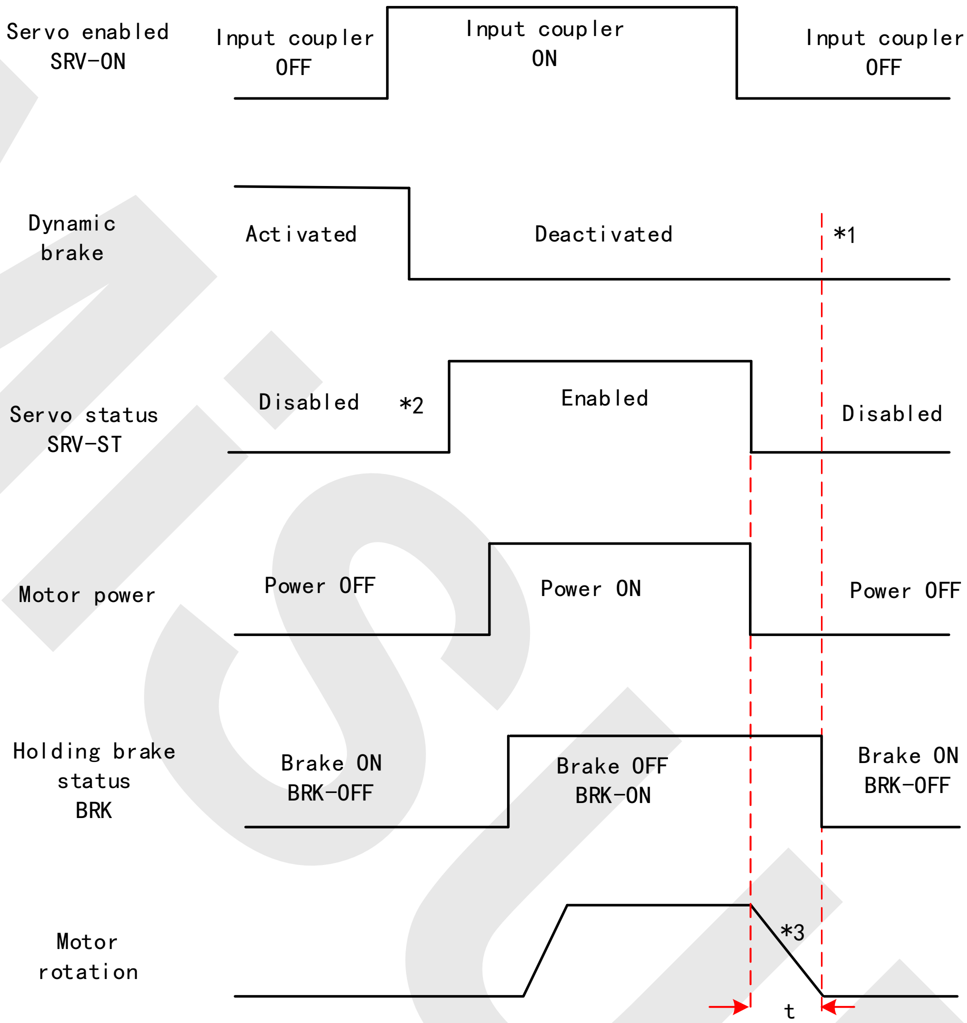
Dynamic braking method. Status after stopping: Dynamic braking (P05.06 = 2)



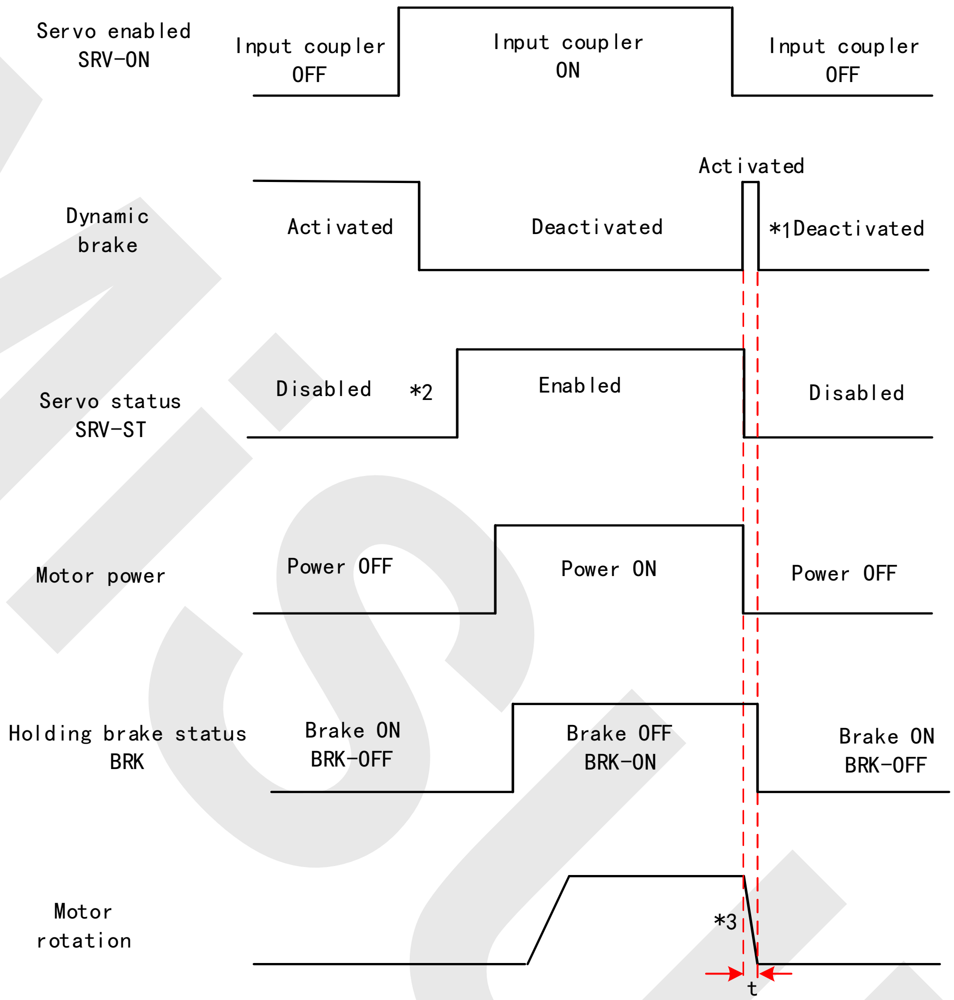
Servo stopping method. Status after stopping: Free running (P05.06 = 3)



Free stopping method. Status after stopping: Free running (P05.06 = 4)



Dynamic braking method. Status after stopping: Free running (P05.06 = 5)



*1. Status after stopping is as defined in P05.06.

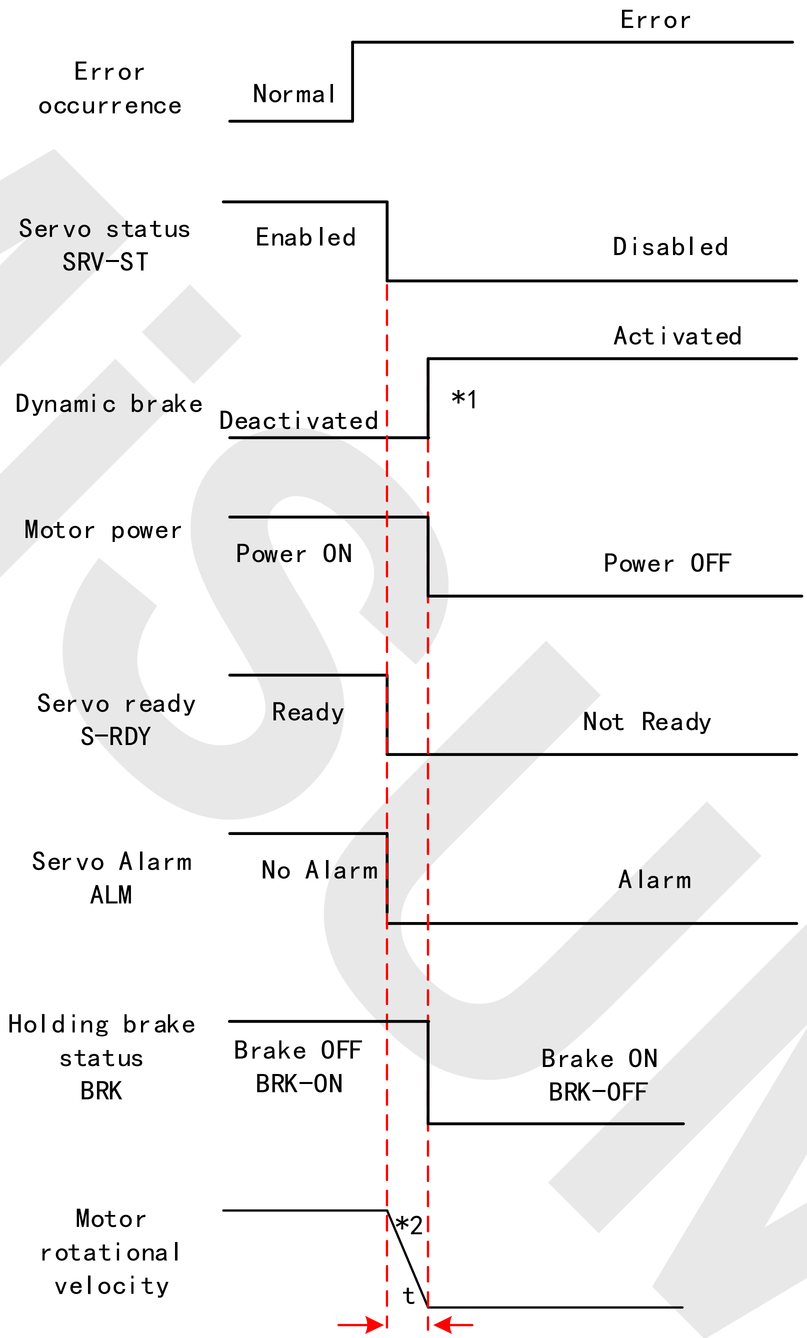
*2. SRV-ST signal is received when servo driver is enabled. Command input is not allowed yet.

*3. Servo stopping method is as defined in P05.06; braking torque in opposite direction to decelerate the motor is as defined in P05.11. Deceleration time t is determined by whichever comes first between time set in P06.14 and time needed for motor to drop below velocity set in P04.39. After deceleration time t, dynamic braking will be off and holding brake signal will be set to OFF (Holding brake is activated. Although BRK-OFF signal is valid, actual activation of holding brake is dependent on whether the motor comes with holding brake).

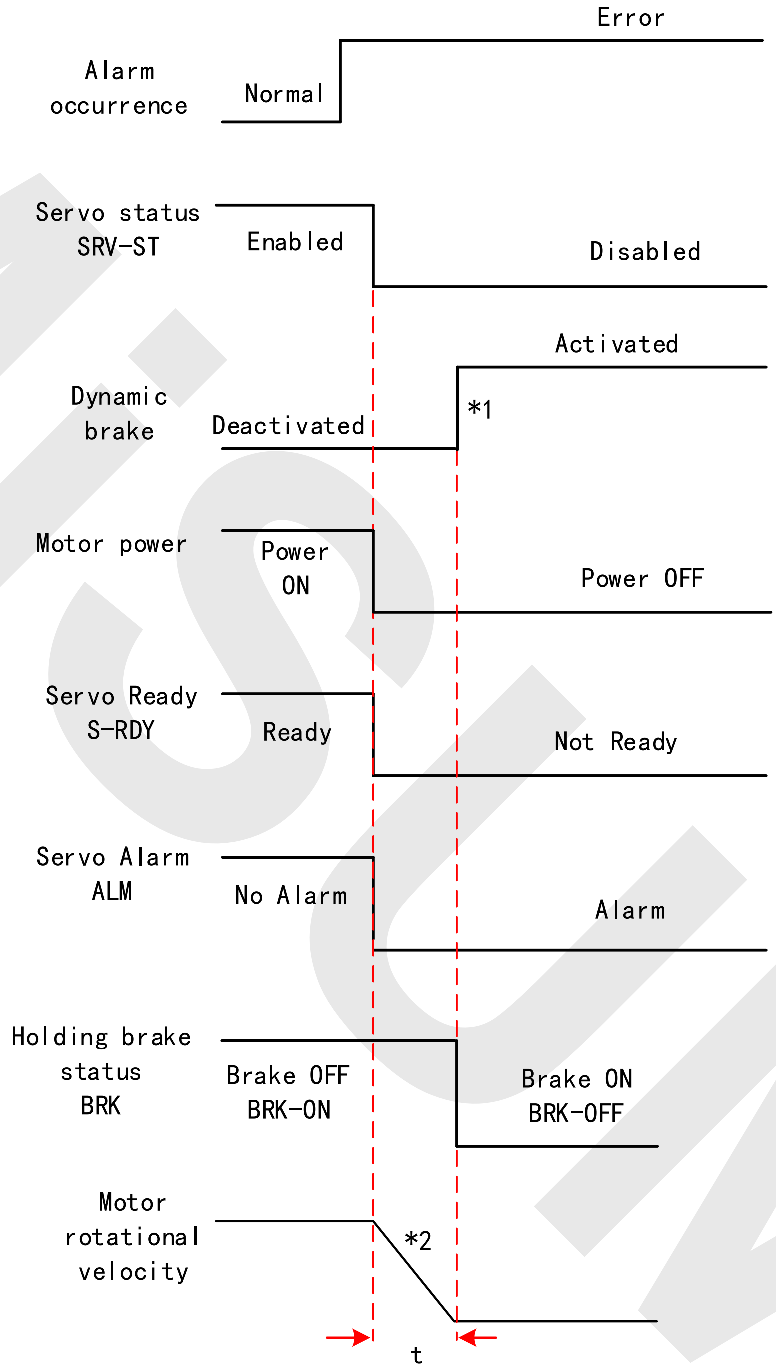
4. BRK-ON signal doesn't indicate the activation of holding brake but the validation of the signal. Holding brake is not applied when BRK-ON signal is valid. Same idea goes for BRK-OFF signal.

Stopping when alarm occurs – Sequence Diagram

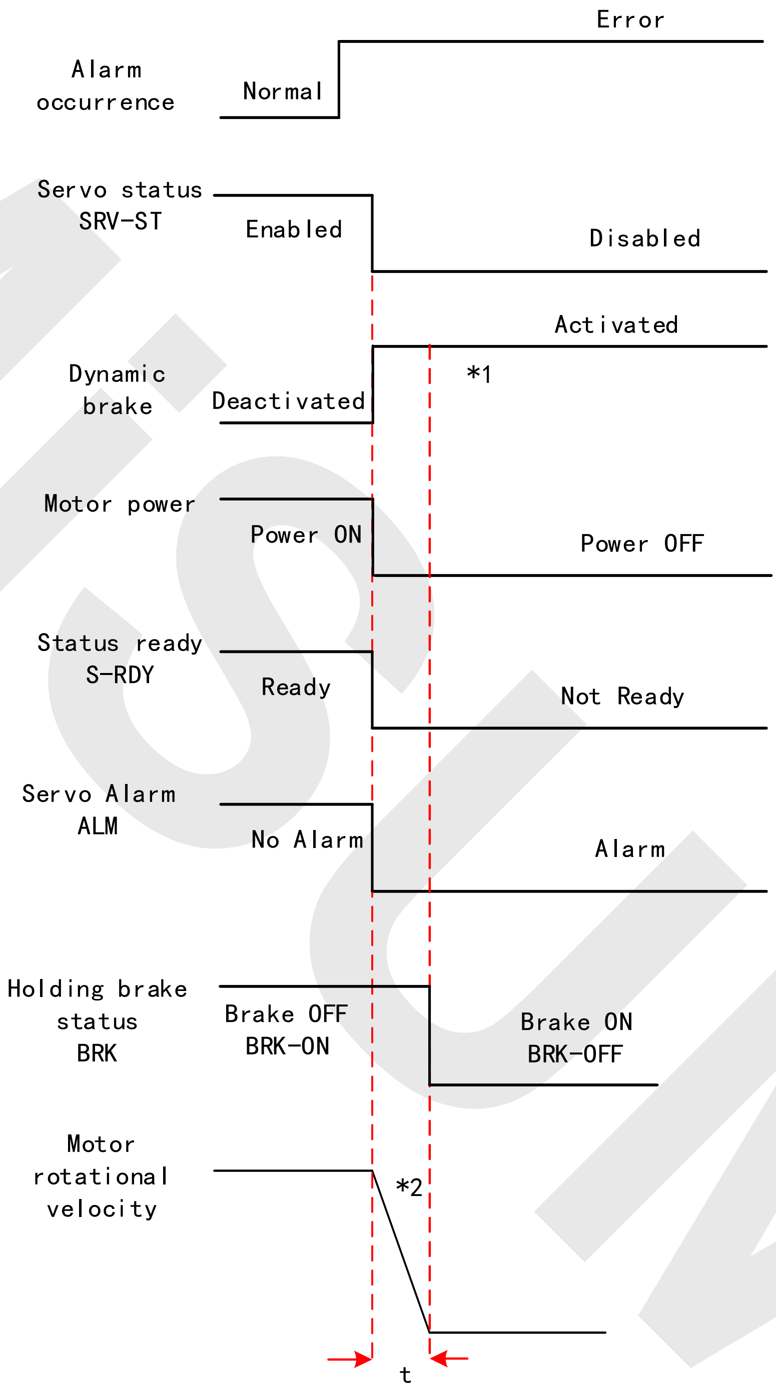
Servo braking method. Status after stopping: Dynamic braking



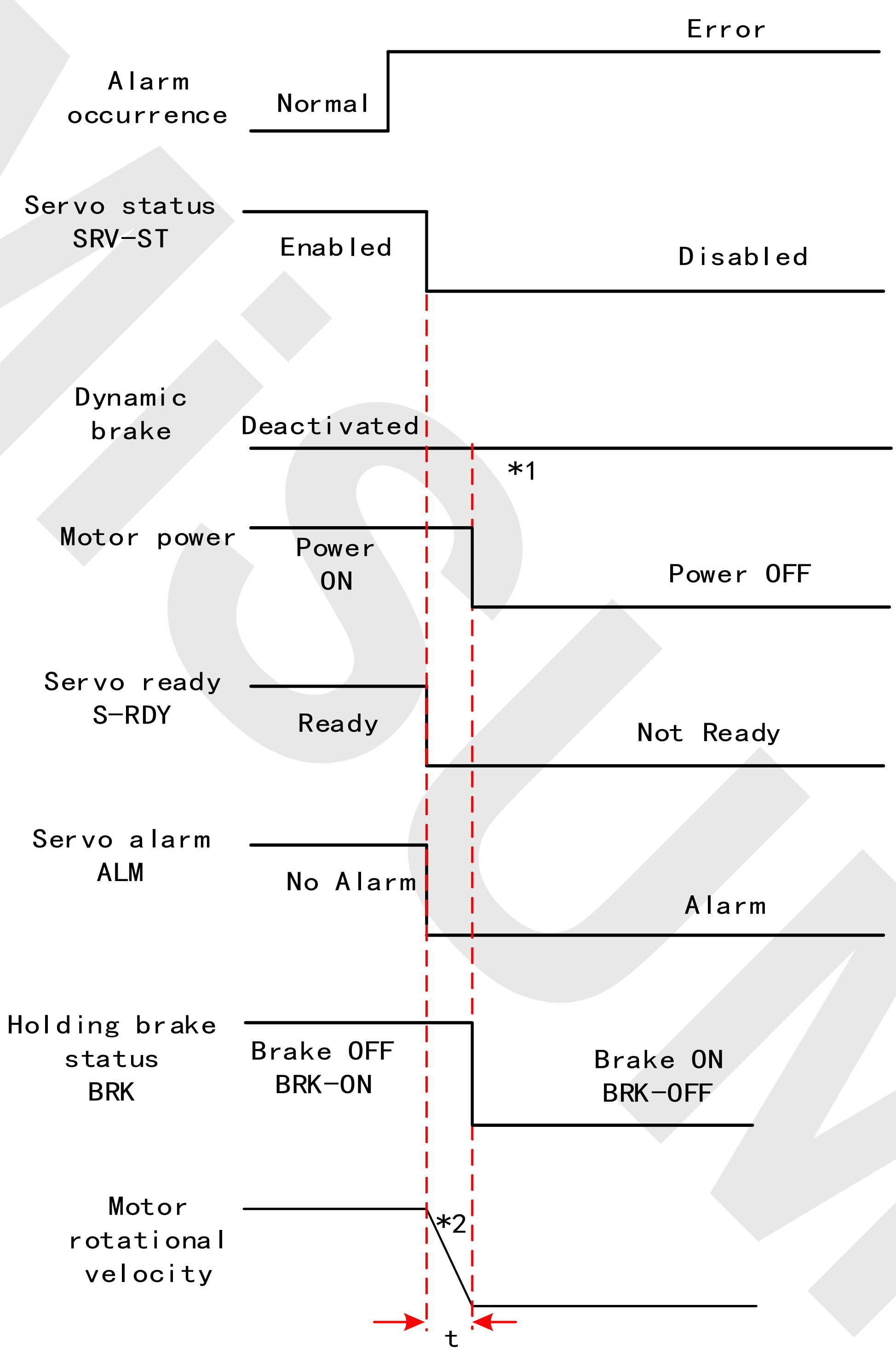
Free stopping method. Status after stopping: Dynamic braking



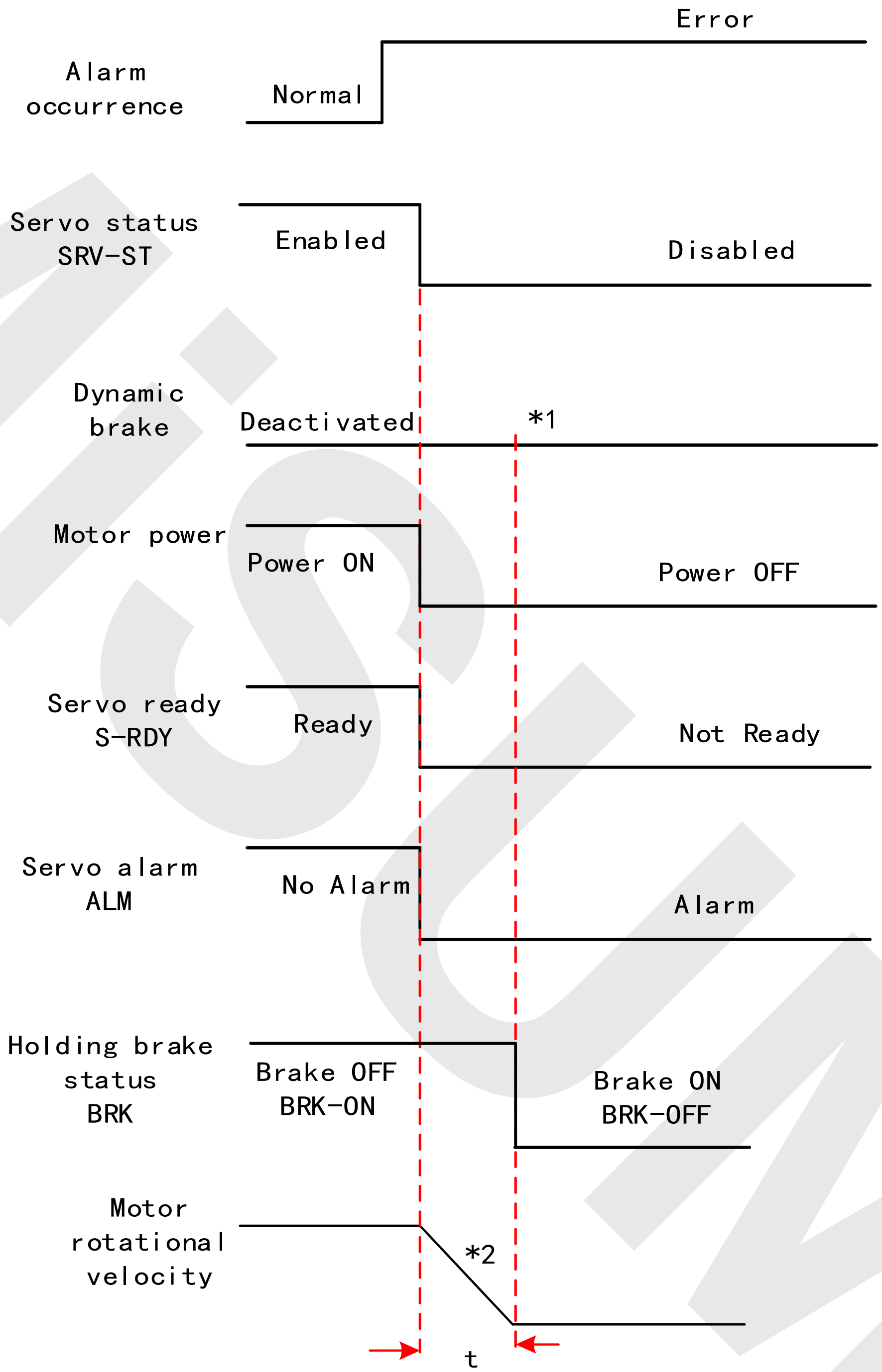
Dynamic braking method. Status after stopping: Dynamic braking



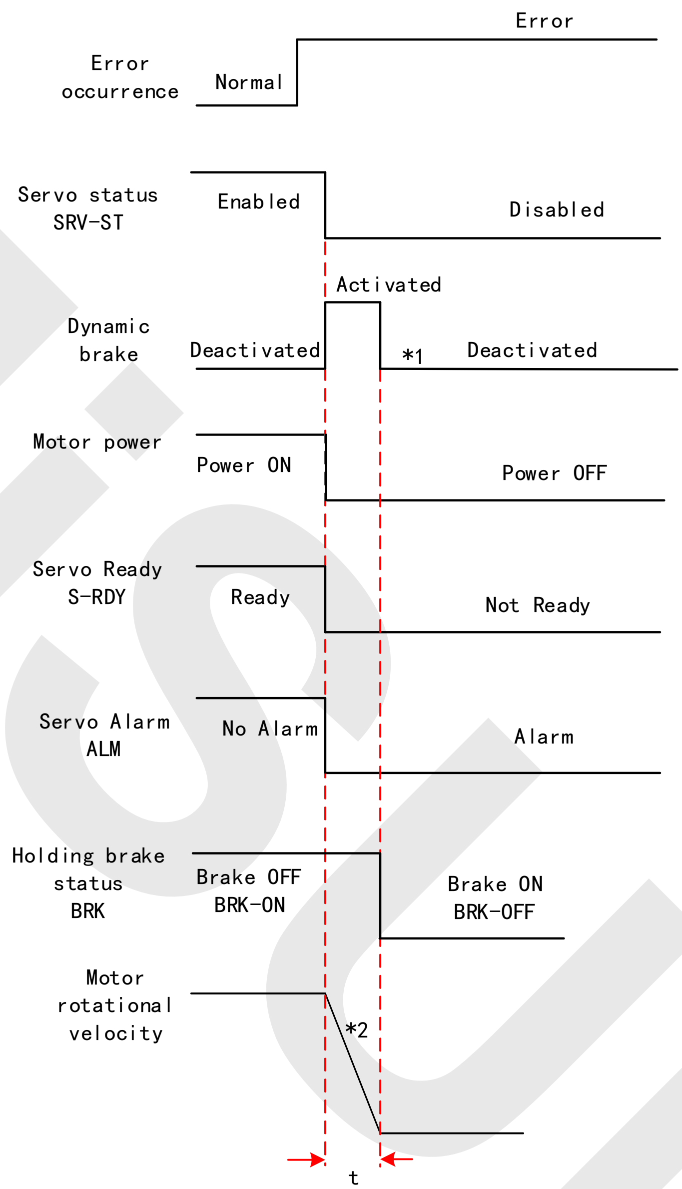
Servo braking method. Status after stopping: Free running



Free stopping method. Status after stopping: Free running



Dynamic braking. Status after stopping: Free running

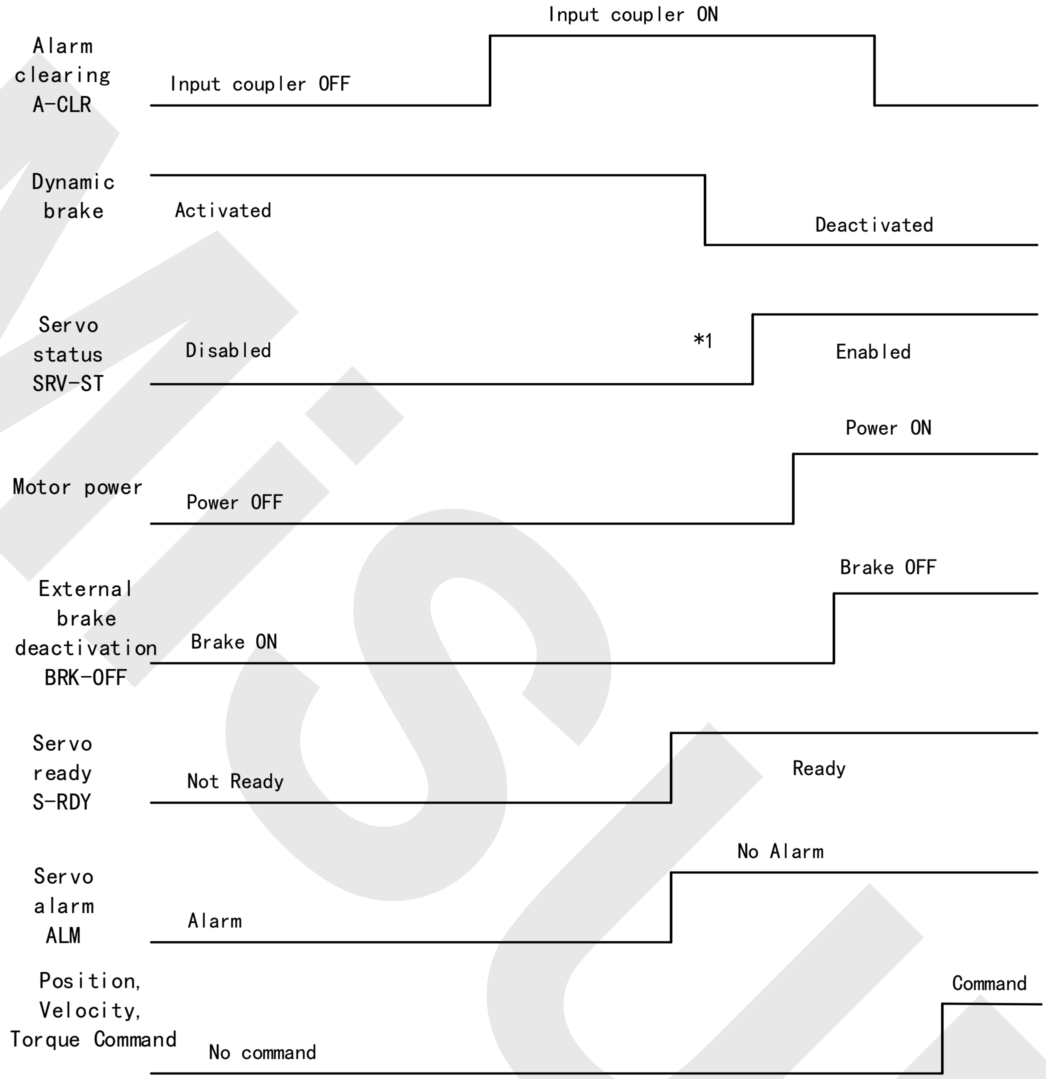


*1. Status after stopping is as defined in P05.10.

*2. Servo stopping method is as defined in P05.10. Deceleration time t is determined by whichever comes first between time set in P06.14 and time needed for motor to drop below velocity set in P04.39. After deceleration time t, dynamic braking will be off and holding brake signal will be set to OFF (Holding brake is activated. Although BRK-OFF signal is valid, actual activation of holding brake is dependent on whether the motor comes with holding brake).

3. BRK-ON signal doesn't indicate the activation of holding brake but the invalidation of the signal. Holding brake is not applied when BRK-ON signal is valid. Same idea goes for BRK-OFF signal.

Alarm clearing - Sequence diagram



*1.SRV-ST signal is received when servo driver is enabled. Command input is not allowed yet

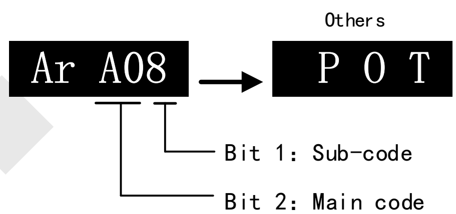
*2. BRK-OFF signal doesn't indicate the deactivation of holding brake but the invalidation of the signal. Holding brake is applied when BRK-OFF signal is invalid.

Chapter 10 Warning and Alarm

10.1 Servo driver warning

When warning occurs, driver will set protective function but **motor won't stop moving**. Error code will be displayed on the front panel.

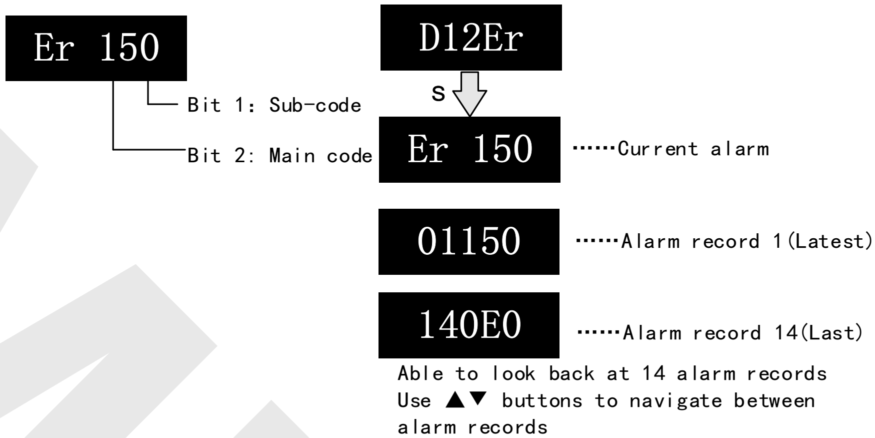
Example of warning code:



Warning Code		Content
Main	Code	
A0	1	Overload warning
	2	Regeneration energy overload warning (**85% of the regeneration threshold**)
	3	Absolute encoder **battery voltage low (<3.1V)**. Valid when P00.15 is set to 1.
	4	Change the parameter to a non-real time valid warning
	7	Low temperature warning **(< 20℃)**
	8	Positive limit switch valid. **POT** blinking on front panel
	9	Negative limit switch valid. **NOT** blinking on front panel
	A	Positive and negative limit switch valid. **PNOT** blinking on front panel
	B	Current position is beyond software positive limit. **SPOT** blinking on front panel
	C	Current position is beyond software negative limit. **NPOT** blinking on front panel
	D	Current position is beyond software negative, positive limit. **SPNOT** blinking on front panel
	E	Parameters reset to factory default. Restart needed
A1	3	The encoder multi-turn data cannot be cleared in the enabled state
	5	Communication fault when gantry is disabled
	6	Gantry axis fault, other axis warning Ar16
	7	Gantry axis emergency stop signal active, other axis warning Ar17
	8	Gantry axis limit active, other axis warning Ar18
	9	Slave axis PWM synchronization alarm when gantry is disabled
	A	Gantry communication error too high
	B	Gantry-related parameter settings error (gantry alignment offset setting exceeds 1/4 pulse, spindle warning Ar1b)

10.2 Servo driver alarm

When an alarm occurs, the driver will set protective function and **motor stops moving**. Error code will be displayed on the front panel. Alarm history records can also be viewed in data monitoring mode, with the alarm log sub-menu displaying "d12Er".

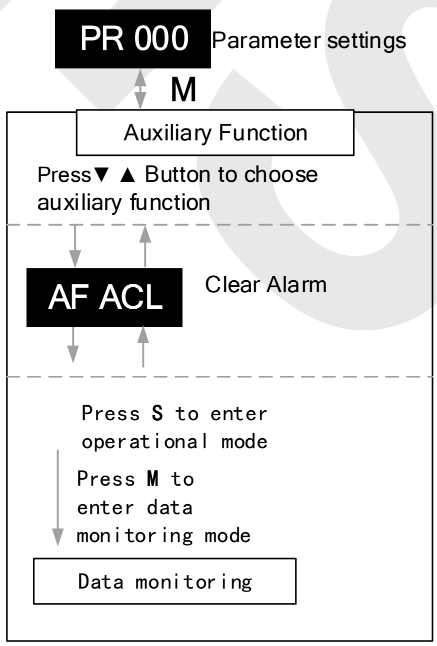


Error code		Content	Attribute		
Main	Sub		Save	Type	Clearable
09	0~F	FPGA communication error	●	2	
0A	0~1	Circuit current detection error	●	2	
	2 , 4	Analog input error	●	2	
	3	Motor power cable not connected	●	1	
	5	DC bus error	●	2	
	6	Temperature measuring error	●	2	
0b	0	Control circuit power supply voltage too low		2	
	1	Control circuit power supply voltage too high		2	●
0c	0	DC bus overvoltage	●	1	●
0d	0	DC bus undervoltage	●	1	●
	1	Single phasing of main power supply	●	2	
	2	No main power supply detected		2	
0E	0	Overcurrent	●	1	
	1	Intelligent Power Module (IPM) overcurrent	●	1	
	2	Power output to motor shorted to ground	●	1	
	4	Phase overcurrent	●	1	
0F	0	Driver overheated	●	2	
10	0	Motor overloaded	●	1	●
	1	Driver overloaded	●	1	●
	2	Motor rotor blocked	●	1	●
11	0	Soft start relay is not energized	●		
	1	Cooling fan damaged	●		
12	0	Regenerative resistor overvoltage	●	2	
	1	Holding brake error	●	1	
	2	Regenerative resistor value too low	●	2	
15	0	Encoder disconnected	●	1	
	1	Encoder communication error	●	1	
	2	Encoder initial position error	●	1	
	3	Multiturn encoder error	●	2	
	4	Encoder parameter settings error	●	2	
	5	Encoder data overflow	●	2	●
	6	Encoder overheated	●	2	●
	7	Encoder counter error	●	2	●
	A	Encoder wire broken (A)	●	1	

	b	Encoder wire broken (B)	●	1	
	C	Encoder wire broken (Z)	●	1	
	d	Encoder wire broken (UVW)	●	1	
17	0	Encoder data error	●	1	
	1	Encoder parameter initialization error	●	1	
18	0	Excessive position deviation	●	2	●
	1	Excessive velocity deviation	●	2	●
19	0	Motor vibration too strong	●	2	●
	1	Excessive hybrid position deviation	●	1	●
1A	0	Overspeed	●	2	●
	1	Velocity out of control	●	1	●
1b	0	Bus input signal dithering	●	2	●
	1	Incorrect electronic gear ratio	●	2	●
	3	External encoder frequency divider parameter error	●	1	
	4	Excessive synchronous position command	●	2	●
1c	0	Both STO failed	●	1	●
	1	1st STO failed	●	1	●
	2	2nd STO failed	●	1	●
	3	STO power supply 3.3v anomaly		2	
	4	STO power supply 5.0v anomaly		2	
	5~8	Faulty STO internal optocoupler, inverter		2	
21	0	I/O input interface assignment error	●	2	
	1	I/O input interface function assignment error	●	2	
	2	I/O output interface function assignment error	●	2	
24	0	CRC correction during EEPROM parameter saving		2	
	1	I2C communication status error		2	
	2	Error r/w alarm history record		2	
	3	Error r/w diagnostic data		2	
	4	Error r/w 402 parameters		2	
	5	Error r/w communication parameters		2	
25	0	Gantry deviation error			
	1	Gantry communication error			
	2	Gantry slave axis is not enabled	●		●
	3	Gantry synchronous torque deviation is too high	●		●
	4	Gantry synchronization mode is in non-position control mode	●		●
	5	Gantry alignment failed	●		●
26	0	Positive/Negative position limit triggered under non-homing mode	●	2	●
27	0	Analog 1 input overrun limit	●	2	●
	1	Analog 2 input overrun limit	●	2	●
	2	Analog 3 input overrun limit	●	2	●
28	0	Pulse regeneration limit protection	●	2	●
29	0	Control mode not match under full closed loop mode	●	1	
	1	Encoder mode not match under full closed loop mode	●	1	
55	0	External ABZ encoder disconnected	●	1	
	1	External ABZ encoder Phase A disconnected	●	1	
	2	External ABZ encoder Phase B	●	1	

		disconnected			
	3	External ABZ encoder Phase Z disconnected	●	1	
57	0	Forced alarm input valid(E-stop)	●	2	●
5F	0	Motor model no. detection error		2	
	1	Driver power module detection error		2	
60	0	Main loop interrupted timeout		2	
	1	Velocity loop interrupted timeout		2	
70	0	Encryption error		2	
89	0	Homing error		2	●
92	0	External encoder parameter initialization error	●	1	

Save: Save error messages to alarm history.
Type: The type 1 and type 2 fault stop mode can be set via P05.10 [Sequence at alarm].
Clearable: Clearable alarm by operating the front panel and use auxiliary function **AFACL** as below. Besides clearable alarms, please first solve the error and restart the servo driver to clear alarm.



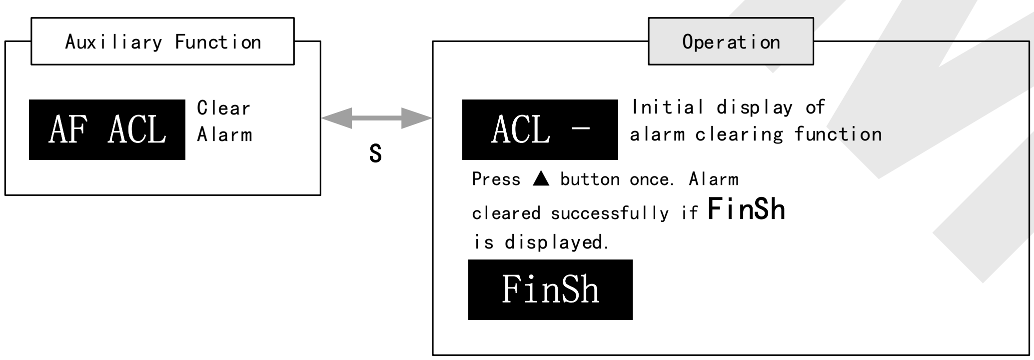


Table 8.2 Alarm and 603F correspondence

Error Code Display	1001 h	603Fh	ETG Code	Alarm Description
Er 0A0	0x04	0x3150		Phase A circuit current detection error
Er 0A1	0x04	0x3151		Phase B circuit current detection error
Er 0A3	0x04	0x3153		Motor power cable not connected
Er 0b0				Control circuit power supply voltage too low
Er 0b1	0x04	0x3206		Control power supply voltage too high
Er 0C0	0x04	0x3211		DC bus overvoltage
Er 0d0	0x04	0x3221		DC bus undervoltage
Er 0d1	0x04	0x3130		Single phasing of main power supply
Er 0d2	0x04	0x3222		No main power supply detected
Er 0E0	0x02	0x2211		Overcurrent
Er 0E1	0x02	0x2212		Intelligent Power Module (IPM) overcurrent
Er 0E2	0x02	0x2218		Power output to motor shorted to ground
Er 0E4	0x02	0x2230		Phase overcurrent
Er 0f0	0x08	0x4210		Driver overheated
Er 100	0x02	0x8311		Motor overloaded
Er 101	0x02	0x8310		Driver overloaded
Er 102	0x02	0x8301		Motor rotor blocked
Er 120	0x80	0x7701		Regenerative resistor overvoltage
Er 121	0x80	0x7702		Holding brake error
Er 122	0x80	0x7703		Regenerative resistor value too low
Er 150	0x80	0x7321		Encoder disconnected
Er 151	0x80	0x7322		Encoder communication error
Er 152	0x80	0x7323		Encoder initial position error
Er 153/Er 154	0x80	0x7325		Multiturn encoder error / Encoder parameter settings error
Er 155	0x80	0x7326		Encoder data overflow
Er 156	0x80	0x7327		Encoder overheated
Er 157	0x80	0x7328		Encoder count error
Er 170	0x80	0x7324		Encoder data error
Er 171	0x80	0x7325		Encoder parameter initialization error
Er 180	0x20	0x 8611		Excessive position deviation
Er 181				Excessive velocity deviation
Er 190	0x20	0x 8401		Motor vibration too strong
Er 1A0	0x20	0x 8402		Overspeed
Er 1A1	0x20	0x 8403		Velocity out of control
Er 1b0	0x20	0x 8612		Bus input signal dithering
Er 1b1	0x20	0x 8503		Incorrect electronic gear ratio
Er 1c0	0x02	8313		Both STO failed
Er 1c1	0x02	8313		1st STO failed
Er 1c2	0x02	8313		2nd STO failed
Er 210	0x80	0x6321		I/O input interface assignment error
Er 211	0x80	0x6322		I/O input interface function assignment error
Er 212	0x80	0x6323		I/O output interface function assignment error
Er 240	0x80	0x5530		EEPROM parameters initialization error
Er 241	0x80	0x5531		EEPROM hardware error
Er 242	0x80	0x5532		Error saving alarm history record
Er 243	0x80	0x5533		Error occurred when saving vendor parameters
Er 244	0x80	0x5534		Error occurred when saving communication

				parameters
Er 245	0x80	0x5535		Error occurred when saving parameter 402
Er 246	0x80	0x5536		Data saving error during power-off
Er 260	0x80	0x7329		Positive/Negative position limit triggered under non-homing mode
Er 270				Analog 1 input overrun limit
Er 271				Analog 2 input overrun limit
Er 280	0x80	0x7201		Output pulse frequency too high
Er 570	0x80	0x5441		Forced alarm input valid
Er 5f0	0x80	0x7122		Motor model no. detection error
Er 5f1	0x80	0x1100		Driver power module detection error
Er 600	0x80	0x6204		Main loop interrupted timeout
Er 601	0x80	0x6204		Velocity loop interrupted timeout
Er 700	0x80	0x7001		Encryption error
Er 73A	0x10	0x873A		SyncManager2 lost
Er 73b	0x10	0x873B		SYNC0 lost
Er 73c	0x10	0x873C		Excessive Distributed Clock error
Er 801	0x10	0x8201	0x0001	Unknown communication error
Er 802	0x80	0x5510	0x0002	Memory overflow
Er 803	0x80	0x5511		RAM out of bound
Er 805	0x80	0x6202		FOE firmware upgrade failed
Er 806	0x80	0x6201		Saved ESI file does not match driver firmware
Er 811	0x10	0xA001	0x0011	Invalid EtherCAT transition request
Er 812	0x10	0xA002	0x0012	Unknown EtherCAT state machine transition request
Er 813	0x10	0x8213	0x0013	Protection request from boot state
Er 814	0x80	0x6203		Invalid firmware
Er 815	0x10	0x8215	0x0015	Invalid mailbox configuration under boot state
Er 816	0x10	0x8216	0x0016	Pre-Op status is invalid for the mailbox configuration
Er 817	0x10	0x8217		Invalid SyncManager configuration
Er 818	0x10	0x8211		No valid input data
Er 819	0x10	0x8212		No valid output data
Er 81A	0x10	0xFF02	0x871A	Synchronization error
Er 81b	0x10	0x821B	0x001B	SyncManager2 watchdog timer timeout
Er 81C	0x10	0x821C	0x001C	Invalid SyncManager type
Er 81d	0x10	0x821D	0x001D	Invalid output configuration
Er 81E	0x10	0x821E	0x001E	Invalid input configuration
Er 81f	0x10	0x821F		Watchdog configuration invalid
Er 821	0x10	0xA003	0x0021	Waiting for EtherCAT state machine Init state
Er 822	0x10	0xA004	0x0022	Waiting for the EtherCAT state machine Pre-Op state
Er 823	0x10	0xA005	0x0023	Waiting for master device for Safe-Op request
Er 824	0x10	0x8224	0x0024	Invalid process data input mapping
Er 825	0x10	0x8225	0x0025	RPDO mapping invalid (length, parameter not present, no this property)
Er 827	0x10	0x8227		Free running mode is not supported
Er 828	0x10	0x8228		Sync mode not supported
Er 82b	0x10	0x8210	0x002B	Invalid inputs and outputs
Er 82C	0x10	0x872C	0x002C	Fatal synchronization error

Er 82d	0x10	0x872D	0x002D	No synchronization error
Er 82E	0x10	0x872E	0x002E	Synchronization cycle time is too short
Er 830	0x10	0x8730	0x0030	Invalid Distributed Clock synchronization settings
Er 832	0x10	0x8732	0x0032	Distribution Clock phase-locked loop failure
Er 833	0x10	0x8733		DC sync IO error
Er 834	0x10	0x8734		DC sync timeout
Er 835	0x10	0x8735		Distribution Clock cycle time is invalid
Er 836	0x10	0x8736	0x0036	Invalid Distribution Clock synchronization cycle time
Er 850	0x80	0x5550	0x0050	EEPROM is inaccessible
Er 851	0x80	0x5551	0x0051	EEPROM error
Er 852	0x80	0x5552	0x0052	Hardware is not ready
Er 860	0x80	0xFF01		EtherCAT frame lost per unit time exceeds limit
Er 870	0x80	0x5201		Driver can’t be enabled under current control mode
Er 890	0x80	0x8614		Homing error

10.3 Alarm Handling

***When an error occurs, please perform troubleshooting accordingly. Then, restart the driver. If the solutions described don't work, please consider replacing the driver.*

Error code	Main	Sub	Display: "Er 090"--"Er 09F"	
	09	0~F	**Content:** FPGA communication error	
Cause			Diagnosis	Solution
L1, L2 terminal voltage too low			Verify L1, L2 terminal voltage	Make sure L1, L2 terminal voltage is within recommended range

Error code	Main	Sub	Display: "Er 0A0"--"Er 0A1"	
	0A	0~1	**Content:** Circuit current detection error	
Cause			Diagnosis	Solution
Motor power cable wiring error			Verify motor power cable wiring	Make sure U,V,W terminal wired properly
Main power supply undervoltage			Verify L1, L2, L3 terminal voltage	Increase main power supply voltage

Error code	Main	Sub	Display: "Er 0A2" / "Er 0A4"	
	0A	2 / 4	**Content:** Analog input error	
Cause			Diagnosis	Solution
Analog input wiring error			Verify analog input wiring	Make sure of analog input wiring connection

Error code	Main	Sub	Display: "Er 0A3"	
	0A	3	**Content:** Motor power cable not connected	
Cause			Diagnosis	Solution
Motor power cable not connected			Verify motor power cable wiring	Measure **resistance values between U, V, W terminals**, make sure the values are almost equal. If not, might be due to damaged motor or motor winding open circuit.
Motor fault			/	Replace motor

Error code	Main	Sub	Display: "Er 0A5"	
	0A	5	**Content:** DC Bus error	
Cause			Diagnosis	Solution
L1, L2 terminal voltage too low			Verify L1, L2 terminal voltage. Check if power on indicator light on servo driver is on and d27 DC bus voltage.	Make sure L1, L2 terminal voltage is within recommended range

Error code	Main	Sub	Display: "Er 0A6"	
	0A	6	**Content:** Temperature measuring error	
Cause			Diagnosis	Solution
L1, L2 terminal voltage too low			Verify L1, L2 terminal voltage	Make sure L1, L2 terminal voltage is within recommended range

Error code	Main	Sub	Display: "Er 0b0"	
	0b	0	**Content:** Control circuit power supply voltage too low	
Cause			Diagnosis	Solution
Control circuit power supply voltage too low			Verify L1C, L2C terminal voltage; check if wiring connection is tight	Increase L1C, L2C terminal voltage; Tighten L1C, L2C terminal connection
Power supply under capacity			/	Increase power supply capacity for L1C, L2C terminals

Error code	Main	Sub	Display: "Er 0b1"	
	0b	1	**Content:** Control circuit power supply abnormal	
Cause			Diagnosis	Solution
USB power supply too low			Verify if USB cable is properly connected and not damaged.	Replace USB Type-C cable

Error code	Main	Sub	Display: "Er 0c0"	
	0c	0	**Content:** DC bus overvoltage	
Cause			Diagnosis	Solution
Main power supply overvoltage			Verify L1, L2, L3 terminal voltage	Decrease main power supply voltage
Acceleration/deceleration time too short			Verify if the time is actually too short	Increase the duration time or change to a regenerative resistor with higher resistance.
Regenerative brake parameter anomaly			Verify P07.32/P07.33	Modify vent overload parameter
Inner brake circuit damaged			/	Replace driver

Error code	Main	Sub	Display: "Er 0d0"	
	0d	0	**Content**: DC bus undervoltage	
Cause			Diagnosis	Solution
Main power supply undervoltage			Verify L1, L2, L3 terminal voltage	Increase main power supply voltage
L1C, L2C connected when USB cable is connected			Control circuit power on before driver initialization. Alarm might occur.	Please disconnect the USB cable before powering on control circuit.

Error code	Main	Sub	**Display:** "Er 0d1"	
	0d	1	**Content**: Single phasing of main power supply	
Cause			Diagnosis	Solution
Main power supply undervoltage			Verify L1, L2, L3 terminal voltage	Increase main power supply voltage
Main power supply wiring error			Loose connection of L1, L2, L3	Secure connections

Error code	Main	Sub	**Display:** "Er 0d2"	
	0d	2	**Content**: No main power supply detected	
Cause			Diagnosis	Solution
No main power supply			Verify L1, L2, L3 terminal voltage	1. Increase main power supply voltage 2. Secure connections

Error code	Main	Sub	**Display:** "Er 0E0"	
	0E	0	**Content:** Overcurrent	
Cause			Diagnosis	Solution
Driver power output short circuit			Verify if there is short circuit between UVW terminals, or shorted to PG.	1. Make sure there is no circuit. 2. Make sure motor is not damaged
Motor wiring error			Verify motor wiring	Reconnect motor wiring
IGBT module short circuit			Disconnect motor output cable. Then, enable servo driver to check for overcurrent	Replace driver
Control parameter anomaly			Verify if parameter exceeds recommended range	Set parameter within recommended range.
Control command anomaly			Verify if command motion is too acute	Modify control command; use filter

Error code	Main	Sub	**Display:** "Er 0E1"	
	0E	1	**Content**: Intelligent Power Module (IPM) overcurrent	
Cause			Diagnosis	Solution
Driver power output short circuit			Verify if there is short circuit between UVW terminals, or shorted to PG.	1. Make sure there is no circuit. 2. Make sure motor is not damaged
Motor wiring error			Verify motor wiring	Reconnect motor wiring
IGBT module short circuit			Disconnect motor output cable. Then, enable servo driver to check for overcurrent	Replace driver
IGBT module undervoltage			/	Replace driver
Control parameter anomaly			Verify if parameter exceeds recommended range	Set parameter within recommended range.
Control command anomaly			Verify if command motion is too acute	Modify control command; use filter

Error code	Main	Sub	Display: "Er 0E2"	
	0E	2	**Content**: Power output to motor shorted to ground	
Cause			Diagnosis	Solution
Driver U, V, W terminals shorted to ground			Disconnect motor power cable and check for short circuit between driver UVW and PE	1. Reconnect wiring. 2. Change motor power cable.
Motor shorted to ground			Connect motor power cable to driver power output. Verify if resistance value of UVW to PE is in the range of MegaOhm (MΩ)	Replace motor

Error code	Main	Sub	Display: "Er 0E4"	
	0E	2	**Content**: Phase overcurrent	
Cause			Diagnosis	Solution
Driver U, V, W terminals shorted to ground			Disconnect motor power cable and check for short circuit between driver UVW and PE	1. Reconnect wiring. 2. Change motor power cable.
Motor shorted to ground			Connect motor power cable to driver power output. Verify if resistance value of UVW to PE is equal and if there is short circuit	Replace motor

Error code	Main	Sub	Display: "Er 0F0"	
	0F	0	**Content**: Driver overheated	
Cause			Diagnosis	Solution
Temperature of power module exceeded upper limit			Measure the temperature of driver radiator.	1. Improve cooling condition. Please check installation guide; 2. Replace driver and motor with higher power rating; 3. Increase duration time for acceleration and deceleration; 4. Decrease load

Error code	Main	Sub	Display: "Er 100"	
	10	0	**Content:** Motor overloaded	
Cause	Diagnosis			Solution
Load too heavy	Verify if actual load exceeds maximum value allowed			1. Decrease load 2. Adjust limit values
Strong mechanical vibration	Look for mechanical vibration from machine system			1. Adjust gain value of control loop 2. Increase duration time for acceleration and deceleration
Motor or encoder cable wiring error	Verify motor and encoder wiring			1. Reconnect wiring 2. Replace motor and encoder cable
Holding brake engaged	Verify holding brake terminal voltage			Cut off holding brake

Error	Main	Sub	Display: "Er 101"

code	10	1	**Content:** Driver overloaded

Cause	Diagnosis	Solution
Motor power cable wiring error	UVW terminals wiring error	Make sure motor power cable wiring connection is correct
Motor not matched	Motor current is too high	Motor rated current is higher than driver rated current. Please change to a driver with higher rated current.

Error code	Main	Sub	**Display:** "Er 102"
	10	2	**Content:** Motor rotor blocked

Cause	Diagnosis	Solution
Motor rotor blocked	Look for mechanical blockages	Check the machinery
Motor rotor blocking time threshold value too low	Verify value of P06.57	Adjust value of P06.57

Error code	Main	Sub	**Display:** "Er 120"
	12	0	**Content:** Regenerative resistor overvoltage

Cause	Diagnosis	Solution
Regenerative energy exceeded capacity of regenerative resistor	1. Verify if velocity is too high 2. Verify if load is too large	1. Decrease motor rotational velocity; 2. Decrease load inertia; 3. Add an external regenerative resistor;
Power supply voltage too high	1. Verify if power supply voltage is within the rated range. 2. Interval regenerative resistor value is too low	1. Decrease power supply voltage 2. Increase regeneration resistance value(add external regenerative resistor)
Unstable power supply voltage	Verify if power supply voltage is stable	Add a surge suppressor to main power supply.
Regenerative energy discharge circuit damaged	/	1. Add an external regenerative resistor; 2. Replace driver

Error code	Main	Sub	**Display:** "Er 121"
	12	1	**Content:** Holding brake error

Cause	Diagnosis	Solution
Holding brake circuit damaged	Regenerative resistor disconnected	Replace regenerative resistor
	Holding brake IGBT damaged	Replace driver

Error code	Main	Sub	**Display:** "Er 122"
	12	2	**Content:** Regenerative resistor value too low

Cause	Diagnosis	Solution
External regenerative resistor value is less than the minimum value allowed by the drive	/	Replace the regenerative resistor with the right resistance value which meets the specification of the driver

Error code	Main	Sub	**Display:** "Er 150"
	15	0	**Content:** Encoder disconnected

Cause	Diagnosis	Solution
Encoder cable disconnected	Verify encoder cable connection	Make sure encoder cable properly connected
Encoder cable wiring error	Verify if encoder wiring is correct	Reconnect encoder wiring
Encoder damaged	/	Replace motor
Encoder measuring circuit damaged	/	Replace driver

Error code	Main	Sub	**Display:** "Er 151"
	15	1	**Content:** Encoder communication error

Cause	Diagnosis	Solution
Encoder wire shielding layer is missing	Verify if encoder cable has shielding layer	Replace with standard encoder cable
Encoder cable wiring error	Verify if encoder wiring is correct	Reconnect encoder wiring
Encoder damaged	/	Replace motor

Error code	Main	Sub	**Display:** "Er 152"
	15	2	**Content:** Encoder initial position error

Cause	Diagnosis	Solution
Communication data abnormal	1. Verify if encoder power supply voltage is DC5V±5% ; 2. Verify if encoder cable and shielded layer is not damaged; 3. Verify if encoder cable is close to high-powered power supply cable	1. Make sure encoder power supply voltage is stable 2. Make sure encoder cable is not damaged. 3. Make sure encoder cable shielded layer is grounded to frame 4. Make sure encoder cable is away from high-powered power supply cable
Encoder damaged	/	Replace motor
Encoder measuring circuit damaged	/	Replace driver

Error code	Main	Sub	**Display:** "Er 153"
	15	3	**Content:** Multiturn encoder error

Cause	Diagnosis	Solution

Initial use	Origin calibration not performed	Perform origin positioning and multiturn position initialization, calibrate the origin of coordinate system.
Encoder without multiturn absolute function used	Verify if encoder has multiturn absolute function	1. Replace the motor with a multiturn absolute encoder. 2. Set P00.15 = 0 to deactivate multiturn absolute function.
Low battery power	Replace battery and restart driver to clear alarm	Replace battery
Battery has no power or has been dismantled	Alarm not cleared after replacing battery and restart	Absolute position lost. Return to origin and perform multiturn initialization, calibrate the origin of coordinate system

Error code	Main	Sub	**Display:** "Er 154"	
	15	4	**Content:** Encoder parameter settings error	
Cause			Diagnosis	Solution
Absolute encoder mode is incorrectly set.			Verify if encoder has multi-turn absolute value function.	Modify absolute encoder mode settings

Error code	Main	Sub	**Display:** "Er 155"	
	15	5	**Content:** Encoder data overflow	
Cause			Diagnosis	Solution
Encoder data overflow			Verify if encoder is not damaged	Initialize multiturn data
Absolute value applications, motor rotates in one direction			Verify if encoder is not damaged	Adjust absolute value application mode, set to turntable mode

Error code	Main	Sub	**Display:** "Er 156"	
	15	6	**Content:** Encoder overheated	
Cause			Diagnosis	Solution
The encoder temperature is too high.			Verify if motor temperature is too high	Reduce encoder temperature.

Error code	Main	Sub	**Display:** "Er 157"	
	15	7	**Content:** Encoder counter error	
Cause			Diagnosis	Solution
Encoder data overflow			Verify if encoder is not damaged	Initialize multiturn data
Absolute value applications, motor rotates in one direction			Verify if encoder is not damaged	Adjust absolute value application mode, set to turntable mode

Error code	Main	Sub	**Display:** "Er 170"	
	17	0	**Content:** Encoder data error	
Cause			Diagnosis	Solution
Communication			1. Verify if encoder power supply	1. Make sure encoder power supply

data abnormal	voltage is DC5V±5% ; 2. Verify if encoder cable and shielded layer is not damaged; 3. Verify if encoder cable is close to high-powered power supply cable	voltage is stable 2. Make sure encoder cable is not damaged. 3. Make sure encoder cable shielded layer is grounded to frame 4. Make sure encoder cable is away from high-powered power supply cable
Encoder damaged	/	Replace motor
Encoder measuring circuit damaged	/	Replace driver

Error code	Main	Sub	Display: "Er 171"
	17	1	Content: Encoder parameter initialization error

Cause	Diagnosis	Solution
Driver and motor not matched	Verify driver and motor models.	Replace with matching driver and motor
Error while getting parameters from encoder	1. Verify if encoder cable is standard. 2. Verify if encoder has no peeled insulator, broken connection or improper contact.	Use standard encoder cable, verify the connection of both sides of driver and motor, change encoder cable if necessary

Error code	Main	Sub	Display: "Er 180"
	18	0	Content: Excessive position deviation

Cause	Diagnosis	Solution
Improper position deviation settings	Verify if value of Pr_014 is too low	Increase value of Pr_014
Position gain setting too low	Verify if values of P01.00 & P01.05 are too low	Increase values of P01.00 & P01.05
Torque limit too low	Verify if values of P00.13 & P05.22 are too low	Increase values of P00.13 & P05.22
Excessive external load	1. Verify if acceleration and deceleration duration time is too low. 2. Verify if rotational velocity is too high 3. Verify if load is too large	1. Increase duration time for acceleration and deceleration 2. Decrease rotational velocity 3. Decrease load

Error code	Main	Sub	Display: "Er 181"
	18	1	Content: Excessive velocity deviation

Cause	Diagnosis	Solution
Deviation between set velocity and actual velocity is too great	Verify if value of P06.02 is too low	1. Increase value of P06.02; 2. Set P06.02 to 0, position error detection off.
Acceleration and deceleration duration time for set velocity is too low	Verify if value of P03.12 and P03.13 are too low	1. Increase value of P03.12, P03.13; 2. Adjust velocity gain to reduce velocity lag error

Error code	Main	Sub	Display: "Er 190"
	19	0	Content: Vibration too strong

Cause	Diagnosis	Solution

Resonance	Mechanical stiffness is too high, resonance occurs	Reduce mechanical stiffness or use filter
Current loop gain too large	Verify current loop gain value	Reduce current loop gain

Error code	Main	Sub	Display: "Er 191"
	19	1	**Content:** Excessive hybrid position deviation

Cause	Diagnosis	Solution
Driver UVW terminal output single phasing or wiring error	Verify if UVW terminal wiring connection is right	Make sure UVW terminals are correctly connected to UVW of motor; change motor power cable.
Motor rotor blocked	Look for mechanical blockages	Check the machinery
Driver stiffness too low	Verify if position loop and velocity loop gain is too low	Increase position loop and velocity loop gain
Full closed loop position deviation (**Deviation between external encoder feedback position and motor feedback position**) exceeds P00.33	Verify if P00.33 is set too low	Increase P00.33 set value accordingly but please aware that doing so might cause the position deviation to be higher.

Error code	Main	Sub	Display: "Er 1A0"
	1A	0	**Content:** Overspeed

Cause	Diagnosis	Solution
Motor velocity exceeded first speed limit (P03.21)	1. Verify if velocity command is too high; 2. Verify if simulated velocity command voltage is too high; 3. Verify if parameter value of P03.21 is too low; 4. Verify if input frequency and division frequency coefficient of pulse train is proper; 5. Verify if encoder is wired correctly	1. Adjust velocity input command; 2. Increase P03.21 value; 3. Adjust pulse train input frequency and division frequency coefficient; 4. Verify encoder wiring;

Error code	Main	Sub	Display: "Er 1A1"
	1A	1	**Content:** Velocity out of control

Cause	Diagnosis	Solution
Motor velocity out of control, Excessive velocity error	Verify encoder phase sequence; Verify if UVW cable is connected to the right terminal	Reconnect UVW if wrongly connected. If still remains unsolved, please contact technical support.

Error code	Main	Sub	Display: "Er 1b0"
	1b	0	**Content:** Bus input signal dithering

Cause	Diagnosis	Solution

Controller synchronization dithering	/	Increase alarm threshold value

Error code	Main	Sub	**Display:** "Er 1b1"	
	1b	1	**Content:** Incorrect electronic gear ratio	
Cause			Diagnosis	Solution
Values out of range			Numerator or denominator is zero/Set values out of range	Reduce number of pulses per revolution

Error code	Main	Sub	**Display:** "Er 1b3"	
	1b	3	**Content:** External encoder frequency divider parameter error	
Cause			Diagnosis	Solution
Values out of range			Numerator or denominator is zero/Set values out of range	Reduce number of pulses per revolution

Error code	Main	Sub	**Display:** "Er 1b4"	
	1b	4	**Content:** Excessive synchronous position mode command	
Cause			Diagnosis	Solution
Values out of range			Numerator or denominator is zero/Set values out of range	Reduce number of pulses per revolution

Error code	Main	Sub	**Display:** "Er 1c0"	
	1c	0	**Content:** Both STO failed	
Cause			Diagnosis	Solution
Both STO input signals valid			Verify if STO power supply is normal	Verify 24V STO power supply and power cable connection
			Disconnect switch connected to STO	Close switch

Error code	Main	Sub	**Display:** "Er 1c1"	
	1c	1	**Content:** 1st STO failed	
Cause			Diagnosis	Solution
1st STO input signal valid			Verify if STO power supply is normal	Verify 24V STO power supply and power cable connection
			Disconnect switch connected to STO	Close switch

Error code	Main	Sub	**Display:** "Er 1c2"	
	1c	2	**Content:** 2nd STO failed	
Cause			Diagnosis	Solution

2nd STO input signal valid	Verify if STO power supply is normal	Verify 24V STO power supply and power cable connection
	Disconnect switch connected to STO	Close switch

Error code	Main	Sub	**Display:** "Er 210"
	21	0	**Content:** I/O input interface assignment error

Cause	Diagnosis	Solution
Input signal assigned with two or more functions.	Verify values of P04.00-P04.09, P04.44-4.47	Set proper values for P04.00-P04.09, P04.44-4.47

Error code	Main	Sub	**Display:** "Er 211"
	21	1	**Content:** I/O input interface function assignment error

Cause	Diagnosis	Solution
Input signal assignment error	Verify values of P04.00-P04.09, P04.44-4.47	Set proper values for P04.00-P04.09, P04.44-4.47

Error code	Main	Sub	**Display:** "Er 212"
	21	2	**Content:** I/O output interface function assignment error

Cause	Diagnosis	Solution
Input signal assigned with two or more functions.	Verify values of P04.10-P04.15	Set proper values for P04.10-P04.15
Input signal not assigned	Verify values of P04.10-P04.15	Set proper values for P04.10-P04.15

Error code	Main	Sub	**Display:** "Er 240"
	24	0	**Content:** CRC correction error during EEPROM parameter saving

Cause	Diagnosis	Solution
L1, L2 terminal voltage too low	Verify if L1, L2 terminal voltage too low	Make sure L1, L2 terminal voltage is within recommended range
Parameter saving anomaly	Save parameter again and restart	Save parameter again

Error code	Main	Sub	**Display:** "Er 250"
	25	0	**Content:** Gantry deviation error

Cause	Diagnosis	Solution
Excessive Gantry drivers deviation	Verify if both drivers share the same set of parameters	Unify the parameters of both drivers
	Verify if control cable of the drivers are properly connected	Connect control cable properly
	Verify if gantry communication cable is connected properly	Connect communication cable properly

Error code	Main	Sub	**Display:** "Er 251"
	25	1	**Content:** Gantry communication error

Cause	Diagnosis	Solution
Gantry communication	Verify if gantry communication	Connect communication cable

data error	cable is connected properly	properly

Error code	Main	Sub	**Display:** "Er 252"
	25	2	**Content:** Gantry slave axis is not enabled

Cause	Diagnosis	Solution
The salve axis is not enabled normally after 2s of master axis enabling	Check whether the slave axis is communicating normally	Confirm whether the slave axis gantry communication is normal and the wiring is correct

Error code	Main	Sub	**Display:** "Er 253"
	25	3	**Content:** Gantry synchronous torque deviation is too high

Cause	Diagnosis	Solution
When the gantry synchronous torque deviation exceeds the gantry torque deviation threshold and exceeds 5ms, an alarm is triggered	Check whether the gantry torque deviation threshold parameter is set appropriately	Ensure that the gantry torque deviation value setting parameters are appropriate

Error code	Main	Sub	**Display:** "Er 254"
	25	4	**Content:** Gantry synchronization mode is in non-position control mode

Cause	Diagnosis	Solution
Gantry synchronization is not in position mode	Check the current mode of the gantry	Check the current mode of the gantry

Error code	Main	Sub	**Display:** "Er 255"
	25	5	**Content:** Gantry alignment failed

Cause	Diagnosis	Solution
After receiving the command, the gantry alignment fails to complete normally after more than 200ms, and an alarm is triggered.	Check whether the timing of gantry alignment enable and servo enable is normal; after the gantry alignment action is completed, the position error is not within the positioning end range	Servo enable, connect to gantry alignment enable timing; set reasonable parameters to ensure that the spindle movement distance and gantry alignment offset error are within the positioning end range

Error code	Main	Sub	**Display:** "Er 260"
	26	0	**Content:** Positive/Negative position limit triggered under non-homing mode

Cause	Diagnosis	Solution
Positive/negative position limit triggered	Verify position limit signal	/

Error code	Main	Sub	**Display:** "Er 270" -- "Er 272"
	27	0~2	**Error description:** Analog input 1-3 out of range

Cause	Diagnosis	Solution
Analog value out of range	Verify if analog input value is out	Adjust analog input voltage

	of range	

Error code	Main	Sub	**Display:** "Er 280"	
	28	0	**Error description:** Output pulse frequency too high	
Cause			Diagnosis	Solution
Frequency divided pulse output exceeds 1MHz			Verify if motor rotational speed and the number of frequency divided pulse output are too high	Reduce the number of frequency divided pulse output or reduce rotational speed

Error code	Main	Sub	**Display:** "Er 290"	
	29	0	**Error description:** Control mode not match in full closed loop mode	
Cause			Diagnosis	Solution
Control mode is not position mode when full closed loop mode is on			Verify if P00.01 is set to 0	Make sure P00.01 is set to 0 – Position mode

Error code	Main	Sub	**Display:** "Er 291"	
	29	1	**Error description:** Encoder mode not match in full closed loop mode	
Cause			Diagnosis	Solution
Encoder mode not match in full closed loop mode			Only ABZ encoder is supported for the moment being	For external ABZ encoder, please set P00.31 = 0.

Error code	Main	Sub	**Display:** "Er 550" -- "Er 553"	
	55	0~3	**Error description:** Encoder mode not match in full closed loop mode	
Cause			Diagnosis	Solution
Er550: External ABZ encoder disconnected			Verify if encoder cable is connected properly	1. Make sure encoder cable connection is tight,; 2. Change encoder cable.; 3. External encoder cable needs to be shielded.
Er551: External encoder Phase A disconnected				
Er552: External encoder Phase B disconnected				
Er553: External encoder Phase Z disconnected				

Error code	Main	Sub	**Display:** "Er 570"	
	57	0	**Error description:** Forced alarm input valid	
Cause			Diagnosis	Solution

Forced alarm input signal occurred	Verify forced alarm input signal	Verify if the input wiring connection is correct

Error code	Main	Sub	**Display:** "Er 5F0"	
	5F	0	**Content:** Motor model no. detection error	
Cause			Diagnosis	Solution
Automatically detected motor doesn't match set motor			/	Please contact our technical support

Error code	Main	Sub	**Display:** "Er 5F1"	
	5F	1	**Error description:** Driver power module detection error	
Cause			Diagnosis	Solution
Driver power rating not within range.			Restart driver	Please contact our technical support

Error code	Main	Sub	**Display:** "Er 600"	
	60	0	**Error description:** Main loop interrupted timeout	
Cause			Diagnosis	Solution
The motor control loop calculation time overflow			Check for interference from devices releasing electromagnetic field	Ground driver and motor to reduce interference
			Restart driver	Replace driver

Error code	Main	Sub	**Display:** "Er 601"	
	60	1	**Error description:** Velocity loop interrupted timeout	
Cause			Diagnosis	Solution
Motor control loop calculation time overflow			Verify if encoder connection is and that the encoder cable is too not long (more than 20 meters)	Replace encoder cable if necessary
			Restart driver	Replace the drive with a new one

Error code	Main Extr	Sub	**Display:** "Er 700"	
	70	0	**Error description:** Encryption error	
Cause			Diagnosis	Solution
Encryption error during initialization upon power-on.			Restart driver	Please contact our technical support

Error code	Main	Sub	**Display:** "Er 890"
	89	0	**Error description:** Homing error

Cause	Diagnosis	Solution
1. Excess homing velocity 2. Homing mode is different from given signal 3. Sensor signal edge inconsistent	1. Verify if homing velocity is too high 2. Verify if homing mode is set correctly 3. Verify if sensor signal edge is consistent	1. Set an optimal homing velocity 2. Make sure sensor signal edge is consistent.
Inconsistent origin status	1. Homing acceleration/ deceleration is set too low 2. Electronic gear ratio is low which causes acceleration/ deceleration to be too low	1. If electronic gear ratio cannot be changed, please set a suitable 609A. 2. Increase electronic gear ratio

Error code	Main	Sub	**Display:** "Er 920"	
	92	0	**Error description:** External encoder parameter initialization error	
Cause			Diagnosis	Solution
Encoder parameter P00.37 setting error			Verify if P00.37 set value is out of range	Modify P00.37 set value, please use default value and see if the error still persists.

10.4 EtherCAT Communication Alarm

EtherCAT communication related alarms are erasable and will not be recorded in alarm history.

Clearing EtherCAT communication alarm is similar to clearing servo driver alarm. Please clear the alarm before switching to 402 machine state.

EtherCAT communication alarm however, relies on register clearance from the main station. Can be solved according to following steps:

1、Set bit 4 of ESC control register 0x120 (error responder) to 1.

2、The communication alarm can be cleared until the feedback of the ESC status code register 0x134~0x135 is 0.

3、By setting bit 7 of 6040h to 1, switches state machine from fault to initialization completion , No fault(Switch on disabled).

10.4.1 Network failure

Error code	Main	Sub	**Display:** "Er 73A"
	73	A	**Error description:** SyncManager2 lost

Cause	Diagnosis	Solution
Poor master performance	--	Increase the alarm threshold
Single-unit drive has problem	Is it a single unit or multiple units together in the network	Switch drive
interfere	Check the grounding and network wiring quality	Replace the network cable

Error code	Main	Sub	**Display:** "Er 73b"
	73	B	**Error description:** SYNC0 lost

Cause	Diagnosis	Solution
Poor master performance	--	Increase threshold value limit
Single-unit drive has problem	Is it a single unit or multiple units together in the network	Switch drive
interfere	Check the grounding and network wiring quality	Replace the network cable

Error code	Main	Sub	**Display:** "Er 73c"
	73	C	**Error description:** Excessive Distributed Clock error

Cause	Diagnosis	Solution
Poor master device performance	--	Increase threshold value limit
Single-unit drive has problem	Is it a single unit or multiple units together in the network	Replace driver
Interference	Check the grounding and network wiring quality	Replace network cable

Error code	Main	Sub xtra	**Display:** "Er 801"
	80	1	**Error description:** Unknown communication error
Cause			EtherCAT state machine transition failed
The status of the error can be detected			All ESM status
Network port LED			Blinking
The result status			The current state is maintained below the safe operation, and the operation state is switched to the safe operation state
Solution			Verify network connection and master device EtherCAT state machine transition order

Error code	Main	Sub	**Display:** "Er 802"
	80	2	**Error description:** Memory overflow
Cause			CPU failed to request memory
The status of the error can be detected			All ESM status
Network port LED			ON
The result status			The current state is maintained below the safe operation, and the operation state is switched to the safe operation state
Solution			Verify if E-DHASxxE hardware is faulty

Error code	Main	Sub	**Display:** "Er 803"
	80	3	**Error description:** RAM out of bound
Cause			EtherCAT state machine memory address access request from master device is out of bound
The status of the error can be detected			All communication status
Network port LED			None
The result status			NO
Solution			Verify master device configuration or replace master device

Error code	Main	Sub	**Display:** "Er 805"
	80	5	**Error description:** FOE firmware upgrade failed
Cause			Firmware burn error
The status of the error can be detected			BOOT
Network port LED			None
The result status			Remain in the detection state
Solution			Replace firmware/driver

Error code	Main	Sub	**Display:** "Er 806"
	80	6	**Error description:** Saved ESI file does not match driver firmware
Cause			ESI file does not match driver firmware
The status of the			INIT

error can be detected	
Network port LED	None
The result status	Remain in the detection state
Solution	Burn matching firmware to driver

Error code	Main	Sub	Display: "Er 811"
	81	1	**Error description:** Invalid EtherCAT transition request
Cause			Driver received unconvertible request from EtherCAT state machine
The status of the error can be detected			All ESM Status
Network port LED			Blinking
The result status			The current state is maintained below the safe operation, and the operation state is switched to the safe operation state
Solution			Verify if the transition information from master device is correct

Error code	Main	Sub	Display: "Er 812"
	81	2	**Error description:** Unknown EtherCAT state machine transition request
Cause			Driver receives a transition request other than states of the EtherCAT state machine
The status of the error can be detected			All ESM Status
Network port LED			Blinking
The result status			The current state is maintained below the safe operation, and the operation state is switched to the safe operation state
Solution			Verify transition information from master device

Error code	Main	Sub	Display: "Er 813"
	81	3	**Error description:** Protection request from boot state
Cause			Driver receives a transition request to boot state
The status of the error can be detected			Initialize the conversion to a boot
Network port LED			Flickering
The result status			initialization
Solution			Verify if driver software version supports this state transition

Error code	Main	Sub	Display: "Er 814"
	81	4	**Error description:** Invalid firmware
Cause			Firmware not matched with driver
The status of the error can be detected			BOOT/INIT
Network port LED			None
The result status			Keeping in the detection status
Solution			Return driver to supplier to update firmware

Error code	Main	Sub	**Display:** "Er 815"
	81	5	**Error description:** Invalid mailbox configuration under boot state
Cause			Boot state action not supported under current configuration
The status of the error can be detected			Initialize the conversion to a boot
Network port LED			Blinking
The result status			Initialization
Solution			Verify if E-DHASxxE software version supports action under this state.

Error code	Main	Sub	**Display:** "Er 816"
	81	6	**Error description:** Pre-Op status is invalid for the mailbox configuration
Cause			The synchronization manager configuration under Pre-Op is invalid
The status of the error can be detected			pre-operation
Network port LED			Blinking
The result status			initialization
Solution			1. Verify if XML file version is consistent with software version 2. EtherCAT slave controller error, please contact technical support

Error code	Main	Sub	**Display:** "Er 817"
	81	7	**Error description:** Invalid SyncManager configuration
Cause			Synchronization manager configuration is invalid
The status of the error can be detected			Pre-op above
Network port LED			Single flash
The result status			Pre-op
Solution			Verify master device configuration/ESI file version

Error code	Main	Sub	**Display:** "Er 818"
	81	8	**Error description:** No valid input data
Cause			The input data is not updated for more than 1 second
The status of the error can be detected			All ESM status
Network port LED			Double flashing
The result status			The current state is maintained below the safe operation, and the operation state is switched to the safe operation state
Solution			1. Verify if TxPDO is valid 2. Verify master device synchronization settings

Error code	Main	Sub	**Display:** "Er 819"
	81	9	**Error description:** No valid output data
Cause			Output data is not updated for more than 1 second
The status of the			All ESM status

error can be detected	
Network port LED	Double flash
The result status	The current state is maintained below the safe operation, and the operation state is switched to the safe operation state
Solution	1. Verify if RxPDO is valid 2. Verify master device synchronization settings

Error code	Main	Sub	**Display:** "Er 81A"
	81	A	**Error description:** Synchronization error
Cause			RxPDO and DC update order failed or one of them is not updated in sync
The status of the error can be detected			All ESM status
Network port LED			Single flash
The result status			The current state is maintained below the safe operation, and the operation state is switched to the safe operation state
Solution			1. Verify if PXPDO is valid 2. Verify master device synchronization settings

Error code	Main	Sub	**Display:** "Er 81b"
	81	b	**Error description:** SyncManager2 watchdog timer timeout
Cause			The RxPDO update timeout in operational state
The status of the error can be detected			Operation
Network port LED			Double flash
The result status			Safe operation
Solution			1. Verify if E-DHASxxE network is connected 2. Verify RxPDO update time

Error code	Main	Sub	**Display:** "Er 81c"
	81	c	**Error description:** Invalid SyncManager type
Cause			Synchronization Manager configuration types other than the following: 1. Mailbox output 2. Mailbox input 3. Process data output 4. Process data input
The status of the error can be detected			Pre-operation
Network port LED			Blinking
The result status			Initialize
Solution			Verify if XML file version is consistent with software version

Error	Main	Sub	**Display:** "Er 81d"

code	81	d	**Error description:** Invalid output configuration
Cause			Process data output synchronization manager configuration is invalid
The status of the error can be detected			Pre-operation
Network port LED			Blinking
The result status			Initialize
Solution			1. Verify E-DHASxxE synchronization manager configuration 2. Verify if XML file version is consistent with software version

Error code	Main	Sub	**Display:** "Er 81E"
	81	E	**Error description:** Invalid input configuration
Cause			Process data input synchronization manager configuration is invalid
The status of the error can be detected			Pre-operation
Network port LED			Blinking
The result status			Initialize
Solution			1. Verify E-DHASxxE synchronization manager configuration 2. Verify if XML file version is consistent with software version

Error code	Main	Sub	**Display:** "Er 821"
	82	1	**Error description:** Waiting for EtherCAT state machine Init state
Cause			Driver waiting for master device to send Init request
The status of the error can be detected			All ESM status
Network port LED			Blinking
The result status			Keeping the current state
Solution			Verify transition request sent from master device

Error code	Main	Sub	**Display:** "Er 822"
	82	2	**Error description:** Waiting for the EtherCAT state machine Pre-Op state
Cause			Driver waiting for master device to send Pre-Op request
The status of the error can be detected			Safe operation, operation
Network port LED			Blinking
The result status			Keeping the current state
Solution			Verify transition request sent from master device

Error	Main	Sub	**Display:** "Er 823"

code	82	3	**Error description:** Waiting for master device for Safe-Op request
Cause			Process data output synchronization manager configuration is invalid
The status of the error can be detected			Operation
Network port LED			Blinking
The result status			Keeping the current state
Solution			Verify transition request sent from master device

Error code	Main	Sub	**Display:** "Er 824"
	82	4	**Error description:** Invalid process data input mapping
Cause			TxPDO is configured with non-mappable objects
The status of the error can be detected			Safe operation
Network port LED			Blinking
The result status			Pre-operation
Solution			Reconfigure the TxPDO mapping object

Error code	Main	Sub	**Display:** "Er 825"
	82	5	**Error description:** Invalid process data output mapping
Cause			RxPDO is configured with non-mappable objects
The status of the error can be detected			Safe operation
Network port LED			Blinking
The result status			Pre-operation
Solution			Reconfigure the RxPDO mapping object

Error code	Main	Sub	**Display:** "Er 828"
	82	8	**Error description:** Sync mode not supported
Cause			Sync mode is not supported in the current configuration
The status of the error can be detected			Safe operation
Network port LED			Single flash
The result status			Pre-operation
Solution			1. Verify E-DHASxxE software version 2. Verify XML version

Error code	Main	Sub	**Display:** "Er 82b"
	82	b	**Error description:** Invalid inputs and outputs
Cause			No RxPDO and TxPDO updates for more than 1 second
The status of the error can be detected			All ESM status
Network port LED			Blinking
The result status			The current state is maintained below the safe operation, and the operation state is switched to the safe operation state
Solution			1. Verify if current RxPDO and TxPDO are invalid 2. Verify master device synchronization settings

Error code	Main	Sub	**Display:** "Er 82c"
	82	c	**Error description:** Fatal synchronization error
Cause			DC watchdog timer timeout
The status of the error can be detected			Safe operation, operation
Network port LED			Double flash
The result status			Safe operation
Solution			1. Verify if E-DHASxxE hardware is faulty 2. Verify DC setting and delay

Error code	Main	Sub	**Display:** "Er 82d"
	82	d	**Error description:** No synchronization error
Cause			Synchronization is invalid
The status of the error can be detected			operation
Network port LED			Single flash
The result status			Safe operation
Solution			1. Verify if "fatal synchronization error" has occurred. 2. Verify master device synchronization settings

Error code	Main	Sub	**Display:** "Er 82E"
	82	E	**Error description:** Synchronization cycle time is too short
Cause			Master device synchronization cycle time is set to less than 125 microseconds
The status of the error can be detected			operation
Network port LED			Single flash
The result status			Pre-operation
Solution			Verify master device synchronization cycle time

Error code	Main	Sub	**Display:** "Er 830"
	83	0	**Error description:** Invalid Distributed Clock synchronization settings
Cause			Synchronization settings in sync mode are not valid
The status of the error can be detected			Safe operation
Network port LED			Blinking
The result status			Pre-operation
Solution			Verify master device synchronization settings

Error code	Main	Sub	**Display:** "Er 832"
	83	2	**Error description:** Distribution Clock phase-locked loop failure
Cause			Distribution Clock phase-locked loop setting is invalid
The status of the error can be detected			Safe operation, operation
Network port LED			Single flash
The result status			Safe operation
Solution			Verify master device Distribution Clock settings and network transmission delay

Error code	Main	Sub	**Display:** "Er 835"
	83	5	**Error description:** Distribution Clock cycle time is invalid
Cause			Set synchronization cycle time is not proportional to drive position loop
The status of the error can be detected			Safe operation
Network port LED			Flickering
The result status			Pre-operation
Solution			Refer to user manual to set a reasonable synchronization cycle time.

Error code	Main	Sub	**Display:** "Er 836"
	83	6	**Error description:** Invalid Distribution Clock synchronization cycle
Cause			The synchronization cycle time setting is not as the following 1：125us 2：250us 3：500us 4：750us 5：1000us 6：2000us 7：4000us
The status of the error can be detected			Safe operation
Network port LED			Single flash
The result status			Pre-operation
Solution			Verify master device synchronization cycle time

Error code	Main	Sub	**Display:** "Er 850"
	85	0	**Error description:** EEPROM is inaccessible
Cause			EtherCAT slave controller failed to access EEPROM
The status of the error can be detected			All ESM status
Network port LED			Flickering
The result status			Keeping the current state
Solution			1. Verify if E-DHASxxE hardware is faulty 2. Verify if master device released access

Error code	Main	Sub	**Display:** "Er 851"
	85	1	**Error description:** EEPROM error
Cause			EEPROM operation of EtherCAT slave controller failed
The status of the error can be detected			All ESM status
Network port LED			Flickering
The result status			Keeping the current state
Solution			Verify if master device released access

Error code	Main	Sub	**Display:** "Er 852"
	85	2	**Error description:** Hardware is not ready
Cause			Data communication lost
The status of the error can be detected			All ESM status
Network port LED			ON
The result status			Keeping the current state
Solution			Verify if E-DHASxxE hardware is faulty

Error code	Main	Sub	**Display:** "Er 860"
	86	0	**Error description:** EtherCAT frame lost per unit time exceeds limit
Cause			EtherCAT frame lost per unit time exceeds the setting in 2635-00h
The status of the error can be detected			All states
Network port LED			None
The result status			Keeping the detection state
Solution			Change to network cable with higher bandwidth / Replace driver

Error code	Main	Sub	**Display:** "Er 870"
	87	0	**Error description:** Driver can't be enabled under current control
Cause			Enable driver under unsupported mode
The status of the error can be detected			All status
Network port LED			None
The result status			Maintain status
Solution			Switch to the correct control mode

10.5 Alarm clearing

10.5.1 Servo driver Alarm

For alarm to be cleared, there are 3 methods.

Method 1:

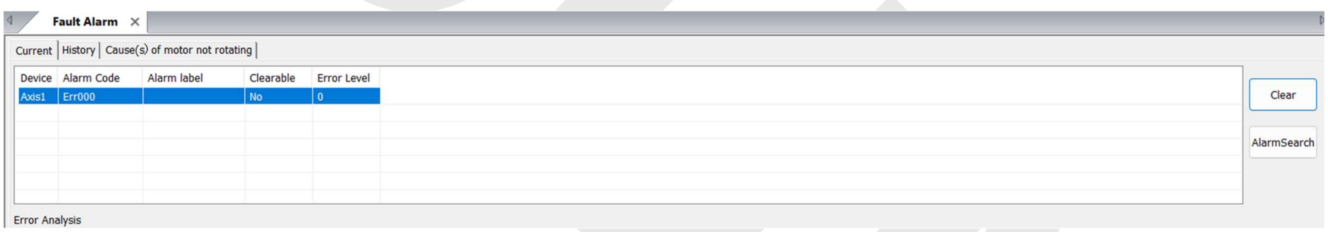
After resolving the cause of the alarm, press SET under AF_ACL on the front panel, then press the Up Arrow key to clear the current alarm.

Method 2:

Refer to "3.15.1 DI Input Signal and Setting Method." Configure an IO input parameter to the " (A-CLR)" function. Connect according to the IO input interface level input principle to clear the current alarm.

Method 3:

After confirming the problem, you can directly clear the alarm using the Clear Alarm button in the alarm information in the debugging software.



10.5.2 Communication alarm clear

All E-DHASxxE communication-related alarms are clearable and are not saved in the history log.
Communication alarms are primarily cleared via the master's registers. First, clear the alarm itself, then switch to the 402 state machine. This process follows the following:
Step 1: The master writes bit 4 (error acknowledgement bit) of the E-DHASxxE's ESC control register 0x120 to 1.
Step 2: The communication alarm is cleared until the E-DHASxxE's ESC status code registers 0x134-0x135 return a value of 0.
Then, similar to the second step in clearing drive alarms, bit 7 of object 6040h is set from 0 to 1, switching the 402 state machine from Fault to Disabled.
When a network fault occurs on the E-DHASxxE, the operator panel displays a fault code, and the ERR status indicator also indicates the fault. Furthermore, error information in object dictionary 1001h and 603Fh, which conform to CIA/IEC standards, is sent to the master station via an emergency message. The master station can determine the specific fault using the emergency message or the error codes in these two object dictionaries.

Chapter 11 Peripheral Devices

11.1 Peripheral Device Overview Table

Component Type	Component Name	Installation Location	Compatible Models	Function Description
Peripheral Electronic Components	Fuse & Circuit Breaker	Driver input side	All models	Required for compliance with EN 61800-5-1 and UL61800-5-1 standards. Must be installed on the input side to prevent accidents caused by internal circuit short circuits.
	AC Input Reactor	Driver input side		Reduces high-frequency harmonics and improves power factor.
	EMC Filter	Driver input side		Reduces conducted and radiated interference from the driver.
	Magnetic Ring / Clamp	Driver output side		Reduces external interference and bearing current.
		Signal Cable		Enhances signal anti-interference performance.

11.2 Fuses, Contactors, and Circuit Breakers

11.2.1 Fuses

To prevent accidents due to short circuits, fuses must be installed on the input side.

Servo driver Model	Rated Input Current	Recommended Fuse		
		Manufacturer	Rated Current (A)	Model
Single phase 220V				
E-DHAS01E	1.7	Bussmann	15 A	FWP-15B
E-DHAS04E	4		20 A	FWP-20B
E-DHAS08E	7.9		35 A	FWP-35C
E-DHAS10E	8.8		40 A	FWP-40C

11.2.2 Electromagnetic Contactors

Servo driver Model	Rated Input Current	Recommended Contactor		
		Manufacturer	Rated Current (A)	Model
Single phase 220V				
E-DHAS01E	1.7	Schneider	9	LC1 D09
E-DHAS04E	4		9	LC1 D09
E-DHAS08E	7.9		9	LC1 D09
E-DHAS10E	8.8		12	LC1 D12

11.2.3 Circuit Breakers

Servo driver Model	Rated Input Current	Recommended Breaker		
		Manufacturer	Rated Current (A)	Model
Single phase 220V				
E-DHAS01E	1.7	Schneider	4	OSMC32N2C4
E-DHAS04E	4		6	OSMC32N2C6
E-DHAS08E	7.9		16	OSMC32N2C16
E-DHAS10E	8.8		16	OSMC32N2C16

RCD (Residual Current Device) Selection Guidelines:

- Use Type B RCDs to handle DC leakage current generated by the driver.
- To avoid false triggering due to high-frequency leakage, use RCDs with ≥100 mA trip current per driver.
- For multiple drivers sharing one RCD, use RCDs with ≥300 mA trip current.

11.2.4 AC Input Reactor

Used to reduce harmonic content in input current. Optional accessory. Recommended for environments with strict harmonic requirements.

11.2.5 EMC Filter

To meet EN/IEC 61800-3 standards for radiated and conducted emissions, external EMC filters are required. Recommended Filters: Schaffner FN2090 and FN3258 Series. Please select according to the rated input current of this product and the following table:

Filter Model		Appearance
SCHAFFNER	FN2090 Series	
	FN3258 Series	

Servo driver Model	Rated Input Current (A)	Recommended Filter
Single phase 220V		
E-DHAS01E	1.7	FN 2090-3-06
E-DHAS04E	4	FN 2090-6-06
E-DHAS08E	7.9	FN 2090-8-06
E-DHAS10E	8.8	FN 2090-10-06

11.2.6 Magnetic Rings and Clamps

Install magnetic rings as close to the driver as possible on either the input or output side. Install at Input side can suppress noise in the power supply system. Install at Output side can reduces external interference and bearing current.

For leakage current and signal interference issues, use magnetic rings or clamps:

- Amorphous Magnetic Rings: High permeability below 1 MHz, excellent interference suppression, higher cost.
- Ferrite Clamps: Effective above 1 MHz, suitable for low-power servo drivers and signal lines, cost-effective and aesthetically pleasing.