INOVANCE

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ES810 Series

Standard Servo Drive (Multi-drive System)

User Guide

Industrial Automation

Intelligent Elevator

New Energy Vehicle

Industrial Robot

Rail Transit

Data code 19010648A03

Preface

Thank you for purchasing the ES810 series servo drive.

The ES810 servo drive (multidrive system), which covers a power range from 2.2 kW to 126 kW, is comprised of a power supply unit and multiple drive units to form a drive system with common DC bus. It supports EtherCAT communication to allow online operation of multiple servo drives when used together with a host controller. In addition, it optimizes process control for all-electric injection molding machines, such as the control on injection speed and pressure holding precision. By providing functions such as stiffness level setting and inertia auto-tuning, it allows fast and accurate position, speed and torque control together with low- to medium-inertia high response servo motors. The ES810 series servo drive applies to automation equipment such as plastic molding machines, semi-conductor manufacturing equipment, SMT machines, PCB punching machines, handling machineries, food processing machineries, machine tools, and transmission machineries.

This guide describes how to use the ES810 series servo drive, including safety information, mechanical and electrical installation, commissioning, and maintenance. Read through this user guide before initial use. In case of any question about functions or performance, contact the technical support of Inovance.

Precautions
◆ Drawings in the user guide are sometimes shown without covers or protective guards. Remember to install the covers or protective guards as specified first, and then perform operations in accordance with the instructions.
◆ The drawings in the user guide are shown for illustration only and may be different from the product you purchased.
◆ The guide is subject to change due to product upgrade, specification modification as well as efforts to the accuracy and convenience of the guide.
◆ If the guide is damaged or lost, contact our regional agents or customer service centers to order the user guide.
◆ Contact Inovance customer service center for concerns during use.

§ **Cautions for New Users**

Read through this user guide carefully before use for the first time. If you have any question concerning product functions or performance, contact Inovance for technical support.

§ **About this guide**

The information in this user guide is subject to change without notice. Get the latest document version by the following means:

- Contact Inovance agents.
- Visit Inovance's website http://www.inovance.com and download the user guide.

§ Standards Compliance

Certification marks on the product nameplate indicate compliance with the corresponding certifications.

Certification	Mark	Directive		Standard
CE	CE	EMC Directive	2014/30/EU	EN IEC 61800-3
		LVD	2014/35/EU	EN 61800-5-1
UL	c UL us LISTED	-		UL 61800-5-1 CSA C22.2 No.274
UCKA	-	Electrical Equipment(Safety) Regulations 2016		EN 61800-5-1
		Electromagnetic Compatibility Regulations 2016		EN IEC 61800-3
KC	-			Article 58-2 of Radio Waves Act

NOTE

- The above EMC directive is complied with only when the EMC electrical installation requirements described in this user guide are strictly observed.
- The integrator who integrates the drive into other devices and attaches the CE mark to the final assembly has the responsibility of ensuring compliance with CE standards and European standards.
- Not all the models have KC certification. Applicable certifications are listed on the product nameplate.
- For more information on product certifications, contact Inovance agent.

Contents

Fundamental Safety Instructions

Safety Disclaimer

1. Before installation, operation, and maintenance, read through the safety instructions.
2. To ensure personal and equipment safety of humans and products, follow all the safety instructions in this user guide.
3. "CAUTION", "Alarm", and "DANGER" items in this manual do not indicate all safety precautions that need to be followed; instead, they just supplement the safety precautions.
4. Use this product according to the designated environment requirements. Damage caused by improper use is not covered by warranty.
5. Inovance shall take no responsibility for any personal injury or property loss caused by improper operation.

Safety Levels and Definition

Indicates that failure to comply with the notice can result in severe personal injury or even death.

Indicates that failure to comply with the notice may result in death or severe personal injury.

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

Safety instructions

Unpacking

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

WARNING

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

Storage and Transportation

CAUTION

- Store and transport the product according to the following requirements. The storage temperature and humidity requirements must be met.
- Do not store or transport the drive in environments with water splash, rain, direct sunlight, strong electric field, strong magnetic field, and strong vibration.
- Avoid storing this product for more than three months. Long-term storage requires stricter protection and necessary inspection.
- Pack the equipment strictly before transportation. Use a sealed box for long-distance transportation.
- Never transport the equipment with other equipment or materials that may harm or have negative impacts on this equipment.

WARNING

- Use professional loading and unloading tool to carry large-scale or heavy equipment.
- When carrying the equipment with bare hands, hold the equipment casing firmly with care to prevent parts from falling. Failure to comply may result in personal injuries.
- Handle the equipment with care during transportation and mind your steps to prevent personal injuries or equipment damage.
- Never stand or stay below the equipment when the equipment is being hoisted by the hoisting equipment.

Installation

WARNING

- Read through the guide and safety instructions before installation.
- Do not retrofit the equipment.
- Do not fiddle with the bolts used to fix equipment components or the bolts marked in red.
- Do not install the equipment in environment with water or corrosive gas.
- Make sure that the air inlet and outlet are unblocked and prevent entry of foreign objects. Otherwise, internal components may be aged, causing faults and fires.
- Install the product in the required direction. Failure to comply may result in faults.
- Do not install this equipment in places with strong electric or magnetic fields.
- Ensure that specified clearance is reserved among the servo drive, the interior surface of the cabinet, and other devices. Failure to comply will result in a fire or fault.
- When the equipment is installed in a cabinet or final assembly, a fireproof enclosure providing both electrical and mechanical protections must be provided. The IP rating must meet IEC standards and local laws and regulations.
- Install the stop device at the mechanical side to ensure safety.
- The brake (if available) of the servo motor is not used as the stop device for safety. If the stop device is not installed, personal injuries may be caused.

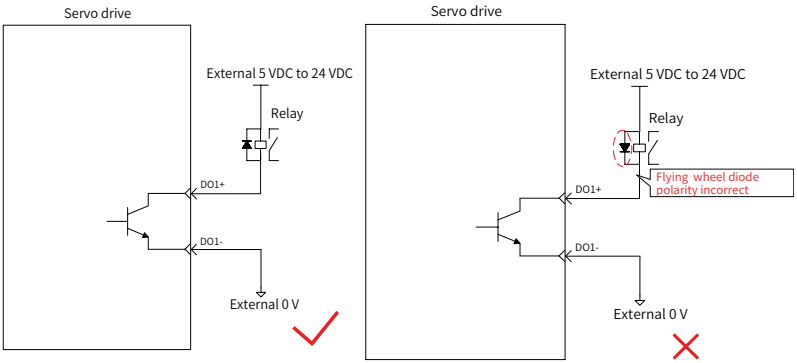
DANGER

- Only well-trained professionals are allowed to perform installation, wiring, maintenance, inspection or parts replacement on the product.
- The installation personnel must be familiar with installation requirements and related technical documents.
- Before installing devices with strong electromagnetic interference, such as a transformer, install a shielding device to the equipment to prevent malfunction.

Wiring

DANGER

- Insulate the connection parts of the power terminals. Failure to comply may result in electric shock.
- Do not damage or pull the cable forcefully, and do not subject the cable to excessive force, place it under heavy objects, or clamp it up. Failure to comply may result in electrical shock, causing equipment stop or damage.
- When the DO needs to drive a relay, connect a snubber diode on both sides of the relay coil. Do not reverse the polarity of the snubber diode during installation, as shown in the following figure. Otherwise, the 24 VDC power supply will be damaged immediately when the DO generates output.



- Do not route the power cable and the signal cable through the same duct or bundle them together. Keep the power cable at least 30 cm away from the signal cable.
- Use the shielded twisted pair cables as the signal cable and encoder cable with both ends of the shield grounded.
- The maximum length of the command input cable and encoder cable is 3 m and 20 m respectively.
- Perform inspection only after the CHARGE indicator is off.
- As the servo drive contains a capacitor in the power supply part, the capacitor will be charged with a high current for 0.2 seconds upon power-on or power-off. Therefore, frequent ON/OFF operations can deteriorate performance of the main circuit components in the servo drive.
- Observe the following precautions when wiring the main circuit connector:

  1. Remove the connector from the drive before wiring.
  2. Insert one cable into one cable terminal of the connector. Avoid short circuit between the conductor and the adjacent cable when inserting the cable.
- Take proper shielding measures to prevent equipment damage in environments suject to:

  1. Interference due to static electricity
  2. Strong electric field or magnetic field
  3. Radioactive rays
  4. Interference generated by power cables nearby

Wiring

WARNING

- Never connect the three-phase power supply to the output terminals U, V, W of the drive. Failure to comply will result in personal injury or a fire.
- Connect the power terminals and motor terminals securely. Failure to comply may result in a fire.
- Connect the U, V, W terminals of the servo drive to of those of the servo motor directly without an electromagnetic contactor. Failure to comply may result in abnormalities and faults.
- Connect the cables correctly and securely. Failure to comply may result in motor out of control, personal injuries, or faults.
- Ground the grounding terminal ⏚ of the drive. Failure to comply may result in electric shock.
- Use the specified power supply. Otherwise, the equipment may be burnt.
- Install safety devices such as a circuit breaker to prevent short circuit in the external circuit. Failure to comply may result in a fire.

Power-on

DANGER

- Before power-on, make sure that the equipment and product are installed properly with reliable wiring and the motor can be restarted.
- Before power-on, ensure that the power supply meets equipment requirements. Failure to comply will result in equipment damage or even a fire.
- During power-on, unexpected operations may be triggered on the equipment. Therefore, stay away from the equipment.
- After power-on, do not open the cabinet door and protective cover of the equipment. Failure to comply will result in an electric shock. Do not touch the power terminal within 10 minutes after power-off because high residual voltage may still exist in the servo drive after the power supply is switched off.
- Do not turn on or off the power supply frequently. If frequent ON/OFF operations are needed, make sure that the ON/OFF interval is at least one minute.
- Do not touch any wiring terminals during power-on. Failure to comply will result in an electric shock.
- After power-on, do not disassemble any unit or component of the equipment. Failure to comply will result in an electric shock.

Operation


DANGER

- Do not touch any wiring terminals during operation. Failure to comply will result in an electric shock.
- Do not remove any part of equipment or the product during operation. Failure to comply may result in an electric shock.
- Do not touch the interior part of the drive. Failure to comply may result in an electric shock.
- Do not touch the equipment enclosure, fan, or resistor with bare hands to sense the temperature. Failure to comply may result in personal injury.
- Signal detection during operation must be performed only by professionals. Failure to comply may result in personal injury or damage to the equipment.
- Perform a trial run on the motor without load (not connected to the shaft) to prevent accidents. Failure to comply may result in personal injuries.
- Do not touch the heatsink of the servo drive, external braking resistor, or motor after power-on or immediately after power-off. Failure to comply may result in personal injury.
- Never touch the rotating part of the servo motor during operation. Failure to comply may result in personal injury.
- When a fault occurs, find the cause and ensure safety before resetting the fault for a restart. Failure to comply may result in personal injury.
- If the power supply recovers from an instantaneous power failure during operation, the equipment may restart suddenly. Do not get close to the equipment in this case.

Operation

- Prevent metal or other objects from falling into the device during operation. Failure to comply may result in equipment damage.
- Do not start or stop the equipment by using the contactor. Failure to comply may result in equipment damage.
- When the equipment is installed to the machine, preset user parameters that match the machine before operation. Failure to comply may result in equipment mal-operation or faults.
- Upon the homing operation, the positive limit switch (P-OT) and the negative limit switch (N-OT) signals are invalid.
- When the servo motor is used on a vertical axis, install a safety device to prevent the workpiece from falling upon a fault or overtravel. Lock the servo drive to stop it upon overtravel to prevent the workpiece from falling.
- Set the load inertia ratio correctly to prevent vibration.
- Do not use the brake of the motor for normal braking. Failure to comply may result in faults.

Maintenance

- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Do not perform maintenance with power ON. Failure to comply can result in electric shock.
- Before maintenance, switch off all the power supplies of the equipment and wait for at least 10 minutes.

- Perform routine and regular inspection and maintenance on the equipment according to maintenance requirements, with the inspection and maintenance records kept properly.

Repair

- Equipment installation, wiring, maintenance, inspection, or parts replacement must be performed only by professionals.
- Do not repair the equipment with power ON. Failure to comply can result in electric shock.
- Before performing the insulation resistance test on the drive, disconnect all the connections to the drive. Failure to comply can result in equipment fault.
- Do not change wiring with power on. Failure to comply may result in electric shock or personal injury.
- Before inspection and repair, disconnect all the power supplies of the equipment and wait for at least 10 minutes.

WARNING

- When the equipment is faulty or damaged, the troubleshooting and repair work must be performed by professionals that follow the repair instructions, with repair records kept properly.
- Replace quick-wear parts of the equipment according to the replacement instructions.
- When replacing the servo drive, upload user parameters saved in the old servo drive to the new one before operating on the new one. Failure to comply may result in damage.
- Do not use the gasoline, diluent, alcohol, acidic or alkaline detergent during cleaning to prevent enclosure discoloration or damage.
- Do not operate damaged equipment. Failure to comply may result in worse damage.
- After the equipment is replaced, check the wiring and set parameters again.

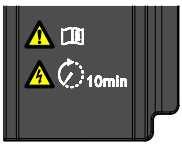
Disposal

WARNING

- Dispose of retired equipment in accordance with local regulations and standards. Failure to comply may result in property damage, personal injury, or even death.
- Recycle retired equipment by observing industry waste disposal standards to avoid environmental pollution.

Safety Labels

To guarantee safe operations and maintenance of the equipment, follow the safety labels on the equipment. Do not damage or remove the safety labels. The following table describes the meaning of the safety labels.

Safety label	Description
	◆ Read the user guide before installation and operation. Failure to comply will result in an electric shock. ◆ Do not remove the cover during power-on or within 10 minutes after power-off. ◆ After switching off the input and output power supplies, wait for at least 10 minutes until the power indicator turns off before further operations.

Checklist

The standard environmental conditions are as follows:
Average ambient temperature: 30° C
Average load rate: Below 80%
Daily operating time: Below 20 hours

Perform routine and regular inspections according to the following table.

Type	Inspection cycle	Item
Routine inspection	Routine	◆ Check the ambient temperature, humidity, dust, and foreign objects.
		◆ Check whether unusual vibration and noise are generated.
		◆ Check whether the power supply voltage is normal.
		◆ Check whether unusual smell is generated.
		◆ Check whether the air vent is stuck with fiber threads.
		◆ Check whether the front end and connectors of the drive are clean.
		◆ Check for intrusion of unwanted objects on the load side.
Regular inspection	One year	◆ Check whether the fastening parts are loose.
		◆ Check whether the equipment is overheated.
		◆ Check whether the terminal is damaged.
		◆ Check whether the fastening parts of the terminal become loose.

Inhibitions

The equipment can be dismantled and repaired only by Inovance engineers.

The electrical and electronic parts inside the servo drive may be mechanically worn out and degraded. To keep the servo drive and servo motor in good condition, perform parts replacement based on the following table. Before replacement, contact the agent or Inovance first to check whether the components need to be replaced.

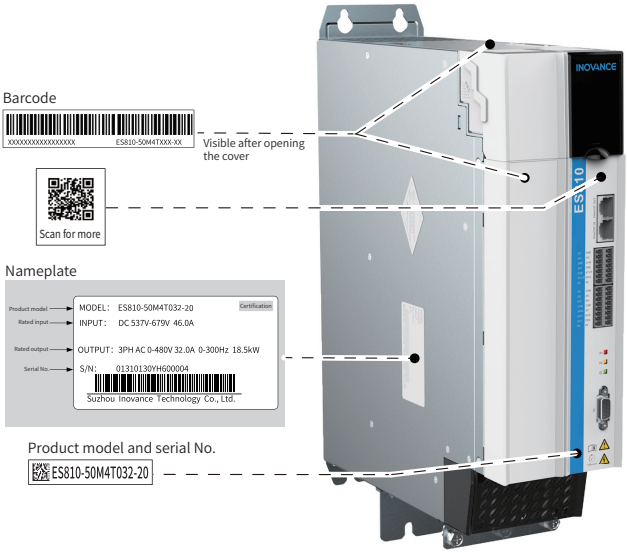
Target	Type	Standard replacement interval	Remarks
Drive	Bus filter capacitor	About five years	The standard replacement cycle is for reference only. If any device/component works improperly before the replacement cycle expires, replace it immediately.
	Cooling fan	2 to 3 years (10,000 h to 30,000 h)	
	Aluminum electrolytic capacitor on the PCB	About five years	
	Pre-charge resistor	20000 operations (depending on the operating conditions)	

1 Product Information

Before using this product, purchase the ES810 power supply unit. For more information on the power supply unit, see the 810 Series Power Supply Unit User Guide.

1.1 Servo Drive

1.1.1 Nameplate and Model



ES810 - 50M 4T 032 - 2 0

Code	Product name
ES810	Hydraulic servo

Code	Module type
50M	Drive unit

Code	Voltage class
4T	380–480 V

Code	Rated output current (A)
...	...
032	32
...	...
112	112
...	...

Code	Drive unit
0	STO function

Code	Encoder type
0	Resolver
1	Heidenhain
2	Weton 23-bit absolute encoder

Figure 1-1 Nameplate and model of the servo drive

1.1.2 Components

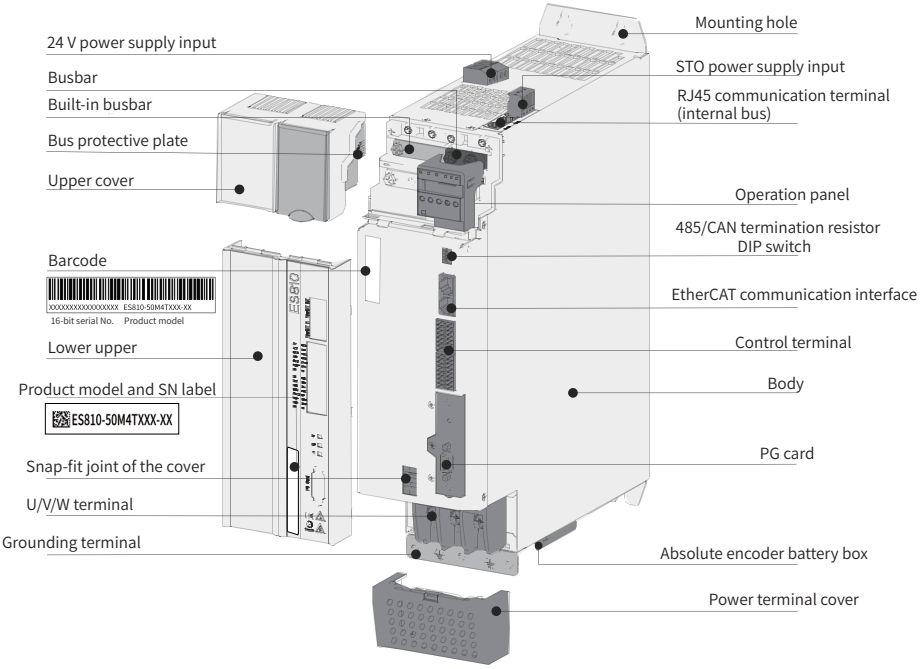


Figure 1-2 Servo drive components

1.1.3 Specifications

<table>
<tr><td colspan="3">Model:
ES810-50M4Txxx-xx</td><td>005</td><td>009</td><td>013</td><td>017</td><td>025</td><td>032</td><td>037</td><td>045</td><td>060</td><td>075</td><td>091</td><td>112</td><td>150</td><td>200</td><td>240</td></tr>
<tr><td rowspan="2">Input</td><td colspan="2">Input current DC (A)</td><td>7</td><td>12</td><td>17</td><td>22</td><td>31</td><td>40</td><td>46</td><td>55</td><td>73</td><td>90</td><td>105</td><td>129</td><td>172</td><td>233</td><td>276</td></tr>
<tr><td colspan="2">Input voltage</td><td colspan="15">Rated input voltage: 537 VDC to 679 VDC
Bus voltage range: 350 VDC to 800 VDC</td></tr>
<tr><td rowspan="4">Output</td><td colspan="2">Output current AC (A)</td><td>5</td><td>9</td><td>13</td><td>17</td><td>25</td><td>32</td><td>37</td><td>45</td><td>60</td><td>75</td><td>91</td><td>112</td><td>150</td><td>200</td><td>240</td></tr>
<tr><td colspan="2">Carrier frequency</td><td colspan="15">Rated carrier frequency: 4 kHz 7-segment pulsing
Carrier frequency range: 2–8 kHz</td></tr>
<tr><td colspan="2">Output voltage</td><td colspan="15">0 VAC to 480 VAC</td></tr>
<tr><td colspan="2">Output frequency</td><td colspan="15">0 Hz to 300 Hz</td></tr>
<tr><td rowspan="2">Heat dissi-pation</td><td colspan="2">Thermal design power (W)</td><td>59</td><td>76</td><td>127</td><td>155</td><td>249</td><td>294</td><td>343</td><td>425</td><td>526</td><td>669</td><td>817</td><td>1033</td><td>1379</td><td>1570</td><td>1875</td></tr>
<tr><td colspan="2">Air exhaust volume (CFM)</td><td>10</td><td>10</td><td>10</td><td>37</td><td>37</td><td>40</td><td>55</td><td>60</td><td>45</td><td>45</td><td>72</td><td>136</td><td>138</td><td>140</td><td>220</td></tr>
<tr><td colspan="2">Weight (kg)</td><td colspan="3">4.1</td><td colspan="3">6.8</td><td>7.4</td><td colspan="2">9.2</td><td>9.9</td><td>16.4</td><td>17.8</td><td>18.8</td><td>24</td><td>25</td></tr>
<tr><td colspan="2">IP rating</td><td colspan="15">IP20</td></tr>
<tr><td colspan="2">Overload capacity</td><td colspan="15"><table><tr><td>Overload ratio</td><td>150%</td><td>180%</td><td>200%</td><td>250%</td></tr><tr><td>Overload time</td><td>80s</td><td>45s</td><td>30s</td><td>10s</td></tr></table>Note 1: Values in the preceding table are the minimum values obtained at 4 kHz carrier frequency under an ambient temperature of 40° C, with 100 Hz outputted.
Note 2: After an overload fault occurs, wait for 1 min and then start the drive.
Note 3: Contact the technical support of the drive manufacturer for the overload time at low-speed operation.</td></tr>
<tr><td colspan="2">MTBF (h)</td><td colspan="15">558744 h
Note: MTBF (Mean Time Between Failures) is one of the indicators used to measure product reliability. The above MTBF values are theoretical values and are applicable only to the estimation of maintenance costs and spare parts.</td></tr>
<tr><td rowspan="5">Speed/ Torque control mode</td><td rowspan="3">Perfor-mance</td><td>Speed change rate</td><td colspan="15">Load change rate: 0.5% at 0% to 100% load (under rated speed)
Voltage change rate: 0.5% at rated voltage±10% (under rated speed)
Temperature change rate: ±0.5% at 25±25° C (under rated speed)</td></tr>
<tr><td>Speed control range</td><td colspan="15">1:5000
(Under the rated torque load, the servo drive can keep running as long as the lower limit of the speed control range is not exceeded.)</td></tr>
<tr><td>Frequency</td><td colspan="15">300 Hz ($J_L = J_M$)</td></tr>
<tr><td rowspan="2">Input signal</td><td>Torque control accuracy (repeatability)</td><td colspan="15">±2%</td></tr>
<tr><td>Speed reference input</td><td colspan="15">Inputted through EtherCAT communication or parameter setting</td></tr>
<tr><td></td><td>Torque reference input</td><td colspan="15">Inputted through EtherCAT communication or parameter setting</td></tr>
</table>

Model: ES810-50M4Txxx-xx			005	009	013	017	025	032	037	045	060	075	091	112	150	200	240
Built-in functions	Overtravel (OT) prevention		Decelerating to stop when P-OT and N-OT activated														
	Electronic gear ratio		0.001 ⩽ B/A ⩽ 4000														
	Protective functions		Providing protections against overcurrent, overvoltage, undervoltage, overload, main circuit detection error, heatsink overtemperature, output phase loss, overspend, encoder error, CPU error, and parameter error														
	LED display		1. Main power supply (CHARGE) indicator 2. Operating panel (5-digit display)														
	Analog monitoring		Built-in AO1 terminal for observing the speed and torque reference signals														
	Communication function	Connection devices	EtherCAT														
		Communication protocols	EtherCAT, CoE														
		Functions	Status display, user parameter setting, monitored value display, alarm tracing display, and speed and torque reference signals														
	Others		Gain tuning, alarm record, jog														

1.2 Peripheral Device Connection

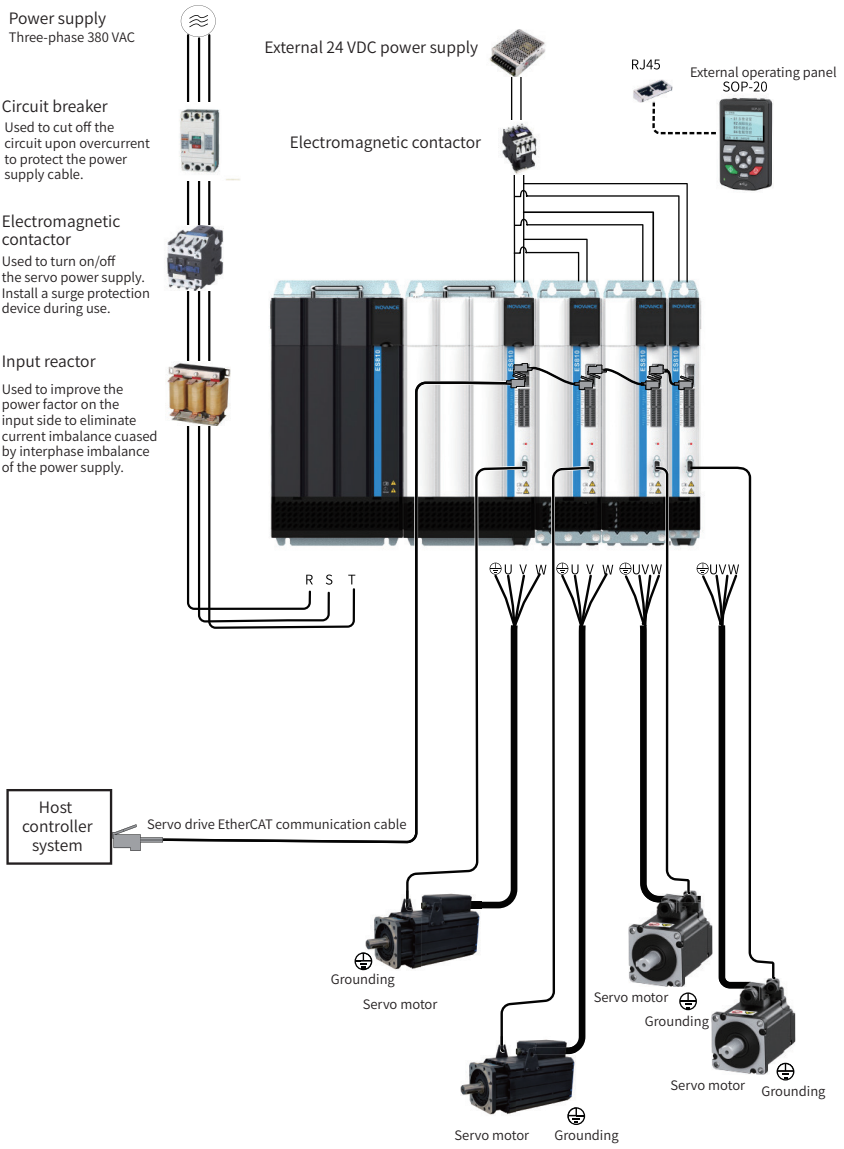


Figure 1-3 Wiring example of a three-phase 380 V system

The servo drive is directly connected to an industrial power supply, with no isolation such as a transformer. A fuse or circuit breaker therefore must be connected to the input power supply to prevent electric shock in the servo system. The servo drive is not configured with the built-

in protective grounding circuit. For the sake of safety, install a residual current device (RCD) to provide protections against overload and short circuit or a specialized RCD to protect the grounding cable.

Do not use an electromagnetic contactor to start or stop the servo motor. As a high-inductance device, the motor may generate transient high voltage that may break down the contactor.

When connecting an external control power supply or a 24 VDC power supply, pay attention to the power supply capacity. When the power supply is used to power up multiple drives or brakes, the capacity may be insufficient, leading to insufficient current supply and failure of the drive or brake. The brake must be powered up by a 24 VDC power supply that matches the motor model and meets the brake power requirements.

2 Mechanical Installation

For details on how to install the power supply unit, see the 810 Series Power Supply Unit User Guide.

2.1 Installation Location

- Install the drive inside a cabinet that meets the following requirements:
  a. Free from sunlight and rain
  b. Free from corrosive and inflammable gases and combustible materials, such as the hydrogen sulfide, chlorine, ammonia, sulfur gas, chloride gas, acid, soda and salt
  c. Free from high temperature, humidity, dust and metal powder
  d. Free from vibration sources
- Pollution degree: PD2

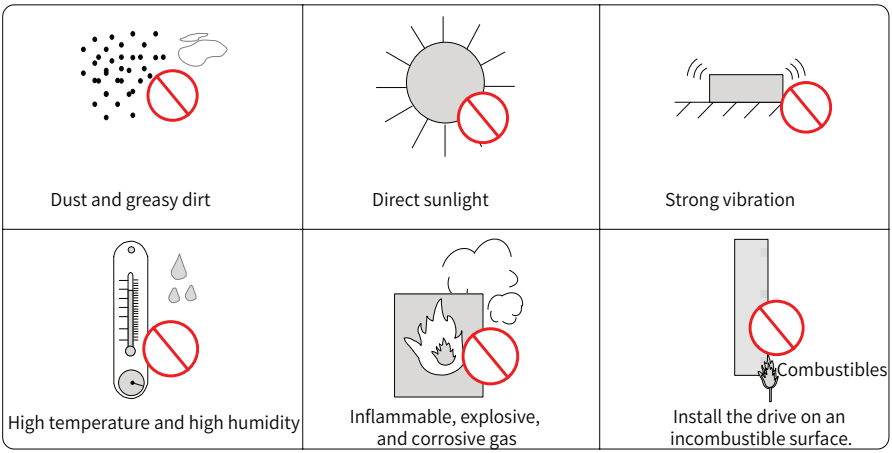


Figure 2-1 Installation environment

2.2 Installation Environment

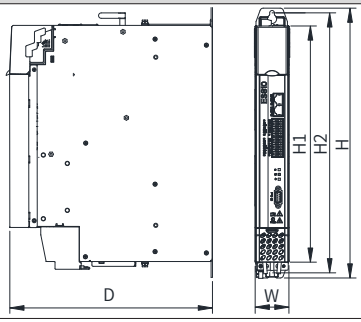
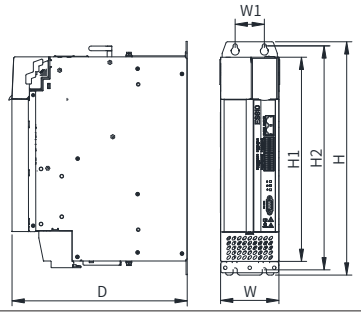
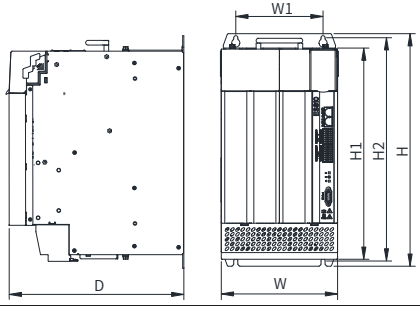
Table 2-1 Installation environment

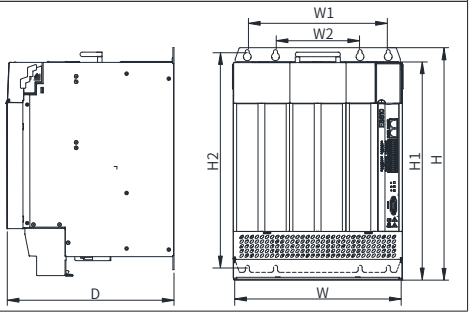
Item	Description
Ambient temperature	-10°C to +50°C , with temperature change rate lower than 0.5°C /min (Derating is required for temperatures above 40°C . For temperatures above 40°C and lower than 50°C (maximum temperature), derate 1.5% for every additional 1°C .)
Ambient humidity	20% to 95% RH (without condensation)
Storage temperature	-25°C to +70°C
Storage humidity	< 95% RH (without condensation)

Vibration	Less than 1G
Shock	Less than 2G
IP rating	IP20
Altitude	1000 m (For altitudes higher than 1000 m and lower than 3000 m (maximum altitude), derate 1% for every additional 100 m.)

2.3 Mounting Dimensions

Note: The mounting hole diameter is 7.

Model	Total width	Dimensions	Structure
ES810-50M4T005-xx ES810-50M4T009-xx ES810-50M4T013-xx	50 mm	[H1]: 350 mm [H2]: 384 mm [H]: 400 mm [W]: 50 mm [D]: 305 mm	
ES810-50M4T017-xx ES810-50M4T025-xx ES810-50M4T032-xx ES810-50M4T037-xx ES810-50M4T045-xx ES810-50M4T060-xx ES810-50M4T075-xx	100 mm	[H1]: 350 mm [H2]: 384 mm [H]: 400 mm [W]: 100 mm [W1]: 50 mm [D]: 305 mm	
ES810-50M4T091-xx ES810-50M4T112-xx ES810-50M4T150-xx	200 mm	[H1]: 350 mm [H2]: 384 mm [H]: 400 mm [W]: 200 mm [W1]: 150 mm [D]: 305 mm	

Model	Total width	Dimensions	Structure
ES810-50M4T200-xx ES810-50M4T240-xx	300 mm	[H1]: 385.3 mm [H2]: 384 mm [H]: 411.8 mm [W]: 300 mm [W1]: 250 mm [W2]: 150 mm [D]: 303 mm	

2.4 Installation Clearance

Make sure the servo drive is installed vertically to the wall. Cool the servo drive with a cooling fan. Fix the servo drive securely on the mounting surface through two to four mounting holes. The number of mounting holes depends on the capacity of the servo drive.

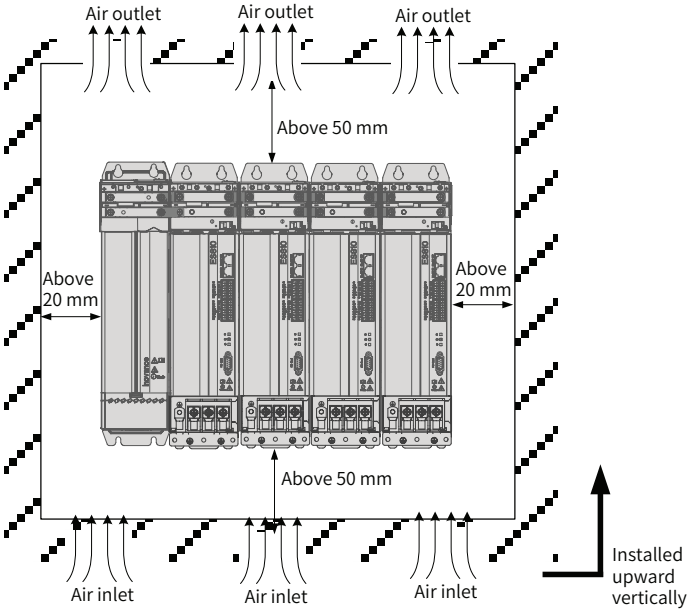
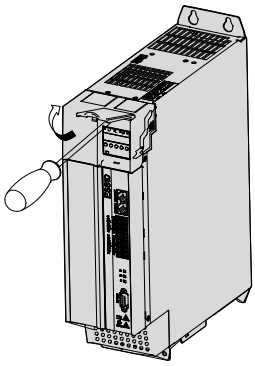
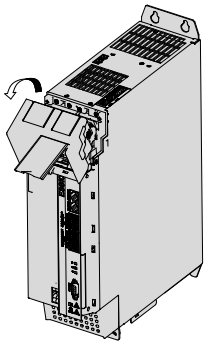
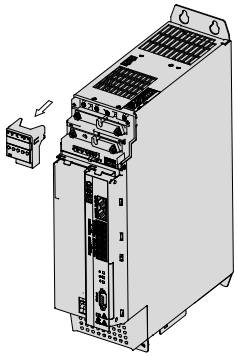
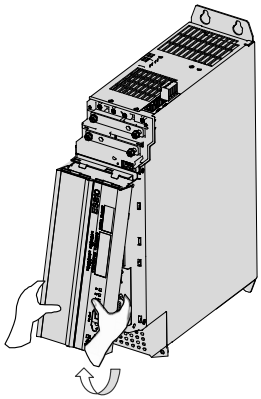
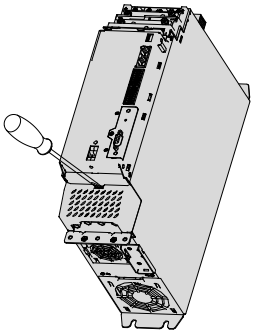
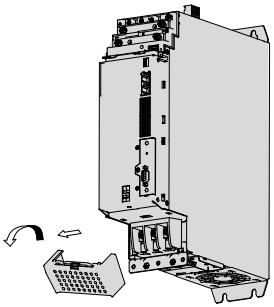


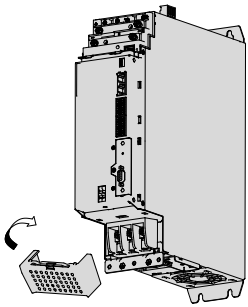
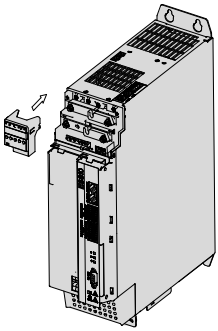
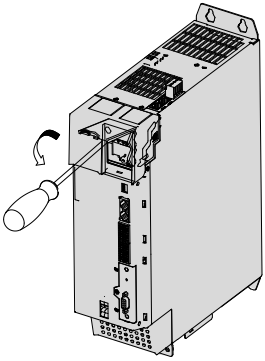
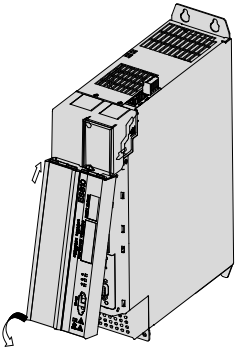
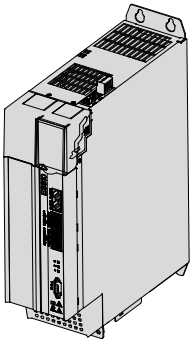
Figure 2-2 Installation clearance of the servo drive

NOTE

◆ Install the servo drive vertically to the wall, with its front (actual mounting face) facing the operator.

2.5 Removing and Installing the Cover

<table>
<tr><th colspan="3">Removing the cover</th></tr>
<tr>
<td>1. Lift the translucent operating panel cover. Loosen the screws in the upper cover with a screwdriver.
  </td>
<td>2. Remove the upper cover by turning it frontward.
  </td>
<td>3. Pull out the operating panel box.
  </td>
</tr>
<tr>
<td>4. Hold the bottom of the lower cover with your hands, and pull the lower part and then the upper part to remove the lower cover.
  </td>
<td>5. Use the screwdriver to push inwards on the latch of the power terminal cover to release the cover.
  </td>
<td>6. Pull the upper part of the power terminal cover and then the lower part to remove it.
  </td>
</tr>
</table>

<table>
<tr><th colspan="3">Cover installation</th></tr>
<tr><td>1. Align the power terminal cover with the position of the clasp of the bus seat. Press the power terminal cover to clasp and fix it.
  </td><td>2. Insert the operating panel.
  </td><td>3. Align the upper cover with its latch position, press the upper cover to fix it, and then tighten the screw with a screwdriver.
  </td></tr>
<tr><td>4. Insert the upper part of the lower cover into the upper cover, and then press the lower part of the lower cover to clasp it.
  </td><td>5. Installation is done.
  </td><td></td></tr>
</table>

2.6 Backplate Mounting

1 Recommended tightening torque (N·m) during installation

Item	M6	M8	M10	M12
Recommended tightening torque (N·m)	4.8	13	20	35

NOTE

- Ensure that there is enough installation space on the right of the power supply unit to install the product.
- A multi-axis system requires units to be lined up along the top.
- Mark the position of the threaded holes for installation and drill a screw hole on the base plate for each screw.
- The servo drive must be installed on the base plate vertically.

2 Backplate mounting of the servo drive

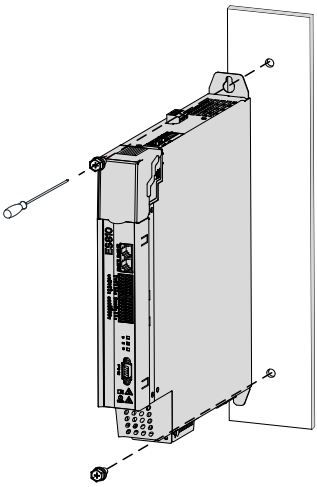


Figure 2-3 Backplate mounting of ES810-50M4T005-xx to ES810-50M4T013-xx (50-mm wide)

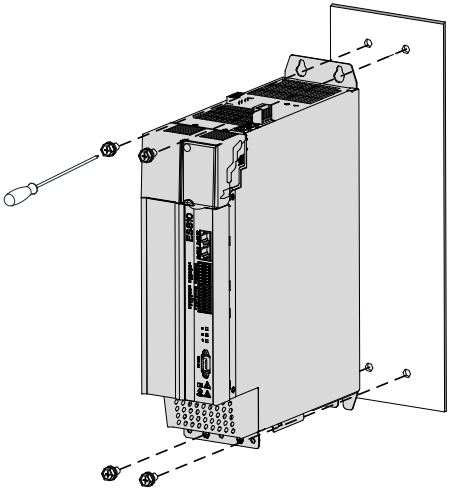


Figure 2-4 Backplate mounting of ES810-50M4T017-xx to ES810-50M4T075-xx (100-mm wide)

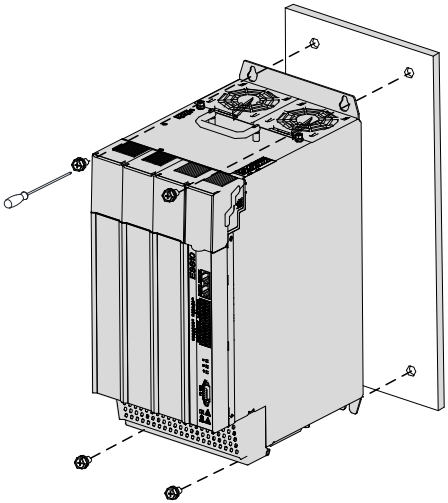


Figure 2-5 Backplate mounting of ES810-50M4T091-xx to ES810-50M4T150-xx (200-mm wide)

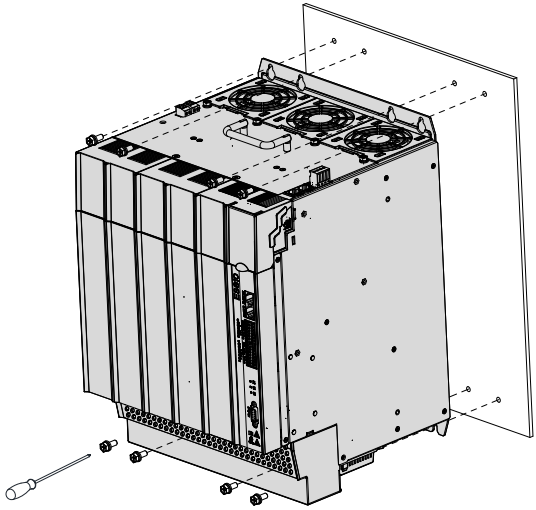


Figure 2-6 Backplate mounting of ES810-50M4T200-xx to ES810-50M4T240-xx (300-mm wide)

3 Cooling

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

As shown in Figure 2-2, keep sufficient space around the servo drive to ensure the cooling effect by a cooling fan. Install the cooling fan onto the top of the servo drive to avoid excessive temperature rise in a certain region, keeping an even temperature inside the cabinet.

4 Grounding

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

To ensure proper grounding of the entire system (equipotential), install a grounding aluminum bar between the mounting holes of two adjacent power supply unit and drive unit. Then install the units to the mounting plate.

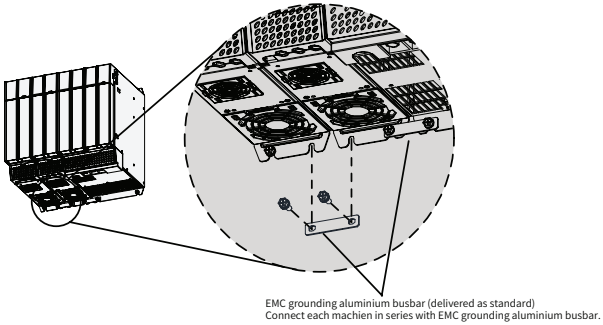


Figure 2-7 System grounding

5 Wiring requirements

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

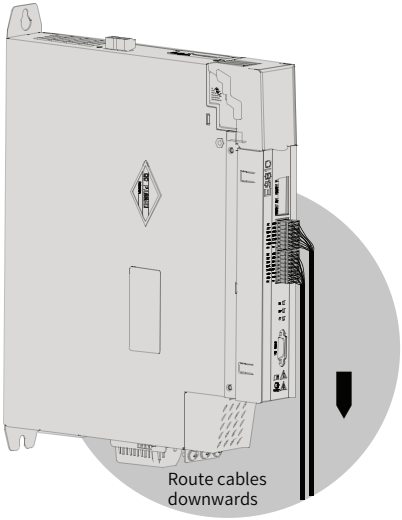


Figure 2-8 Routing direction

3 Electrical Installation

This chapter describes only the electrical installation of the drive unit. For the electrical installation of the power supply unit, see the 810 Series Power Supply Unit User Guide.

DANGER

- Wiring must be performed by authorized and qualified personnel.
- To prevent electric shock, perform assembly/disassembly work on the drive after measuring that the voltage between + and - is within the safe range 10 min after power off, with the power supply indicator off.
- Perform wiring after the servo drive and motor are installed properly. Failure to comply can result in electric shock.
- Do not damage the cables, lay them under large tension or pressure, or hang them. Failure to comply may result in electric shock.
- Insulate the connecting part of the power terminals to prevent electric shock.
- The specification and installation of external cables must comply with applicable local regulations.
- In Table 3-1, the cables must be comprised of copper conductors and the grounding cables must be the yellow-green cables.
- Ensure the entire system is grounded.

CAUTION

- Carry out wiring correctly. Failure to comply will result in servo motor malfunction or physical injury.
- Connect the terminals correctly. Failure to comply may result in damage to the terminals.
- Connect the electromagnetic contactor between the power supply and the main circuit of the drive to form a structure that can cut off the power supply on the servo drive power side. If no electromagnetic contactor is connected, a fire may occur when a fault occurs and continuous large current flows through the product.
- Before power-on, check the voltage specifications of the drive. Check whether the input power supply is correct (537 VAC to 679 VAC).
- Use a noise filter to reduce electromagnetic interference on electronic devices around the product.
- When connecting the power supply and the main circuit, change the state of the servo drive from ON to OFF after an alarm signal is detected and before the main circuit power supply is cut off.
- Connect U, V, W cables of the servo drive to U, V, W terminals of the motor directly. Do not connect an electromagnetic contactor. Failure to comply may result in exceptions and faults.

3.1 Cable Models

Type	Model
Absolute encoder cable	ES-P21-4
	ES-P21-5
	ES-P21-6
	ES-P21-8
	ES-P21-10
	ES-P21-12
	ES-P21-15
	ES-P21-20

Soldering side of aviation connector

Table 3-1 Relationship among the resolver cable, aviation connector, and DB9P male connector

End A (17-pin aviation connector)	A	B	C	D	E	F	G	H	K	L		M	J
End B (DB9P male)	1	2					7	8					Enclosure
2P					1	2							
Labels											KP-N	KTY-P	
Conductor color	Green	Green/ black			Red	Black	Yellow	Yellow/ Black	Brown	Gray/ Brown	Gray/ Orange	Orange	Shield
Signal assignment	PS+	PS-			VB+	VB-	+5V	GND			KP-N	KTY-P	Shield
Remarks	One pair				One pair		One pair		One pair		One pair		

3.2 Servo Drive Terminals

3.2.1 Main Circuit Terminals

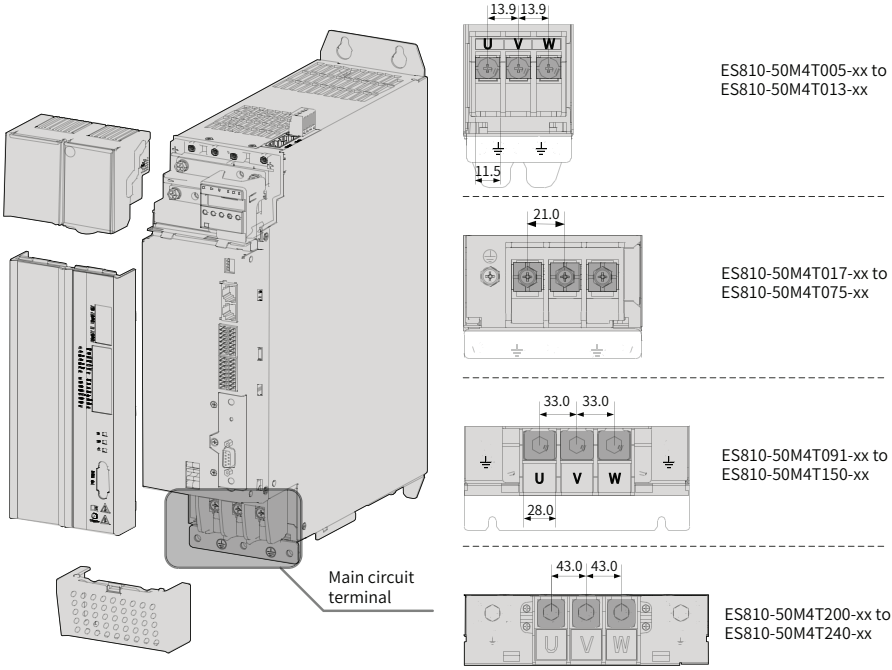


Figure 3-1 Layout and dimensions of the main circuit terminals (unit: mm)

Symbol	Name and Function
+, -	DC bus terminal
U, V, W	Three-phase AC output terminal
⏚	PE grounding terminal

3.2.2 Specifications of Main Circuit Cables

Table 3-2 Recommended specifications of main circuit cables (unit: mm)

Drive model	IEC grounding cable (mm^2)	IEC cable on the output side (mm^2)	Screws	Tightening torque (N·m)
ES810-50M4T005-xx	0.75	3 x 0.75	M5	2.8
ES810-50M4T009-xx	1.5	3 x 1.5	M5	2.8
ES810-50M4T013-xx	2.5	3 x 2.5	M5	2.8
ES810-50M4T017-xx	4.0	3 x 4.0	M6	4.8
ES810-50M4T025-xx	6.0	3 x 6.0	M6	4.8
ES810-50M4T032-xx	10.0	3 x 10.0	M6	4.8
ES810-50M4T037-xx	10.0	3 x 10.0	M6	4.8
ES810-50M4T045-xx	16.0	3 x 16.0	M6	4.8

Drive model	IEC grounding cable (mm^2)	IEC cable on the output side (mm^2)	Screws	Tightening torque (N·m)
ES810-50M4T060-xx	16.0	3 x 16.0	M6	4.8
ES810-50M4T075-xx	16.0	3 x 25.0	M6	4.8
ES810-50M4T091-xx	16.0	3 x 35.0	M10	20
ES810-50M4T112-xx	25.0	3 x 50.0	M10	20
ES810-50M4T150-xx	35.0	3 x 70.0	M10	20
ES810-50M4T200-xx	50.0	3 x 95.0	M12	35
ES810-50M4T240-xx	60.0	3 x 120.0	M12	35

3.2.3 Control Circuit Terminals

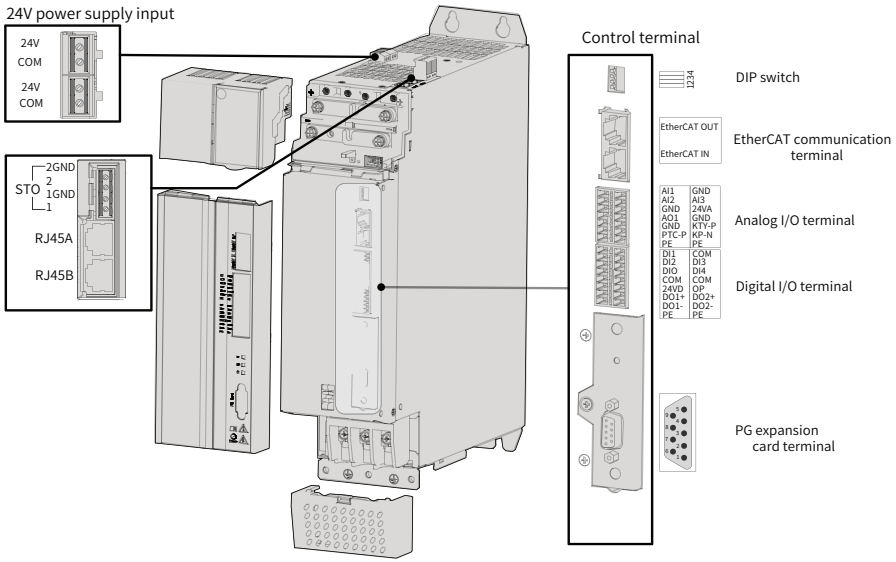


Figure 3-2 Layout of control circuit terminals

Table 3-3 Definitions of control circuit terminals

Type	Name	Function	Performance
STO interface	1	Power supply+ of STO 1	Recommended input voltage: 24 VDC Input voltage range: 12 VDC to 30 VDC Input current range: < 50 mA
	1GND	Power supply- of STO1	
	2	Power supply+ of STO2	
	2GND	Power supply- of STO2	
24 V power supply input	24 V	External 24 V control power and brake power input	Recommended input voltage: 24 VDC Input voltage range: 20 VDC to 30 VDC Input current: 1.5 A
	COM		

Type		Name	Function	Performance
DI/DO	DI	DI1-DI4	DI terminals	Programmable terminal for isolated sink/source input Input frequency < 100 Hz Input voltage range: 15 V to 30 V Input current range: < 20 mA
	DO	DO1+/- DO2+/-	DO	Programmable terminal for Isolated sink/source output: driven by internal or external 24 V Output current range: < 50 mA
	DI/DO	DIO	DI/DO	Used as DI5 or DO3 DI5: Programmable terminal for isolated sink/source input Input frequency < 100 Hz Input voltage range: 15 V to 30 V Input current range: < 20 mA DO3: Programmable terminal for non-isolated sink/source output, which can be driven by internal 24 V only, with reference ground being COM Output current range: < 50 mA
	Digital power supply terminal	24VD	24 V digital voltage output	24 V±10%; no-load voltage: ⩽ 30 V; maximum output current: 200 mA
		OP	Multi-functional digital input common terminal	Voltage range: 15 V to 25 V Current range: < 100 mA
		COM	Digital ground	Internally isolated from GND

Type		Name	Function	Performance
AI/AO	AI interface	AI1 to AI2	AI terminal	Programmable terminal that supports -10 V to +10 V, with 12-bit resolution
		AI3	High-accuracy AI	Programmable terminal that supports the voltage mode (0 V to 10 V) or the current mode (0 mA to 20 mA), with 16-bit resolution
	AO	AO1	AO	Output range: Supports the voltage mode (0 V to 10 V) or the current mode (0 mA to 20 mA), with 12-bit resolution; maximum load resistance: < 500 Ω
	Analog power supply interface	24VA	24 V analog voltage output	24 V±10%; maximum output current: 10 mA Generally used to power up the pressure sensor
		GND	Analog ground	Internally isolated from COM
	Motor temperature sampling terminal	KTY-P	KTY resistance input	Supports KTY, PT1000, and PT100, with KTY84-130 used as default
		KP-N	KTY and PTC common terminal	-
		PTC-P	KTY resistor input	PTC temperature protection; Triggered at 2.69 kΩ and canceled at 2.4 kΩ

■ DIP switch

Name	Function	Position
RS485 termination resistor	Set DIP switches 1 and 2 to “ON”: Termination resistor connected	
	Set DIP switches 1 and 2 to “OFF”: Termination resistor not connected	
CAN termination resistor	Set DIP switches 3 and 4 to “ON”: Termination resistor connected	
	Set DIP switches 3 and 4 to “OFF”: Termination resistor not connected	

3.2.4 STO Terminals

The STO terminal is powered by 24 VDC input power supply. The STO function can be enabled by a bipolar disconnection device in the peripheral circuit. The disconnection device can be an emergency stop switch, safety PLC, etc. The STO terminal must be connected to an external 24 V power supply. Figure 3-12 shows the specific wiring method for each servo drive. If the STO function is available for multiple drives, connect the STO terminal of every drive to an external 24 V switched-mode power supply. The following figure shows a wiring diagram in which the STO terminals of multiple drives are cascaded to share one external switched-mode power supply.

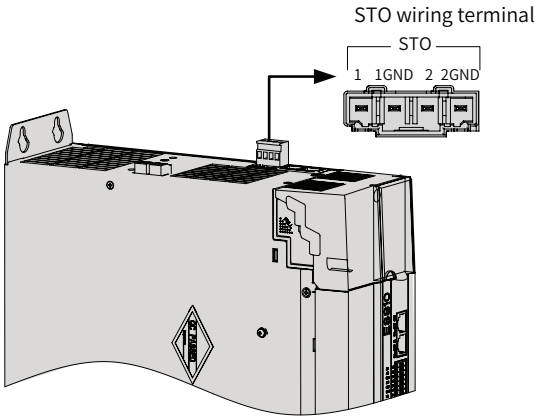


Figure 3-3 Wiring of STO terminal

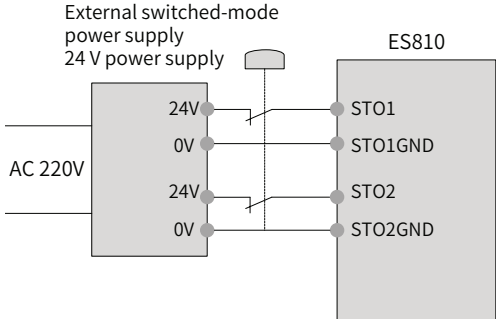


Figure 3-4 Wiring of the STO terminal

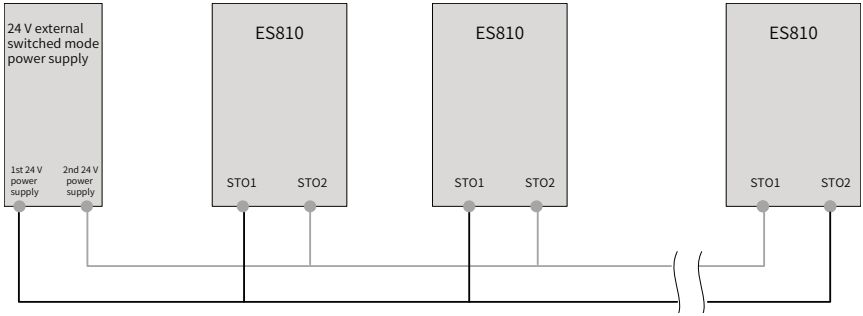
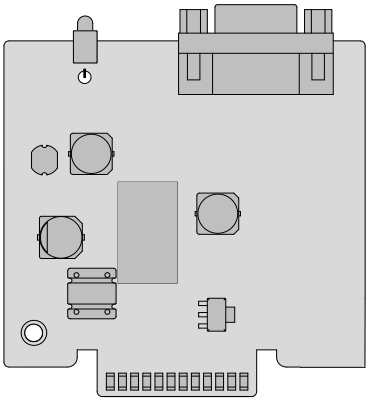


Figure 3-5 Wiring diagram in which the STO terminals of multiple drives are cascaded to share one 24 V power supply

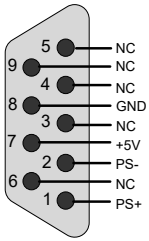
3.2.5 PG Expansion Cards

ES810-PG-CT expansion card



Specifications of ES810-PG-CT	
User Interface	DB9 (female)
Pluggable	Supported
Cable Specification	16AWG to 26AWG Use the shielded twisted pair for the power supply cable and differential signal cable
Communication baud rate	⩽ 4 MHz
RS485 differential min. receiving voltage	±200 mV
Communication cable length	20 m
Power supply voltage	4.75 V to 5.25 V
Differential voltage upon drive output	> 2 V (R = 50 Ω) > 1.5 V (R = 27 Ω)

Table 3-4 ES810-PG-CT terminals

Pin No.	Pin Assignment	Function	Layout
1	PS+	Digital signal+	 Note: DB9 female
2	PS-	Digital signal-	
3	NC	Not connected	
4	NC	Not connected	
5	NC	Not connected	
6	NC	Not connected	
7	+5 V	+5 V power supply	
8	GND	Reference ground	
9	NC	Not connected	
	Enclosure	Shield	

3.3 Connecting the Power Supply Unit to the Servo Drive

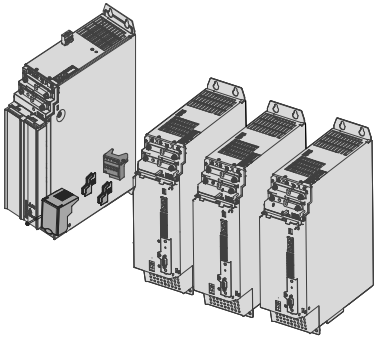
3.3.1 Connecting the Power Supply of the DC Bus

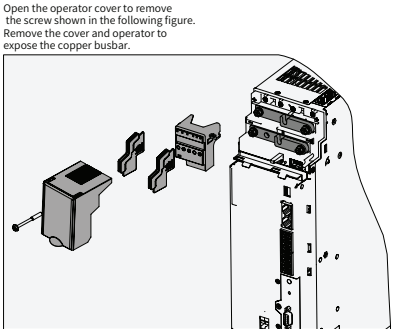
Remove the display cover on the servo drive side. Connect the power supply unit to the servo drive with the DC bus.

CAUTION

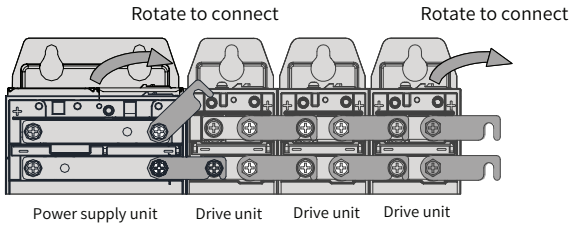
- Use the pre-installed connector (busbar) rather than conductors for electrical connection of the device. Failure to comply can affect stability and safety of operation.

Busbar
1) Loosen the screws of the operator, and remove the cover and operator, as shown in the following figure.





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

Busbar
2) Loosen the screws of the DC busbar (without taking them off), and turn over the DC busbar. 
3) Tighten the screws and calibrate the tightening torques of all screws based on the recommended range: 2.6 N · m to 3.0 N · m.

3.3.2 Connecting the PE (Protective Earthing) Terminal

Ground each device in the system properly. Connect components such as the servo drive, filter, reactor, and motor in the cabinet to the PE copper bar in the star connection mode, as shown in the following figure.

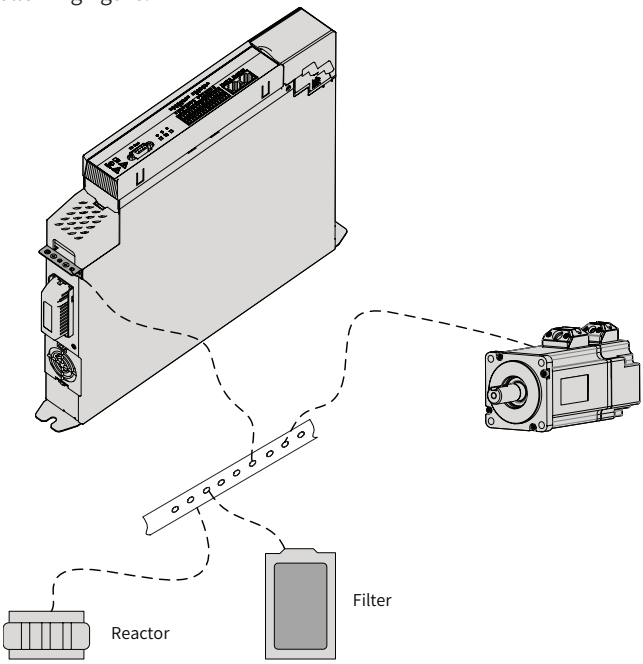
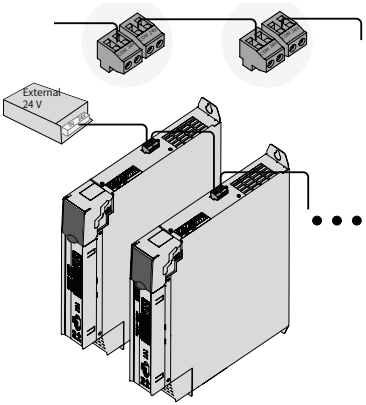


Figure 3-6 Connection of the PE terminal

3.3.3 24 V Control Power Supply

The power supply of the servo drive is divided into the control part and the power part. The control part is preferentially powered by the DC busbar connected to the power supply unit. It

is recommended to connect the 24 V switched-mode power supply of the servo drive to an external power supply. This ensures that the control circuit power supply is not interrupted if the power supply unit stops due to a fault. Connect the 24 V terminal of the servo drive correctly, as shown in the following figure.



3.4 Connecting the Servo Motor to the Drive

3.4.1 Connecting the Motor Power Cable (With Aviation Connector) to the Drive

Connect the U, V, and W power cables of the servo motor (with the aviation connector) to the U, V, and W terminals of the servo drive, and connect the grounding cable of the servo motor to the PE terminal of the servo drive.

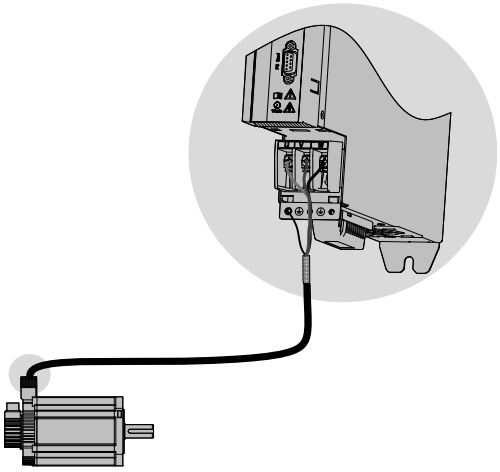


Figure 3-7 Wiring between the servo drive and the servo motor (with the aviation connector)

3.4.2 Connecting Motor Power Cable (Without Aviation Connector) to the Drive

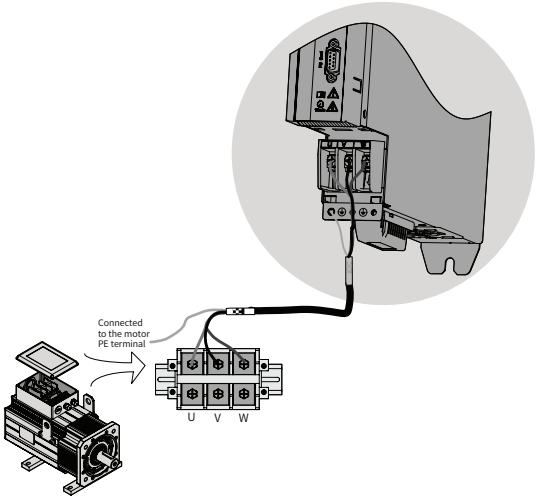
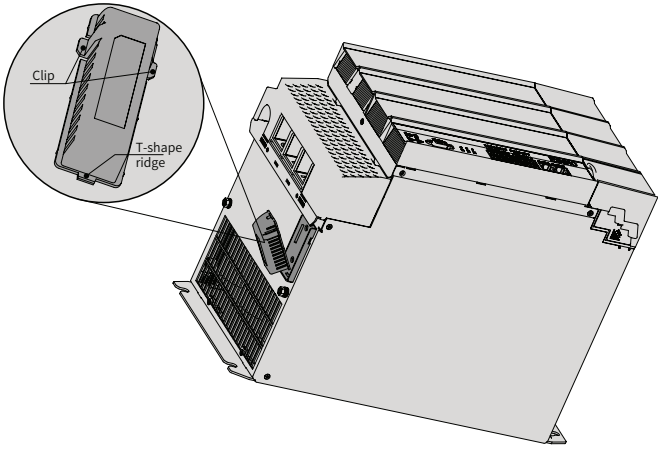


Figure 3-8 Wiring between servo drive and the servo motor (without the aviation connector)

3.4.3 Connecting the Absolute Encoder to the Drive

1 Installing the battery box

Insert the T-shape ridge at the bottom of the battery box into the sheet metal card slot. Press and hold the elastic buckles on both sides, install the battery box to the bracket, and then release the buckles, as shown below.



2 Connecting the battery box

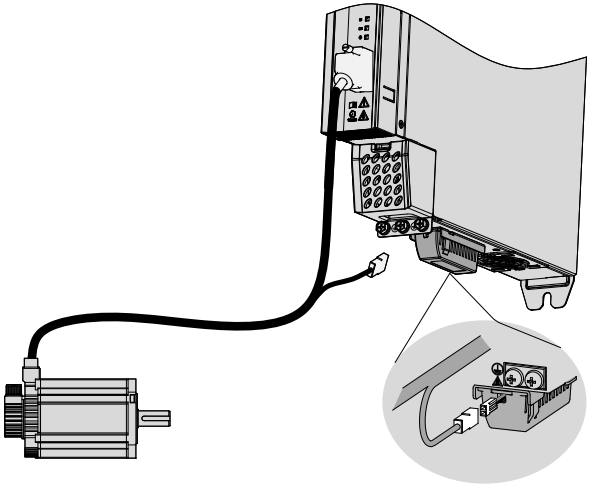


Figure 3-9 Wiring example of absolute encoder signals and the battery box

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

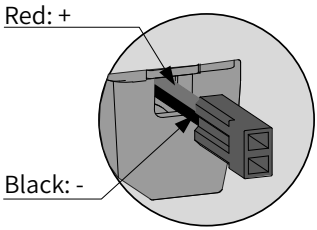


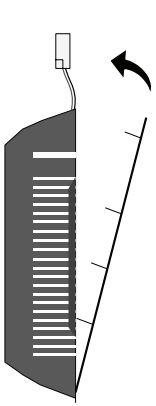
Figure 3-10 Drain wire colors of the battery box

NOTE

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

3 Removing the battery box

The battery may generate leakage liquid after long-term use. Replace it every two years. Remove the battery box based on the procedure shown in the preceding figure, but in the reverse order. When closing the battery box cover, prevent the connector cable from being pinched.



CAUTION

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

1) Insert the battery with polarity (+/-) placed correctly.
2) Leaving an idled or retired battery inside the device may lead to electrolyte leakage. The electrolyte inside the battery is highly corrosive, not only corroding surrounding components but also incurring the risk of short circuit. Replace the battery periodically (recommended interval: Every 2 years).
3) Do not decompose the battery. This is to prevent physical injuries caused by spraying of the electrolyte.
4) Do not throw the battery into the fire or heat up the battery. Failure to comply may result in an explosion.
5) Do not strip off the battery tube or short-circuit the battery. Prevent terminals (+) and (-) of the battery from coming into contact with the metal. Contact with the metal will result in a large current, not only weakening the battery power, but also incurring the risk of explosion due to severe heating.
6) This battery is not rechargeable.
7) Dispose of the retired battery according to local regulations.

4 Selecting the battery model

Select an appropriate battery according to the following table

Table 3-5 Description of the absolute encoder battery

Specification	Item	Rating			Condition
		Min. value	Typical Value	Max. value	
Output: 3.6 V, 2500 mAh	External battery voltage (V)	3.2	3.6	5.0	In the standby mode[1]
	Circuit fault voltage (V)		2.6		In the standby mode
	Battery alarm voltage (V)	2.85	3.0	3.15	
	Current consumed by the circuit (uA)		2.0		In the normal operation mode[2]
			10.0		In standby state, shaft at standstill
			80.0		In standby state, shaft rotating
	Ambient temperature (°C)	0.0		40.0	Same as the motor
	Storage temperature (°C)	-20.0		60.0	

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

Note [1]: In the standby mode, when the servo drive is not switched on, the encoder counts the multi-turn data by using the external battery power. In this mode, the absolute encoder stops receiving and sending the data.

[2] In the normal operation mode, the absolute encoder counts the one-turn and multi-turn data and sends and receives the data. Power on the servo drive after connecting the absolute encoder properly. The encoder starts data transceiving after a short delay of about 5s upon power-on. The motor speed must be lower than or equal to 10 rpm during transition from the standby state to the normal operation state (upon power-on). Otherwise, Er.740 (Encoder fault) may occur. In this case, you need to power off and on the servo drive again.

5 Design life of the battery

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

The following is an example telling you how to calculate the design life of the battery. In the following table, T1 represents the duration in which the drive works normally in a day. T2 represents the duration in which the motor rotates after the drive is powered off. T3 represents the duration in which the motor stops after power-off [unit: hour (H)].

Table 3-6 Design life of the absolute encoder battery

Item	Working Time 1	Working Time 2
Working Days in Different Operating Conditions in One Year	313.0	52.0
T1 (h)	8.0	0.0
T2 (h)	0.1	0.0
T3 (h)	15.9	24.0

- Capacity consumed in 1 year = (8 h x 2 uA + 0.1 h x 80 uA + 15.9 h x 10 uA) x 313 + (0 h x 2 uA + 0 h x 80 uA +24 h x 10 uA) x 52 ≈ 70 mAh
- Design life = Battery capacity/Capacity consumed in 1 year = 2600 mAh/70 mAh = 37.1 years

3.5 Wiring of the Control Circuit

3.5.1 DI1 to DI4

The DI can be wired in the SINK mode (NPN) or SOURCE mode (PNP).

1 SINK wiring mode

To use the internal 24 V power supply of the drive, which is the most commonly used method, short the OP terminal and 24V terminal of the drive, and connect the COM terminal of the drive to the 0V terminal of the external controller.

To use an external 24 V power supply, connect the +VCC terminal of the external power supply to the OP terminal, and connect the 0V terminal of the external power supply to a DI through the controller contact. (Note: Do not short the 24VD terminal and the OP terminal of the drive.)

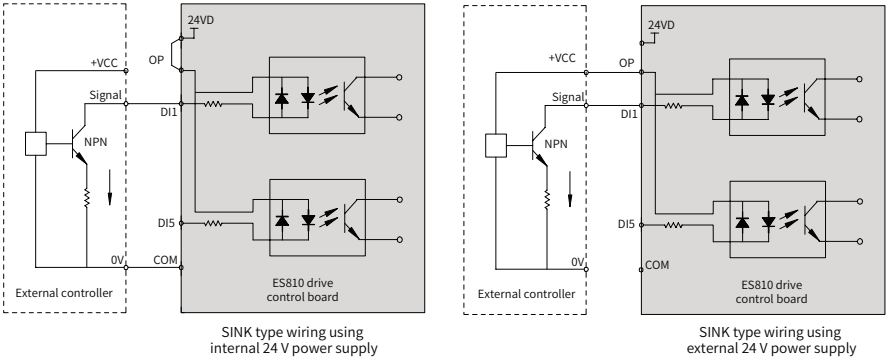


Figure 3-11 SINK wiring mode

Note: In the preceding figure, the +VCC and 0V terminals are those of the external 24 V power supply. The 24VD and COM terminals are those of the internal power supply.

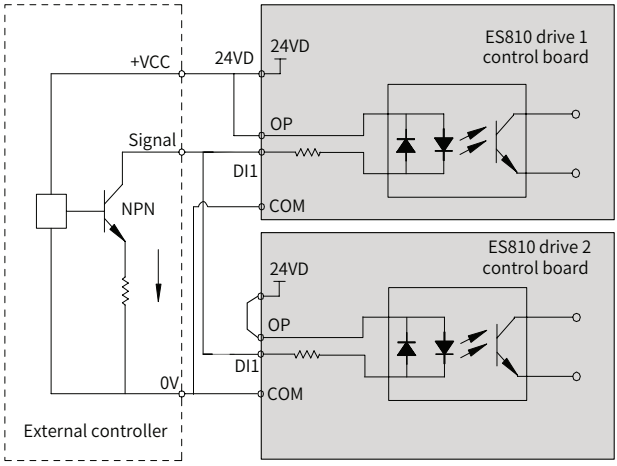


Figure 3-12 Parallel connection of DI terminals of multiple drives in the SINK mode

Note: In the preceding figure, the +VCC and 0V terminals are those of the external 24 V power supply. The 24VD and COM terminals are those of the internal power supply.

2 SOURCE wiring mode

To use the internal 24 V power supply of the drive, connect the OP terminal to the COM terminal, and connect the 24VD terminal to the common terminal of the external controller. (Note: Do not short the 24VD terminal and the OP terminal of the drive.)

To use an external 24 V power supply, connect the OP terminal to the 0V terminal of the external power supply, and connect the +VCC terminal of the external power supply to a DI through the external controller contact. (Note: Do not short the 24VD terminal and the OP terminal of the drive.)

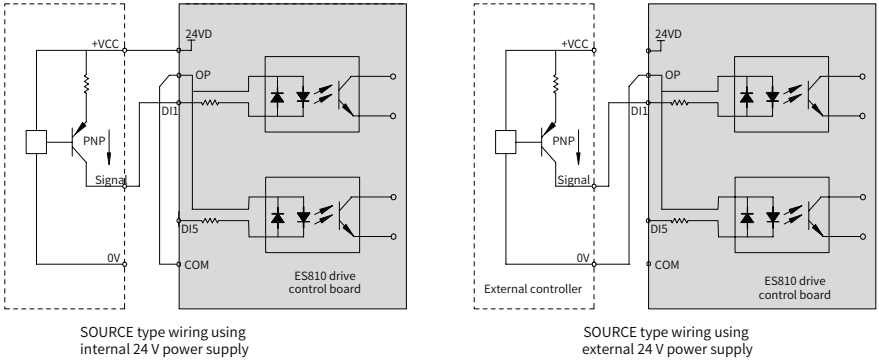


Figure 3-13 SOURCE wiring mode

Note: In the preceding figure, the +VCC and 0V terminals are those of the external 24 V power supply. The 24VD and COM terminals are those of the internal power supply.

3.5.2 DIO Terminals

The DIO terminal can be used as the DI or the DO, which is determined by F03-36. By default, the DIO terminal is used as the DI. Note that the DIO terminal can be used as either the DI or the DO at the same time.

When the DIO terminal is used as the DI terminal, the wiring mode of DIO is the same as that of DI1 to DI4. When the DIO terminal is used as the DO terminal, the common point of DIO is COM and only the SINK wiring mode is supported, as shown in the following figure. In this case, it is recommended to connect the DI common point OP to 24V. Do not connect OP to COM. Otherwise, the user equipment will receive the input signal by mistake when the DIO terminal does not generate output.

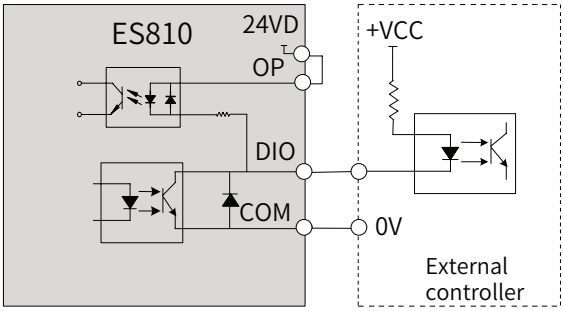


Figure 3-14 Wiring of the DIO terminal used as the DO

Note: In the preceding figure, the +VCC and 0V terminals indicate the external 24 V power supply. The 24VD and COM terminals indicate the internal power supply.

3.5.3 AI Terminals

1 AI1/AI2

AI1 and AI2 are 12-bit analog sampling terminals that support -10 V to +10 V voltage input. Weak analog voltage signals may be easily disturbed by external interference. Therefore, use shielded cable shorter than 20 m. AI1 and AI2 are used to receive analog commands from the host controller.

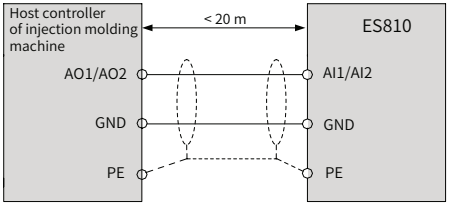
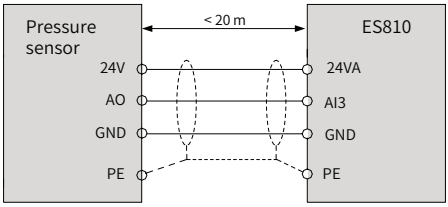


Figure 3-15 Wiring of AI1

Connect the drain wire of the analog terminal shield to the PE terminal.

2 AI3

AI3 is the 16-bit high-resolution analog sampling terminal that supports 0 V to 10 V voltage input or 0 mA to 20 mA current input, which can be switched by H03-65 (0: voltage type; 1: current type). AI3 is generally used to connect to the pressure sensor for pressure feedback input.



Note: The AO indicates the analog output of the pressure sensor.

Figure 3-16 Wiring of AI3 terminal

3.5.4 AO Terminals

AO1 supports 0 V to 10 V voltage output and 0 mA to 20 mA current output.

By default, AO1 supports voltage output. In this mode, the load resistance must be higher than or equal to 5 kΩ, and the driving current must be lower than 2 mA. When current output mode is used, the load resistance must be lower than or equal to 500 Ω; otherwise, the linearity of the AO output can be distorted.

Weak analog voltage signals may be easily disturbed by external interference. Therefore, use shielded cables shorter than 20 m, as shown in the following figure In applications where certain analog signals are subject to severe interference, install a filter capacitor or ferrite core on the analog signal source side.

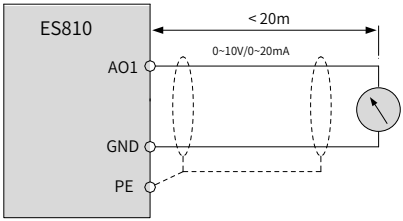


Figure 3-17 Wiring of AO1

3.6 Wiring of Communication Signal EtherCAT

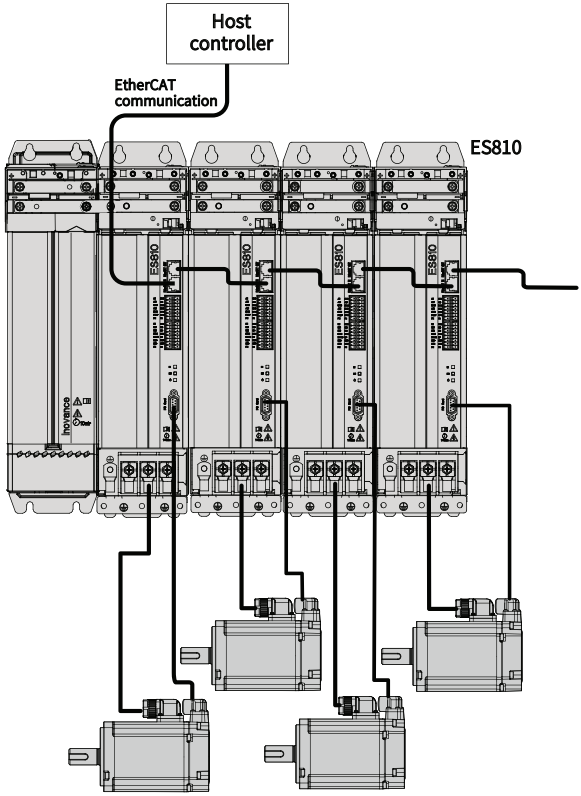
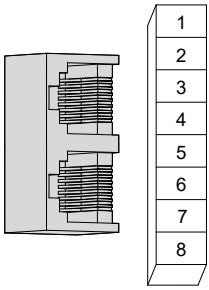


Figure 3-18 Network topology

Table 3-7 Assignment of EtherCAT signal pins

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

3.7 Anti-interference Precautions for Electrical Wiring

3.7.1 Typical Wiring Example

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

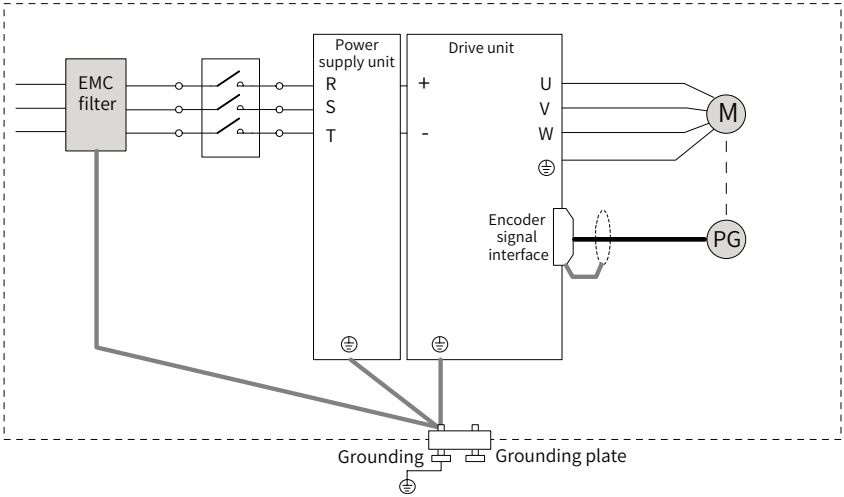


Figure 3-19 Star-type wiring

3.7.2 Use of the EMC Filter

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

1. Route the input and output cables of the EMC filer through different routes. Do not bundle them together.

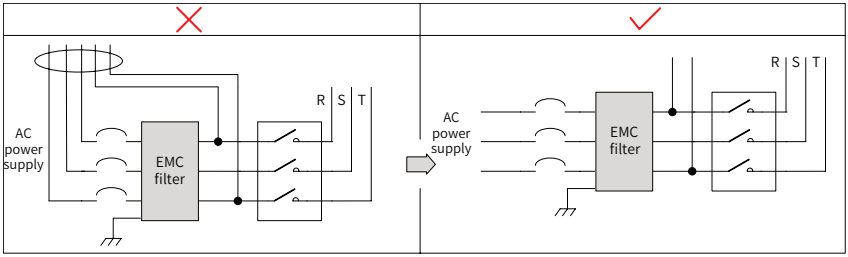


Figure 3-20 Separate routing of EMC filter input and output cables

2. Route the grounding cable and the output power cable of the EMC filter through different routes.

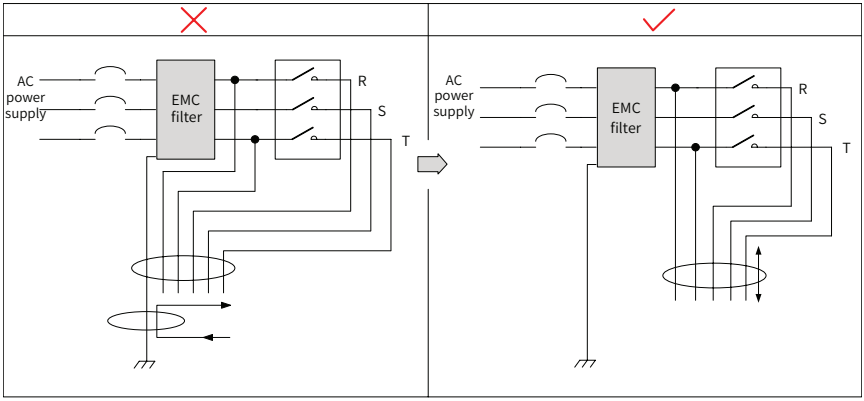


Figure 3-21 Separate routing of the grounding cable and output power cable

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

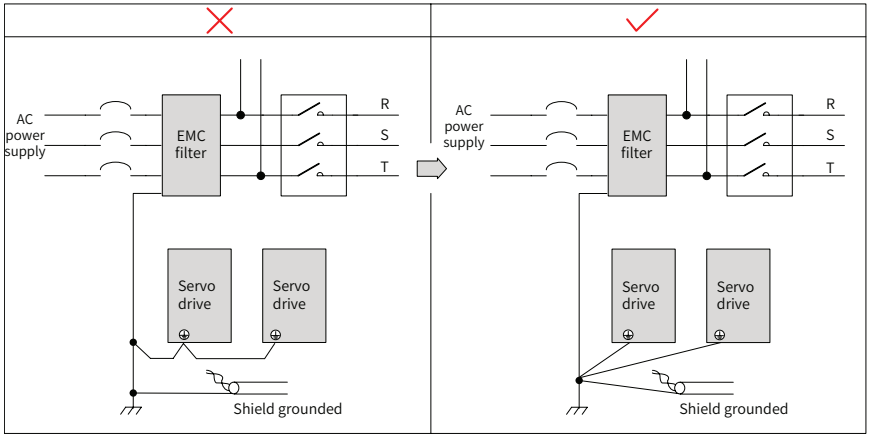


Figure 3-22 Single-point grounding

4. Grounding the noise filter inside the cabinet

If the EMC filter and the servo drive are installed in the same control cabinet, fix the EMC filter and the servo drive on the same metal plate. Make sure the contact part is in good conductive condition, and ground the metal plate properly.

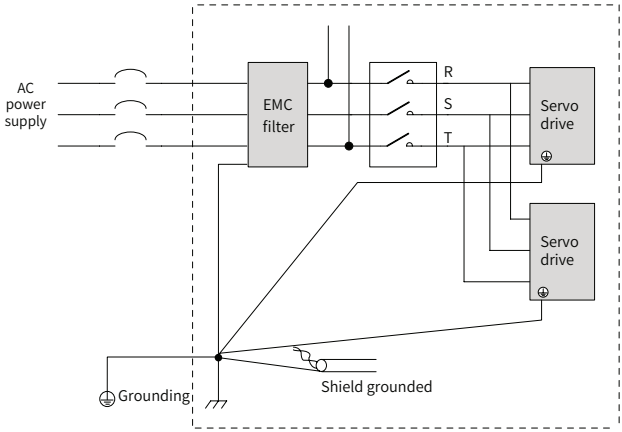


Figure 3-23 Grounding of the EMC filter

3.8 Instructions for Use of Cables

- Do not bend or subject cables to tension. The diameter of a signal cable conductor is only 0.2 mm or 0.3 mm. Handle the cables carefully to prevent fracture.
- In cases where cables need to be moved, use flexible cables. Ordinary cables may be easily damaged after being bent for a long time. Cables of low-power servo motors cannot be used in cable drag chains.
- If the cable drag chain is used, ensure the following requirements are met.

1. The bending radius of the cable is at least 10 times its outer diameter.
2. Do not fix or bundle the cables inside the cable carrier. The cables can be bundled and fixed only at two unmovable ends of the cable carrier.
3. Do not wind or twist the cables.
4. Ensure the duty cycle inside the cable drag chain is below 60%.
5. Do not use cables with different dimensions together. Otherwise, thin cables may be broken under the gravity of the thick cable. If thick and thin cables need to be used together, use a spacer plate to separate them.

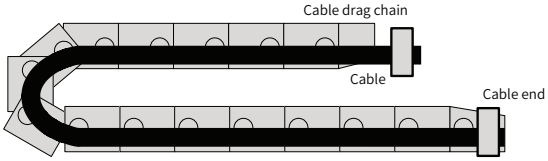
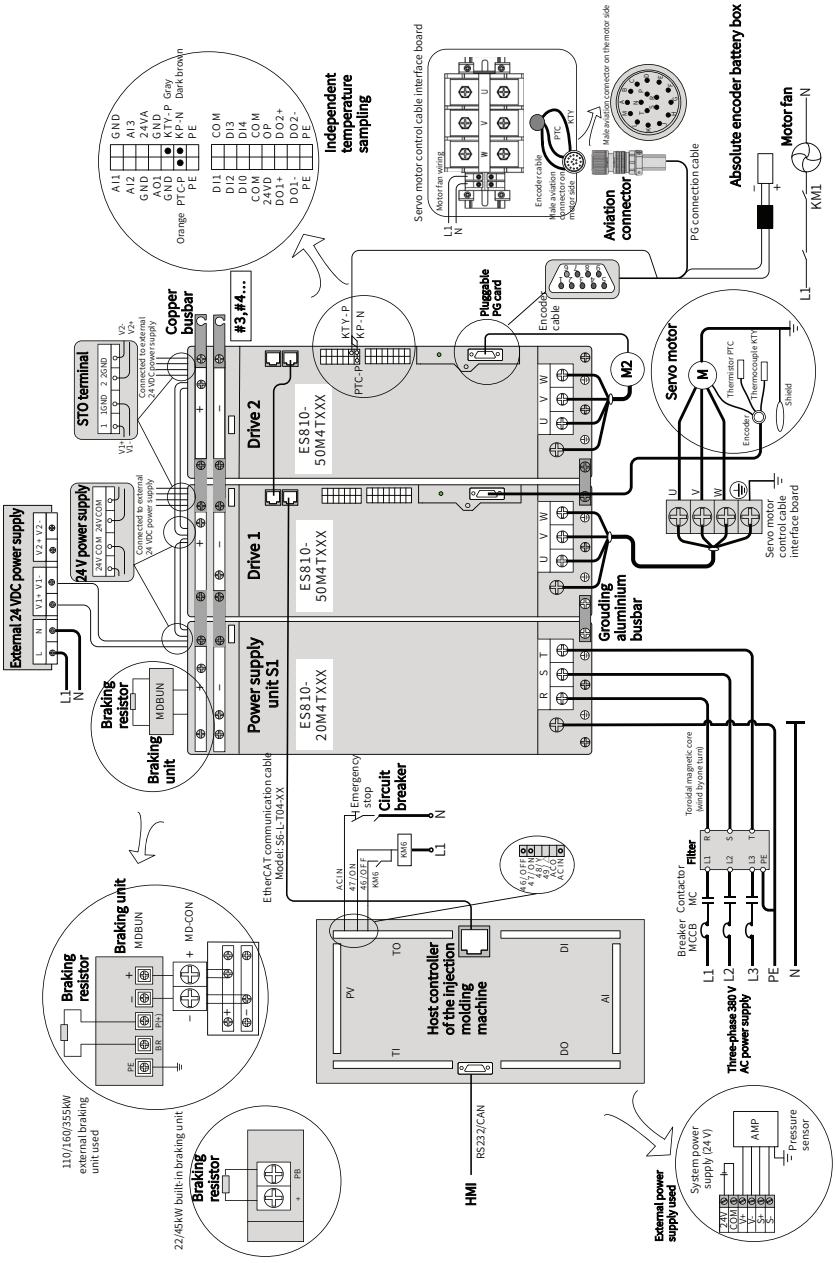


Figure 3-24 Cable drag chain

3.9 Overall Wiring Diagram



4 Operating Panel

For details on the operating panel of the power supply unit, see the 810 Series Power Supply Unit User Guide.

4.1 Introduction to the LED Operating Panel

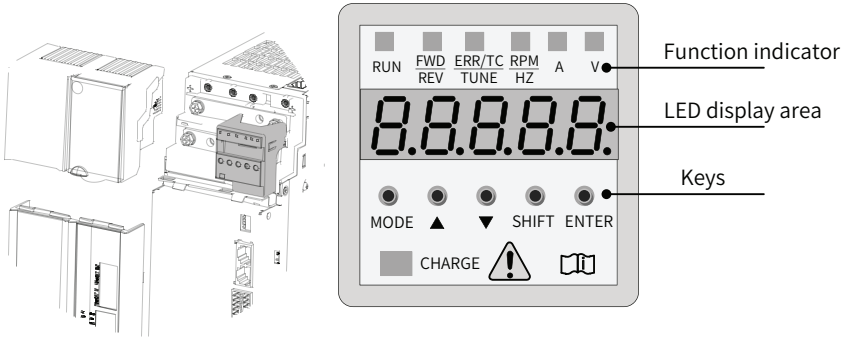


Figure 4-1 Appearance of the LED operating panel

The operating panel consists of the 5-digit 7-segment LEDs and keys. The operating panel is used for display, parameter setting, user password setting and general functions operations. The following table takes parameter setting as an example to describe the general functions of the keys.

Table 4-1 Functions of keys

Key	Name	Function
MODE	MODE	Used to switch among different modes and return to the previous menu.
▲	UP	Used to increase the value of the blinking digit.
▼	DOWN	Used to decrease the value of the blinking digit.
SHIFT	SHIFT	Used to shift the blinking digit and view the high digits of a number consisting of more than 5 digits.
ENTER	ENTE	Used to switch to the next menu and execute commands such as saving parameter setpoints.

■ LED display area

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

Table 4-2 LED display and actual data

Display	Actual data	Display	Actual data	Display	Actual data	Display	Actual data
	0		7		E		P
	1, I		8		F		R
	2		9, g		H		T
	3		A		J		u
	4		B		L		V
	5, S		C		N		y
	6		D		o		

4.2 Display of the Operating Panel

■ Mapping relation between the operating panel display and the objects operated by the host controller

The mapping relation between the parameter (decimal) displayed by the operating panel and the object dictionary operated by the host controller (hexadecimal, "Index" and "Sub-index") is as follows.

Object dictionary index = 0x2000 + Parameter group No.

Object dictionary sub-index = Hexadecimal offset within the parameter group + 1
For example:

Display	Object Dictionary Operated by the Host Controller
H00-00	2000-01h
H00-01	2000-02h
……	……
H01-09	2001-0Ah
H01-10	2001-0Bh
……	……
H02-15	2002-10h

The following parts only describe parameter display and settings on the operating panel (decimal). You need to make conversion when setting parameters (hexadecimal) on the host controller.

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

Status display: Displays the current servo drive status, such as servo ready or servo running.

Parameter display: Displays parameters and their set values;

Fault display: Displays faults and alarms occurred on the servo drive.

Monitored value display: Displays values of monitoring parameters

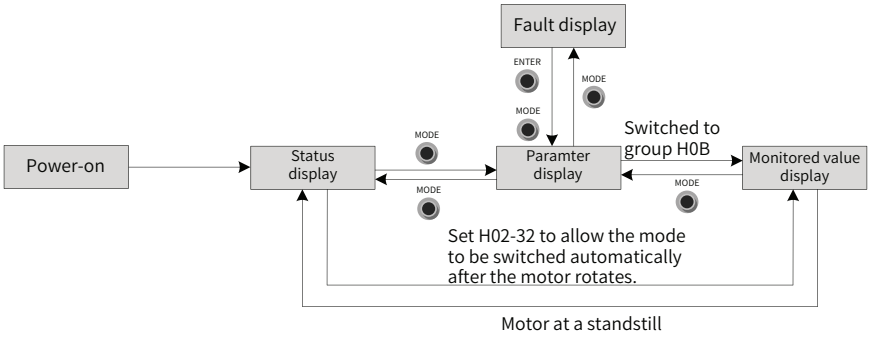
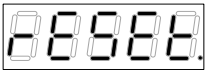
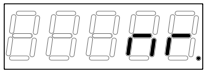
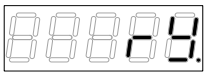
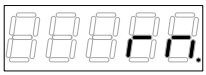
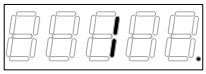
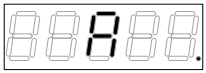
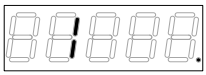
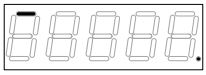
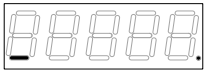


Figure 4-2 Switchover among different display modes

1. The operating panel enters the status display mode immediately upon power-on.
2. Press MODE to switch between different modes based on the conditions shown in the preceding figure.
3. In status display, set H02.32 to select the parameter to be monitored. When the motor rotates, the operating panel automatically switches to monitored value display. After the motor stops, the operating panel automatically returns to status display.
4. In the parameter display mode, after you select the parameter to be monitored in H02.32, the operating panel switches to monitored value display.
5. Once a fault occurs, the operating panel switches to fault display immediately, with all the five digits blinking. Pressing the ENTER key stops the LEDs from blinking. Keeping the ENTER key pressed down for three seconds triggers a reset operation. Pressing the MODE key switches to the parameter display mode.

1 Status display

Display	Name	Applicable Scenario	Description
 (axis number not displayed in the reset status)	reset Servo drive initializing	Upon power-on	The servo drive is in the initialization or reset status. After initialization or reset is done, the servo drive automatically switches to other status.
	nr Servo not ready	The servo drive is initialized, but is not ready.	The main circuit is not powered on, and the servo drive is not ready to run. For details, see “7 Troubleshooting”.

Display	Name	Applicable Scenario	Description
	ry Ready (Ready)	Servo drive ready	The servo drive is ready to run and waits for the enable signal to be sent from the host controller.
	rn Running (run)	Servo ON (S-ON) signal activated	The servo drive is in the operational state.
 	1 to A Control mode		Displays the present operation mode of the servo drive in hexadecimal. 1: Profile position control 3: Profile velocity mode 4: Profile torque mode 6: Homing mode 8: Cyclic synchronous position mode 9: Cyclic synchronous velocity mode
 	1 to 8 Communication status		Displays the status of the slave EtherCAT status machine in the form of characters. 1: Initialization 2: Pre-operational 4: Safe-operational 8: Operational
	- Port 1 connection indicator	PORT1	Solid OFF: No communication connection is detected in the physical layer. Solid ON: Communication connection is detected in the physical layer.
	- Port 0 connection indicator	PORT0	

2 Parameter display

Parameters have been divided into 17 groups based on functions. The parameter can be located quickly based on the group it belongs to. For details on the parameters, see "Appendix B List of Object Dictionaries".

■ Param. group

Display	Name	Description

HXX.YY	Parameter group	XX: Parameter group YY: Offset within the parameter group

For example, H02-00 is displayed as follows:

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

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

Such numbers are displayed in a single page (five digits). For signed numbers, the highest bit "-" represents the negative symbol.

For example, -9999 is displayed as follows:

For example, 65535 is displayed as follows:

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

Such numbers are displayed from low-order bits to high-order bits on several interfaces (5 digits per interface) in the format of current interface + values on current interface. Hold down **SHIFT** for more than 2s to switch to the next interface.

For example, -1073741824 is displayed as follows:

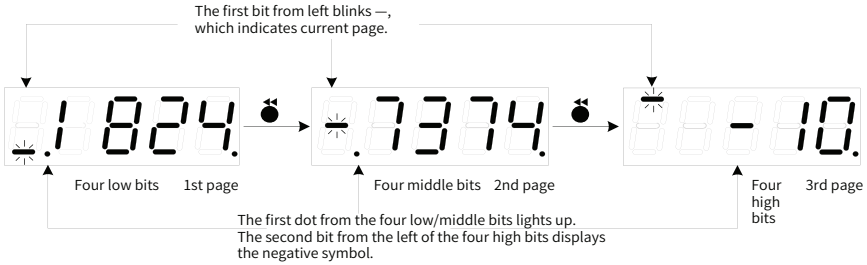


Figure 4-3 Display of 1073741824

For example, "1073741824" is displayed as follows:

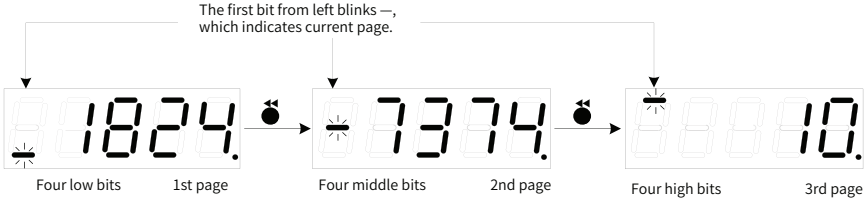


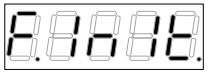
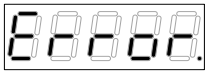
Figure 4-4 Display of "1073741824"

■ Display of the decimal point

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

Display	Name	Description
	Decimal point	100.0

■ Display of parameter setting status

Display	Name	Applicable Scenario	Description
	F.InIt Restore to default settings	Parameters are being initialized (H02-31 = 1).	The servo drive is restoring parameters to default settings (Function Code Initialize). After parameter initialization is done, switch on the control power supply again.
	Error Wrong password	The user password function is enabled (H02-30), but a wrong password is entered. The system indicates an “Error”, requiring you to enter the password again.	
	FAIL	One-key tuning enabled	The function of one-key tuning fails.

■ Fault display

1. The operating panel can display present or previous faults and errors. For details on troubleshooting, see “7 Troubleshooting”.

2. When a fault or an alarm occurs, the operating panel displays the corresponding fault or error code immediately. When multiple faults or errors occur, the operating panel displays the fault or error code of the highest fault level.

3. Set in H0B-33 the number of history faults to be viewed. View H0B-34 to display the selected fault or alarm codes.

4. Set H02-31 to 2 to clear information about latest 10 faults or alarms saved in the servo drive.

Display	Name	Description
	Active fault code	A: The drive is in the stop state when the alarm occurs. The alarm type is displayed. E: The drive is in the stop state when the fault occurs. The fault type is displayed. 941: Fault code 0: Fault sub-code

■ Monitored value display

Group H0B: Parameters in this group are used to monitor the operating status of the servo drive.

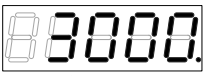
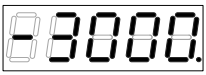
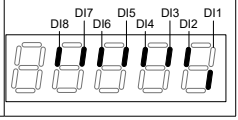
Set H02-32 (Default operating panel display). After the servo motor runs properly, the operating panel switches from servo status display mode to parameter display mode and displays the parameters set in H0B-32.

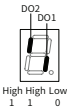
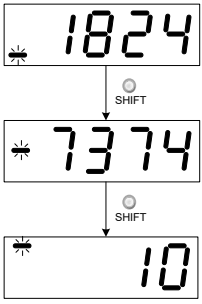
Example: When H02-32 is set to 00 and the motor speed is not 0, the parameter value of H0B-00 will be displayed. Param.	Name	Unit	Description	Example
H0B-00	Actual motor speed	rpm	The actual motor speed after round-off is displayed, in unit of 1 rpm.	Display of 3000 rpm:  Display of -3000 rpm: 

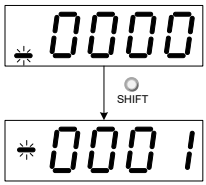
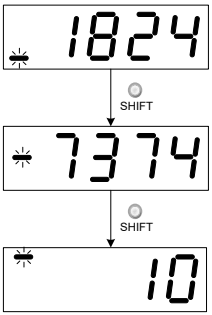
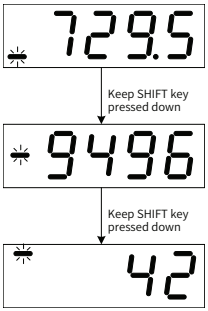
4.3 Monitoring Parameters

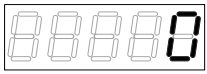
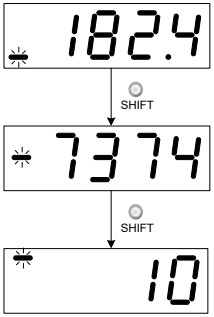
Group H0B: The parameters in this group are used to monitor the operating status of the servo drive.

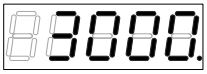
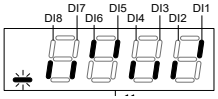
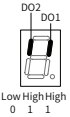
Parameter display in group H0B is as follows:

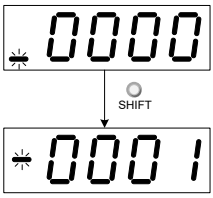
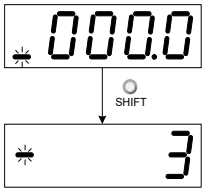
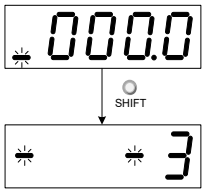
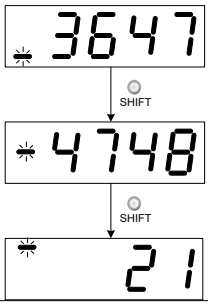
Param.	Name	Unit	Description	Example
H0B-00	Actual motor speed	rpm	Displays the actual motor speed after round-off, in unit of 1 rpm.	Display of 3000 rpm:  Display of -3000 rpm: 
H0B-01	Speed reference	rpm	Displays the present speed reference of the servo drive.	Display of 3000 rpm:  Display of -3000 rpm: 
H0B-02	Internal torque reference	0.1%	Indicates the percentage of the actual output torque of the motor to the rated torque of the motor.	Display of 100.0%:  Display of -100.0%: 
H0B-03	Input (DI) signal monitoring	-	Displays the level states of the eight DI terminals: The upper LED segment ON indicates optocoupler OFF (expressed by "1"). The lower LED segment ON indicates optocoupler ON (expressed by "0"). The value of H0B-03 read by the software tool is a hexadecimal.	For example, if DI1 is optocoupler ON and DI2 to DI7 are optocoupler OFF: the corresponding binary value is "11111110". The value of H0B.03 read in the software tool is 0xFE. Display on the operating panel: 

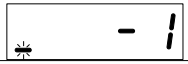
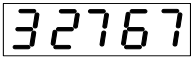
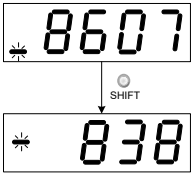
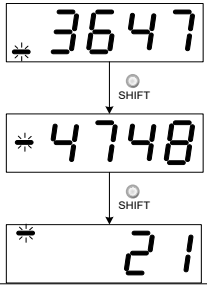
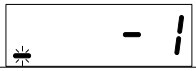
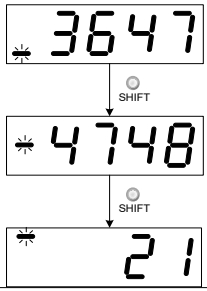
Param.	Name	Unit	Description	Example
H0B-05	DO signal monitoring	-	Displays the level states of the two DO terminals: The upper LED segment ON indicates optocoupler OFF (expressed by "1"). The lower LED segment ON indicates optocoupler ON (expressed by "0"). The value of H0B-05 read by the software tool is a decimal.	For example, if DO1 is optocoupler ON and DO2 is high level: The corresponding binary value is "10". The value of H0B-05 read through the software tool is 0x2. Display on the operating panel: 
H0B-07	Absolute position counter (32-bit decimal)	Reference unit	Indicates the present absolute position of the motor (in reference unit).	Display of 1073741824: 
H0B-09	Mechanical angle	°	Displays the present mechanical angle of the motor.	Display of 360.0° : 
H0B-10	Rotation angle (Electrical angle)	°	Indicates the present electrical angle of the motor.	Display of 360° : 
H0B-11	Speed information corresponding to input position reference	rpm	Indicates the speed corresponding to the position reference per control cycle of the servo drive.	Display of 3000 rpm:  Display of -3000 rpm: 

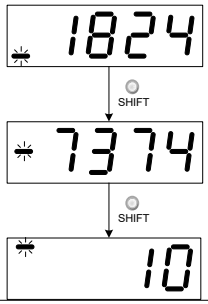
Param.	Name	Unit	Description	Example
H0B-12	Average load ratio	0.1%	Indicates the percentage of the average load torque to the rated torque of the motor.	Display of 100.0%: 
H0B-15	Encoder position deviation counter (32-bit decimal)	Encoder unit	Deviation of the encoder position = Sum of input position references (encoder unit) - Sum of pulses returned by the encoder (in encoder unit)	Display of 10000 in encoder unit: 
H0B-17	Feedback pulse counter (32-bit decimal display)	Encoder unit	Counts and displays the servo motor position feedback (encoder unit). Note: When a motor with the absolute encoder is used, H0B-17 displays only the low 32-bit data of motor position feedback. The actual motor position feedback can be obtained by H0B-77 (absolute position low 32 bits of absolute encoder) and H0B-79 (absolute position high 32 bits of absolute encoder).	Display of 1073741824 in encoder unit: 
H0B-19	Total power-on time (32-bit decimal)	0.1s	Counts and displays the total power-on time of the servo drive.	Display of 429496729.5s: 
H0B-24	Phase current RMS value	0.01 A	Indicates the RMS value of the phase current of the servo motor.	Display of 4.60 A: 

Param.	Name	Unit	Description	Example
H0B-26	Bus voltage	0.1 V	Indicates the DC bus voltage of the main circuit.	Display of 540.0 V rectified from 380 V: 
H0B-27	Module temperature	° C	Displays the temperature of the power module inside the servo drive.	Display of 27°C : 
H0B-33	Fault log	-	Used to select the previous fault to be viewed. 0: Present fault 1: Last fault 2: 2nd to last fault ... 9: 9th to last fault	0: Display of present fault: 
H0B-34	Fault code set by H0B-33	-	Indicates the fault code selected by H0B-33. When there is no fault, the value of H0B-34 is displayed as "E+Fault sub-code.000."	If H0B-33 = 0, H0B-34 = A.941.0, the current fault code is 941. Display: 
H0B-35	Time stamp of the selected fault	s	Indicates the total operating time of the drive when the fault displayed in H0B-34 occurs. When no fault occurs, the displayed value of H0B-35 is "0".	If H0B-34 = A.941.0 H0B-35 = 107374182.4, indicating the present fault code is 941 and the total operating time of the drive is 107374182.4s when the fault occurred. 

Param.	Name	Unit	Description	Example
H0B-37	Motor speed upon occurrence of the selected fault	rpm	Indicates the servo motor speed when the fault displayed in H0B-34 occurs. When no fault occurs, the displayed value of H0B-37 is "0".	Display of 3000 rpm:  Display of -3000 rpm: 
H0B-38	Motor phase U current upon occurrence of the selected fault	0.01 A	Indicates the phase U winding current effective value when the fault displayed in H0B-34 occurs. When no fault occurs, the displayed value of H0B-38 is "0".	Display of 4.60 A: 
H0B-39	Motor phase V current upon occurrence of the selected fault	0.01 A	Indicates the phase V winding current effective value of the motor when the fault displayed in H0B-34 occurs. When no fault occurs, the displayed value of H0B-39 is "0".	Display of 4.60 A: 
H0B-40	Bus voltage upon occurrence of the selected fault	V	Indicates the DC bus voltage of the main circuit when the fault displayed in H0B-34 occurs. When no fault occurs, the displayed value of H0B-40 is "0".	Display of 537.0 V rectified from 380 V: 
H0B-41	Input terminal state on selected fault	-	Indicates the optocoupler status corresponding to the eight DIs when the fault displayed by H0B-34 occurs. View in the same way as H0B-03. When no fault occurs, all DOs are displayed as low level in H0B-41 (indicated by the decimal value 0).	For example, when the value of H0B-41 read in the software tool is 0x31, the corresponding binary value is "00110001". Display on the operating panel: 
H0B-43	Output terminal status upon occurrence of the selected fault	-	Indicates the optocoupler status corresponding to the two DOs when the fault displayed by H0B-34 occurs. View in the same way as H0B-05. When no fault occurs, all DOs are displayed as low level in H0B-42 (indicated by the decimal value 0).	Display of H0B-42=3: 

Param.	Name	Unit	Description	Example
H0B-53	Position deviation counter (32-bit decimal)	Reference unit	Position deviation = Sum of input position references (reference unit) - Sum of pulses fed back by the encoder (in reference unit)	Display of 10000 in reference unit: 
H0B-55	Actual motor speed	0.1 rpm	Indicates the actual motor speed, in unit of 0.1 rpm.	Display of 3000.0 rpm:  -3000.0 rpm 
H0B-57	Control circuit bus voltage	0.1 V	Displays the DC voltage of the control circuit.	Display of 540.0 V: 
H0B-58	Mechanical absolute position (low 32 bits)	Encoder unit	Displays the mechanical absolute position (low 32 bits) when an absolute encoder is used.	Display of 2147483647 in encoder unit: 

Param.	Name	Unit	Description	Example
H0B-60	Mechanical absolute position (high 32 bits)	Encoder unit	Displays the mechanical absolute position (high 32 bits) when an absolute encoder is used.	Display of “-1” in encoder unit: 
H0B-70	Number of absolute encoder revolutions	r	Displays the present number of revolutions of an absolute encoder.	Example: 32767 
H0B-71	Single-turn position feedback of an absolute encoder	Encoder unit	Displays the single-turn position feedback of an absolute encoder.	Display of "8388607” in encoder unit: 
H0B-77	Absolute encoder position (low 32 bits)	Encoder unit	Displays the absolute position (low 32 bits) of the motor when an absolute encoder is used.	Display of “2147483647” in encoder unit: 
H0B-79	Absolute encoder position (high 32 bits)	Encoder unit	Displays the absolute position (low 32 bits) of the motor when an absolute encoder is used.	Display of “-1” in encoder unit: 
H0B-81	Single-turn position feedback of the load in rotation mode (low 32 bits)	Encoder unit	Displays the position feedback of the mechanical load (low 32 bits) when the absolute system works in the rotation mode.	Display of "2147483647” in encoder unit: 

Param.	Name	Unit	Description	Example
H0B-83	Single-turn position feedback of the load in rotation mode (high 32 bits)	Encoder unit	Displays the position feedback of the mechanical load (high 32 bits) when the absolute system works in rotation mode.	Display of "1" in encoder unit: 
H0B-85	Single-turn position of the load in rotation mode	Reference unit	Displays the mechanical absolute position when the absolute system works in rotation mode.	Example: 1073741824 in referent unit 
H0B-88	Motor temperature	° C	Indicates the motor temperature.	Display of 27°C : 

4.4 Parameter Setting

You can set parameters through the operating panel. For details on parameters, see "Appendix B List of Object Dictionaries". The following figure shows how to switch from position control mode to speed control mode using the operating panel after power-on.

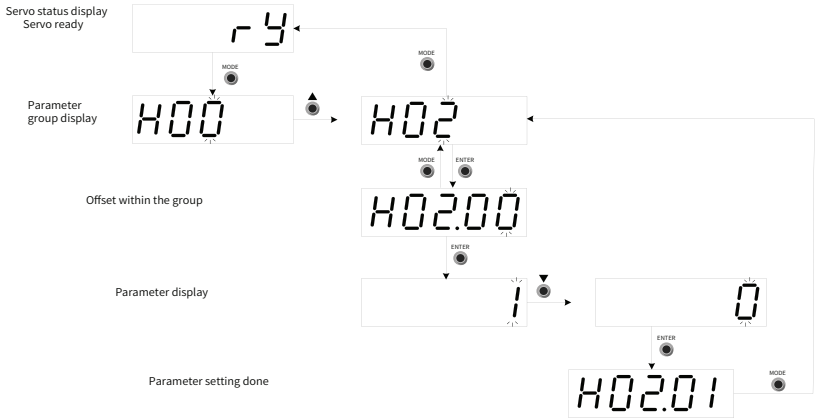


Figure 4-5 Example of parameter setting

1. MODE: Used to switch the display mode and return to the previous interface.
2. UP/DOWN: Used to increase or decrease the value of the blinking bit.
3. SHIFT: Used to shift the blinking bit.
4. ENTER: Used to save present setpoint or switch to the next interface.

After parameters are set, the parameter group interface is automatically displayed (interface of H02-01).

4.5 User Password

After the user password function (H02-30) is enabled, only the authorized user can set parameters. Other operators can only view the parameter.

1 Setting the user password

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

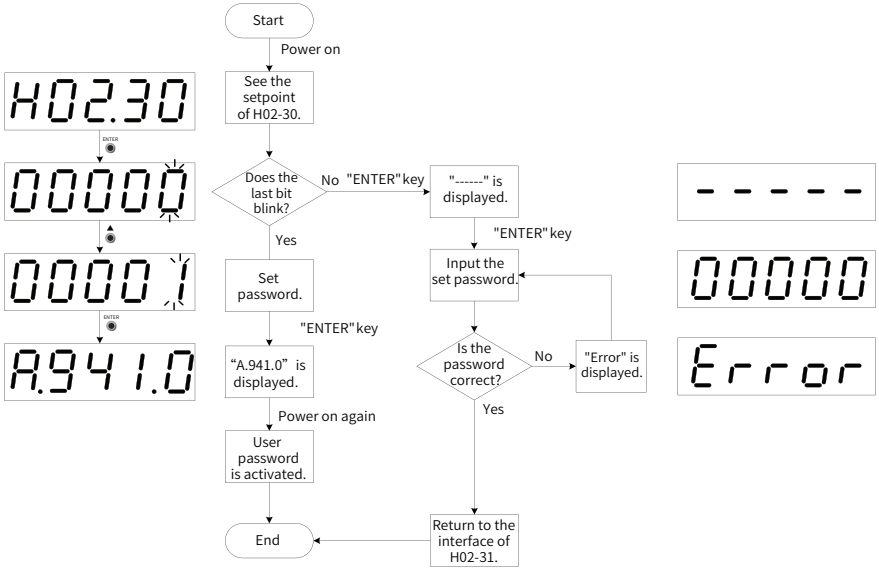


Figure 4-6 Procedure for setting the user password

NOTE

- If the last bit does not blink, the access to parameters is password protected. If the last bit blinks, password is not needed or the password entered is correct.
- To change the user password, enter the current password first to authorize the access to parameter settings. Enter H02-30 again, and then set a new password according to the method described in the preceding figure.

2 Disabling the user password

Enter the current user password, and set H02-30 to "00000". The user password is canceled.

4.6 Trial Jog

CAUTION

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

The jog function can be used in trial run of the servo drive and motor.

1 Operation method

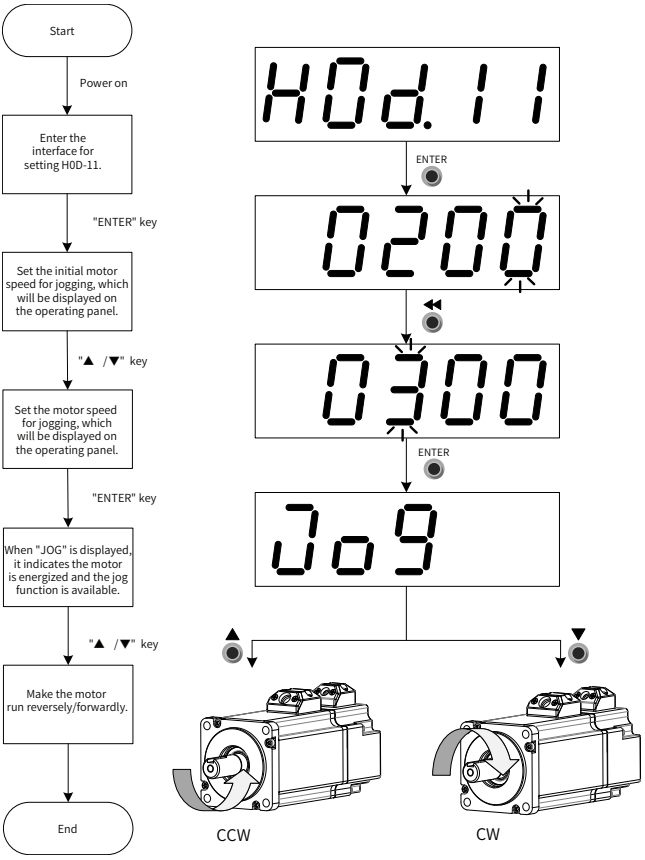


Figure 4-7 Procedure for setting jog operation


NOTE

- Press the UP or DOWN key to increase or decrease the jog speed. After exiting from the jog mode, the initial speed applies.
- Press key UP or DOWN to enable the servo motor to rotate in forward or reverse direction. After you release the key, the servo motor stops immediately.

2 Exiting from jog

Press the MODE key to exit from jog and return to the previous menu.

4.7 DI and DO Function Setting

There are four DIs and two DOs in the ES810 series drive. Parameters in groups H03 (DI function assignment and logic selection) and H04 (DO function assignment and logic selection) can be set and changed through the operating panel.

1 DI/DO Function Assignment

Code	Name	Function	Description	Remarks
Consisting of three digits, with the first one (from left to right) indicating the axis number, and the last two indicating the terminal function				
Function of input signals				
01	S-ON	Servo ON	Disabled - Servo motor disabled in local mode Enabled - Servo motor enabled in local mode	The S-ON function is only active in non-bus control mode. The corresponding terminal logic must be level-triggered.
14	P-OT	Positive limit switch	Enabled - Forward driving inhibited Disabled - Forward driving permitted	Overtravel prevention applies when the load moves beyond the limit. The corresponding terminal logic is recommended to be level-triggered.
15	N-OT	Negative limit switch	Enabled - Reverse driving inhibited Disabled - Reverse driving permitted	Overtravel prevention applies when the load moves beyond the limit. The corresponding terminal logic is recommended to be level-triggered.
31	HomeSwitch	Home switch	Disabled - Mechanical load beyond the home switch range Enabled - Mechanical load within the home switch range	The corresponding terminal logic must be level-triggered. If the logic is set to 2 (Rising edge-triggered), the servo drive changes it to 1 (Active high) automatically. If the logic is set to 3 (Falling edge-triggered), the servo drive changes it to 0 (Active low) automatically. If the logic is set to 4 (Rising/Falling edge-triggered), the servo drive changes it to 0 (Active low) automatically.
Functions of output signals				
01	S-RDY	Ready to switch on	Enabled - Servo ready Disabled - Servo not ready	The servo drive is ready to run.

Code	Name	Function	Description	Remarks
02	TGON	Motor rotation	Inactive: Absolute value of filtered motor speed lower than the setpoint of H06.16 Active: Absolute value of filtered motor speed reaching the setpoint of H06.16	-
10	WARN	Alarm	Enabled - Alarm occurred on the servo drive Disabled: No alarm reported or the alarm has been reset	-
11	ALM	Fault	Enabled - Fault occurred on the servo drive Inactive: No fault occurred on the servo drive or the fault has been reset	-
21	DB_OUT	dynamic braking signal	Active: Dynamic braking occurred Inactive: Dynamic braking not occurred	

2 DI function setting (Taking H03-02 as an example)

Parameters in H03 group are set through the last two digits, which are used to assign functions to terminals, as shown in the dotted box below.

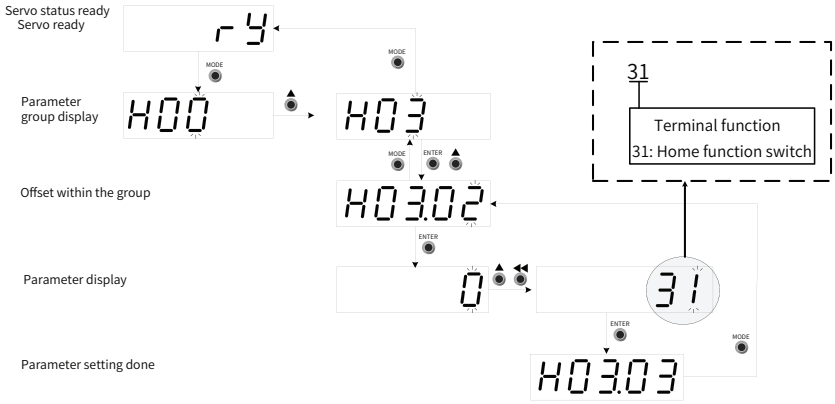


Figure 4-8 Procedure for DI function setting

For example, to set DI1 as the home signal of the module, set parameter H03-02 to 31 through the software tool or the operating panel, as shown below:
H03-02 = 31

NOTE

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

3 DO function setting (taking H04-00 as an example)

Parameters in H04 group are set through the last two decimal digits, which are used to assign functions to terminals, as shown in the dotted box below.

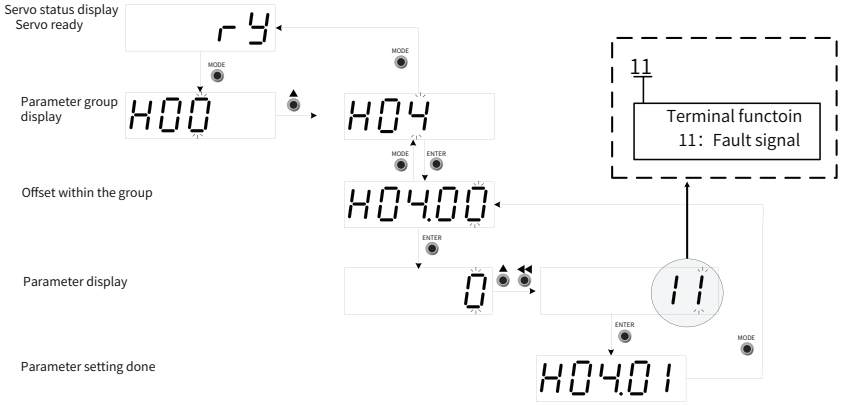


Figure 4-9 Procedure for DO function setting

For example, to set DO1 as the fault signal of the module, set parameter H04-00 to 11 through the software tool or the operating panel, as shown below:

H04-00 = 11

NOTE

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

5 Communication Network Configuration

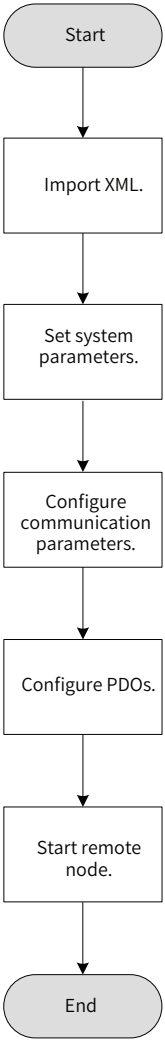


Figure 5-1 EtherCAT configuration flowchart

5.1 Overview of EtherCAT Protocol

EtherCAT features high-performance, low cost, easy use and flexible topology. It is applicable to industrial applications requiring ultra high-speed I/O network. EtherCAT adopts standard Ethernet physical layer with twisted pairs or optical fibers (100Base-TX or 100Base-FX) as the transmission media.

An EtherCAT system consists of the master and the slave. The master requires a common network adapter, and the slave requires a special slave control chip, such as ET1100, ET1200, and FPGA.

EtherCAT can process data at the I/O layer,

-Without any sub-bus

-Without gateway delay.

-All-in-one system

- including input/output devices, sensors, activators, drives, and display...

-Transmission rate:

- 2 x 100 Mbit/s (high-speed Ethernet, full duplex mode).

-Synchronization: synchronization jitter < 1 μs (with 300 nodes between two devices and 120 m cable)

-Update time:

- 256 DI/DOs: 11 μs
- 1000 DI/DOs distributed in 100 nodes: 30 μs = 0.03 ms
- 200 analog I/Os (16-bit): 50 μs, sampling rate 20 kHz
- 100 servo axes (8 byte IN+8 byte OUT for each): 100 μs = 0.1 ms
- 12000 digital I/Os: 350 μs

To support more types of devices and applications, the following EtherCAT-based application protocols are formed:

- CANopen over EtherCAT (CoE)

-SoE (Safety over EtherCAT, compliant with IEC 61800-7-204)

-EoE (Ethernet over EtherCAT)

-FoE (File over EtherCAT)

The slave only needs to support the suitable application protocol.

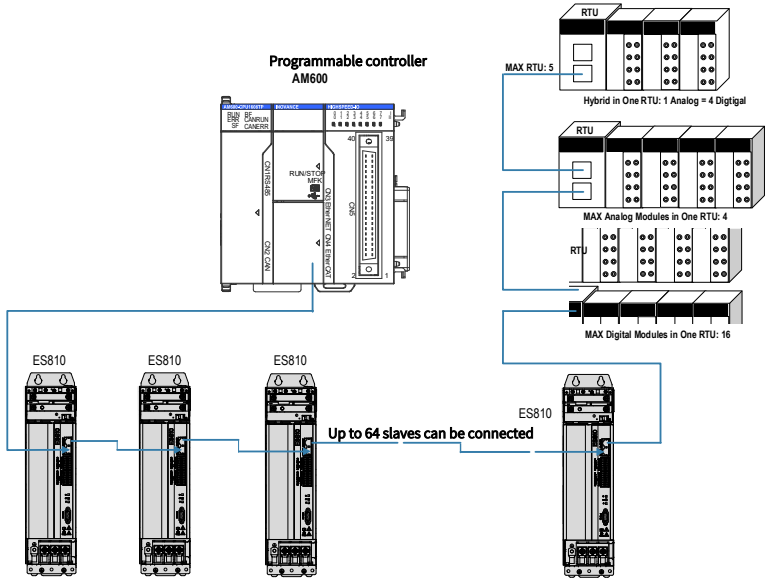


Figure 5-2 EtherCAT networking

5.2 System Parameter Setting

Set the parameters of the servo drive so that it can access the EtherCAT fieldbus network correctly.

Object dictionary Index	Object dictionary Sub-index	Name	Value	Default
2002	01h	Control mode	0: Speed control mode 1: Position control mode 2: Torque control mode 3: Speed control mode or torque control mode 4: Position control mode or speed control mode 5: Position control mode or torque control mode 6: Position control mode, speed control mode, or torque control mode 7: Absolute position system mode 8: CANopen mode 9: EtherCAT mode	9

Object dictionary Index	Object dictionary Sub-index	Name	Value	Default
200C	0Dh	Save parameter values modified through communication to EEPROM	1: Not save 2: Save 2XXXh parameters 3: Save 6XXXh parameters 4: Save all parameters	3

Before saving parameters to EEPROM, set 200C-0Dh to a proper value. Otherwise, parameters will be restored to default values at next power-on.

5.3 EtherCAT Communication Basis

5.3.1 EtherCAT Communication Specifications

Item		Specification
Communication protocol		IEC 61158 Type 12, IEC 618007 CiA 402 Drive Profile
Application layer	SDO	SDO request, SDO response
	PDO	Variable PDO mapping
	CiA402	Profile position mode (PP) Profile velocity mode (PV) Profile torque mode (PT) Homing mode (HM) Cyclic synchronous position mode (CSP) Cyclic synchronous velocity mode (CSV) Cyclic synchronous torque mode (CST)
Physical layer	Transmission protocol	100BASE-TX (IEEE802.3)
	Maximum distance	100 m
	Interface	RJ45 x 2 (INT, OUT)

5.3.2 Communication Structure

The EtherCAT protocol support multiple protocols at the application layer. The servo drive uses the IEC 61800-7 (CiA 402) — CANopen drive profile.

The following figure shows the EtherCAT communication structure at CANopen application layer.

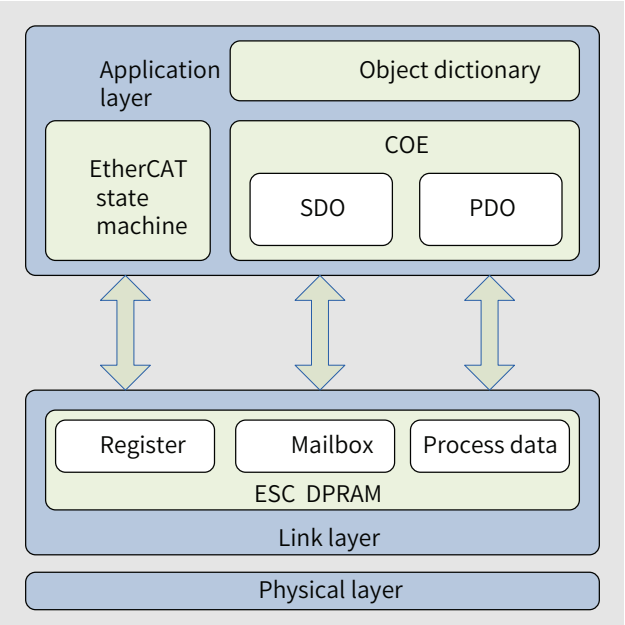


Figure 5-3 EtherCAT communication structure at CANopen application layer

The object dictionary in the application layer includes communication parameters, application process data, and PDO mapping data. The process data object (PDO) consists of objects in the object dictionary that can be mapped to the PDO. The contents of the process data are defined by the PDO mapping. Process data communications cyclically reads and writes the PDO. In the SDO mailbox communication, the communication objects and PDO objects are being accessed and modified non-cyclically.

5.3.3 State Machine

The following figure shows the state transition diagram of EtherCAT.

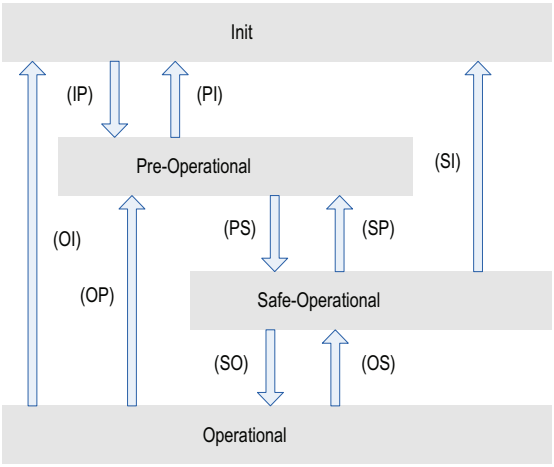


Figure 5-4 EtherCAT state machine

The EtherCAT state machine must support four states and coordinates the state relationship between the master and slave applications during initialization and operation.

Init: Initialization, shortened as I

Pre-Operational: Shortened as P

Safe-Operational: Shortened as S

Operational: Shortened as O

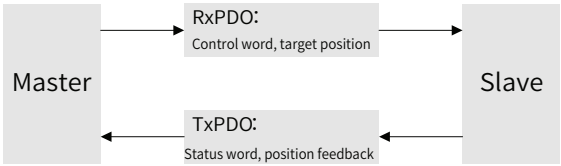
Transition from Init state to Operational state must be in the sequence of Init, Pre-Operational, Safe-Operational, and then Operational step by step. In transition from the Operational state to the Init state, certain steps can be skipped. The following table lists the state transition and the initialization process.

State and Transition	Operation
Init (I)	No communication is available in the application layer, and the master can only read and write the EtherCAT slave controller (ESC) register.
IP	Master configures the slave addresses; Configuring mailbox channels; Configuring distributed clock; Requesting for the Pre-Operational state
Pre-Operational (P)	Service Data Object (SDO) in the application layer
PS	The master initializes PDO mapping through mailbox communication. The master configures the Sync Manager channel used during process data communication. The master configures the FMMU. Requesting for the Safe-operational state

State and Transition	Operation
Safe-Operational (S)	Process data communication is available, but the system only allows input and inhibits output (SDO, TPDO).
SO	The master sends valid output data to make a request for the “Operational state”.
Operational (O)	Both input and output are valid. Mailbox communication can still be used. (SDO, TPDO, RPDO)

5.3.4 Process Data Object (PDO)

PDO data is transmitted in the producer-consumer model. PDO can be divided into RPDO (Reception PDO) and TPDO (Transmission PDO). The slave receives the master commands through the RPDO and feeds back the slave state through TPDO.



1. PDO mapping parameters

The PDO mapping indicates the mapping relation between the object dictionary and the PDO. 1600h to 17FFh are RPDOs, and 1A00h to 1BFFh are TPDOs. The ES810 series servo drive provides six RPDOs and five TPDOs, as listed in the following table.

RPDO (6)	1600h	Mutable mapping
	1701h to 1705h	Fixed mapping
TPDO (5)	1A00h	Mutable mapping
	1B01h to 0x1B04h	Fixed mapping

a) Fixed PDO mapping

The servo drive provides five fixed RPDOs and four fixed TPDOs.

The following table lists the typical instances of RPDOs and TPDOs.

Operation mode available	PP/CSP
1701h (RPDO258)	Three mapping objects (8 bytes)
	6040h (Control word) 607Ah (Target position)

1B01h (TPDO258)	Eight mapping objects (24 bytes)
	603Fh (Error code) 6041h (Status word) 6064h (Position actual value) 6077h (Torque actual value) 60F4 (Following error actual value) 60FD (DI status)

Operation mode available	PP/PV/PT/CSP/CSV/CST
1702h (RPDO259)	Mapping objects (7 mapping objects, 19 bytes)
	6040h (Control word) 607Ah (Target position) 60FFh (Target velocity) 6071h (Target torque) 6060h (Modes of operation) 607Fh (Max. profile velocity)
1B02h (TPDO259)	Nine mapping objects (25 bytes)
	603Fh (Error code) 6041h (Status word) 6064h (Position actual value) 6077h (Torque actual value) 6061h (Modes of operation display) 60FD (DI status)

Operation mode available	PP/PV/CSP/CSV
1703h (RPDO260)	Mapping objects (7 mapping objects, 17 bytes)
	6040h (Control word) 607Ah (Target position) 60FFh (Target velocity) 6060h (Modes of operation) 60E0h (Positive torque limit value) 60E1h (Negative torque limit value)
1B03h (TPDO260)	Ten mapping objects (29 bytes)
	603Fh (Error code) 6041h (Status word) 6064h (Position actual value) 6077h (Torque actual value) 60F4 (Following error actual value) 6061h (Modes of operation display) 60FD (DI status)

Operation mode available	PP/PV/CSP/CSV

1705h (RPDO262)	Eight mapping objects (19 bytes)
	6040h (Control word) 607Ah (Target position) 60FFh (Target velocity) 6060h (Modes of operation) 60E0h (Positive torque limit value) 60E1h (Negative torque limit value) 60B2h (Torque offset)
1B04h (TPDO261)	Ten mapping objects (29 bytes)
	603Fh (Error code) 6041h (Status word) 6064h (Position actual value) 6077h (Torque actual value) 6061h (Modes of operation display) 60F4 (Following error actual value) 606C (Velocity actual value)

b) Variable PDO mapping

The servo drive provides one variable RPDO and one variable TPDO.

Variable PDO	Index	Max. number of mapping objects	Max. length of the byte	Default mapping object
RPDO1	1600h	10	40	6040h (Control word) 607Ah (Target position)
TPDO1	1A00h	10	40	603F (Error code) 6041 (Status word) 6064 (Position actual value) 60FD (DI status)

2. Sync manager PDO assignment

Several PDO mapping objects are included during EtherCAT cyclic data communication. The CoE defines the PDO mapping object list of the sync manager with 0x1C10 to 0x1C2F. The PDOs can be mapped to different sub-indexes.

The servo drive supports one RPDO and one TPDO, as described in the following table.

Index	Sub-index	Description
0x1C12	01h	Use one of 0x1600 and 0x1701 to 0x1705 as the actual RPDO.
0x1C13	01h	Use one of 0x1A00 and 0x1B01 to 0x1B04 as the actual TPDO.

3. PDO configuration

PDO mapping parameters include pointers of process data that corresponds to PDO and that to be sent or received by PDO, including index, sub-index, and mapping object length. The sub-index 0 indicates the number (N) of mapping objects in the PDO, and the maximum length of each PDO is 4N bytes. One or multiple objects can be mapped simultaneously. Sub-indexes 1 to N indicate the mapping content, The following defines mapping parameters.

Bit	31	…	16	15	…	8	7	…	0
Definition	Index			Sub-index			Object length		

The index and sub-index together define the position of an object in the object dictionary. The object length indicates the bit length of the object in hexadecimal, as shown below.

Object Length	Bit Length
08h	8 bits
10h	16 bits
20h	32 bits

For example, the mapping parameter of the 16-bit control word 6040h-00 is 60400010h.

◆ Observe the following procedure for PDO mapping:

Follow the following PDO mapping configuration:

1: Invalid PDO (Write 0 to sub-index 00h of 1C12h or 1C13h.)

Clear the original mapping content. All the original mapping content of the PDO is cleared when 0 is written in sub-index 00h of the mapping object.

Write the PDO mapping content. Write the content in sub-indexes 1 to 10 according to the preceding mapping definition.

Write the total number of PDO mapping objects. Write the number of mapping objects in sub-index 0 of the mapping object.

2: Valid PDO (Write 1 to sub-index 00h of 1C12h or 1C13h.)

NOTE

◆ Configure the PDO only when the EtherCAT state machine is in Pre-operation state ("2" displayed on the operating panel). Otherwise, an error is reported.

◆ PDO configuration parameters cannot be saved in EEPROM. Configure the mapping objects again after each power-on. Otherwise, the mapping objects are default servo drive parameters.

◆ An SDO fault code will be returned when the following operations are under execution:

Modify PDO parameters in status other than pre-operational.

Write a value outside the range of 1600/1701–1705 to 1C12h. Write a value outside the range of 1A00/1B01–1B04 to 1C13h.

5.3.5 Service Data Object (SDO)

The EtherCAT SDO is used to transfer non-cyclic data, such as communication or running parameter configurations of the drive. The CoE service type includes emergency message, SDO request, SDO response, TxPDO, RxPDO, remote TxPDO transmit request, remote RxPDO

transmit request, and SDO information.

The ES810 supports SDO request and SDO response.

5.3.6 Distributed Clock (DC)

The distributed clock (DC) enables all EtherCAT devices to use the same system time and allows tasks to be executed synchronously among all the devices. A slave can generate synchronous signals according to the synchronized system time. The ES810 supports only the DC synchronization mode. The synchronization cycle is determined by SYNC0. The cycle varies according to the motion mode.

5.3.7 Status Indication

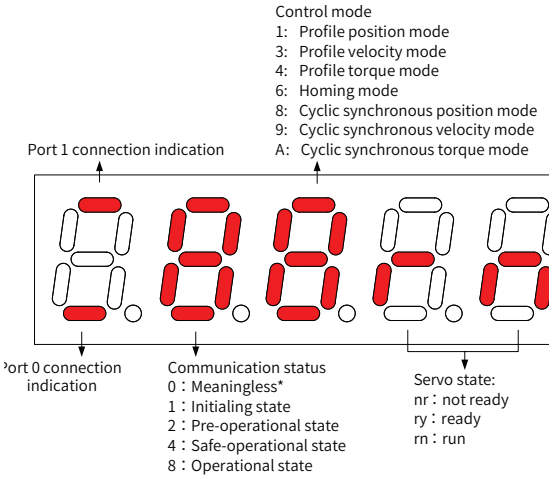


Figure 5-5 Status indication diagram

NOTE

◆ If the value 0 is displayed, no value or 0 is written to H6060.

1. Communication connection status

The connection status of the two RJ45 ports is indicated by "-" on the upper and lower part of the first left LED. The upper "-" indicates the status of PORT1, and the lower "-" indicates the status of PORT0.

Solid OFF: No communication connection is detected in the physical layer.

Solid on: Communication connection is detected in the physical layer.

2. Communication operation status

When the communication and servo drive status and the communication connection status are displayed on the same interface, the 2nd left LED indicates the EtherCAT state machine status of the slave, as described in the following table.

Status of EtherCAT state machine

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

3. Servo operation mode display

The 3rd LED from left displays the current operation mode of the servo drive in hexadecimal, without blinking.

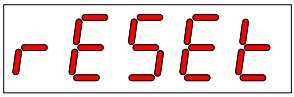
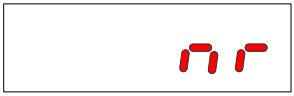
The operation modes are as follows:

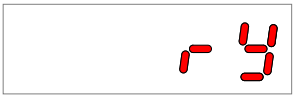
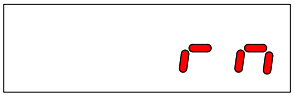
Modes of operation (6060h)	Display
1: Profile position mode	1
3: Profile velocity mode	3
4: Profile torque mode	4
6: Homing mode	6
8: Cyclic synchronous position mode	8
9: Cyclic synchronous velocity mode	9

4. Servo status display

The 4th and 5th LEDs from left display the servo status of the slave in characters.

The servo status includes the following.

Status	Description	Display
Reset	Initialization	 reset
Not ready	Initialization is done. The control circuit is switched on but the main circuit is not switched on. Not ready	 nr

Status	Description	Display
Ready	The main circuit is switched on, but the S-ON signal is inactive. Ready	 ry The character "y" blinks when the motor speed is not 0 rpm. When the communication layer is in the pre-operational or safe-operational state, the blinking frequency is the same as that of characters "2" or "4" (see "communication status" in the previous page for details). When the communication layer is in Init or Operational state, the blinking frequency is 2 Hz.
Operational	The S-ON signal is active, and the motor is energized. Run	 rn The display "n" blinks when the motor speed is not 0. When the communication layer is in the pre-operational or safe-operational state, the blinking frequency is the same as that of characters "2" or "4" (see "communication status" in the previous page for details). When the communication layer is in Init or Operational state, the blinking frequency is 2 Hz.

5.3.8 Overview of CiA402

The ES810 can run in the specified status only when it is instructed according to the flowchart defined in CiA402.

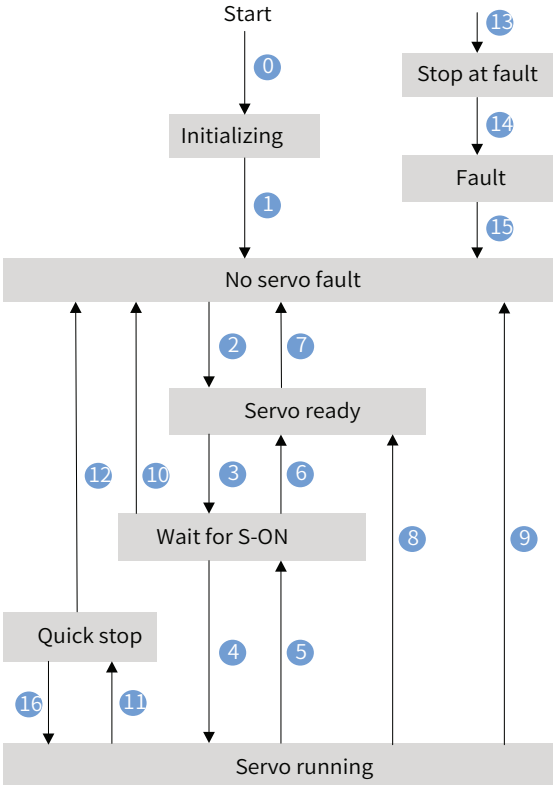


Figure 5-6 Switchover of the CiA402 state machine

See the following table for descriptions of different status.

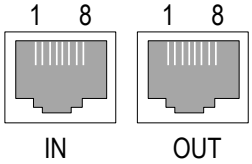
Initialization	Initialization of the servo drive and internal auto-inspection are done. Parameters cannot be set and the driving function cannot be executed.
No fault	No fault exists in the servo drive or the fault has been cleared. Parameters can be set.
Ready to switch on	The servo drive is ready to run. Parameters can be set.
Wait for the S-ON signal	The servo drive is waiting for the S-ON signal. Parameters can be set.
Operational	The servo drive is running properly and a certain operation mode is enabled. The motor is energized and starts rotating when the speed reference is not 0. Only parameters whose "Effective time" is "During operation" can be set.

Quick stop	Quick stop is activated and the servo drive is in the process of quick stop. Only parameters whose "Effective time" is "During operation" can be set.
Stop at fault	A fault occurs and the servo drive is in the process of stop. Only parameters whose "Effective time" is "During operation" can be set.
Fault	The stop process is done and all the drive functions are disabled. Parameters can be modified for troubleshooting purpose.

5.3.9 Basic Features

1. Interfaces

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

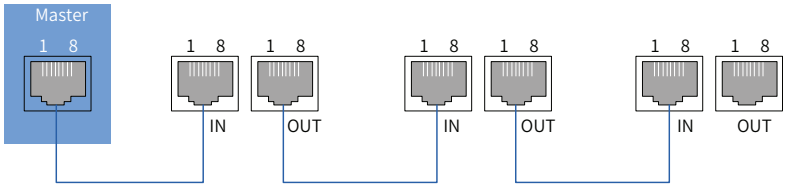


Pin	Assignment	Description
1	TX+	Transmitting data (+)
2	TX-	Transmitting data (-)
3	RX+	Receiving data (-)
4	NULL	Not connected
5	NULL	Not connected
6	RX-	Receiving data (+)
7	NULL	Not connected
8	NULL	Not connected

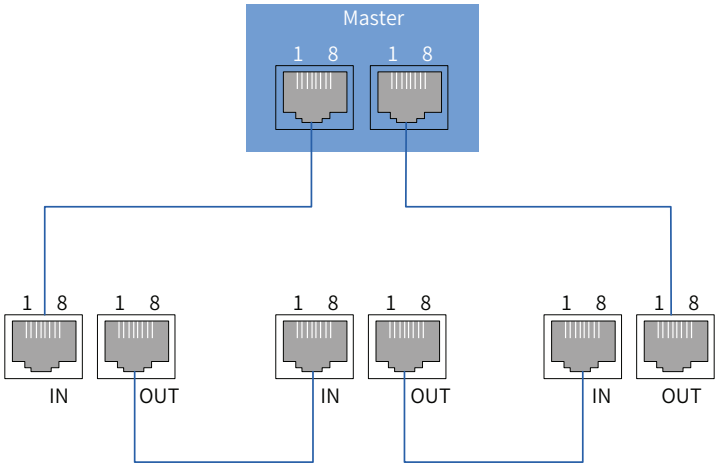
2. Topology connection

The EtherCAT communication features flexible topological structure, as shown in the following figures.

Linear Connection



Redundancy ring topology



3. Communication cables

The EtherCAT communication cable must be Ethernet Category 5 (100BASE-TX) network cable or high-strength shielded network cable. The cables used for the servo drive must also be network cable, with length shorter than 100 m. The shielded network cable enhances the anti-interference capacity of the system.

4. EMC standards

The servo drive complies with the following standards:
IEC/EN61800-3:2004 (Adjustable speed electrical power drive systems---part 3: EMC requirements and specific test methods).

6 Commissioning Software

6.1 Basic Settings

Table 6-1 Servo drive setting flowchart

Procedure		Operation	Remarks
Start			
Step 1	Pre-operation Inspection	● Wiring check ● Environment and mechanical condition check	
Step 2	Power-on	● 1. Connect the power supplies of the control circuit and main circuit.	S-ON inactive
Step 3	Motor parameter setting	1) Set motor encoder model. 2) After setting parameters, keep the MODE key pressed down for 3s to enter software reset.	
Step 4	Jog	● Jog triggered through the operating panel ● Jog triggered through the host controller	Press the UP key to make the motor run forwardly and the DOWN key to make the motor run reversely.
Step 5	Stop	● S-ON signal inactive ● Stop at fault ● Stop at overtravel ● Emergency stop	
End			

6.1.1 Pre-operation Inspection

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

Table 6-2 Pre-operation checklist

Log	No.	Description
Wiring		
□	1	The servo drive input terminals + and - are connected to the power supply, with the input power supply ranging from 537 VDC to 679 VDC.

Log	No.	Description
☐	2	The motor main circuit output terminals U, V, W of the servo drive are connected to the power cables U, V, W of the servo motor in correct phase sequence.
☐	3	The control signal cables, such as the brake signal cables and overtravel protection signal cables, are connected properly.
☐	4	The servo drive and servo motor are grounded properly.
☐	5	The cable tension is within the specified range.
☐	6	All the wiring terminals are insulated properly.
Environment and Mechanical Conditions		
☐	1	There are no unwanted objects (such as cable terminals and metal chippings) that may cause short circuit of the signal cable and power cable inside or outside the servo drive.
☐	2	The servo drive and the external braking resistor are placed on incombustible objects.
☐	3	The servo motor is installed properly. The motor shaft is connected to the machine securely.
☐	4	The servo motor and the machine that connected to the motor are in good condition and ready to run.

NOTE

◆ To determine whether the phase sequence of the servo drive output terminals U, V, and W are the same as that of the servo motor terminals U, V, and W, power on the main circuit and perform auto-tuning on the encoder initial angle (H0D-03=1).

- If the encoder initial angle is correct, the phase sequence is correct.
- If a fault occurs, the phase sequence is incorrect. Change the cable connection to correct the phase sequence.

6.1.2 Connecting the Power Supply

1. Connect the power supply of the main circuit.
2. After connecting the power supply of the main circuit, if the bus voltage indicator is normal and the operating panel displays “reset”, “nr”, and “ry” in sequence, it indicates that the servo drive is ready to run and waiting for the S-ON signal to be sent from the host controller.

6.1.3 Photoelectric Encoder Setting

1. Set H00-00 to 14101.

2. After setting, keep the MODE key pressed down for 3s to reset the drive automatically.

6.1.4 Jog

Perform jogging to check whether the servo motor can rotate properly without unusual vibration or noise. You can trigger the jog function through the operating panel.

NOTE

◆ The acceleration and deceleration time constants can be set through H06-05 (2006-06h) and H06-06 (2006-07h) during jogging.

■ Jog triggered through the operating panel

Switch to the speed jogging mode by setting H0D-11 through the operating panel, and the operating panel displays the default jogging speed.
Press key UP/DOWN to set the jogging speed, and press key ENTER to enter the jogging state. The operating panel displays "JOG". Then, press key UP/DOWN to perform forward or reverse jogging. Press MODE to exit from the jog mode.

6.1.5 Rotation Direction Selection

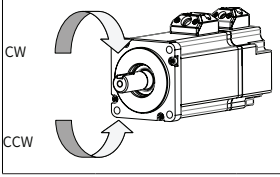
Set H02-02 (2002-03h) (Direction of rotation) to change the motor direction of rotation without changing the polarity of the input reference.

■ Related parameters

H02-02	Name	Rotation direction selection			Setting condition & Effective time	At stop & Next power-on	Data structure	-	Data type	Uint16
2002-03h	Access	RW	Mapping	-	Related mode	All	Data range	0 to 1	Default	0

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

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



The change of H02-02 (2002-03h) does not affect the pulse output form or the sign (+/-) of monitoring parameter values.
The direction of "Forward driving" in overtravel prevention is the same as that defined by H02.02 (2002-03h).

6.1.6 Servo ON

1. Activate the S-ON signal.

When the servo drive is ready to run, the operating panel displays "rn". As there is no reference input at this moment, the servo motor does not rotate. If the control mode of the servo drive has not been set in 6060h or the torque and speed limits of the servo drive are 0, the servo motor is in de-energized state, or in locked state otherwise.

2. After a reference is input, the servo motor starts to rotate.

Table 6-3 Operation of the servo drive

Log	No.	Description
☐	1	During initial operation, set a proper command to make the motor run at low speed and check whether the motor rotates properly.
☐	2	Check whether the motor rotates in the correct direction. If the direction of rotation is opposite to the expected direction, check the input command signal and the command direction setting signal.
☐	3	If the motor rotates in the correct direction, you can view the actual speed in 200B-01h and the average load rate in 200B-0Dh through the operating panel or the software tool.
☐	4	After checking preceding conditions, adjust related parameters to make the motor operate as desired.
☐	5	Commission the servo drive.

3. Power-on time sequence

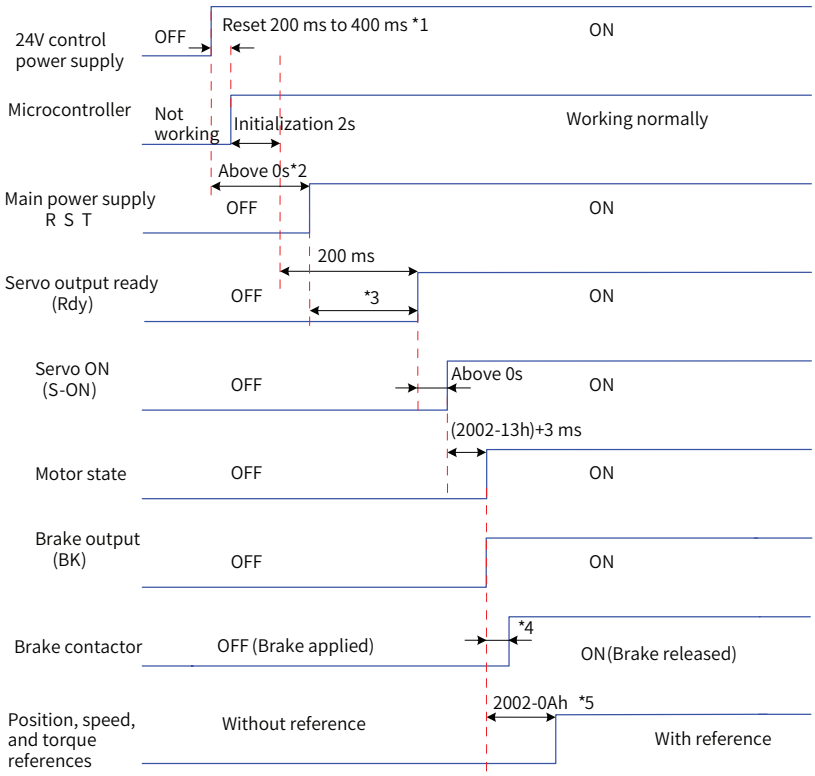


Figure 6-1 Power-on sequence diagram

NOTE

- *1: The reset time is determined by the setup time of the +5V power supply of the microprocessor.
- *2: The time longer than 0s means that the time is determined by the moment when the main power supply is switched on.
- *3: When the control power supply and main power supply are connected simultaneously, the time equals to the time from when micro-processor initialization is completed to the time when the Rdy signal is active.
- *4: For delay of brake contactor actions, see section 1.2.
- *5: When DO function 9 (FunOUT.9:BK) is not used, 2002-0Ah is invalid.

4. Sequence diagram upon stop at alarm or fault

a) Fault 1: Coast to stop, keeping de-energized status

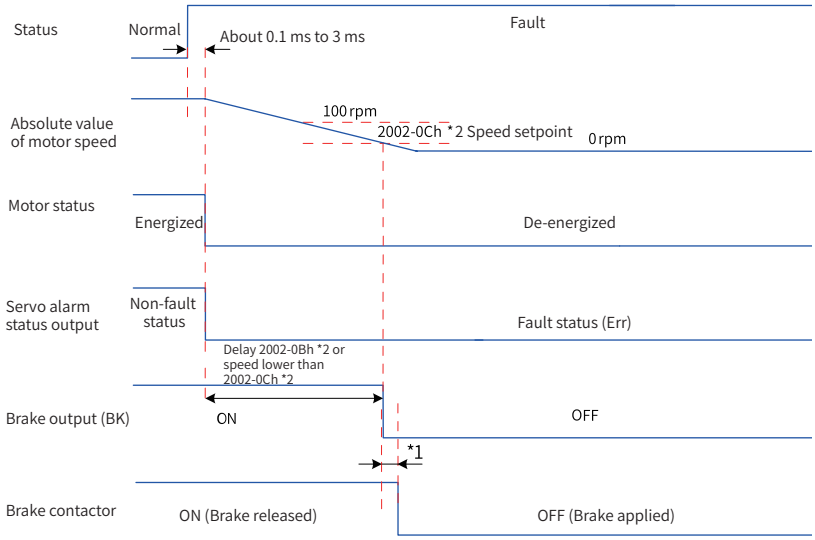


Figure 6-2 Sequence of "coast to stop, keeping de-energized state" at No. 1 fault

NOTE

- *1: For delay of brake contactor actions, see section 1.2.
- *2: When the DO function is not set to 9 (FunOUT.9:BK), 2002-0Ch and 2002-0Dh are invalid.

b) Fault 2 (without brake): Coast to stop, keeping de-energized state

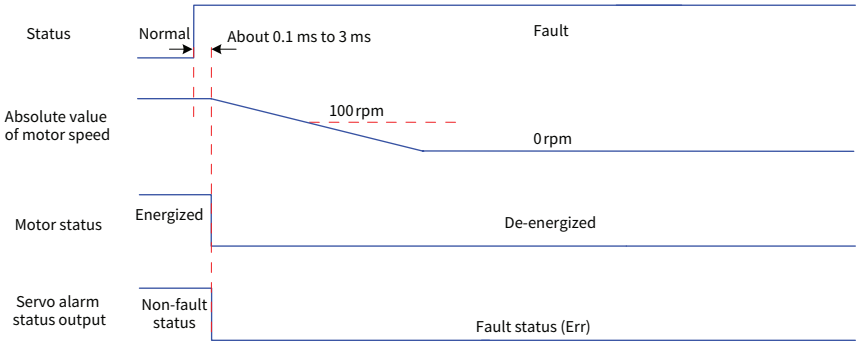


Figure 6-3 Sequence of "coast to stop, keeping de-energized state" at No. 2 fault

c) Fault 2 (without brake): Stop at zero speed, keeping de-energized state

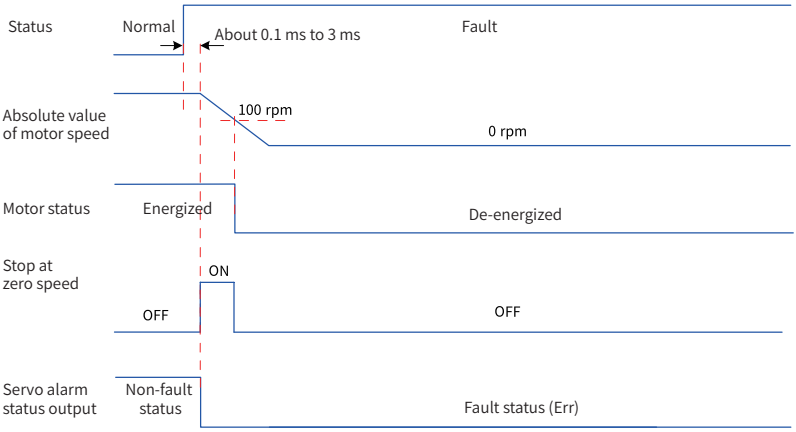


Figure 6-4 Sequence of "Stop at zero speed, keeping de-energized state" at No. 2 fault (without brake)

d) Fault 2 (with brake): Forced to stop at zero speed, keeping de-energized state

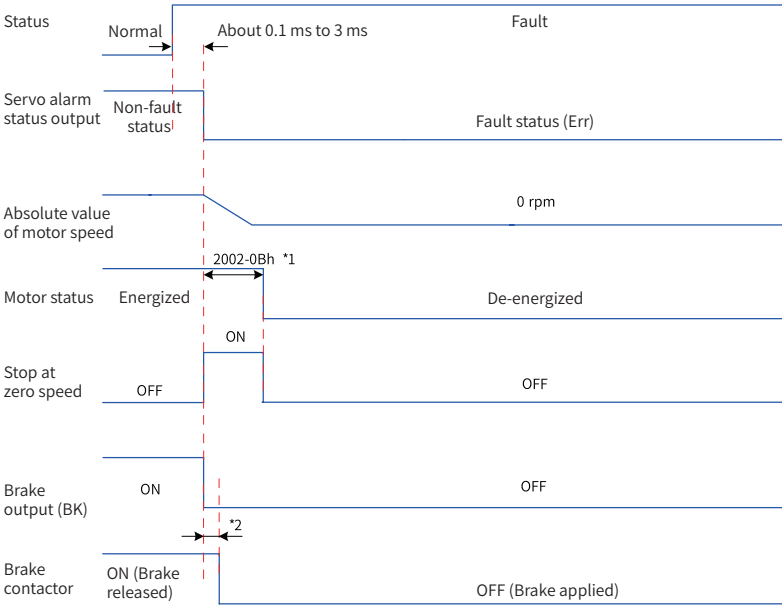


Figure 6-5 Time sequence at fault 2

NOTE

- *1: When DO function 9 (FunOUT.9:BK) is not used, 2002-0Bh is invalid.
- *2: For delay of brake contactor actions, see section 1.2.

When No.3 alarms occur in the servo drive, such as Er.900 (DI emergency braking), Er.950 (Forward limit switch alarm), and Er.952 (Reverse limit switch alarm), the servo drive stops according to the following time sequence.

e) Time sequence at alarms that cause stop: Stop at zero speed, keeping position lock status

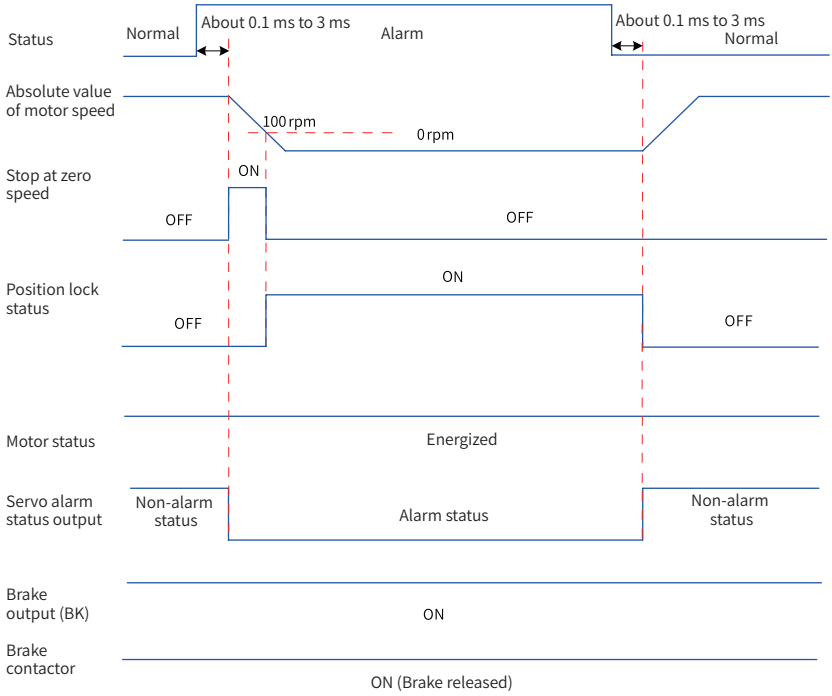


Figure 6-6 Sequence for alarms that cause stop

The other alarms do not affect the servo running state. The time sequence at occurrence of these alarms is as follows:

f) Alarms that do not cause stop

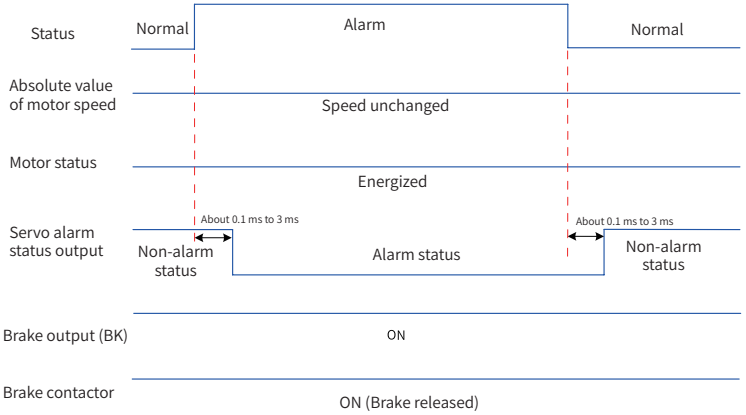


Figure 6-7 Sequence for alarms that do not cause stop

g) Fault reset

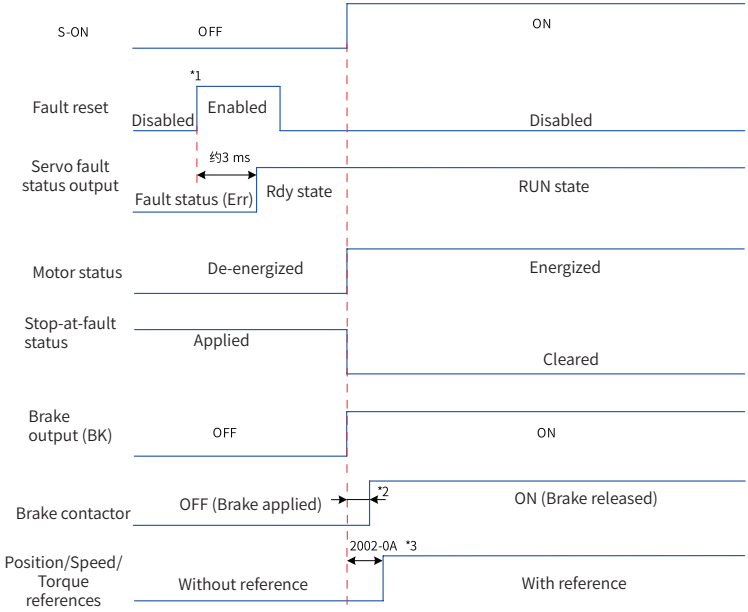


Figure 6-8 Sequence for fault reset

NOTE

- [1] The fault reset signal (FunIN.2: ALM-RST) is edge-triggered.
- *2: For delay of brake contactor actions, see section 1.2.
- *3: When DO function 9 (FunOUT.9:BK) is not used, 2002-0Ah is invalid.

6.1.7 Servo Stop

Different types of stop modes are available for the servo drive, including coast to stop, ramp to stop, stop at zero speed, stop at emergency-stop torque, and dynamic braking stop.

The stop state is classified into the de-energized state and the position lock state. See the following table for details.

Table 6-4 Comparison among different stop modes

Stop mode	Description	Feature
Coast to stop	The motor is de-energized and coasts to 0 rpm. The deceleration time is affected by the mechanical inertia and mechanical friction.	This mode features smooth and slow deceleration with small mechanical shock.
Stop at zero speed	The motor decelerates to 0 rpm immediately and stops.	Features quick deceleration with obvious mechanical shock.
Ramp to stop	The servo drive decelerates smoothly to 0 rpm and stops.	This mode features smooth and controllable deceleration with small mechanical shock.
Stop at emergency stop torque	The servo drive outputs reverse braking torque to stop the motor.	Features quick deceleration with obvious mechanical shock.
Dynamic braking	The motor stops due to external or internal dynamic braking.	This mode features quick deceleration with obvious mechanical shock.
Stop based on smooth deceleration and torque reduction	The servo drive decelerates smoothly to the switch speed, and then reduces torque smoothly and stops.	This mode features smooth and controllable deceleration with small mechanical shock.

Table 6-5 Comparison of the stop states

De-energized	Position lock
The motor is de-energized and the motor shaft can rotate freely after the motor stops rotating.	The motor shaft is locked and cannot rotate freely after the motor stops rotating.

The servo stops due to the following causes:

1 Stop at S-ON OFF

Deactivate the S-ON signal through communication. The servo drive stops accordingly.

■ Related parameters

2002-06h	Name	Stop mode at S-ON OFF			Setting condition & Effective time	Any condition & At stop	Data structure	-	Data type	Uint16
	Access	RW	Mapping	No	Related mode	All	Data range	0 to 4	Default	0

Defines the deceleration mode of the motor for stopping rotating upon S-ON OFF and the motor status after stop.

Value	Stop mode
0	Coast to stop, keeping de-energized status
1	Stop at zero speed, keeping de-energized status
2	Stop based on smooth deceleration and torque reduction, keeping de-energized status
3	Dynamic braking stop, keeping the dynamic braking state
4	Stop based on smooth deceleration and torque reduction, keeping dynamic braking status

Set a proper stop mode according to the mechanical status and operation requirements.
Enable the brake output, the stop mode at S-ON OFF is forced to "Stop at zero speed, keeping de-energized state"

2 Stop at fault

The stop mode varies with the fault type. For details on fault types and stop modes at fault, see Chapter Troubleshooting.

■ Related parameters

H02-08	Name	Stop mode at No. 1 fault			Setting condition & Effective time	At display	Data structure	-	Data type	Uint16
	Access	R	Mapping	RPDO	Related mode	All	Data range	0 to 10	Default	0

Defines the deceleration mode of the motor for stopping rotating upon occurrence of a No. 1 fault and the motor status after stop.

Value	Stop mode
0	Coast to stop, keeping the de-energized status
1	External dynamic braking stop, keeping the de-energized status
2	External dynamic braking stop, keeping the dynamic braking status
3	Internal dynamic braking stop, keeping the de-energized status
4	Internal dynamic braking stop, keeping the dynamic braking status
5	Stop at zero speed, keeping the de-energized status
6	Stop at zero speed, keeping the dynamic braking status
7	Ramp to stop, keeping the de-energized status
8	Ramp to stop, keeping the dynamic braking status
9	Stop based on smooth deceleration and torque reduction, keeping the de-energized status
A	Stop based on smooth deceleration and torque reduction, keeping the dynamic braking status

After the brake output is enabled, the stop mode at fault 1 is forced to "Dynamic braking stop, keeping the de-energized state".
When dynamic braking is enabled, the motor power must be equal to or smaller than the drive power; otherwise, the drive will report a hardware overcurrent fault and coast to stop.

H02-06	Name	Stop mode at No. 2 fault			Setting condition & Effective time	At display	Data structure	VAR	Data type	Uint16
	Access	R	Mapping	No	Related mode	All	Data range	0 to 10	Default	2

Fault type:

Value	Stop mode
0	Coast to stop, keeping the de-energized status
1	External dynamic braking stop, keeping the de-energized status
2	External dynamic braking stop, keeping the dynamic braking status
3	Internal dynamic braking stop, keeping the de-energized status
4	Internal dynamic braking stop, keeping the dynamic braking status
5	Stop at zero speed, keeping the de-energized status
6	Stop at zero speed, keeping the dynamic braking status
7	Ramp to stop, keeping the de-energized status
8	Ramp to stop, keeping the dynamic braking status
9	Stop based on smooth deceleration and torque reduction, keeping the de-energized status
A	Stop based on smooth deceleration and torque reduction, keeping the dynamic braking status

After the brake output is enabled, the stop mode at fault 2 is forced to "zero speed stop, keeping the de-energized state".
When dynamic braking is enabled, the motor power must be equal to or smaller than the drive power; otherwise, the drive will report a hardware overcurrent fault and coast to stop.

3 Stop at overtravel

■ Definition of terms:

Overtravel: The mechanical motion goes beyond the designed range of safe movement.

Stop at overtravel: When a motion part moves beyond the range of safe movement, the limit switch outputs a level change signal, and the servo drive forcibly stops the motor.

■ Related parameters

H02-07	Name	Stop mode at overtravel			Setting condition & Effective time	At stop & Real time	Data structure	-	Data type	Uint16
2002-08h	Access	RW	Mapping	-	Related mode	All	Data range	0 to 2	Default	1

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

Setpoint	Stop mode
0	Coast to stop, keeping de-energized status
1	Stop at zero speed, keeping position lock status
2	Stop at zero speed, keeping de-energized status

When the servo motor drives vertical axis, set 2002-08h to 1 to make the motor axis in position locking state after the limit switch signal is active to ensure safety.
After the brake output is enabled, the stop mode at overtravel is forcibly set to "Stop at zero speed, keeping the position lock status".

When overtravel occurs on a motor used to drive a vertical axis, the workpiece may fall. To pre-

vent the risk of falling, set 2002-08h (stop mode at overtravel) to 1 (stop at zero speed, keeping position lock state). When the workpiece moves linearly, install the limit switch to prevent mechanical damage. When overtravel occurs, input a reverse run command to make the motor (workpiece) run in the reverse direction.

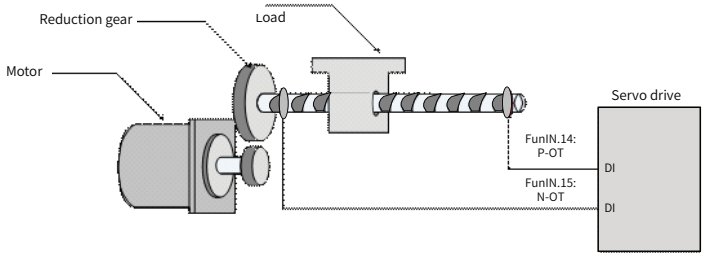


Figure 6-9 Installation of limit switches

To use the "stop at overtravel" function, assign FunIN.14 (P-OT, positive limit switch) and FunIN.15 (N-OT, negative limit switch) to two DIs of the drive and set the active logic of these DIs. This enables the drive to receive the level signals input from the limit switches. The servo drive enters the "stop at overtravel" state or exists the state based on the state of the DI level.

■ Related parameter

Code	Name	Function	Description
FunIN.14	P-OT	Positive limit switch	When the mechanical movement is outside the movable range, the servo drive implements the function of preventing the motor from sensing the limit switch. Invalid: Forward drive permitted Valid: Forward drive inhibited
FunIN.15	N-OT	Negative limit switch	When the mechanical movement is outside the movable range, the servo drive implements the function of preventing the motor from sensing the limit switch. Invalid: Reverse drive permitted Valid: Reverse drive inhibited

4 Quick stop

When the bit2 of the control word 6040h (Quick stop) is 0 during operation, the servo drive executes quick stop as defined by 605Ah.

605Ah	Name	Quick stop option code			Setting condition & Effective time	Any condition & At stop	Data structure	VAR	Data type	Int16
	Access	RW	Mapping	No	Related mode	All	Data range	0 to 7	Default	2

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

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

5 Halt

When the servo drive is in the running status and the bit8 of the control word 6040h is 1 (Halt), a halt command is input and the servo drive performs the halt operation in the mode defined by 605Dh.

605Dh	Name	Halt option code			Setting condition & Effective time	Any condition & At stop	Data structure	VAR	Data type	Int16
	Access	RW	Mapping	No	Related mode	All	Data range	1 to 3	Default	1

Defines the deceleration mode of the motor for stopping rotating upon halt and the motor status after stop.
CSP/CST/CST/PP/HM

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

Profile torque mode

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

6 Setting the stop mode upon fault

The stop mode of the drive is enabled by default. The drive stops upon a fault according to the mode set by parameters in group H0E. Two different stop modes are available. For the system without external braking, set H0E-45 to 1. For the system with external braking, set H0E-45 to 2.

6.1.8 Conversion Factor Setting

NOTE

- For 20-bit encoders, the default gear ratio 6091-01h/6091-02h is 1:1.
- For 23-bit encoders, the default gear ratio 6091-01h/6091-02h is 8:1.

6091h: Gear ratio

The gear ratio indicates the motor displacement (in encoder unit) corresponding to the load shaft displacement per one reference unit.

The gear ratio is comprised of the numerator 6091-01h and denominator 6091-02h. It determines the proportional relation between the load shaft displacement (reference unit) and the motor displacement (encoder unit), as shown below.

Motor displacement = Load shaft displacement x Gear ratio

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

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

Index 6091h	Name	Gear ratio			Setting condition & Effective time	-	Data structure	ARR	Data type	UInt32
	Access	-	Mapping	Yes	Related mode	All	Data range	OD data range	Default	OD default value

Defines the proportional relation between the load shaft displacement designated by the user and the motor shaft displacement.
The electronic gear ratio must be within the following range:
0.001 x Encoder resolution/10000, 4000 x Encoder resolution/10000
If this range is exceeded, E.B03.3 will be detected.
The relation between motor position feedback (encoder unit) and load shaft position feedback (reference unit) is as follows.

Motor position feedback = Load shaft position feedback x Gear ratio

The relation between the motor speed (rpm) and the load shaft speed (reference unit/s) is as follows:

$$\text{Motor speed (rpm)} = \frac{\text{Load shaft speed x Gear ratio (6091h)}}{\text{Encoder resolution}} \times 60$$

The relation between the motor acceleration (rpm/ms) and the load shaft acceleration (reference unit/s^2) is as follows.

$$\text{Motor acceleration} = \frac{\text{Load shaft acceleration x Gear ratio (6091h)}}{\text{Encoder resolution}} \times \frac{1000}{60}$$

Sub-index 0h	Name	Number of gear ratio sub-indexes			Setting condition & Effective time	-	Data structure	-	Data type	Uint8
	Access	RO	Mapping	No	Related mode	-	Data range	-	Default	2

Sub-index 1h	Name	Motor revolutions			Setting condition & Effective time	During operation & Real time	Data structure	-	Data type	UInt32
	Access	RW	Mapping	RPDO	Related mode	-	Data range	1 to (2^{32} - 1)	Default	Encoder resolution dependent

Sub-index 2h	Name	Shaft revolutions			Setting condition & Effective time	During operation & Real time	Data structure	-	Data type	UInt32
	Access	RW	Mapping	RPDO	Related mode	-	Data range	1 to (2^{32} - 1)	Default	1

For 20-bit encoders, the default gear ratio 6091-01h/6091-02h is 1:1.
For 23-bit encoders, the default gear ratio 6091-01h/6091-02h is 8:1.
The gear ratio is within the following range: 0.001 x Encoder resolution/10000 to 4000 x Encoder resolution/10000.
If this range is exceeded, E.B03.3 will be detected.

Taking the ball screw as an example:

Minimum reference unit (fc) = 1 mm
Screw lead (PB) = 10 mm/r
Reduction ratio (n) = 5:1

Inovance 20-bit serial encoder resolution P = 1048576 (p/r)

The position factor is therefore calculated as follows:

$$\text{Position factor} = \frac{\text{Motor resolution P*n}}{\text{PB}}$$

$$= \frac{1048576 \times 5}{10}$$

$$= \frac{5242880}{10}$$

$$= 524288$$

According to the preceding formula, 6091-1h = 524288 and 6091-2h = 1, which means that when the load shaft displacement is 1 mm, the motor displacement is 524288.

Reduce the values of 1h and 2h to a point where there is no common divisor, and take the final value.

6.2 Setting the Servo Drive State

To enable the ES810 to operate in the specified status, observe the process stipulated in the CiA402.

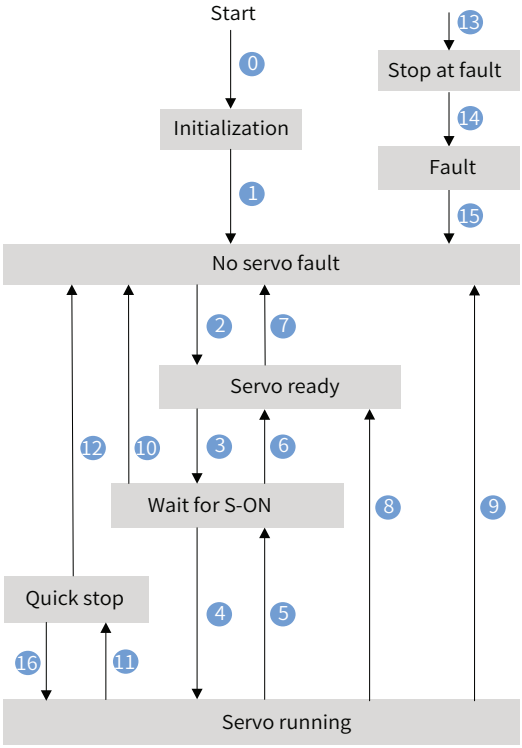


Figure 6-10 Switchover of the CiA402 state machine

See the following table for descriptions of different status.

Init	Initialization of the servo drive and internal auto-inspection are done. Parameters cannot be set and the driving function cannot be executed.
No fault	No fault exists in the servo drive or the fault has been cleared. Parameters can be set.
Ready to switch on	The servo drive is ready to run. Parameters can be set.
Wait for the S-ON signal	The servo drive is waiting for the S-ON signal. Parameters can be set.

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

The following table describes the control commands and status switchover.

CiA402 status switchover		Control word 6040h	Bit 0 to Bit 9 [1] of status word 6041h
0	Power-on → Initialization	Natural transition, control command not required	0x0000
1	Initialization → No fault	Natural transition, control command not required If an error occurs during initialization, the servo drive directly enters status 13.	0x0250
2	No fault → Servo ready	0x0006	0x0231
3	Servo ready → Wait for the S-ON signal	0x0007	0x0233
4	Wait for the S-ON signal → Servo running	0x000F	0x0237
5	Servo running → Wait for the S-ON signal	0x0007	0x0233
6	Wait for the S-ON signal → Servo ready	0x0006	0x0231
7	Servo ready → No fault	0x0000	0x0250
8	Servo running → Servo ready	0x0006	0x0231
9	Servo running → No fault	0x0000	0x0250
10	Wait for the S-ON signal → No fault	0x0000	0x0250
11	Servo running → Quick stop	0x0002	0x0217

CiA402 status switchover		Control word 6040h	Bit 0 to Bit 9 [1] of status word 6041h
12	Quick stop → No fault	Set 605A to a value between 0 and 3. Natural transition applies after stop and no control command is required.	0x0250
13	→ Stop at fault	If a fault occurs in any status other than "fault", the servo drive automatically switches to the stop-at-fault state, without the need for a control command.	0x021F
14	Stop at fault → Fault	Natural transition applies after stop and no control command is required.	0x0218
15	Fault → No fault	0x80 Bit7 is rising edge-triggered. If bit7 = 1, other control commands are invalid.	0x0250
16	Quick stop → Servo running	Set 605Ah to a value among 5 to 7. 0x0F is sent after the stop process is completed.	0x0237

NOTE

- As bit 10 to bit 15 (bit 14 is meaningless) of status word 6041h are related to the operation status of the servo drive, their values are represented by 0 in the preceding table.

6.2.1 Control Word 6040h

Index 6040h	Name	Control word			Setting condition & Effective time	During operation & At stop	Data structure	VAR	Data type	Uint16
	Access	RW	Mapping	RPDO	Related mode	All	Data range	0 to 65535	Default	0

Set the control command.

bit	Name	Description
0	Switch on	1: Active, 0: Inactive
1	Enable voltage	1: Active, 0: Inactive
2	Quick stop	0: Active, 1: Inactive
3	Enable operation	1: Active, 0: Inactive
4 to 6	Operation mode specific	Related to the operation mode of the servo drive.
7	Fault reset	Fault reset is performed for faults and alarms that can be reset. Bit7 is rising edge-triggered. If bit7 = 1, other control commands are invalid.

8	Halt	For the pause method in each control mode, see 605Dh.
9	Operation mode specific	Related to the operation mode of the servo drive.
10	Reserved	Not defined
11 to 15	Manufacturer-specific	Manufacturer-specific

◆ Note:

The bits in the control word together specify a certain control command, and are useless if set separately.
The meanings of bit 0 to bit 3 and bit 7 keep the same in each control mode of the servo drive. The servo drive switches to the preset state according to the CiA402 state machine only when the control words are sent in sequence. Each command indicates a state.
The meanings of bit 4 to bit 6 vary according to each control mode. For details, see the control command in each control mode.

Bit 9 is not defined.

6.2.2 Status Word 6041h

Index 6041h	Name	Status word			Setting condition & Effective time	-	Data structure	VAR	Data type	Uint16
	Access	RO	Mapping	TPDO	Mode	All	Data range	0 to xFFFF	Default	0

Indicates the servo drive status.

bit	Name	Description
0	Ready to switch on	1: Active, 0: Inactive
1	S-ON	1: Active, 0: Inactive
2	Enable operation	1: Active, 0: Inactive
3	Fault	1: Active, 0: Inactive
4	Voltage enabled	1: Active, 0: Inactive
5	Quick stop	0: Active, 1: Inactive
6	Switch on disabled	1: Active, 0: Inactive
7	Alarm	1: Active, 0: Inactive
8	Manufacturer-specific	Not defined
9	Remote	1: Active, control word effective 0: Inactive
10	Target reach	1: Active, 0: Inactive
11	Internal limit active	1: Active, 0: Inactive
12 to 13	Operation mode specific	Related to the operation mode of the servo drive.
14	Manufacturer-specific	Not defined
15	Home find	1: Active, 0: Inactive

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

◆ Note:

1. The meanings of bit 0 to bit 9 are the same in all servo drive modes. After commands in 6040h are sent in sequence, the servo drive feds back an acknowledged state.
The meanings of bit 12 and bit 13 vary with the operation modes. For details, see control commands in different modes.
3. The meanings of bit 10, bit 11, and bit 15 are the same in each operation mode of the servo drive, and indicate the status after a certain operation mode is implemented.

6.3 Servo Mode Setting

6.3.1 Servo Mode Description

Index 6502h	Name	Supported drive modes			Setting condition & Effective time	-	Data structure	VAR	Data type	UDINT32
	Access	RO	Mapping	No	Related mode	-	Data range	-	Default	3A1h

Indicates the operation modes supported by the servo drive.

bit	Description	Supported or Not 0: No 1: Yes
0	N/A	1
1	N/A	0
2	N/A	1
3	N/A	1
4	N/A	0
5	Homing (HM) mode	1
6	Interpolated position (IP) mode	0
7	Cyclic Synchronous Position (CSP) Mode	1
8	Cyclic synchronous velocity (CSV) mode	1
10 to 31	Manufacturer-specific	Reserved and not defined

If the device supports 6502h, the supported drive modes can be get through 6502h.

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

◆ Modes of operation (6060h):

Index 6060h	Name	Modes of operation			Setting condition & Effective time	During operation & At stop	Data structure	VAR	Data type	Int8
	Access	RW	Mapping	RPDO	Related mode	All	Data range	0 to 10	Default	0

Defines the operation mode of the servo drive.

Setpoint	Servo mode	
0	N/A	Reserved
1	N/A	Reserved
2	N/A	Reserved
3	N/A	Reserved
4	N/A	Reserved
5	N/A	Reserved
6	Homing (HM) mode	See section 6.5 for details.
7	Interpolated position (IP) mode	No
9	Cyclic synchronous velocity (CSV) mode	See section 6.4 for details.

If an unsupported operation mode is set through SDO, an SDO error will be returned. For details, see section 7.3.

If an operation mode not supported is set through PDO, this operation mode is invalid. For details on mode switchover, see section 6.3.2.

◆ 6061h (modes of operation display)

Index 6061h	Name	Modes of operation display			Setting condition & Effective time	-	Data structure	VAR	Data type	Int8
	Access	RO	Mapping	TPDO	Mode	All	Data range	0 to 10	Default	0

Displays the current operation mode of the servo drive.

Setpoint	Servo mode	
0	N/A	Reserved
1	N/A	Reserved
2	N/A	Reserved
3	N/A	Reserved
4	N/A	Reserved

5	N/A	Reserved
6	Homing (HM) mode	See section 6.5.
7	Interpolated position (IP) mode	Not supported
9	Cyclic synchronous velocity (CSV) mode	See section 6.4.

6.3.2 Mode Switchover

Precautions for mode switchover

Note:

1. When the servo drive in any state switches from the PP or CSP mode to another mode, the position references not executed will be abandoned.

2. When the servo drive in any state switches from the PV, PT, or CSV mode to another mode, ramp-to-stop will be performed before entering other modes.

3. When the servo drive is in the homing mode during operation, it cannot switch to another mode. After homing is done or interrupted (fault or S-ON off), the servo drive can enter another mode.

4. When the servo drive in the operational state switches to the cyclic synchronous mode, send references at an interval of at least 1 ms; otherwise, reference loss or error can occur.

6.3.3 Communication Cycle

Cycle time	Profile position (PP)	Homing (HM) mode	Cyclic synchronous position (CSP) mode	Cyclic synchronous velocity (CSV) mode	Profile velocity (PV) mode	Profile torque (PT) mode
125 µs	X	X	X	X	X	Y
250 µs	X	X	X	X	X	Y
500 µs	X	X	X	Y	Y	Y
1 ms	Y	Y	Y	Y	Y	Y

The cycle time of 1 ms and below is listed in the preceding table, and an error may be generated if the cycle time is not observed.

The cycle time that is above 1 ms and integer multiple of the position loop control cycle (250 us for ES810) is also supported.

6.4 Cyclic Synchronous Velocity (CSV) Mode

In the CSV mode, the host controller synchronizes the target speed in 60FF to the servo drive periodically. The servo drive performs speed control and torque control.

6.4.1 Block Diagram

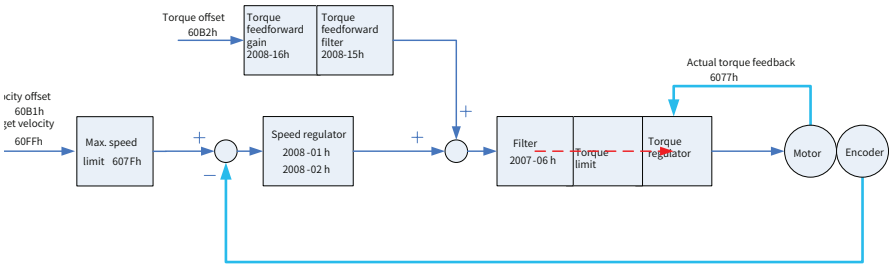


Figure 6-11 CSV mode

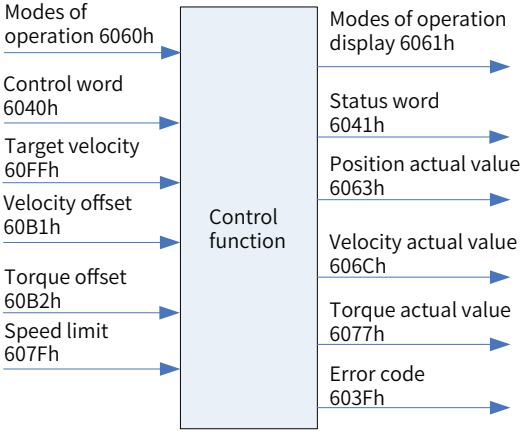


Figure 6-12 Input/Output objects

- Speed limit

The speed limit is determined by the smaller of the maximum motor speed and the value of 607F.

6.4.2 Related Objects

Control word 6040h		
Bit	Name	Description
0	Switch on	If bit0 to bit3 are all 1, the servo drive starts running.
1	Enable voltage	
2	Quick stop	
3	Enable operation	
8	Halt	0: The servo drive acts according to the setting of bit 0 to bit 3. 1: The servo drive halts according to 605Dh.

Status word (6041h)		
Bit	Name	Description
10	Target reach	0: Target velocity not reached 1: Target velocity reached
12	Drive follow the command value	0: Drive not following the command 1: Drive following command
13	--	Not defined
15	Home find	0: Home not found 1: Home found

Index (HEX)	Sub-index (HEX)	Name	Access	Data type	Unit	Value	Default
603F	00	Error code	RO	UINT16	-	0 to 65535	0
6040	00	Control word	RW	UINT16	-	0 to 65535	0
6041	00	Status word	RO	UINT16	-	0 to xFFFF	0
6060	00	Modes of operation display	RW	Int8	-	0 to 10	0
6061	00	Mode display	RO	Int8	-	0 to 10	0
6063	00	Position actual value*	RO	INT32	Encoder unit	-	-
6064	00	Position actual value	RO	INT32	Reference unit	-	-
606C	00	Velocity actual value	RO	INT32	Reference unit/s	-	-
6077	00	Torque actual value	RO	INT16	0.1%	-5000 to +5000	0
607F	00	Max. speed	RW	UDINT32	Reference unit/s	0 to $(2^{32} - 1)$	2^{30}
6083	00	Profile acceleration	RW	UDINT32	Reference unit/s^2	0 to $(2^{32} - 1)$	100
6084	00	Profile deceleration	RW	UDINT32	Reference unit/s^2	0 to $(2^{32} - 1)$	100
60B1	00	Velocity offset	RW	INT32	Reference unit/s	-2^{31} to $+(2^{31} - 1)$	0
60B2	00	Torque offset	RW	INT32	0.1%	-5000 to +5000	0
60E0	00	Positive torque limit	RW	UINT16	0.1%	0 to 5000	5000

60E1	00	Negative torque limit	RW	UINT16	0.1%	0 to 5000	5000
60FF	00	Target velocity	RW	INT32	Reference unit/s	-2^{31} to $+(2^{31}-1)$	0
2007	06	Torque filter time constant	RW	UINT16	0.01 ms	0 to 3000	79
2008	01	Speed loop gain	RW	UINT16	0.1 Hz	1 to 20000	250
	02	Speed loop integral time	RW	UINT16	0.01 ms	15 to 51200	3183
	15	Torque feedforward filter time	RW	UINT16	0.01 ms	0 to 6400	50
	16	Torque feedforward gain	RW	UINT16	0.1%	0 to 2000	0

Note: For details on the objects, see "Appendix B List of Object Dictionaries".

6.4.3 Related Function Setting

1. Speed reach function

Index	Sub-index	Name	Description
606Dh	00	Speed reach threshold	When the difference between 60FFh (converted into motor speed/rpm) and actual motor speed is within ±606Dh, and the time reaches 606Eh, the speed reference is reached. In this case, bit 10 of status word 6041h is set to 1 and the speed reach DO signal is active. This flag bit is valid only when the S-ON signal is active in profile position mode and cyclic synchronous velocity mode.
606Eh	00	Velocity window time	

6.4.4 Recommended Configuration

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

RPDO	TPDO	Remarks
6040: Control word	6041: Status word	Mandatory
60FF: Target velocity	-	
-	6064: Position actual value	Optional
-	606C: Velocity actual value	Optional
6060: Modes of operation	6061: Modes of operation display	Optional

6.5 Homing Mode (HM)

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

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

Mechanical zero: absolute zero point on the machine

After homing is done, the motor stops at the mechanical home. The relationship between the mechanical home and mechanical zero is defined by 607Ch.

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

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

6.5.1 Block Diagram

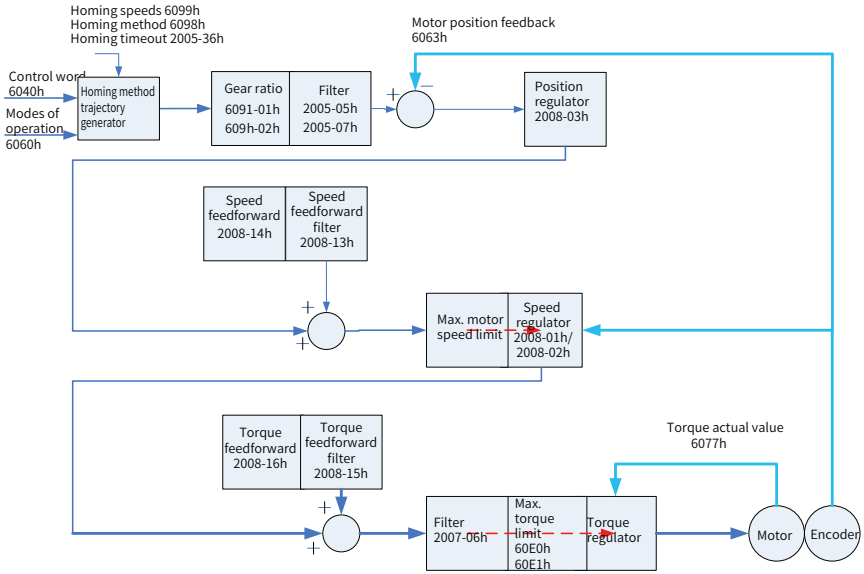


Figure 6-13 Block diagram of the homing mode

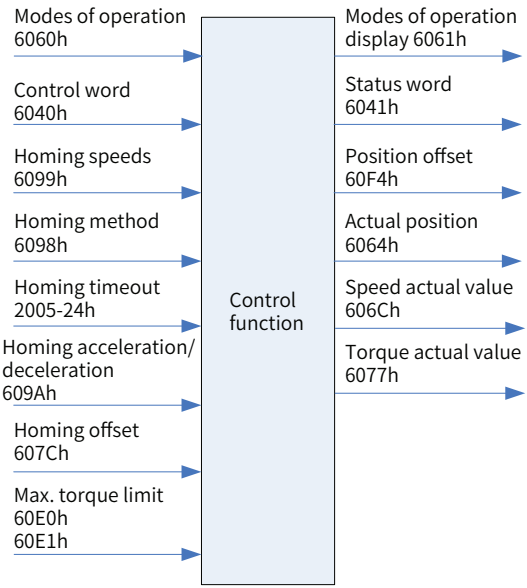


Figure 6-14 Input/Output objects

- Speed limit

The speed limit is determined by the smaller of the maximum motor speed and the value of 607F.

6.5.2 Related Objects

Control word 6040h			
Bit	Name	Description	
0	Switch on	1: Active; 0: Inactive	If bit0 to bit3 are all 1, the servo drive starts running.
1	Enable voltage	1: Active; 0: Inactive	
2	Quick stop	1: Inactive 0: Active	
3	Enable operation	1: Active; 0: Inactive	
4	Homing start	0->1: Homing start 1: Homing ongoing 1->0: Homing end	
8	Halt	0: The servo drive determines whether to start homing according to the setting of bit4. 1: The servo drive halts according to the setting of 605Dh.	

Status Word (6041h)		
Bit	Name	Description
10	Target reached	0: Target position not reached 1: Target position reached
12	Homing attained	0: Homing failed 1: Homing successful This flag bit is valid when the drive is in homing mode and the target reach signal is active.
13	Homing error	0: Homing error not occurred 1: Homing timeout or deviation excessive
15	Home find	0: Home not found 1: Homing completed This flag bit is set when the home signal is reached.

Index (HEX)	Sub-index (HEX)	Name	Access	Data type	Unit	Value	Default
603F	00	Error code	RO	UINT16	-	0 to 65535	0
6040	00	Control word	RW	UINT16	-	0 to 65535	0
6041	00	Status word	RO	UINT16	-	0 to xFFFF	0
6060	00	Operation mode	RW	Int8	-	0 to 10	0
6061	00	Mode display	RO	Int8	-	0 to 10	0
6062	00	Position demand value	RO	INT32	Reference unit	-	-
6064	00	Position actual value	RO	INT32	Reference unit	-	-
6067	00	Position window	RW	UInt32	Encoder unit	0 to 65535	734
6068	00	Position window time	RW	UINT16	ms	0 to 65535	x10
6077	00	Torque actual value	RO	INT16	0.1%	-5000 to 5000	0
606C	00	Velocity actual value	RO	INT32	Reference unit/s	-	-
6098	00	Homing method	RW	Int8	-	1–35	1
6099	01	Speed during search for switch	RW	UInt32	Reference unit/s	0 to (2^{32} - 1)	100
	02	Speed during search for zero	RW	UInt32	Reference unit/s	10 to (2^{32} - 1)	100

609 A	00	Homing acceleration	RW	UDINT32	Reference unit/ s^2	0 to (2^{32} - 1)	100
2005	24	Timeout duration	RW	UINT16	10 ms	100 to 65535	50000
60F4	00	Following error actual value	RO	DINT32	Reference unit	-	-

Note: For details on the objects, see "Appendix B List of Object Dictionaries".

6.5.3 Related Functions

1. Homing timeout

Index	Sub-index	Name	Description
2005	24	Homing timeout	If homing is not completed within the duration, Er.601 will be detected, indicating homing timeout.

2. Current position calculation method

Index	Sub-index	Name	Description
60E6	00	Current position calculation method	This object determines whether to use absolute homing or relative homing in an incremental system. ◆ 60E6h = 0 (Absolute homing) After homing is done, 6064h (Position actual value) is equal to the home offset 607Ch. ◆ 60E6h = 1 (Relative homing) After homing is done, 6064h is the sum of the original value plus the home offset 607Ch.

6.5.5 Recommended Configuration

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

RPDO	TPDO	Remarks
6040: Control word	6041: Status word	Mandatory
6098: Homing method	-	Optional
6099-01: Speed during search for switch	-	Optional
6099-02: Speed during search for zero	-	Optional
609A: Homing acceleration	-	Optional
-	6064: Position actual value	Optional
6060: Modes of operation	6061: Modes of operation display	Optional

6.6 Motor Protective Functions

1. Motor overload protection

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

Set the motor overload protection gain (200A-05h) to adjust the time when Er.620 is reported. Use the default value of 200A-05h. You can change the value of 200A-05h based on the actual motor heating situation when one of the following condition occurs:

The motor works in environments with high temperature.

The motor is in the cyclic motion featuring short motion cycle and frequent acceleration/deceleration.

Motor overload detection can be hidden (200A-1Bh = 1) when the motor is not affected by overload.

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

Related index codes:

200A-05h	Name	Motor overload protection gain			Setting condition & Effective time	During operation & Real time	Data structure	-	Data type	Uint16
	Access	RW	Mapping	-	Related mode	-	Data range	50 to 300 (unit: %)	Default	100

You can set the motor overload duration before Er.620 (Motor overload) is reported through 200A-05h.

Change the setpoint of 200A-05h to advance or delay the time when overload protection is triggered based on the motor heating condition. The setpoint 50% indicates the overload duration is cut by half; 150% indicates the overload duration is increased by 50%.

Set this parameter based on the actual heating condition of the motor.

200A-1Bh	Name	Motor overload detection			Setting condition & Effective time	At stop & Real time	Data structure	-	Data type	Uint16
	Access	RW	Mapping	-	Related mode	-	Data range	0 to 1	Default	0

This parameter is used to set whether to enable motor overload detection.

Setpoint	Functions
0	The motor overload detection function is enabled.
1	The motor overload alarm (Er.909) and fault (Er.620) are hidden.

Take caution during setting as improper setting may damage the motor.

2. Motor stall overtemperature protection

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

Set the time threshold for motor stall overtemperature protection (200A-21h) to adjust the time when Er.630 is reported. Set 200A-22h to determine whether to enable the protection function (enabled by default).

Take caution when hiding motor stall overtemperature protection as it may result in a damage to the motor.

Related index codes:

200A-21h	Name	Time window of motor stall overtemperature protection			Setting condition & Effective time	During operation & Real time	Data structure	-	Data type	Uint16
	Access	RW	Mapping	-	Related mode	P	Data range	10 to 65535 (ms)	Default	200
Defines the overtemperature duration before Er.630 (Motor stalled) is detected by the servo drive. 200A-21h can be used to adjust the sensitivity of motor stall overtemperature detection.										

200A-22h	Name	Motor stall overtemperature protection			Setting condition & Effective time	During operation & Real time	Data structure	-	Data type	Uint16
	Access	RW	Mapping	-	Related mode	-	Data range	0 to 1	Default	1

This parameter is used to enable detection on motor stall overtemperature protection (Er.630).

Setpoint	Function
0	Hide motor stall overtemperature protection (Er.630)
1	Enable motor stall overtemperature protection (Er.630).

3. Motor speed protection

An excessively high speed may damage the motor or machine. The servo drive provides motor overspeed protection.

In the applications where the motor drives vertical axis or is driven by load, set 200A-0Dh to 0

to disable runaway fault detection. Use this setting with caution.

Related index codes:

200A-09h	Name	Overspeed threshold			Setting condition & Effective time	During operation & Real time	Data structure	-	Data type	Uint16
	Access	RW	Mapping	-	Related mode	PST	Data range	0 to 10000 (unit: rpm)	Default	0

Defines the overspeed threshold of the motor.

Setpoint	Threshold	Condition for reporting Er.500
0	Maximum motor speed x 1.2	When the feedback speed keeps higher than the overspeed threshold for several times, the servo drive reports Er.500 (Overspeed fault).
1 to 10000	If 200A-09h ⩾ (Maximum motor speed x 1.2):	Overspeed threshold = Maximum motor speed x 1.2
	If 200A-09h < (Maximum motor speed x 1.2):	Overspeed threshold = 200A-09h

200A-0Dh	Name	Runaway protection			Setting condition & Effective time	During operation & Real time	Data structure	-	Data type	Uint16
	Access	RW	Mapping	-	Related mode	PST	Data range	0 to 1	Default	1

Enable runaway protection

Setpoint	Function	Remarks
0	Disabled	When the motor drives vertical axis or is driven by load, set 200A-0Dh to 0 to disable runaway fault (Er.234) detection.
1 to 10000	Enable	Enable the runaway protection function.

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

6.7 Absolute Encoder System

6.7.1 Descriptions of Absolute Encoder System

1 Overview

The absolute encoder detects the motor position within one revolution and counts the number of motor revolutions. For a 23-bit encoder, 16-bit multi-turn data can be recorded. The absolute encoder system integrated with the absolute encoder works in absolute position linear mode or absolute position rotating mode. These modes apply to position control, speed control, and torque control. The absolute encoder with a battery can back up data when the servo drive is powered off. This enables the servo drive to calculate the absolute mechanical position upon power-on again. Therefore, the homing operation is not required.

When using the absolute encoder for the ES810, set 2000-01h to 14101 (Inovance 23-bit absolute encoder) and set 2002-02h (Absolute system selection) based on actual conditions. Er.731 is reported when the battery is connected for the first time. Set 200D-15h to 1 to reset the fault and perform the homing operation.

When you change 2002-03h (Rotation direction selection) or 200D-15h (Absolute encoder reset), an abrupt change occurs in the encoder absolute position, causing change of the absolute position reference. Therefore, you need to perform the homing operation. After homing is completed, the servo drive automatically calculates the deviation between the mechanical absolute position and the encoder absolute position and stores it in the EEPROM.

2. Setting related index codes

a) Absolute encoder system setting

Set 2000-01h to 14101 to select Inovance 23-bit absolute encoder motor, and select the absolute position mode in 2002-02h.

2000-01h	Name	Motor code			Setting condition & Effective time	At stop & Next power-on	Data structure	-	Data type	Uint16
	Access	RW	Mapping	-	Related mode	-	Data range	0 to 65535	Default	14000

2002-02h	Name	Absolute system selection			Setting condition & Effective time	At stop & Next power-on	Data structure	-	Data type	Uint16
	Access	RW	Mapping	-	Related mode	All	Data range	0 to 2	Default	0

NOTE

◆ In the absolute position mode, the system detects the motor code automatically to check whether the motor used is configured with an absolute encoder. If not, Er.122 (Product mismatch in the absolute position mode) occurs.

b) Encoder feedback data

The feedback data of the absolute encoder is divided into the number of revolutions and the encoder position within one turn. For the incremental position mode, there is no feedback data concerning the number of revolutions.

200B-47h	Name	Number of absolute encoder revolutions			Setting condition & Effective time	-	Data structure	-	Data type	Uint16
	Access	RO	Mapping	TPDO	Mode	All	Data range	-	Default	-

200B-48h	Name	Single-turn position feedback of an absolute encoder			Setting condition & Effective time	-	Data structure	-	Data type	int32
	Access	RO	Mapping	TPDO	Mode	All	Data range	- (Unit: encoder unit)	Default	-

200B-4Eh	Name	Absolute position (low 32 bits) of absolute encoder feedback position of absolute encode(Low)			Setting condition & Effective time	-	Data structure	-	Data type	int32
	Access	RO	Mapping	TPDO	Mode	All	Data range	- (unit: encoder unit)	Default	-

200B-50h	Name	Absolute position (high 32 bits) of absolute encoder			Setting condition & Effective time	-	Data structure	-	Data type	int32
	Access	RO	Mapping	TPDO	Mode	All	Data range	- (unit: encoder unit)	Default	-

The number of absolute encoder revolutions (200B-47h) is an unsigned number ranging from 0 to 65535. If the encoder resolution is R_E ($R_E = 2^{23}$), the value of 200B-48h (Position of the absolute encoder within one turn) ranges from 0 to R_E.

The absolute position of the absolute encoder 200B-50h x 2^{32} + 200B-4Eh is calculated with the feedback data of the absolute encoder(200B-47h, 200B-48h) and the encoder resolution R_E. When 200B-47h is lower than 32768, (200B-50h x 2^{32}+ 200B-4Eh) = 200B-47hxR_E+ 200B-48h. When 200B-47h is greater than or equal to 32768 (200B-50hx 2^{32}+ 200B-4Eh) = 200B-47h-65536xR_E+200B-48h

c) Absolute position linear mode

2005–2Fh	Name	Position offset in absolute position linear mode (low 32 bits)			Setting condition & Effective time	At stop & Real time	Data structure	-	Data type	int32
	Access	RW	Mapping	-	Related mode	All	Data range	-2^{31} to $+(2^{31}-1)$ (encoder unit)	Default	0

2005–31h	Name	Position offset in absolute position linear mode (high 32 bits)			Setting condition & Effective time	At stop & Real time	Data structure	-	Data type	int32
	Access	RW	Mapping	-	Related mode	All	Data range	-2^{31} to $+(2^{31}-1)$ (encoder unit)	Default	0

200B/08h	Name	Absolute position counter			Setting condition & Effective time	At stop & Real time	Data structure	-	Data type	int32
	Access	RO	Mapping	-	Related mode	All	Data range	-2^{31} to $+2^{31}$ (encoder unit)	Default	0

200B/3Bh	Name	Mechanical absolute position (low 32 bits)			Setting condition & Effective time	-	Data structure	-	Data type	int32
	Access	RO	Mapping	-	Related mode	All	Data range	- (encoder unit)	Default	-

200B/3Dh	Name	Mechanical absolute position (high 32 bits)			Setting condition & Effective time	-	Data structure	-	Data type	int32
	Access	RO	Mapping	-	Related mode	All	Data range	Unit: Encoder unit	Default	-

This mode is mainly applicable to the scenario where the load traveling range is fixed and the encoder multi-turn data does not overflow, as shown by the following example of a ball screw transmission machine.

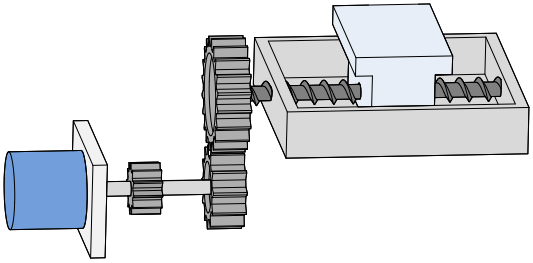


Figure 6-15 Ball screw transmission mechanism

Assume that the mechanical absolute position (200B-3Bh and 200B-3Dh) is P_M (P_M = 200B-3Dh x 2^{32} + 200B-3Bh), the encoder absolute position is P_E (P_E ranging from -2^{38} to (2^{38}-1), and the position offset in absolute position linear mode (2005-2Fh and 2005-31h) is P_O,

then their relationship is as follows: $P_M = P_E - P_O$.....

Assume that the electronic gear ratio is $\frac{B}{A}$ and the absolute position counter (200B-08h) indicates the mechanical absolute position (reference unit), then the following formula applies:

200B-08h = $P_M / (\frac{B}{A})$

The offset of the absolute position linear mode (2005-2Fh and 2005-31h) is 0 by default. If the homing operation is performed, the servo drive automatically calculates the deviation between the encoder absolute position and the mechanical absolute position, assigns values to 2005-2Fh and 2005-31h, and stores the values in EEPROM after homing is done.

The encoder multi-turn data range of the absolute position linear mode is -32768 to +32767. If the number of forward revolutions is larger than 32767 or the number of reverse revolutions is smaller than -32768, Er. 735 occurs, indicating the encoder multi-turn overflow fault. You can set 200A-25h to hide this fault.

d) Absolute position rotation mode

2005-33h	Name	Mechanical gear ratio (numerator) in the absolute position rotation mode			Setting condition & Effective time	At stop & Real time	Data structure	-	Data type	Uint16
	Access	RW	Mapping	-	Related mode	All	Data range	1 to 65535	Default	1

2005-34h	Name	Mechanical gear ratio (denominator) in absolute position rotation mode			Setting condition & Effective time	At stop & Real time	Data structure	-	Data type	Uint16
	Access	RW	Mapping	-	Related mode	All	Data range	1 to 65535	Default	1

2005-35h	Name	Pulses per load revolution in the absolute position rotation mode (low 32 bits)			Setting condition & Effective time	At stop & Real time	Data structure	-	Data type	UInt32
	Access	RW	Mapping	-	Related mode	All	Data range	0 to (2^{32} - 1) (encoder unit)	Default	0

2005–37h	Name	Pulses per load revolution in absolute position rotation mode (high 32 bits)			Setting condition & Effective time	At stop & Real time	Data structure	-	Data type	UInt32
	Access	RW	Mapping	-	Related mode	All	Data range	0 to 127 (encoder unit)	Default	0

200B-3Bh	Name	Mechanical absolute position (low 32 bits)			Setting condition & Effective time	-	Data structure	-	Data type	int32
	Access	RO	Mapping	-	Related mode	All	Data range	- (encoder unit)	Default	-

200B-3Dh	Name	Mechanical absolute position (high 32 bits)			Setting condition & Effective time	-	Data structure	-	Data type	int32	
	Access	RO	Mapping	-	Related mode	All	Data range	(unit: Encoder unit)	Default	-	

200B-4Eh	Name	Absolute position (low 32 bits) of absolute encoder			Setting condition & Effective time	-	Data structure	-	Data type	int32
	Access	RO	Mapping	TPDO	Mode	All	Data range	- (unit: encoder unit)	Default	-

200B-50h	Name	Absolute position (high 32 bits) of absolute encoder			Setting condition & Effective time	-	Data structure	-	Data type	int32
	Access	RO	Mapping	TPDO	Mode	All	Data range	- (unit: encoder unit)	Default	-

200B-52h	Name	Single-turn position of the load in rotation mode (low 32 bits)			Setting condition & Effective time	-	Data structure	-	Data type	UInt32
	Access	RO	Mapping	TPDO	Mode	All	Data range	(unit: Encoder unit)	Default	-

200B-54h	Name	Single-turn position of the load in rotation mode (high 32 bits)			Setting condition & Effective time	-	Data structure	-	Data type	UInt32
	Access	RO	Mapping	TPDO	Mode	All	Data range	- (unit: encoder unit)	Default	-

200B-56h	Name	Single-turn position of the load in rotation mode Single feedback position of rotating load			Setting condition & Effective time	-	Data structure	-	Data type	UInt32
	Access	RO	Mapping	TPDO	Mode	All	Data range	- (unit: reference unit)	Default	-

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

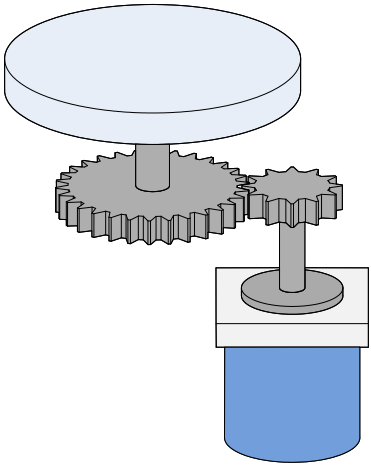


Figure 6-16 Rotating load

The servo drive calculates the upper limit of the mechanical absolute position using 2005-35h and 2005-37h first. If 2005-35h and 2005-37h are both set to 0, the servo drive uses 2005-33h and 2005-34h for calculation. When the encoder resolution (R_E) is 2^{23}, and the number of encoder pulses per load revolution is represented by R_M, the following formula applies:

2005-35h or 2005-37h $\neq$ 0: R_M = 2005-37h x 2^{32} + 2005-35h

2005-35h or 2005-37h = 0: R_M=R_E x (2005-33h/2005-34h)

Assume that the electronic gear ratio is $\frac{B}{A}$, the single-turn position of the load in rotation mode (encoder unit, 200B-54h x 2^{32} + 200B-52h) ranges from 0 to RM, and the single-turn position of the load in rotation mode (reference unit, 200B-56h) ranges from 0 to RM/($\frac{B}{A}$), then

the following formula applies:

$$200B\text{-}56h = (200B\text{-}54h \times 2^{32} + 200B\text{-}52h)/(\frac{B}{A})$$

Assume that the mechanical absolute position (200B-3Bh and 200B-3Dh) is P_M (P_M = 200B-3Dh x 2^{32} + 200B-3Bh), then the following formula applies:

$$P_M = \text{Number of revolutions of the rotary table} \times R_m + (200B\text{-}54h \times 2^{32} + 200B\text{-}52h)$$

Assume that the electronic gear ratio is $\frac{B}{A}$ and the absolute position counter (200B-08h) indicates the mechanical absolute position (reference unit), then the following formula applies:

$$200B\text{-}08h = P_M/(\frac{B}{A}) = \text{Number of revolutions of the rotary table} \times R_M/(\frac{B}{A}) + 200B\text{-}56h$$

The following figure shows the relation between the single-turn position of the rotating load and the position of the rotary platen.

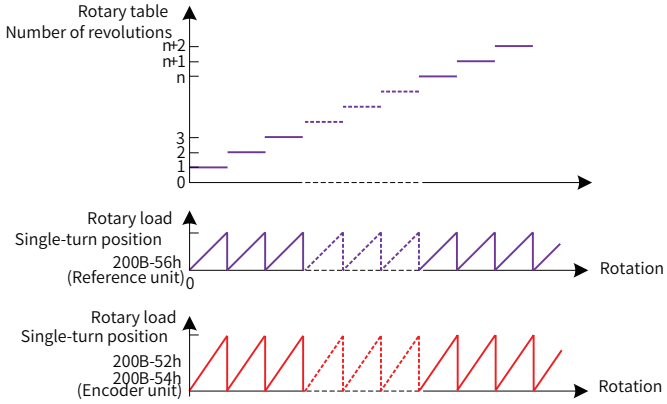


Figure 6-17 Relation between the single-turn position of the rotating load and the position of the rotary table

The multi-turn data range is not limited in the absolute position rotation mode. Er.735 (Encoder multi-turn overflow) can be hidden.

e) Encoder multi-turn overflow fault

You can hide Er.735 (Encoder multi-turn overflow) by setting 200A-25h in the absolute position linear mode.

200A-25h	Name	Encoder multi-turn overflow fault			Setting condition & Effective time	At stop & Real time	Data structure	-	Data type	Uint16
	Access	RW	Mapping	No	Related mode	All	Data range	0 to 1	Default	0

f) Absolute encoder reset

You can reset the encoder internal faults or multi-turn feedback data by setting 200D-15h.

200D-15h	Name	Absolute encoder reset			Setting condition & Effective time	At stop & Real time	Data structure	-	Data type	Uint16
	Access	RW	Mapping	-	Related mode	All	Data range	0 to 2	Default	0

Note: After reset of encoder feedback multi-turn data, the absolute position of the encoder changes abruptly. In this case, perform the mechanical homing operation.

0: No operation
1: Reset the fault
2: Reset the fault and multi-turn data

6.7.2 Precautions for Use of the Battery Box

When the battery is connected for the first time, Er.731 (Encoder battery fault) will be reported. In this case, set 200D-15h to 1 to reset the fault, and then operate on the absolute system.

When the battery voltage detected is lower than 3.0 V, Er.730 (Encoder battery alarm) occurs. Replace the battery as follows:

Step 1: Power on the servo drive, and ensure the servo drive is in non-operational status.

Step 2: Replace the battery.

Step 3: The servo drive automatically clears Er.730 (Encoder battery alarm). If there is no other alarm, make the servo drive run normally.

CAUTION

- If the battery is replaced when the servo drive is in power-down status, Er.731 (Encoder battery fault) can occur when the servo drive is powered on again, leading to an abrupt change in the multi-turn data feedback. In this case, set 200D-15h (Absolute encoder reset selection) to 1 (Reset the fault) to reset the fault and perform the homing operation again.
- In the power-down state, ensure that the maximum motor speed does not exceed 6000 rpm so that the encoder position can be recorded correctly.
- Keep the battery in environments within the required ambient temperature range and ensure the battery is in reliable contact and carries sufficient power capacity. Otherwise, encoder data loss may occur.

6.8 Software Tool for Commissioning

InoDriveShop is the commissioning software developed for ES810. The following figure shows the software icon.

In the PC with the InoDriveShop installed, you can perform functions such as real-time monitoring, parameter setting, real-time sampling, and individual sampling.

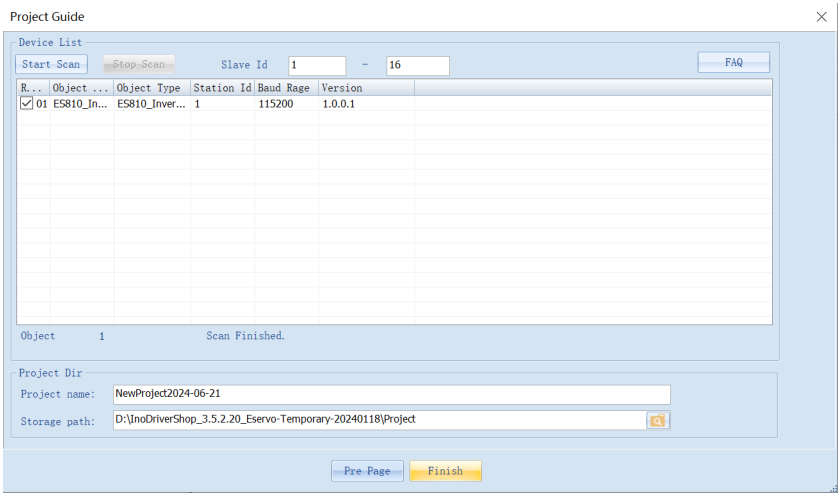
6.8.1 Creating/Loading Projects

After the software runs, select **New project/Open Project** on the home page.

Operation description:

1. Creating a project

Select ES810 for the device and usb for the communication type. Then check **Adaptive baud rate**. The following figure describes the USB connection.



2. Opening a project

Open the project file type with the suffix .inoPro.

NOTE

- If you use **Load existing item**, note that the drive information recorded is consistent with the current site conditions.

6.8.2 Connecting/Disconnecting Communication

Click the button on the toolbar to establish the connection., Click **Disconnect**.

Operation description:

1. Establishing connection

Click **Connect device** to set the communication parameters, as shown in Figure 6-24.

If connection fails, a message indicating communication configuration fails will be displayed. In this case, select **Auto search** to enter the device search interface. After searching is done, connection will be applied automatically.

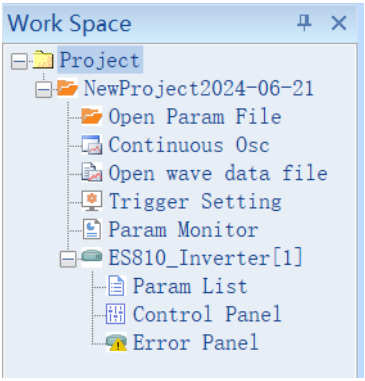


Figure 6-18 Connection succeeded

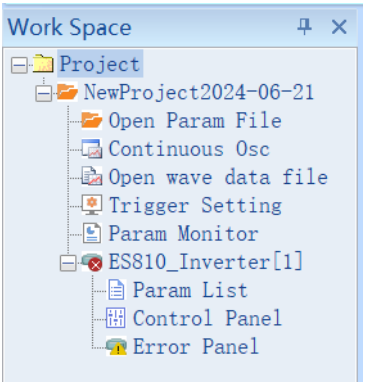


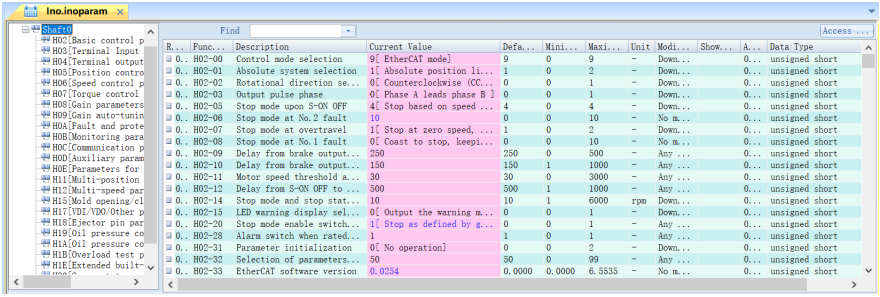
Figure 6-19 Connection failed

2. Interrupting connection

After you click **Disconnect device**, connection will be interrupted automatically, as shown in Figure 6-25 .

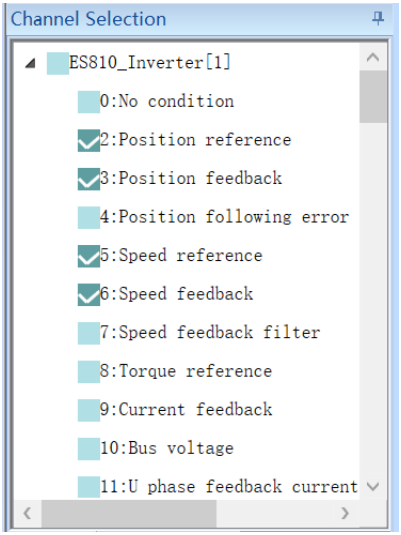
6.8.3 Opening the Parameter File

This button is used to open the parameter file (xxx.inoparam) saved. You can view the saved parameters in the software.



6.8.4 Continuous Oscilloscope

This button is used for continuous waveform collection. Select the channel needed in the channel selection interface.



Functions of the buttons on the menu bar:

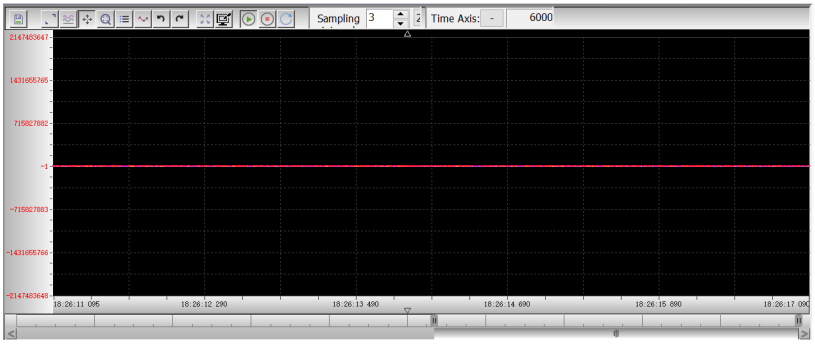
Save files: Used to save waveform files (.inocwv).

Auto fit: Used to adjust the scale automatically.

Tile: Used to separate different channels.

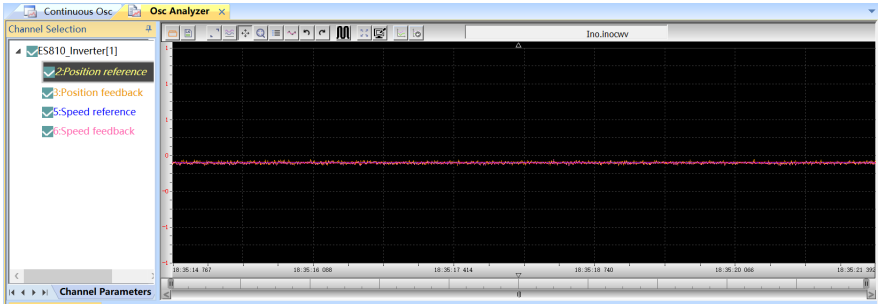
Cursor: Used to view the current value of the channel at different times and the average value over time.

Open/Save configuration file: Used to save or open the channel configuration.



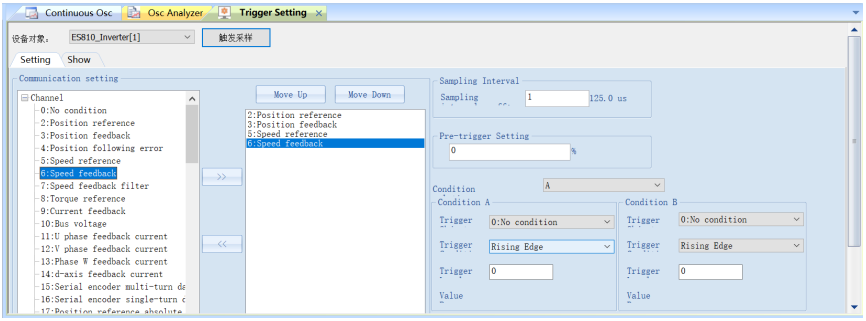
6.8.5 Waveform Analyzer

In the waveform analyzer, You can open a saved waveform or compare two waveforms.



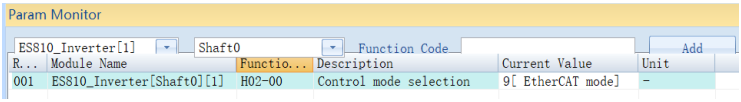
6.8.6 Trigger Setting

Waveforms of high resolution can be obtained by triggering waveform sampling. Select the channel needed in **Channel settings** and set the trigger condition needed. When all the settings are done, click **Trigger sampling** to obtain waveforms.



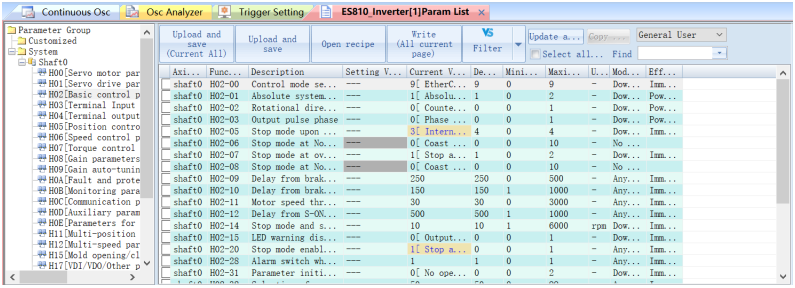
6.8.7 Parameter Monitoring

You can add the parameter to the **Monitoring table**, You can view the parameters in the parameter monitoring interface after adding them.



6.8.8 Parameter List

The drive parameters can be viewed in the parameter list. You can use the comparison function to compare the two saved parameter files. When you need to download parameters to the drive, make corresponding changes in the setpoint and click **Download**.



7 Troubleshooting

For details on the troubleshooting of the power supply unit, see the 810 Series Power Supply Unit User Manual.

7.1 Faults and Alarm Types

Faults and alarms of the servo drive are divided into three levels based on severity: No. 1 > No. 2 > No. 3, as shown below.

No.1 non-resettable fault

No.2 resettable fault

No.3 resettable alarm

"Resettable" means the operating panel stops displaying the fault/alarm once a "Reset signal" is input.

To reset a fault/alarm, use one of the following methods:

1. Set 200D-02h to 1 (Fault reset).
2. Use DI function 2 (FunIN.2, ALM-RST).
3. Set the rising edge of bit 7 through setting bit 7 of the control word 0x6040.

To reset No. 1 and No. 2 faults, switch off the S-ON signal first and then send the fault reset signal.

To reset No.3 alarms, send the fault reset signal directly.

■ Related parameters

Param.	Name	Value	Function	Setting mode	Effective time	Default
200Dh-02h	Fault reset	0: No operation 1: Reset fault/ alarm	Used to stop the operating panel from displaying the fault/alarm when a resettable fault/alarm occurs. 200Dh-02h is set to 0 immediately after reset.	At stop	Real time	0

■ Related function No.

Code	Name	Function	Description
FunIN.2	ALM-RST	Fault/Alarm reset signal	This DI function is edge-triggered and inactive when the high/low level keeps apply. The servo drive may, depending on the alarm type, continue operating after reset. When FunIN.2 is assigned to a low-speed DI, the logic of this DI will be set to “Edge-triggered” forcibly, and the effective level change of this DI must be kept for more than 3 ms. Otherwise, fault reset is inactive. Do not assign FunIN.2 to a high-speed DI. Otherwise, fault/alarm reset is inactive. Inactive: Not resetting the fault/alarm Active: Resetting the fault/alarm

■ Fault/Alarm code output

The servo drive can output the fault/alarm code of the highest level.

To implement fault/alarm output, assign FunOUT.12, FunOUT.13, and FunOUT.14 to set three DOs of the servo drive.

FunOUT.12: ALMO1 (first digit of the fault/alarm code, short for AL1)

FunOUT.13: ALMO2 (second digit of the fault/alarm code, short for AL2)

FunOUT.14: ALMO3 (third digit of the fault/alarm code, short for AL3)

When different faults/alarms occur, the levels of the three DOs can change.

7.2 List of Fault and Alarm Codes

When a communication error or drive error occurs, the ES810 series servo drive sends an emergency message to the network as a producer or sends an abort response when SDO transmission is abnormal.

7.2.1 List of Fault Codes

No.	Fault name	Fault display	Fault level	Default stop mode	Position in group 0E
1	Access to FPGA by MCU timeout	E.100.0	Level 1 non-resettable fault	0: Coast to stop	0
2	Logic configuration fault	E.102.0	Level 1 non-resettable fault	0: Coast to stop	0
3	Mismatch between FPGA models and MCU models	E.103.0	Level 1 non-resettable fault	0: Coast to stop	0
4	FPGA interruption timeout	E.104.0	Level 1 non-resettable fault	0: Coast to stop	0
5	Current loop or software interruption timeout	E.104.1	Level 1 non-resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	1
6	System parameter error	E.105.0	Level 1 non-resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	1
7	Parameter write fault	E.108.0	Level 1 non-resettable fault	0: Coast to stop	1
8	Parameter read fault	E.108.1	Level 1 non-resettable fault	0: Coast to stop	1
9	Factory parameter error	E.111.0	Level 1 non-resettable fault	0: Coast to stop	2
10	Product models mismatch and no corresponding encoder	E.120.0	Level 1 non-resettable fault	0: Coast to stop	2
11	Product models mismatch and no corresponding motor	E.120.1	Level 1 non-resettable fault	0: Coast to stop	2

No.	Fault name	Fault display	Fault level	Default stop mode	Position in group 0E
12	Serial motor code error	E.120.2	Level 1 non-resettable fault	0: Coast to stop	2
13	Parameter mismatch when set to 2nd generation encoder motor	E.122.0	Level 1 non-resettable fault	0: Coast to stop	3
14	Product model mismatch and no corresponding drive	E.123.0	Level 1 non-resettable fault	0: Coast to stop	3
15	Data check error or no parameter saved in the motor ROM	E.136.0	Level 1 non-resettable fault	0: Coast to stop	3
16	Data check error or no parameter saved in the motor ROM	E.136.1	Level 1 non-resettable fault	0: Coast to stop	3
17	FPGA system sampling operation timeout	E.208.0	Level 1 non-resettable fault	0: Coast to stop	4
18	Timeout caused by failure of MCU to timely update torque reference	E.208.1	Level 1 non-resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	4
19	Error caused by encoder communication timeout	E.208.2	Level 1 non-resettable fault	0: Coast to stop	4
20	Error caused by current sampling (7860) timeout	E.208.3	Level 1 non-resettable fault	0: Coast to stop	4
21	Error caused by analog/ digital conversion timeout	E.208.4	Level 1 non-resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	5
22	Output short-circuited to ground	E.210.0	Level 1 non-resettable fault	0: Coast to stop	5
23	Output short-circuited to ground	E.210.1	Level 1 non-resettable fault	0: Coast to stop	5
24	Encoder battery failure	E.731.0	Level 1 non-resettable fault	0: Coast to stop	5
25	Encoder multi-turn counting error	E.733.0	Level 1 non-resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	6
26	Encoder multi-turn counting overflow	E.735.0	Level 1 non-resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	6
27	Encoder multi-turn counting overflow	E.735.1	Level 1 non-resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	6
28	Encoder Z signal interference	E.740.0	Level 1 non-resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	6
29	Encoder AB signal interference	E.740.1	Level 1 non-resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	7
30	Encoder Z signal interference	E.740.5	Level 1 non-resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	7

No.	Fault name	Fault display	Fault level	Default stop mode	Position in group 0E
31	Encoder Z signal interference	E.740.6	Level 1 non-resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	7
32	Encoder Z signal interference	E.740.7	Level 1 non-resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	7
33	Encoder Z signal interference	E.740.8	Level 1 non-resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	8
34	Nikon encoder	E.756.0	Level 1 non-resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	8
35	Nikon encoder EEPROM damaged	E.765.2	Level 1 non-resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	8
36	AD sampling fault reported by FPGA	E.835.0	Level 1 non-resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	8
37	Encoder parameter error	E.A33.0	Level 1 non-resettable fault	0: Coast to stop	9
38	Encoder echo check error	E.A34.0	Level 1 non-resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	9
39	Z signal disconnected	E.A35.0	Level 1 non-resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	9
40	System parameter error	E.101.0	Level 1 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	9
41	Model code identification failed	E.102.1	Level 1 resettable fault	0: Coast to stop	10
42	Motor parameter mismatch upon absolute position settings	E.122.1	Level 1 resettable fault	0: Coast to stop	10
43	DI function assignment error	E.130.0	Level 1 resettable fault	0: Coast to stop	10
44	DO function assignment error	E.131.0	Level 1 resettable fault	0: Coast to stop	10
45	Error in reading or writing EEPROM in ABSENC	E.135.0	Level 1 resettable fault	0: Coast to stop	11
46	Hardware overcurrent	E.201.0	Level 1 resettable fault	0: Coast to stop	11
47	Hardware overcurrent	E.201.1	Level 1 resettable fault	0: Coast to stop	11
48	Hardware overcurrent	E.201.2	Level 1 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	11
49	Hardware overcurrent	E.201.3	Level 1 resettable fault	0: Coast to stop	12
50	D-/Q-axis current overflow	E.207.0	Level 1 resettable fault	0: Coast to stop	12

No.	Fault name	Fault display	Fault level	Default stop mode	Position in group 0E
51	U, V, and W phase wiring error	E.220.0	Level 1 resettable fault	0: Coast to stop	12
52	U, V, and W phase loss	E.220.1	Level 1 resettable fault	0: Coast to stop	12
53	Runaway alarm upon incorrect wiring of U, V, and W phases	E.234.0	Level 1 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	13
54	DC busbar overvoltage	E.400.0	Level 1 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	13
55	DC busbar undervoltage	E.410.0	Level 1 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	13
56	Motor overspeed	E.500.0	Level 1 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	13
57	FPGA internal speed measurement overflow	E.501.0	Level 1 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	14
58	Offline inertia auto-tuning failure	E.600.0	Level 1 resettable fault	0: Coast to stop	14
59	Angle auto-tuning failure	E.602.0	Level 1 resettable fault	0: Coast to stop	14
60	Encoder interference fault	E.740.2	Level 1 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	14
61	Single-turn calculation error	E.740.3	Level 1 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	15
62	Counting increment exception	E.740.4	Level 1 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	15
63	Nikon encoder communication fault	E.755.0	Level 1 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	15
64	Nikon encoder communication fault	E.755.1	Level 1 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	15
65	Angle auto-tuning timeout	E.800.0	Level 1 resettable fault	0: Coast to stop	16
66	Parameter auto-tuning timeout	E.800.1	Level 1 resettable fault	0: Coast to stop	16
67	PI auto-tuning timeout	E.800.2	Level 1 resettable fault	0: Coast to stop	16
68	Parameter auto-tuning cancellation	E.801.0	Level 1 resettable fault	0: Coast to stop	16
69	AD sampling overvoltage of the DSP	E.834.1	Level 1 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	17
70	AD sampling overvoltage of the DSP	E.834.2	Level 1 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	17

No.	Fault name	Fault display	Fault level	Default stop mode	Position in group 0E
71	AD sampling overvoltage of the DSP	E.834.3	Level 1 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	17
72	AD zero drift error	E.836.0	Level 1 resettable fault	A: A: Stop based on smooth deceleration and torque reduction, keeping the lock status	17
73	Excessive encoder position deviation upon next power-on	E.901.0	Level 1 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	18
74	Motor power cables disconnected	E.939.0	Level 1 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	18
75	Excessive speed deviation	E.044.0	Level 2 resettable fault	0: Coast to stop	18
76	Excessive deviation due to torque limit	E.044.1	Level 2 resettable fault	0: Coast to stop	18
77	Pressure sensor disconnected	E.046.0	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	19
78	S-ON command invalid	E.121.0	Level 2 resettable fault	2: External dynamic braking stop, keeping dynamic braking status	19
79	STO signal input protection	E.300.0	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	19
80	Power supply unit fault	E.422.0	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	19
81	Power-down of the power supply unit	E.423.0	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	20
82	Root extraction error	E.466.0	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	20
83	Frequency division pulse output overspeed	E.510.0	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	20
84	Drive overload	E.610.0	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	20
85	Motor overload	E.620.0	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	21
86	Motor overload	E.620.1	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	21
87s	Motor stall overtemperature protection	E.630.0	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	21
88	Heatsink overtemperature	E.650.0	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	21
89	Motor overtemperature (PTC)	E.660.0	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	22
90	Excessively high temperature (KTY)	E.660.1	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	22

No.	Fault name	Fault display	Fault level	Default stop mode	Position in group 0E
91	Encoder battery alarm	E.730.0	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	22
92	Encoder Tx-end communication check error	E.732.0	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	22
93	Encoder Z signal interference	E.745.0	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	23
94	Encoder Z signal interference	E.750.2	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	23
95	Encoder Z signal interference	E.750.3	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	23
96	Encoder Z signal interference	E.750.4	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	23
97	Encoder Z signal interference	E.750.5	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	24
98	Encoder Z signal interference	E.750.6	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	24
99	Encoder overtemperature	E.760.0	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	24
100	Nikon encoder out of limit	E.765.0	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	24
101	Three-phase imbalance	E.940.0	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	25
102	Frequent parameter storage	E.942.0	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	25
103	Limit of position reference or feedback reached	E.997.0	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	25
104	Object dictionary data setting error	E.998.0	Level 2 resettable fault	0: Coast to stop	25
105	Resistance auto-tuning failure	E.A42.1	Level 2 resettable fault	0: Coast to stop	26
106	Inductance auto-tuning failure	E.A42.2	Level 2 resettable fault	0: Coast to stop	26
107	Back EMF auto-tuning failure	E.A42.3	Level 2 resettable fault	0: Coast to stop	26
108	Motor parameter auto-tuning failure	E.A42.6	Level 2 resettable fault	0: Coast to stop	26
109	Excessive position deviation	E.B00.6	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	27
110	Position reference input error	E.B01.0	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	27

No.	Fault name	Fault display	Fault level	Default stop mode	Position in group 0E
111	Electronic gear ratio setting error	E.B03.0	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	27
112	Electronic gear ratio setting error	E.B03.1	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	27
113	Electronic gear ratio setting error	E.B03.2	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	28
114	ECT electronic gear ratio setting error	E.B03.3	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	28
115	Switchover (internal/ external) not allowed during hybrid use of fully closed-loop and multi-position absolute modes	E.B04.0	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	28
116	Module protection parameters read error	E.B05.0	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	28
117	Reset required after saving mold protection parameter	E.B06.0	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	29
118	Number of points to be collected higher than the maximum number of points 8 x 1024	E.B07.0	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	29
119	Module protection	E.B08.0	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	29
120	Communication interrupted	E.D03.0	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	29
121	CANopen communication timeout	E.D04.0	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	30
122	CANopen communication initialized	E.D05.0	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	30
123	CANopen communication reset	E.D06.0	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	30
124	Bus disconnection error	E.D07.0	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	30

No.	Fault name	Fault display	Fault level	Default stop mode	Position in group 0E
125 m	Bus PDO transmission length error	E.D08.0	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	31
126	Lower limit of software position higher than the upper limit	E.D09.0	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	31
127	Home offset outside the software position limit	E.D10.0	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	31
128	Synchronization frame error exceeding 1/4 of the synchronization cycle	E.D11.0	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	31
129	CAN information loss of the power supply unit	E.D12.0	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	32
130	Bus disconnected	E.E01.0	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	32
131	Bus off	E.E02.0	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	32
132	Bus connection timeout	E.E03.0	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	32
133	Internal communication timeout of expansion card	E.E04.0	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	33
134	Station No. conflict	E.E05.0	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	33
135 m	Station No. setting error	E.E06.0	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	33
136	Communication state machine error	E.E07.6	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	33
137	Synchronization loss	E.E08.0	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	34
138	System parameter error	E.E09.0	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	34
139	Configuration error	E.E0A.0	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	34

No.	Fault name	Fault display	Fault level	Default stop mode	Position in group 0E
140	ESI configuration file not programmed	E.E11.6	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	34
141	ECAT initialization failure	E.E12.0	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	35
142	ECAT synchronization cycle not being a multiple of the PWM cycle	E.E13.0	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	35
143	Excessive deviation of the ECAT synchronization signal	E.E15.0	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	35
144	Master and slave synchronous reception failed	E.E20.1	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	35
145	Master and slave synchronous transmission failed	E.E20.2	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	36
146	Excessive synchronous transmission delay of master and slave	E.E20.3	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	36
147	Excessive position deviation during master and slave synchronization	E.E20.4	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	36
148	Excessive torque deviation during master and slave synchronization	E.E20.5	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	36
149	Master and slave axes faulty	E.E20.6	Level 1 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	37
150	False home	E.E20.7	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	37
151	Injection axis limit alarm	E.B09.0	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	37
152	Process parameter setting error	E.B10.0	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	37
153	Paralleled screw fault in torque synchronous mode	E.E21.0	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	38
154	STO signal input protection - Used when 03-37 = 2	E.300.1	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	38

No.	Fault name	Fault display	Fault level	Default stop mode	Position in group 0E
155	Brake error	E.310.0	Level 2 resettable fault	2: External dynamic braking stop, keeping dynamic braking status	38
156	ESI check failure, namely XML_FLASH check failure	E.E11.0	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	38
157	XML EEPROM read-write failure	E.E11.1	Level 2 resettable fault	0: Coast to stop	39
158	Pressure sensor disconnected (voltage too low)	E.046.1	Level 2 resettable fault	0: Coast to stop	39
159	Braking unit DI loss	E.311.1	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	39
160	Synchronous quick stop of master and slave	E.E25.0	Level 2 resettable fault	A: Stop based on smooth deceleration and torque reduction, keeping the lock status	39
161	Forward overtravel	E.010.0	Level 2 resettable fault	0: Coast to stop	40
162	Reverse overtravel	E.010.1	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	40
163	Positive/Negative limit setting error	E.010.2	Level 2 resettable fault	4: Internal dynamic braking stop, keeping dynamic braking status	40

The above faults can be set to different stop modes according to parameters in group 0E. One parameter can be used to set four stop modes. All stop modes available are as follows.

0: Coast to stop

1: External dynamic braking stop, keeping the de-energized status

2: External dynamic braking stop, keeping the dynamic braking status

3: Internal dynamic braking stop, keeping the de-energized status

4: Internal dynamic braking stop, keeping the dynamic braking status

5: Stop at zero speed, keeping the de-energized status

6: Stop at zero speed, keeping the lock status

7: Ramp to stop, keeping the de-energized status

8: Ramp to stop, keeping the de-energized status

9: Stop based on smooth deceleration and torque reduction, keeping the de-energized status

A: Stop based on smooth deceleration and torque reduction, keeping the lock status

7.2.2 List of Alarm Codes

Alarm code	Name	Alarm code	Name
A.120.3	Rated current of motor higher than that of the drive	A.A40.5	Parameter auto-tuning failure (Q-axis current steady state error check function)
A.110.0	Frequency-division pulse output setting error	A.A40.6	Parameter auto-tuning failure (Q-axis current steady state error check function)
A.601.0	Homing timeout	A.765.1	Nikon encoder EEPROM busy
A.831.0	AI zero offset too large	A.980.0	Encoder algorithm error
A.900.0	Emergency stop alarm	A.E20.0	Synchronous parameter inconsistent
A.941.0	Parameter modification requiring power-on again	A.B10.1	Process mode not matching control word
A.950.0	Forward overtravel	A.611.0	Drive overload
A.952.0	Reverse overtravel	A.621.0	Motor overload alarm 1
A.A40.0	Parameter auto-tuning failure	A.622.0	Motor overload alarm 2
A.A40.1	Parameter auto-tuning failure (H0806 = 2)	A.631.0	Motor stall overtemperature protection
A.A40.2	Parameter auto-tuning failure (sampling error)	A.E22.8	Double screw leveling not done
A.A40.3	Parameter auto-tuning failure (rising time check error)	A.301.1	STO signal input protection (used when 03-37 = 3)
A.A40.4	Parameter auto-tuning failure (overshoot check error)	-	-

7.3 SDO Transfer Abort Code

Abort Code	Description	Abort Code	Description
0503 0000	Trigger bits not alternated	0607 0012	Incorrect data type: service parameter too long
0504 0000	SDO protocol timed out.	0607 0013	Incorrect data type: service parameter too short
0504 0001	Illegal or unknown client/ server command word	0609 0011	Sub-index does not exist.
0504 0005	Memory overflow	0609 0030	Invalid parameter value
0601 0000	Inaccessible object	0609 0031	Written parameter value too large
0601 0001	Attempt to read a write-only object	0609 0032	Written parameter value too small

Abort Code	Description	Abort Code	Description
0601 0002	Attempt to write a read-only object	0609 0036	Maximum value is less than minimum value.
0602 0000	Object unavailable in the OD	0800 0000	General error
0604 0041	Object cannot be mapped to PDO	0800 0020	Data unable to be transmitted or saved to the application
0604 0042	Number and length of the objects to be mapped exceeding PDO length	0800 0021	Data unable to be transmitted or saved to the application because of local control
0604 0043	General parameter incompatibility	0800 0022	Data unable to be transmitted or saved to the application because of the device state
0604 0047	General internal incompatibility	0800 0023	OD error or OD unavailable
0606 0000	Failure to access objects because of hardware errors	0800 0024	The value does not exist.
0607 0010	Incorrect data type: incorrect service parameter length		

7.4 Solutions To Faults

■ E.044.x : Excessive speed deviation

Cause:

The speed feedback deviates too much from the speed reference.

Fault code	Cause	Check method	Solution
E.044.0	1. The load is too heavy.	Check whether the current output reaches the limit.	Increase the torque limit, or change a servo drive with proper specifications if the limit is reached.
E.044.1	2. The torque is limited.	Check whether the torque is limited to a value below 1.2 x rated torque.	Increase the torque limit.

■ E.046.x: Pressure sensor disconnected

Cause:

The drive output current is greater than a certain threshold; however, the pressure sensor feedback cannot be detected.

Fault code	Cause	Check method	Solution
E.046.0	1. The pressure sensor is wired incorrectly.	Check whether the pressure sensor is wired correctly.	Wire cables correctly.
	2. AI3 sampling errors occur.	Use the multimeter to detect the feedback voltage of the pressure sensor and compare it with the sampling value of H0B-23.	Replace the servo drive.

■ E.101.x: Internal parameter error

Cause:

The total number of parameters changes, which generally occurs after software update.

Values of parameters in group 2002 and higher exceed the limit, which generally occurs after software update.

Fault code	Cause	Check method	Solution
E.101.0	1. The voltage of the control circuit power supply drops instantaneously.	Measure whether the input voltage of the control circuit cable on the non-drive side is within the following range: Bus voltage: 537 V to 679 V	2. Enlarge the power capacity or replace with a power supply of higher capacity, restore default settings (2002-20h = 1) and write parameters again.
	2. Instantaneous power failure occurs when saving parameters.	Check whether instantaneous power failure occurs when saving parameters.	Keep the MODE key pressed down for 3s to trigger automatic reset. Restore system parameters to default values by setting 2002-20h to 1 and re-write parameters.
	3. The software is updated.	Check whether the software is updated.	Reset the servo drive model and servo motor model, and restore system parameters to default settings (2002-20h = 1).
	4. The servo drive is faulty.	If the fault persists though parameters are restored to default settings and the servo drive is powered off and on repeatedly, the servo drive is faulty.	Replace the servo drive.

Fault code	Cause	Check method	Solution
E.101.1	The number of write operations within a certain period of time exceeds the limit.	Check whether parameters are updated frequently through the host controller.	Change the parameter writing method and write parameters again. If the servo drive is faulty, replace it.

■ E.102.x: Programmable logic configuration fault

Cause:

The multi-core logical configuration is faulty, the shared RAM verification is faulty, or the software version of each core does not match.

Fault code	Cause	Check method	Solution
E.102.0	1. The core software versions of the FPGA and CPUs do not match.	View the FPGA software version (2001-03h), CPU0 software version (2001-04h) and CPU1 software version (2001-05h) through the operating panel or Inovance software tool. Check whether the non-zero values of the most significant bit of these software version numbers are consistent.	Contact Inovance for technical support. Update it to the matching FPGA or CPU software.
	2. The FPGA is faulty.	The fault persists after the servo drive is powered off and on repeatedly.	Replace the servo drive.
E.102.1	Model code identification failed	The fault persists after the servo drive is powered off and on repeatedly.	Replace the servo drive.

■ E.103.x: FPGA software version too early

Cause:

The FPGA version (2001-02h) is earlier than 0112.0, and the MCU software version (2001-01h) is 0101.7 or later.

Fault code	Cause	Check method	Solution
E.103.0	1. The FPGA version in 2001-02h is earlier than 0112.0.	View the MCU software version (2001-01h) and the FPGA software version (2001-02h) through the operating panel or Inovance software tool.	Update the MCU and FPGA software to make them match.
	2. The FPGA is faulty.	The fault persists after the servo drive is powered off and on repeatedly.	Replace the servo drive.

■ E.104.x: Programmable logic interruption

The servo drive displays different internal fault codes under the same external fault code. To distinguish fault causes, you can view these internal fault codes in 200B-2Eh.

Cause:

CPU or FPGA interruption timeout/Current loop interruption timeout

Fault code	Cause	Check method	Solution
E.104.0	1. The FPGA is faulty.	The fault persists after the servo drive is powered off and on repeatedly.	Replace the servo drive.
	2. The communication handshaking between FPGA and MCU is abnormal.		
E.104.1	Current loop or software interruption timeout		

■ E.105.x: Internal program error

Cause:

The total number of parameters is incorrect when reading/writing parameters in EEPROM.

The value range of parameters is abnormal, which generally occurs after software update.

Fault code	Cause	Check method	Solution
E.105.0	1.EEPROM is fault.	Check the causes according to the check method for E.101.0.	Restore system parameters to default values by setting 2002-20h to 1, and keep the MODE key pressed down for 3s to trigger automatic reset.
	2. The servo drive is faulty.	The fault persists after the servo drive is powered off and on repeatedly.	Replace the servo drive.

■ E.108.x: Parameter storage fault

Cause:

Parameter values cannot be written to the EEPROM.

Parameter values cannot be read from the EEPROM.

Fault code	Cause	Check method	Solution
E.108.0	1. An error occurs during writing parameters.	Modify a certain parameter, power off and on the servo drive again and check whether the modification is saved.	If the modification is not saved and the fault persists after the servo drive is powered off and on repeatedly, replace the servo drive.
E.108.1	2. An error occurs during reading parameters.		

■ E.120.x: Product mismatch

Cause:

The motor model and the servo drive model do not match or parameter settings are incorrect.

Fault code	Cause	Check method	Solution
E.120.0	Product models mismatch and no corresponding encoder	See "1.1 Servo Drive" to check whether the drive model exists.	If the servo drive model does not exist, set the servo drive model correctly according to the nameplate described in "1.1 Servo Drive".
E.120.1	Product models mismatch and no corresponding motor	View the motor nameplate to check whether the motor is suitable. Check whether 2000-01h is set correctly.	Reset 2000-01h (Motor code) according to the motor nameplate or use a suitable motor.
E.120.2	Serial motor code error		
A.120.3	The power rating of the motor does not match that of the servo drive.		

■ E.121.x: Invalid S-ON command

Cause:

A redundant S-ON signal is sent when some auxiliary functions are used.

Fault code	Cause	Check method	Solution
E.121.0	1. The S-ON signal is activated through communication when the servo drive is already enabled internally.	Check whether an S-ON signal is sent from the host controller when auxiliary functions (200D-03h, 200D-04h, 200D-0Ch) are used.	Switch off the S-ON signal sent from the host controller.

■ E.130.x: Different DIs assigned with the same function

Cause:

The same function is assigned to different DIs, including hardware DI and virtual DI.

The DI function No. exceeds the number of DI functions.

The DI function is not supported.

Fault code	Cause	Check method	Solution
E.130.0	1. Multiple DIs are assigned with the same function.	Check whether 2003-03h, 2003-05h, and 2003-07h… 2003-31h are assigned with the same non-zero DI function No.	Assign different DI function No. to the parameters assigned with the same non-zero DI function No., and then restart the control circuit to activate the assignment, or switch off the S-ON signal and send a "RESET" signal to activate the assignment.
	2. The DI function No. exceeds the maximum number allowed for DI functions	Check whether the MCU program is updated.	Restore system parameters to default values by setting 2002-20h to 1, and keep the MODE key pressed down for 3s to trigger automatic reset.
	3. The DI function is not supported.	View "4.7 DI and DO Function Setting" to determine whether the DI function set by parameters in groups 2003h and 2017h is supported.	Do not set a DI function No. that is not listed in the DI/DO function definition table.

■ E.131.x: DO function No. exceeding the number of DO functions

Cause:

The DO function No. exceeds the maximum number allowed for DO functions.

Fault code	Cause	Check method	Solution
E.131.0	1. The DO function No. exceeds the number of DO functions.	Check whether the MCU program is updated.	Restore system parameters to default values by setting 2002-20h to 1, and keep the MODE key pressed down for 3s to trigger automatic reset.

■ E.136.x: Data check error or no parameter saved in the motor ROM

Cause:

When reading parameters from the encoder ROM, the servo drive detects that no parameters are saved or parameter values is inconsistent with the setpoint.

Fault code	Cause	Check method	Solution
E.136.0 E.136.1	1. The motor model does not match the servo drive model.	View the servo drive and servo motor nameplates to check that the equipment used is Inovance ES810 series servo drive and servo motor.	Replace with the mutually-matching servo drive and servo motor.
	2. A parameter check error occurs or no parameter is saved in the ROM of the serial incremental encoder.	Check whether the encoder cable provided by Inovance is used. The cable must be connected securely without scratching, breaking or poor contact on both ends. Measure signals PS+, PS-, +5V and GND on both ends of the encoder cable and observe whether signals at both ends are consistent. For signal assignment, see the user guide.	Use the encoder cable provided by Inovance. Ensure motor terminals and servo drive screws are connected securely. Use a new encoder cable if necessary. Route encoder cables and power cables (U/V/W) through different routes.
	3. The encoder cables are wired improperly or loosened.	Check the encoder cable connection. Check whether vibration on site is too strong, which loosens the encoder cable and even damages the encoder.	Connect the encoder cables according to the correct wiring diagram. Re-connect encoder cables and ensure encoder terminals are connected securely.
	4. The servo drive is faulty.	Keep the MODE key pressed down for 3s to reset the fault. However, the fault persists.	Replace the servo drive.

■ E.201.x: Hardware overcurrent

Cause:

Hardware overcurrent is detected.

Fault code	Cause	Check method	Solution
E.201.1 E.201.2 E.201.3	1. References are input simultaneously at the servo drive startup or the reference input is too early.	Check whether a command is input before the operating panel displays "ry".	After the operating panel displays "ry", switch on the S-ON signal, and then input a command. Incorporate the reference filter time constant or increase the acceleration/ deceleration time if allowed.
	3. Motor cables are in poor contact.	Check whether the servo drive power cables and motor cables connected to the U, V, and W terminals of the servo drive become loose.	Tighten the cables that are loose or disconnected.
	4. Motor cables are grounded.	After ensuring the servo drive power cables and motor cables are connected securely, measure whether the insulation resistance between the U, V, and W terminals of the servo drive and the ground cable (PE) is MΩ-level.	Replace the motor in case of poor insulation.
	5. The motor UVW cables are short-circuited.	Disconnect the motor cables and check whether short circuit occurs among U, V, and W cables and whether burrs exist on the cable connections.	Connect the motor cables correctly.

Fault code	Cause	Check method	Solution
E.201.1 E.201.2 E.201.3 (continued)	6. The motor is damaged.	Disconnect the motor cables and measure whether the resistance among U, V, and W cables are balanced.	Replace the motor if the resistance is unbalanced.
	7. Gains are set improperly and the motor oscillates.	Check whether vibration or sharp noise occurs during start and operation of the motor, or view "Current feedback" in the software tool.	Adjust the gains.
	8. The encoder cable is aged or corroded, or connected incorrectly or loosely.	Check whether the encoder cable provided by Inovance is used and whether the cable is aging, corroded, or connected loosely. Switch off the S-ON signal, rotate the motor shaft manually, and check whether the value of 200B-12h changes as the motor shaft rotates.	Re-solder, tighten or replace the encoder cable.
	9. The servo drive is faulty.	Disconnect the motor cable, and keep the MODE key pressed down for 3s to reset the fault. However, the fault persists.	Replace the servo drive.

■ E.207.x: Axis D/Q current overflow

Cause:

Abnormal current feedback leads to overflow of the internal register.

Abnormal encoder feedback leads to an internal register fault.

Fault code	Cause	Check method	Solution
E.207.0	1. Axis D/Q current overflow occurs.	If the fault persists after the servo drive is powered off and on several times, the servo drive is faulty.	Replace the servo drive.

■ E.208.x: FPGA system sampling operation timeout

Fault code	Cause	Check method	Solution
E.208.0	FPGA operation timeout	See the following descriptions.	See the following descriptions.

Fault code	Cause	Check method	Solution
E.208.1	MCU failed to update torque reference timely	The fault persists after the servo drive is powered off and on repeatedly.	Replace the servo drive.
E.208.2	Encoder communication timeout	The encoder cable is connected improperly. The encoder cable is connected loosely. The encoder cable is too long. The encoder communication is being disturbed. The encoder is faulty.	Standard encoder cables are recommended. If non-standard encoder cables are used, check whether the cables meet the specifications and whether they are shielded twisted pairs (STPs). Check whether the connectors at both ends of the encoder are in good contact and whether any pin retracts. Contact the manufacturer. Lay the high-voltage cables and low-voltage cables separately. Do not bundle the motor cables and the encoder cables together. Ensure the servo motor and servo drive are well grounded. Replace the servo motor.
E.208.3	Current sampling timeout	Check whether ambient devices are generating disturbance and whether multiple disturbance sources such as variable-frequency devices are present inside the cabinet. The internal current sampling integrated circuit is damaged.	Lay the high-voltage cables and low-voltage cables separately. Replace the servo drive.
E.208.4	High-accuracy AD conversion timeout	Interference exists in high-accuracy AI channel. Check the AI wiring according to wiring diagram.	Use the twisted shielded pair cables and shorten the circuit length.

■ E.210.x: Output short-circuited to ground

Cause:

An abnormal motor phase current or bus voltage is detected during auto-inspection upon power-on.

Fault code	Cause	Check method	Solution
E.210.0 E.210.1	1. The servo drive power cables (UVW) are short-circuited to ground.	Disconnect the motor cables, and measure whether the servo drive power cables (U/V/W) are short-circuited to ground (PE).	Re-connect these cables or replace them.
	2. The motor is short-circuited to ground.	After ensuring the servo drive power cables and motor cables are connected securely, measure whether the insulation resistance between the U, V, and W terminals of the servo drive and the ground cable (PE) is MΩ-level.	Replace the motor.
	3. The servo drive is faulty.	Disconnect the power cables from the servo drive, but the fault persists after the servo drive is powered off and on repeatedly.	Replace the servo drive.

■ E.220.x: Incorrect phase sequence

Cause:

The servo drive detects abnormal motor phase sequences during auto-tuning or operation.

Fault code	Cause	Check method	Solution
E.220.0 E.220.1	1. The servo drive power cables (U/V/W) are short-circuited to ground.	Disconnect the motor cables, and measure whether two of the servo drive power cables (U/V/W) can be conducted.	Re-connect these cables or replace them.
	2. The phase sequence of power cables (U/V/W) is incorrect.	Check whether the wiring sequence of the U, V, W cables on the drive side is the same as that on the motor side.	Change the phase sequence of the motor cable.

■ E.234.x: Runaway

Cause:

The torque reference direction is in reverse to the speed feedback direction in the torque control mode.

The speed feedback direction is in reverse to the speed reference direction in the position or speed control mode.

Fault code	Cause	Check method	Solution
E.234.0	1. The phase sequence of the U, V, and W cables is incorrect.	Check whether the servo drive power cables are in the same phase sequence as the motor U,V, and W cables.	Connect the U, V, and W cables according to correct phase sequence.
	2. The interference signal causes an error in the initial phase detection of the motor rotor upon power-on.	The U/V/W phase sequence is correct, but E.234.0 occurs when the servo drive is enabled.	Keep the MODE key pressed down for 3s to reset the fault.
	3. The encoder model is wrong or the encoder is wired improperly.	View the servo drive and servo motor nameplates to check whether ES810 servo drives and servo motor (-A2***) equipped with a 20-bit encoder are used.	Replace with a mutually-matching servo drive and servo motor. If you use ES810 series servo drive and servo motor, set 2000-01h to 14000. Check the motor model, encoder type, and encoder cable connection again.
	4. The encoder cable is aged or corroded, or connected incorrectly or loosely.	Check whether the encoder cable provided by Inovance is used and whether the cable is aging, corroded, or connected loosely. Switch off the S-ON signal, rotate the motor shaft manually, and check whether the value of 200B-12h changes as the motor shaft rotates.	Re-solder, tighten or replace the encoder cable.

■ E.400.x: Main circuit overvoltage

Cause:

The DC bus voltage between + and - exceeds the overvoltage level.

Normal value: 537 V; Overvoltage threshold: 820 V

Fault code	Cause	Check method	Solution
E.400.0	1. The voltage input to the main circuit is too high.	Check the input power supply specifications of the servo drive and measure whether the input voltage on the main circuit side (U/V/W) is within the following range: DC bus voltage: 537 VDC to 679 VDC	Replace or adjust the power supply according to the specified range.
	2. The power supply is unstable or affected by lightning.	Check whether the power supply is unstable, affected by lightning, or complies with the preceding range.	Connect a surge protection device (SPD) and switch on the power supplies of the control circuit and the main circuit. If the fault persists, replace the servo drive.
	3. The motor is in abrupt acceleration/deceleration status and the maximum braking energy exceeds the energy absorption value.	Confirm the acceleration/deceleration time during operation and measure the DC bus voltage between + and - to check whether overvoltage occurs during deceleration.	After confirming the input voltage of the main circuit is within the specified range, increase the acceleration/deceleration time if the operating conditions allow.
	4. The bus voltage sampling value deviates greatly from the measured value.	Check whether the bus voltage (200B-1Bh) detected is within the following range: 200B-1Bh > 820 V Check whether the DC bus voltage between + and - is within the normal range and is smaller than the value of 200B-1Bh.	Contact Inovance for technical support.
	5. The servo drive is faulty.	The fault persists after the main circuit is powered off and on repeatedly.	Replace the servo drive.

■ E.410.x: Main circuit undervoltage

Cause:

The DC bus voltage between + and - is below the undervoltage threshold.

Normal value: 537 V; Undervoltage threshold: 350 V

Fault code	Cause	Check method	Solution
E.410.0	1. The power supply of the main circuit is unstable or power failure occurs.	Check the specifications of the input power supply. Measure whether the input voltages of the main circuit on the non-drive side and the drive side (U/V/W) are within the following range: DC bus voltage: 537 VDC to 679 VDC	Increase the capacity of the power supply.
	2. Instantaneous power failure occurs.		
	3. The power supply voltage drops during operation.	Monitor the power supply voltage and check whether the main circuit power supply is applied to other devices, resulting in insufficient power capacity and voltage drop.	
	4. The servo drive is faulty.	Check whether the bus voltage (200B-1Bh) detected is within the following range: 200B-1Bh < 350 V. The fault persists after the main circuit is powered off and on several times.	Replace the servo drive.

■ E.422.x: Power supply unit fault

Cause:

The power supply unit is faulty.

Fault code	Cause	Check method	Solution
E.422.0	The power supply unit is faulty.	Check the fault code of the power supply unit.	Check the power supply unit user guide for troubleshooting.

■ E.423.x: Power failure of the power supply unit

Cause:

The power supply of the power supply unit fails.

Fault code	Cause	Check method	Solution
E.423.0	Input voltage fault	Check the bus voltage of the drive unit and the fault code of the power supply unit.	Check the power supply unit user guide for troubleshooting.

■ E.500.x: Overspeed

Cause:

The actual speed of the motor exceeds the overspeed threshold.

Fault code	Cause	Check method	Solution
E.500.0 E.500.1	1. UVW phase sequence is incorrect.	Check whether the servo drive power cables are in the same phase sequence as motor U,V, and W cables.	Connect the U, V, and W cables according to correct phase sequence.
	2. The setting of 200A-09h is incorrect.	Check whether the overspeed threshold is lower than the maximum speed. Overspeed threshold = 1.2 x Maximum motor speed (200A-09h = 0) Overspeed threshold = 200A-09h (200A-09h ≠ 0, and 200A-09h < 1.2 x Maximum motor speed)	Reset the overspeed threshold according to the mechanical requirements.
	3. The input reference exceeds the overspeed threshold.	Check whether the motor speed corresponding to the input reference exceeds the overspeed threshold. Position control mode: In CSP mode, check the gear ratio 6091-01h/6091-02h to determine the position reference increment for an individual synchronization cycle and convert it to the speed information. In PP mode, check the gear ratio 6091-01h/6091-02h and determine the value of 6081h (Profile velocity). In HM mode, check the gear ratio 6091-01h/6091-02h and determine the value of 6099-01h and 6099-02h. Speed control mode: View the gear ratio 6091h, and the values of 60FFh (Target velocity), 2006-07h to 2006-0Ah, and 607Fh. Torque control mode: View the speed limit defined by 2007-12h and check the corresponding speed limit.	Position control mode: CSP: Decrease the position reference increment per synchronization cycle. The host controller should cover the position ramp when generating references. PP: Decrease the value of 6081h, or increase the acceleration/deceleration ramp (6083h, 6084h). HM: Decrease 6099-01h and 6099-02h or increase the acceleration/deceleration ramp (609Ah). Decrease the gear ratio according to actual conditions. Speed mode: Decrease the target velocity, speed limit value, and gear ratio. In PV mode, increase the speed ramp in 6083h and 6084h. In CSV mode, the host controller needs to perform speed ramp additionally. Torque control mode: Set the speed limit to a value lower than the overspeed threshold.
	4. The motor speed overshoots.	Check whether the speed feedback exceeds the overspeed threshold by using Inovance servo commissioning software.	Adjust the gain or mechanical running conditions.
	5. The servo drive is faulty.	Keep the MODE key pressed down for 3s to reset the fault. However, the fault persists.	Replace the servo drive.

■ Er.510: Pulse output overspeed

Cause:

The output pulse frequency exceeds the frequency upper limit allowed by the hardware (1 MHz) when pulse output is used (2005-27h = 0 or 1).

Fault code	Cause	Check method	Solution
E.510.0	The output pulse frequency exceeds the frequency upper limit allowed by the hardware (1 MHz).	When 2005-27h is set to 0 (Encoder frequency-division output), check whether the output pulse frequency corresponding to the motor speed exceeds the limit upon fault. Output pulse frequency (Hz) =	Decrease 2005-12h (Encoder frequency division pulses), making the output pulse frequency below the frequency upper limit allowed by hardware within the speed range required by mechanical conditions.
		The input pulse frequency exceeds 1 MHz or interference exists in the pulse input pins when 2005-27h is set to 1 (Reference pulse synchronous output). High-speed pulse input pins: Differential input terminals: HPULSE+, HPULSE-, HSIGN+, HSIGN- Max. pulse frequency: 1 Mpps	Decrease the input pulse frequency to a value within the frequency upper limit allowed by hardware. Note: In this case, if you do not modify the electronic gear ratio, the motor speed will decrease. If the input pulse frequency is high but is still within the frequency upper limit allowed by the hardware, take anti-interference measures (use STP cable for pulse input and set pin filter parameter 200A-19h or 200A-1F). This is to prevent false alarms caused by interference pulses superimposed to actual pulse references.

■ E.610.x: Servo drive overload

Cause:

The servo drive temperature reaches the fault threshold.

Fault code	Cause	Check method	Solution
E.610.0	1. The motor and encoder cables are connected incorrectly or in poor contact.	Check the wiring among the motor, drive, and encoder according to "3.9 Overall Wiring Diagram".	Connect the cables according to the wiring diagram. It is recommended to use the cables provided by Inovance. When customized cables are used, prepare and connect the customized cables according to the wiring instructions.
	2. The load is so heavy that the effective torque outputted by the motor keeps exceeding the rated torque.	Confirm the overload characteristics of the servo drive or motor. Check whether the average load rate of the drive (200B-0DH) keeps exceeding 100.0%.	Replace with a servo drive of higher capacity and a matching servo motor. Reduce the load and increase the acceleration/deceleration time.
	3. Acceleration/ deceleration is too frequent or the load inertia is too large.	Calculate the mechanical inertia ratio or perform inertia auto-tuning. Check the value of 2008-10h. Confirm the individual operation cycle when the servo motor operates cyclically.	Increase the acceleration/ deceleration time during single-cycle running.
	4. The gain adjustment is improper or the stiffness is too high.	Check whether the motor vibrates and generates unusual noise during operation.	Readjust the gain.
	5. The model of the servo drive or motor is set improperly.	View the serial-type motor model in 2000-06h and the drive model in 2001-0Bh.	View the servo drive nameplate. Set the servo drive model (2001-0Bh) and the motor model correctly to make them match with each other.
	6. The motor is stalled due to mechanical factors, resulting in overload during operation.	Check the reference and motor speed (200B-01h) through the software tool or operating panel. References in the position control mode: 200B-0Eh (Input position reference counter) References in the speed control mode: 200B-02h (Speed reference) References in the torque control mode: 200B-03h (Internal torque reference) Check whether the reference value is not 0 but the motor speed is 0 rpm in the corresponding mode.	Rectify the mechanical-related problem.
	7. The servo drive is faulty.	After power-off, keep the MODE key pressed down for 3s to reset the fault. However, the fault persists.	Replace the servo drive.

■ E.620.x: Motor overload

Cause:

The accumulative heat of the motor reaches the fault threshold.

Fault code	Cause	Check method	Solution
E.620.0 E.620.1	1. The motor and encoder cables are connected incorrectly or in poor contact.	Check the wiring among the servo drive, motor and encoder according to the correct wiring diagram.	Connect the cables according to the wiring diagram. It is recommended to use the cables provided by Inovance. When customized cables are used, prepare and connect the customized cables according to the wiring instructions.
	2. The load is so heavy that the effective torque outputted by the motor keeps exceeding the rated torque.	Confirm the overload characteristics of the servo drive or motor. Check whether the average load rate of the drive (200B-0DH) keeps exceeding 100.0%.	Replace with a servo drive of higher capacity and a matching servo motor. Reduce the load and increase the acceleration/deceleration time.
	3. Acceleration/ deceleration is too frequent or the load inertia is too large.	Calculate the mechanical inertia ratio or perform inertia auto-tuning. Check the value of 2008-10h. Confirm the individual operation cycle when the servo motor operates cyclically.	Increase the acceleration/ deceleration time during single-cycle running.
	4. The gain adjustment is improper or the stiffness is too high.	Check whether the motor vibrates and generates unusual noise during operation.	Readjust the gain.
	5. The model of the servo drive or motor is set improperly.	View the serial-type motor model in 2000-06h and the drive model in 2001-0Bh.	View the servo drive nameplate. See details in "1.1 Servo Drive". Set the servo drive model (2001-0Bh) and the motor model correctly to make them match with each other.
	6. The motor is stalled due to mechanical factors, resulting in overload during operation.	Check the reference and motor speed (200B-01h) through the software tool or operating panel. References in the position control mode: 200B-0Eh (Input position reference counter) References in the speed control mode: 200B-02h (Speed reference) References in the torque control mode: 200B-03h (Internal torque reference) Check whether the reference value is not 0 but the motor speed is 0 rpm in the corresponding mode.	Rectify the mechanical-related problem.
	7. The servo drive is faulty.	After power-off, keep the MODE key pressed down for 3s to reset the fault. However, the fault persists.	Replace the servo drive.

■ E.630.x: Motor stall overtemperature protection

Cause:

The actual motor speed is lower than 10 rpm but the torque reference reaches the limit. The duration reaches the value set by 200A-21h.

Fault code	Cause	Check method	Solution
E.630.0	1. Power output (UVW) phase loss or incorrect phase sequence occurs in the servo drive.	Perform a no-load trial run on the motor and check the wiring.	Re-connect the cables according to the wiring diagram or replace the cables.
	2. The servo drive UVW cables or encoder cable is disconnected.	Check the wiring.	Re-connect the cables according to the wiring diagram or replace the cables.
	3. The motor is stalled due to mechanical factors.	Check the reference and motor speed (200B-01h) through the software tool or operating panel. References in the position control mode: 200B-0Eh (Input position reference counter) References in the speed control mode: 200B-02h (Speed reference) References in the torque control mode: 200B-03h (Internal torque reference) Check whether the reference value is not 0 but the motor speed is 0 rpm in the corresponding mode.	Rectify the mechanical-related problem.

■ E.650.x: Heatsink overtemperature

Cause:

The temperature of the servo drive power module is higher than the overtemperature threshold.

Fault code	Cause	Check method	Solution
E.650.0	1. The ambient temperature is too high.	Measure the ambient temperature.	Improve the cooling conditions of the servo drive to lower down the ambient temperature.
	2. The servo drive is restarted repeatedly to reset the overload fault.	View the fault log. View the fault log (set 200B-22h and view 200B-23h) to check whether an overload fault/alarm is reported (E.610, E.620, E.630, E.650, E.909).	Change the fault reset method. After overload occurs, wait for 30s and then perform the reset operation. Increase the capacities of the servo drive and servo motor. Increase the acceleration/ deceleration time and reduce the load.
	3. The fan is damaged.	Check whether the fan works properly during operation.	Replace the servo drive.
	4. The servo drive is installed in a wrong direction and the clearance between servo drives is improper.	Check whether the servo drive is installed properly.	Install the servo drive according to the installation requirements.
	5. The servo drive is faulty.	The fault persists even though the servo drive is restarted 10 minutes after power-off.	Replace the servo drive.

■ E.730.x: Encoder battery alarm

Cause:

The voltage of the absolute encoder battery is lower than 3.0 V.

Fault code	Cause	Check method	Solution
E.730.0	1. The absolute encoder battery voltage is lower than 3.0 V.	Measure the battery voltage.	Replace with a new battery that meets the voltage requirements and set H0A-02 to 0.

■ E.731.x: Encoder battery failure

Cause:

The voltage of the absolute encoder battery is lower than 3.0 V.

Fault code	Cause	Check method	Solution
E.731.0	The battery is not connected during power-off.	Check whether the battery is connected during power-off.	Set 200D-15h to 1 to clear the fault.
	The encoder battery voltage is excessively low.	Measure the battery voltage.	Use a new battery with the matching voltage.

■ E.733.x: Encoder multi-turn counting error

Cause:

Encoder multi-turn counting error

Fault code	Cause	Check method	Solution
E.733.0	Encoder fault	Set 200D-15h to 2 to clear the fault, and keep the MODE key pressed down for 3s to reset the fault. However, the fault persists.	Replace the motor.

■ E.740.x: Encoder interference

Cause:

The encoder Z signal suffers from interference, resulting in dramatic change of corresponding electrical angle of Z signal.

Fault code	Cause	Check method	Solution
E.740.0 E.740.1 E.740.2 E.740.3 E.740.4 E.740.5 E.740.6 E.740.7 E.740.8	1. The encoder is wired improperly.	Check the wiring of the encoder.	Connect the encoder cables according to the correct wiring diagram.
	2. The encoder cable is connected loosely.	Check whether vibration on site is too strong, which loosens the encoder cable and even damages the encoder.	Re-connect encoder cables and ensure encoder terminals are connected securely.
	3. The encoder Z signal is being disturbed.	Check the field cable layout: Check whether there is large equipment generating interference and whether there are multiple interference sources such as variable-frequency power devices inside the cabinet. Make the servo drive stay in "Rdy" status and rotate the motor shaft counterclockwise (CCW) manually and observer whether 200B-12h (Electrical angle) increases/ decreases smoothly. For Z series motors, turning one circle corresponds to five 0-360°. For X series motors, turning one circle corresponds to four 0-360°. If 200B-12h changes abnormally during motor rotating, the encoder is faulty. If no alarm is reported during motor shaft rotating but an alarm is reported during servo drive running, interference may exist.	It is recommended to use the cables provided by Inovance. If non-standard cables are used, check whether the cables meet the specifications and whether the cables are STPs. Lay the high-voltage cables and low-voltage cables separately. Do not bundle the motor cables and the encoder cables together. Ensure the servo motor and servo drive are well grounded. Check whether the connectors at both ends of the encoder are in good contact and whether any pin retracts.
	4. The encoder is faulty.	Replace with a new encoder cable. If the fault no longer occurs after cable replacement, the original encoder cable is damaged. Keep the motor in a fixed position, power on and off the motor repeatedly and observe the change of 200B-12h (Electrical angle). The electrical angle deviation must be within ±30°.	Replace with new encoder cables. If the fault persists after encoder cables are replaced, the encoder may be faulty. In this case, replace the servo motor.

■ E.834.x: AD sampling overvoltage

Cause:

The AI sampling value is larger than 11.5 V.

Fault code	Cause	Check method	Solution
E.834.1 E.834.2 E.834.3	1. The AI voltage is too high.	Measure the voltage input from AI and check whether the sampling voltage (H0B-21, H0B-22 or H0B-23) is higher than 11.5 V.	Adjust AI input voltage and observe the sampling voltage until the sampling voltage falls below 11.5 V.
	2. The AI wiring is incorrect or interference exists.	Check the AI wiring according to the wiring diagram.	Use shielded twisted pairs and shorten the circuit length. Increase the AI filter time constant. AI1 filter time constant: H03-51 AI2 filter time constant: H03-56 AI3 filter time constant: H03-61

■ E.836.x: AD zero drift error

Cause:

The drive is not connected to 380 V power supply, and AI zero drift correction is only carried out under 24 V power supply.

Fault code	Cause	Check method	Solution
E.836.0	The drive is not connected to 380 V power supply, and AI zero drift correction is only carried out under 24 V power supply.	Check whether the drive is connected to 380 V power supply.	After the drive is connected to 380 V power supply, perform AI zero drift correction.

■ E.901.x: Excessive encoder position deviation

Cause:

When H00-39 is not zero and the position detection upon power-on is enabled, the difference between the position upon power-on and that upon power-off is greater than the angle set by H00-39.

Fault code	Cause	Check method	Solution
E.901.0	1. Upon power-off, the motor encoder rotates during mechanical adjustment.	Power on again, and check the position deviation upon power-on and power-off.	Set H09-41 (dedicated for E.901.0) to 1 to reset the fault.
			Set H00-39 according to actual conditions. 1. Set H00-39 to 0 to hide E.901.0. 2. Increase H00-39 to increase the allowable deviation.
	3. The power-off memory is not enabled.	Check whether H0A-03 is set to 1.	Set H0A-03 to 1.
	3. The encoder is damaged.	Repeat the preceding confirmation operations.	Replace the motor or encoder.

■ E.939.x: Motor power cable disconnected

Cause:

The actual phase current of the motor is smaller than 10% of the rated current and the actual motor speed is low but the internal torque reference is high.

Fault code	Cause	Check method	Solution
E.939.0	Motor power cables disconnected	Check whether the difference between 200B-19h (Phase current effective value) and 200B-03h (Internal torque reference) is above 500% and whether 200B-01h (Actual motor speed) is lower than 25% of the rated speed of the motor.	Re-connect the motor power cables or replace with new cables if necessary.

■ E.940.x: Three-phase output current of the drive unbalanced

Cause:

The drive output is short-circuited to ground or current sampling fault occurs.

Fault code	Cause	Check method	Solution
E.940.0	1. The drive output is short-circuited to ground or inter-phase short circuit occurs.	Check the on-site cable layout.	Wire cables correctly.
	2. The drive current sampling fault occurs.	Collect drive output three-phase current waveform.	Replace the servo drive.

■ E.942.x: Frequent parameter storage

Cause:

The number of modified parameters at a time exceeds 200.

Fault code	Cause	Check method	Solution
E.942.0	A great number of parameters are modified and stored frequently to EEPROM (200C-0Eh = 1)	Check whether parameters are modified through the host controller at a brief interval.	Check the operation mode. For parameters that need not be stored in EEPROM, set 200C-0Eh to 0 before the host controller performs the writing operation.

■ E.A33.x: Encoder data error

Cause:

Internal parameters of the encoder are abnormal.

Fault code	Cause	Check method	Solution
E.A33.0	1. The serial incremental encoder cable is disconnected or loose.	Check the wiring.	Check whether the encoder cables are connected incorrectly, disconnected, or in poor contact. If the motor cables and encoder cables are bundled together, separate them.
	2. An error occurs when reading/writing the serial incremental encoder parameters.	If the fault persists after the servo drive is powered off and on repeatedly, the encoder is faulty.	Replace the servo motor.

■ Er.A34: Encoder echo check error

Cause:

After power-on, an error occurs when reading the rotor's initial phase information of the 2500-PPR incremental encoder.

Fault code	Cause	Check method	Solution
E.A34.0	1. The motor model does not match the servo drive model.	According to the drive and motor nameplate, check whether the correct drive and motor are used and whether 2000-01h (Motor code) is set to 14000.	Replace with a mutually-matching servo drive and servo motor.
	2. The encoder cable is disconnected.	Check whether encoder cable breaks and whether the cable ends are connected firmly to the servo motor and servo drive.	Replace with a new encoder cable and secure connections.

■ Er.A35: Encoder Z signal lost

Cause:

The Z signal of the 2500-PPR incremental encoder gets lost or AB signal edges change simultaneously.

Fault code	Cause	Check method	Solution
E.A35.0	1. The Z signal gets lost due to encoder fault.	Use a new encoder cable and connect cables correctly. Then rotate motor shaft manually and check whether the fault persists.	Replace the servo motor.
	2. Poor contact or incorrect connection results in Z signal loss.	Rotate motor shaft manually and check whether the fault persists.	Check whether encoder cable is in good contact. Reconnect cables or replace the encoder cable.

■ E.B00.x: Excessive position deviation

Cause:

The position deviation is higher than the value of 6065h in the position control mode.

Fault code	Cause	Check method	Solution
E.B00.6	1. Power output (UVW) phase loss or incorrect phase sequence occurs in the servo drive.	Perform a no-load trial run on the motor and check the wiring.	Re-connect the cables according to the wiring diagram or replace the cables.
	2. The servo drive UVW cables or encoder cable is disconnected.	Check the wiring.	Connect the cables again. The drive power cables must be connected in the correct order at both ends. If necessary, replace all cables and ensure a reliable connection.
	3. The motor is stalled due to mechanical factors.	Check the reference and motor speed (200B-01h) through the software tool or operating panel. References in the position control mode: 200B-0Eh (Input position reference counter) References in the speed control mode: 200B-02h (Speed reference) References in the torque control mode: 200B-03h (Internal torque reference) Check whether the reference value is not 0 but the motor speed is 0 rpm in the corresponding mode.	Rectify the mechanical-related problem.
	4. The servo drive gain is too low.	Check the position loop gain and speed loop gain of the servo drive. 1st gain set: 2008-01h to 2008-03h 2nd gain set: 2008-04h to 2008-06h	Adjust the gain values manually or perform gain auto-tuning.

Fault code	Cause	Check method	Solution
E.B00.6	5. The position reference increment is too large.	Position control mode: In CSP mode, check the gear ratio 6091-01h/6091-02h to determine the position reference increment per individual synchronization cycle and convert it to the speed information. In PP mode, check the gear ratio 6091-01h/6091-02h and determine the value of 6081h (Profile velocity). In HM mode, check the gear ratio 6091-01h/6091-02h and determine the value of 6099-01h and 6099-02h.	CSP: Decrease the position reference increment per synchronization cycle. The host controller should cover the position ramp when planning references. PP: Decrease the value of 6081h, or increase the acceleration/deceleration ramp (6083h, 6084h). HM: Decrease 6099-01h and 6099-02h or increase the acceleration/deceleration ramp (609Ah). Decrease the gear ratio according to actual conditions.
	6. The value of 6065h (Threshold of excessive position deviation) is too low under current operating conditions.	Check whether the value of 6065h is too low.	Increase the value of 6065h.
	7. The servo drive/motor is faulty.	Monitor the operating waveform using the oscilloscope function of Inovance commissioning software and check whether the operating waveform includes the following information: position reference, position feedback, speed reference, torque reference	If the position reference is not 0 but the position feedback is always 0, replace the servo drive or motor.

■ Er.B01: Position reference too large

Cause:

The position reference for the adjacent synchronization cycle is too large.

Fault code	Cause	Check method	Solution
E.B01.0	1. The position reference increment is too large.	Check the target position reference increment of the adjacent synchronous cycle (namely, motor speed reference).	Reduce the target position reference increment.
	2. The target position is not aligned with the current position before mode switchover or S-ON.	Check whether the operation of mode switchover or S-ON is performed through the host controller software.	Before mode switchover or the S-ON, assign the value of the present position to the target position (607A).
	3. The accumulative position reference is too large due to synchronization signal loss.	Monitor SYNC and IRQ phases through the oscilloscope and check whether there are large fluctuations.	For the host controller AM600, set the synchronous offset to 0. For other host controllers, check the communication state.
	4. The motor speed limit is set improperly.	Check the maximum motor speed and maximum profile speed.	Check whether the maximum speed of the motor meets the requirements and whether the maximum profile speed (607Fh) is set to an excessively low value.

■ E.B02.x: Excessive position deviation in fully closed-loop mode

Cause:

The absolute value of the position deviation in fully closed-loop mode exceeds 200F-09h (Excessive position deviation threshold in fully closed-loop mode).

Fault code	Cause	Check method	Solution
E.B02.0	1. Power output (UVW) phase loss or incorrect phase sequence occurs in the servo drive.	Perform a no-load trial run on the motor and check the wiring.	Re-connect the cables according to the wiring diagram or replace the cables.
	2. The servo drive UVW cables or internal/ external encoder is disconnected.	Check the wiring.	Connect the cables again. The drive power cables must be connected in the correct order at both ends. If necessary, replace all cables and ensure a reliable connection.
	3. The motor is stalled due to mechanical factors.	Check the reference and motor speed (200B-01h) through the software tool or operating panel. References in the position control mode: 200B-0Eh (Input position reference counter) References in the speed control mode: 200B-02h (Speed reference) References in the torque control mode: 200B-03h (Internal torque reference) Check whether the reference value is not 0 but the motor speed is 0 rpm in the corresponding mode.	Rectify the mechanical-related problem.

Fault code	Cause	Check method	Solution
E.B02.0	4. The gain values are too low.	Check the position loop gain and speed loop gain of the servo drive. 1st gain set: 2008-01h to 2008-03h 2nd gain set: 2008-04h to 2008-06h	Adjust the gain values manually or perform gain auto-tuning.
	5. The position reference increment is too large.	Position control mode: In CSP mode, check the gear ratio 6091-01h/6091-02h to determine the position reference increment for an individual synchronization cycle and convert it to the speed information. In PP mode, check the gear ratio 6091-01h/6091-02h and determine the value of 6081h (Profile velocity). In HM mode, check the gear ratio 6091-01h/6091-02h and determine the value of 6099-01h and 6099-02h.	In CSP mode, decrease the position reference increment for an individual synchronization cycle. The host controller should handle the position ramp when generating references. PP: Decrease the value of 6081h, or increase the acceleration/deceleration ramp (6083h, 6084h). HM: Decrease 6099-01h and 6099-02h or increase the acceleration/deceleration ramp (609Ah). Decrease the gear ratio according to actual conditions.
	6. The value of 200F-09h (Threshold of excessive position deviation) is too low under current operating conditions.	Check whether the value of 200F-09h is too low.	Increase the setpoint of 200F-09h.
	7. The servo drive/motor is faulty.	Monitor the operating waveform using the oscilloscope function of Inovance commissioning software and check whether the operating waveform includes the following information: position reference, position feedback, speed reference, torque reference	If the position reference is not 0 but the position feedback is always 0, replace the servo drive or motor.

■ E.B03.x: Electronic gear ratio beyond the limit

Cause:

Any one group of electronic gear ratio exceeds the limit: (0.001 x Encoder resolution/10000, 4000 x Encoder resolution/10000).

Fault code	Cause	Check method	Solution
E.B03.0 E.B03.3	1. The set electronic gear ratio exceeds the preceding range.	The gear ratio 6091-01h/6091-02h exceeds the preceding range.	Set the gear ratio within the required range.
	2. Parameters are modified in a wrong sequence.	The gear ratio is within the range, but the fault is reported during modification of the gear ratio.	Keep the MODE key pressed down for 3s to reset the fault.

■ E.D12.x: CAN information loss of the power supply unit

Cause:

The CAN communication between the power supply unit and the drive unit is interrupted.

Fault code	Cause	Check method	Solution
E.D12.0	The CAN communication cable is damaged.	Check whether the CAN communication cable between the power supply unit and the drive unit is connected.	Replace with a new CAN communication cable.

7.5 Solutions To Alarms

■ A.110.x: Error in setting the frequency division pulse output

Cause:

The set encoder frequency-division pulses does not match the threshold defined by the encoder specification when encoder frequency-division output is used (2005-27h = 0).

Fault code	Cause	Check method	Solution
A.110.0	The number of encoder frequency-division pulses is outside the specified range.	For incremental encoders, the number of frequency-division pulses cannot exceed the encoder resolution. The resolution of a 20-bit serial incremental encoder is 1048576 PPR. The resolution of a 2500-PPR serial incremental encoder is 10000 PPR. For the absolute encoder, the number of frequency-division pulses cannot exceed one fourth of the encoder resolution.	Reset 2005-12h (Encoder frequency-division pulses) according to the specifications.

■ A.730.x fault: Encoder battery alarm

Cause:

The voltage of the absolute encoder battery is lower than 3.0 V.

Fault code	Cause	Check method	Solution
A.730.0	1. The absolute encoder battery voltage is lower than 3.0 V.	Measure the battery voltage.	Replace with a new battery that meets the voltage requirements and set H0A-02 to 0. The low battery voltage leads to encoder position loss. After the battery is replaced, the mechanical position corresponding to the encoder position needs to be re-calibrated.

■ A.900.x fault: DA emergency braking

Cause:

The logic of the DI terminal (including the hardware DI and virtual DI) assigned with DI function 34 (FunIN.34: EmergencyStop) is valid.

Fault code	Cause	Check method	Solution
A.900.0	1. The DI function 34 (EmergencyStop) is triggered.	Check whether the logic of the DI assigned with DI function 34 (FunIN.34: EmergencyStop) is valid.	Check the operation mode and clear the active DI braking signal without affecting the safety performance.

■ A.941.x: Keep the MODE key pressed down for 3s to activate the modified parameter.

Cause:

Modifications of some parameters take effect only after the servo drive is powered on again. After these parameters are modified, the servo drive reminds users to keep the MODE key pressed down for 3s to perform a reset.

Fault code	Cause	Check method	Solution
A.941.0	The parameters modified are those whose "Effective time" is "Next power-on".	Check whether parameters you modified are those activated after the MODE key is pressed down for 3s.	Keep the MODE key pressed down for 3s to reset the fault.

■ A.942.x: Parameter saved frequently

Cause:

The number of modified parameters at a time exceeds 200.

Fault code	Cause	Check method	Solution
A.942.0	A great number of parameters are modified and stored frequently to EEPROM (200C-0Eh = 1)	Check whether parameters are modified through the host controller at a brief interval.	Check the operation mode. For parameters that need not be stored in EEPROM, set 200C-0Eh to 0 before the host controller performs the writing operation.

■ A.950.x: Forward overtravel

Cause:

The logic of the DI assigned with FunIN.14: P-OT (Positive limit switch) is valid.

Fault code	Cause	Check method	Solution
A.950.0	The logic of the DI assigned with FunIN.14: P-OT (Positive limit switch) is valid.	Check whether a certain DI terminal in group 2003h is assigned with DI function 14. Check whether the logic of DI corresponding to the bit of 200C-0Eh (Monitored DI status) is active.	Check the operation mode. On the prerequisite of safety, send a reverse run command or rotate the motor to deactivate the logic of the DI assigned with DI function 14.

■ E.952.x: Reverse overtravel

Cause:

The logic of the DI assigned with FunIN.15: P-OT (Negative limit switch) is valid.

Fault code	Cause	Check method	Solution
A.952.0	The logic of the DI assigned with FunIN.15 (N-OT, negative limit switch) is active	Check whether FunIN.15 is assigned to the DI in group 2003h. Check whether the logic of DI corresponding to the bit of 200C-0Eh (Monitored DI status) is active.	Check the operation mode. On the prerequisite of ensuring safety, send a forward run command or rotate the motor to deactivate the logic of DI assigned with FunIN.15.

■ E.980.x: Encoder internal fault

Cause:

An encoder algorithm error occurs.

Fault code	Cause	Check method	Solution
A.980.0	The encoder is faulty.	If the fault persists after the servo drive is powered off and on several times, the encoder is faulty.	Replace the servo motor.

7.6 Solutions To Communication Faults

This part only describes how to rectify communication faults.

■ E.E08.x fault: Synchronization loss

Cause:

The master's synchronization signal is lost during communication.

Fault code	Cause	Check method	Solution
E.E08.0	1. Synchronous signal loss occurs on the master during synchronous communication.	Check whether the STP is used as the communication cable. Check whether the servo drive is well grounded.	Use the STP. Connect the cable according to the wiring instructions. Set the synchronization cycle, and switch over the EtherCAT state machine to running status. If there is a large error in the master synchronization cycle, adjust the value of 200C-24h.

■ E.E11.x: XML configuration file not programmed

Cause:

The XML configuration file is not programmed.

Fault code	Cause	Check method	Solution
E.E11.6	1. The device configuration file is not programmed.	When the host controller scans the slave, the slave ID is empty.	Program the device configuration file.
	2. The device configuration file is not programmed.	The servo drive is faulty.	Replace the servo drive.

■ E.E12.x: Network initialization failure

Cause:

Network initialization fails.

Fault code	Cause	Check method	Solution
E.E12.0	1. The FPGA firmware is not programmed.	Check whether 2001-02h is 01XX.Y.	Program the FPGA firmware.
	2. The device configuration file is not programmed.	After connecting to the master, view whether the first left LED on the operating panel displays the state of the corresponding network port, and the second left LED displays a number among 1, 2, 4, 8.	Program the device configuration file.
	3. The servo drive is faulty.	The servo drive is faulty.	Replace the servo drive.

■ E.E13.x: Synchronization cycle configuration error

Cause:

After the system switches over to the operation mode, the synchronization cycle is not an integer multiple of 125 us or 250 us.

Fault code	Cause	Check method	Solution
E.E13.0	1. The synchronization cycle is not a integer multiple of 125 us or 250 us.	Check the setting of the synchronization cycle in the controller.	Modify the synchronization cycle to an integer multiple of 125 us or 250 us.

■ E.E15.x: Excessive synchronization cycle error

Cause:

The synchronization cycle error exceeds the threshold.

Fault code	Cause	Check method	Solution
E.E15.0	1. The error of the controller synchronization cycle is too large.	Measure the synchronization cycle of the controller. Through a digital oscilloscope. Measure the synchronization cycle through the oscilloscope function in Inovance software tool.	Increase 200C-2Dh and carry out the test. If this fault persists, set 200C-2Ch to 2.

8 Maintenance and Inspection

8.1 Routine Inspection

Safety instructions

- Never perform wiring with power on. Failure to comply can result in electric shock.
- Before the inspection, cut off all power supplies, and wait for several minutes specified on the drive until the power indicator is off. This is because there is residual voltage in the DC capacitor of the drive upon power-off.
- Do not modify or disconnect cables, remove optional extension card, or replace the cooling fan during drive operation.
- Ensure that the motor grounding terminal is grounded. Failure to comply may result in electric shock when touching the motor housing.
- Only qualified professionals can repair or maintain the product.
- Installation, wiring, commissioning, maintenance, inspection, and parts replacement can only be performed by electricians that familiar with installation, commissioning, and maintenance.

- Do not run the product with the housing removed.
- Drawings in the guide are sometimes shown without covers or protective guards. Remember to install the covers or protective guards as specified first, and then perform operations in accordance with the instructions.
- Tighten all terminal screws based on specified tightening torque to prevent fire caused by heat due to loose connection.
- Ensure that input voltage is within the permissible range to prevent abnormal running of the product.
- Keep the product away from combustible materials and install the product on the incombustible materials.

- Replace the cooling fan in correct ways as specified in this guide. Ensure the correct air outlet direction of the fan. Failure to comply will degrade the cooling performance.
- Do not connect or disconnect the motor when the product is running. Failure to comply will result in electric shock and damage to the product.
- Use shielded cables for control circuit wiring.
- Meanwhile, ground the shield at one end to prevent product malfunction.
- Do not modify the product circuit. Failure to comply will damage the product.
- Connect the output terminals of the product and the wiring terminals of the motor correctly.
- If you need to change the motor rotating direction, exchange the sequence of any two phases among the U, V, and W phases.
- Do not operate the product that has been damaged to prevent further damage to external equipment.

- Routine checklist

The ambient temperature, humidity, dust, and vibration will cause aging of components in the product, which may cause potential faults or shorten the product life. Therefore, it is essential to carry out routine maintenance on the product. The maintenance interval must be shortened in the following cases:

a. High ambient temperature
b. Frequent startup and stop
c. Fluctuation occurred on the AC power supply or the load
d. Excessive vibrations or shock
e. Dusty or corrosive environment with hydrochloric acids

Check the following items daily to ensure that the product functions properly. It is recommended to make a copy of this checklist and sign the "Checked" column after each inspection.

Item	Content	Solution	Checked
Motor	Check whether unusual vibration or noise exists.	● Check whether the mechanical connection is normal. ● Check whether output phase loss occurs on the motor. ● Check whether the motor fixing screws are tight and secure.	
Fan	Check whether the cooling fans of the product and the motor work properly.	● Check whether the cooling fan of the product is running properly. ● Check whether the cooling fan of the motor is running properly. ● Check whether the ventilation duct is blocked. ● Check whether the ambient temperature is within the permissible range.	
Installation environment	Check the cabinet and cable ducts are normal.	● Check whether the insulation of the I/O cables is intact. ● Check for the mounting bracket vibration. ● Check whether copper bars and wiring terminals become loose or get corroded.	
Load	Check whether the operating current of the drive exceeds the rated current of the drive and the motor for a certain period.	● Check whether the motor parameters are set correctly. ● Check whether the motor is overloaded. ● Check whether the mechanical vibration is severe (> 0.6 g).	
Input voltage	Check whether the supply voltage between the main circuit and control circuit is normal.	● Check whether the input voltage is within the allowed range. ● Check whether a heavy load is being started around the drive.	

8.2 Regular Inspection

8.2.1 Regular Checklist

Perform periodic inspection on items that are difficult to check during operation.
Clear the dust especially metal powders on the surface of the drive to prevent the dust from entering the drive.
Clear the greasy dirt from the cooling fan of the drive.

Safety instructions
DANGER ◆ To prevent electric shock, never perform inspection at power-on. ◆ Before inspection, disconnect all the power supplies and wait for at least 10 minutes to avoid risks caused by the residual voltage in the capacitor of the drive.

Item	Content	Description	Checked
Drive	Check for waste, dirt, and dust on the surface of the drive.	● Check whether the controller cabinet is powered off. ● Use a vacuum cleaner to suck up waste and dust to prevent direct contact with the components. ● Wipe stubborn dirt with alcohol and wait until the surface dries out.	
Cable	Check whether power cables and the connectors are discolored. Check whether the insulation is aged or cracked.	● Replace the cracked cable. ● Replace the damaged terminals.	
Peripherals of the electromagnetic contactor	Check whether the contactor closes loosely or generates unexpected noise during closing. Check whether short circuit, water seepage, swelling, or cracking occurs on any peripheral device.	● Replace the abnormal components.	
Air duct	Check whether the air duct and heatsink are blocked. Check whether the fan is damaged.	● Clean the air duct. ● Replace the fan.	

Item	Content	Description	Checked
Control circuit	Check for components with poor contact. Check whether terminal screws are connected securely. Check whether the insulation of the control circuit cable is intact without cracking.	● Clean up the surface of control circuit cables and terminals. ● Replace the damaged or corroded control cables.	

8.2.2 Insulation Test on the Main Circuit

CAUTION

- Before measuring the insulation resistance with a megameter (500 VDC megameter recommended), disconnect the main circuit from the drive.
- Do not use the insulation resistance meter to test the insulation of the control circuit. See the following figure. High-voltage (> 500 V) test has been performed before delivery. Do not perform high-voltage test again.

Note:

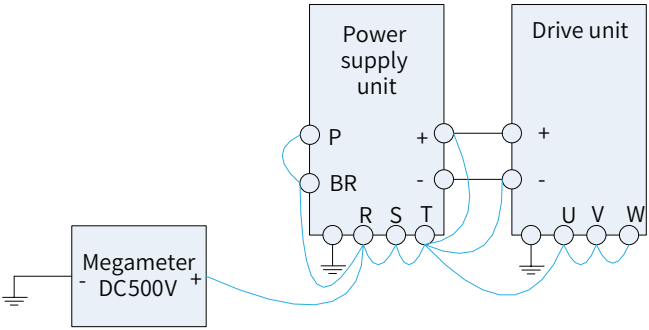


Figure 8-1 Main circuit insulation test diagram

The measured insulation resistance must be greater than 5 MΩ.

Before test, remove the voltage dependent resistor (VDR) screw, as shown in the following position.

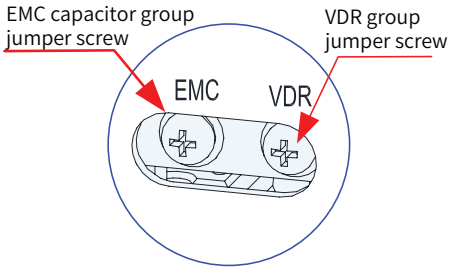


Figure 8-2 VDR and EMC grounding jumper positions

NOTE

- For details on VDR and EMC grounding jumper positions, see the 810 Series Power Supply Unit User Guide.

8.3 Replacing Fans

The fan is easy to wear and the general service time is equal to or longer than three years.

NOTE

The standard service time indicates the time when the fan is used in the following conditions. You can determine when to replace the fan according to the actual operating time.

- Ambient temperature: 40° C
- Load rate: 80%
- Operating rate: 24 hours per day

1. Possible causes of damage: bearing wear and blade aging
2. How to determine whether the cooling fan needs to be replaced:
   a. Check whether there are signs of cracking on the blade.
   b. Check whether the fan generates unusual noise during start.
   c. Check whether the blade works properly.
3. How to replace the fan:

Push down the snap-fit joint of the fan cover and pull the fan out.

After replacing the fan, ensure the fan blows the air upwards.

8.3.1 Number of Fans

Table 8-1 Number of fans

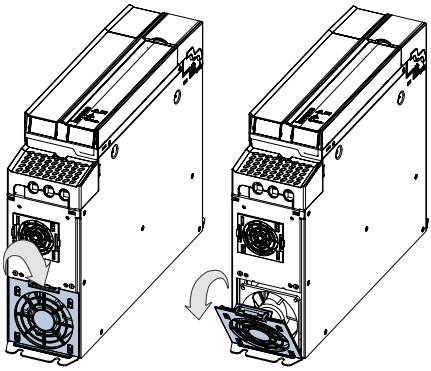
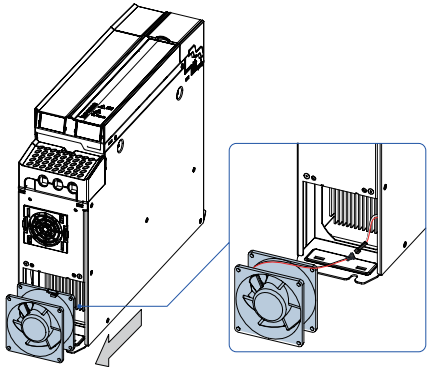
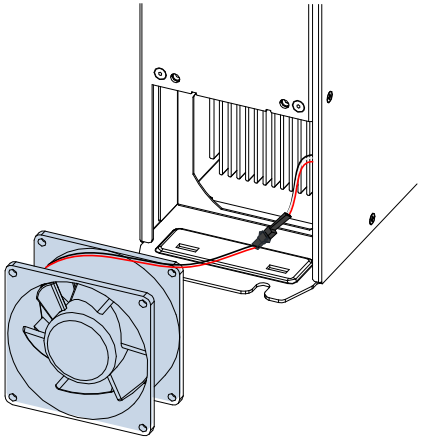
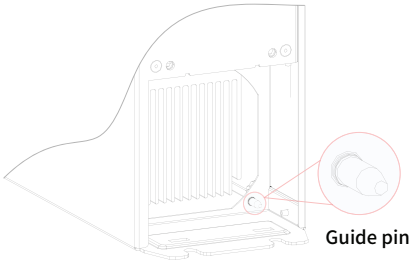
Model	Number of fans						
	40 x 40 x 28 (mm)	50 x 50 x 15 (mm)	80 x 80 x 25 (mm)	80 x 80 x 32 (mm)	80 x 80 x 38 (mm)	120 x 120 x 38 (mm)	Exhaust status
ES810-50M4T005-** ES810-50M4T009-** ES810-50M4T013-**	1	-	-	-	-	-	Blow status
ES810-50M4T017-** ES810-50M4T025-** ES810-50M4T032-**	-	-	1	-	-	-	
ES810-50M4T037-**	-	-	-	1	-	-	
ES810-50M4T045-** ES810-50M4T060-** ES810-50M4T075-**	-	1	-	1	-	-	
ES810-50M4T091-** ES810-50M4T112-** ES810-50M4T150-**	-	-	-	-	2	-	Suction
ES810-50M4T200-** ES810-50M4T240-**	-	-	-	-	3	-	

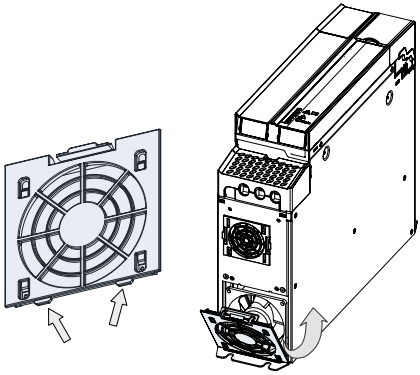
Table 8-2 Built-in fan

Model	Number of fans
ES810-50M4T005-xx ES810-50M4T009-xx ES810-50M4T013-xx	DC fan - 12 V-2.4 W-13.1 CFM-42.5 dB(A)-40 mm x 40 mm x 28 mm-IP52
ES810-50M4T017-xx ES810-50M4T025-xx ES810-50M4T032-xx	DC fan 24 V-3.84 W-56.16CFM-43.4 dB(A)-80 mm x 80 mm x 25 mm-IP52
ES810-50M4T037-xx	DC fan - 24 V-10.5 W-87.9 CFM-55dB(A)-80 mm x 80 mm x 32 mm-IP52 (glued)
ES810-50M4T045-xx ES810-50M4T060-xx ES810-50M4T075-xx	DC fan - 24 V-10.5 W-87.9 CFM-55dB(A)-80 mm x 80 mm x 32 mm-IP52 (glued) DC fan - 24V-2.88W-20.2CFM-38dB (A)-50 mm x 50 mm x 15 mm-IP52 (glued)
ES810-50M4T091-xx ES810-50M4T112-xx ES810-50M4T150-xx	DC fan - 24 V-10.5 W-87.9 CFM-55dB(A)-80 mm x 80 mm x 32 mm-IP52 (glued)
ES810-50M4T200-xx ES810-50M4T240-xx	DC fan - 24 V-10.5 W-87.9 CFM-55dB(A)-80 mm x 80 mm x 32 mm-IP52 (glued)

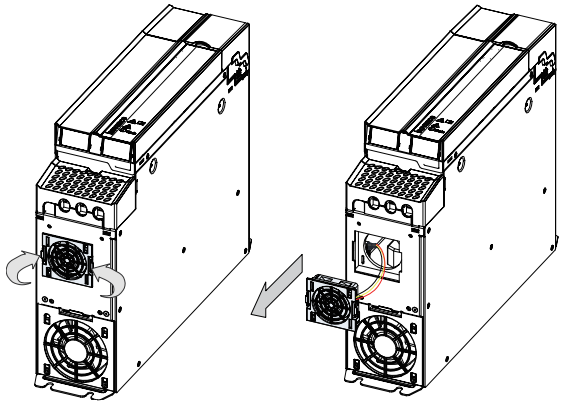
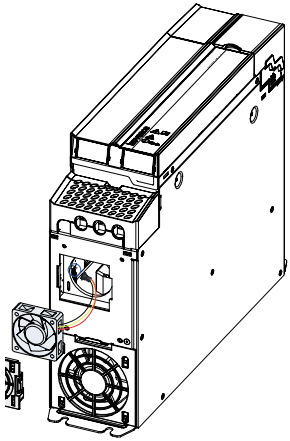
8.3.2 Removing and Installing Fans

■ Removing and installing the fan (80 mm x 80 mm) of the unit with the same height

<table>
<tr><th colspan="2">Removing the fan</th></tr>
<tr><td>1. Press the snap-fit joint of the fan cover and remove the fan cover.
  </td><td>2. Pull the fan outward and disconnect the power cable plug from the socket.
  </td></tr>
<tr><th colspan="2">Installing the fan</th></tr>
<tr><td>1. Install the fan in the reverse order of removal and ensure the correct direction of the fan. Plug the power cable plug into the socket.
  </td><td>2. Install the fan into the drive with the fixing holes at the bottom of the fan aligned with the positioning pins on the drive.
 
Guide pin x 2</td></tr>
</table>

3. Insert the two snap-fit joints into the groove and press down to fix the snap-fit joint. 	4. After replacement is completed, check that the air flow direction is upright.

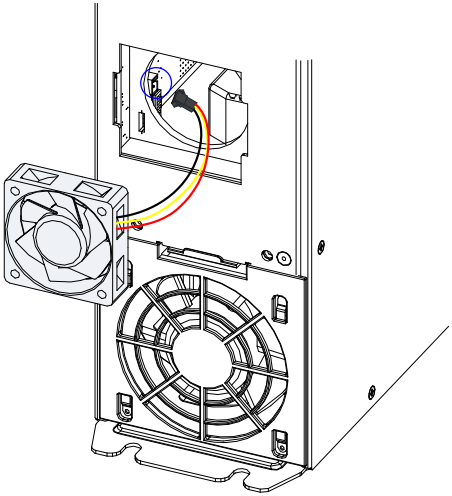
■ Removing and installing the fan (40 mm x 40 mm, 50 mm x 50 mm) of the booksize unit

Removing the fan	
1. Press the snap-fit joint at both sides of the fan cover and remove the fan cover and the fan. 	2. Detach the fan cover from the fan upwards and disconnect the power cable plug from the socket. 

Installing the fan

Install the fan in the reverse order of removal and ensure the correct direction of the fan.

- Plug the power cable plug into the socket.



- Install the fan into the fan cover, place the assembly into the drive, and install the snap-fit joint at both sides of the fan into the groove.
- After replacing the fan, ensure the fan blows the air upwards.

8.4 Storage of the Servo Drive

Observe the following precautions for short-term and long-term storage of the servo drive:

1. Store the drive in the original packing carton provided by Inovance.
2. Do not expose the drive to environments with moisture, high temperatures, or direct sunlight for a long time.
3. The electrolytic capacitor will deteriorate after long-term storage. Therefore, the drive must be switched on once for at least 5 hours every 6 months. The input voltage must be increased slowly to the rated value by using a voltage regulator. You can also contact Inovance for technical support.

8.5 Servo Drive Warranty Agreement

Free warranty applies only to the drive.

Inovance provides an 18-month warranty to the equipment from the date of shipment (subject to the barcode on the drive or contract if there is any) for failure or damage that occurs under normal use. When the warranty period expires, reasonable maintenance fee will be charged.

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

- Damage caused by operations not following the instructions in the guide
- Damage caused by fire, flood, abnormal voltage, or other disasters
- Damage caused by unintended use

- Damage caused by use outside the specifications
- Damage caused by force majeure (natural disaster, earthquake, and lightning strike) and second damage caused thereof

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

For details, see Product Warranty Card.

Appendix A Application of Dual-Screw Synchronization Solution

A.1 Background

The all-electric injection molding machine converts the rotating motion into the linear motion through the ball screw, and the screw drives the injection molding machine. Multiple motors can be used to drive multiple screws to complete the process together.

A.2 Dual-Screw Synchronization Solution

The ES810 for the all-electric injection molding machine can be equipped with two motors to drive two screws. The synchronization solution is as follows:

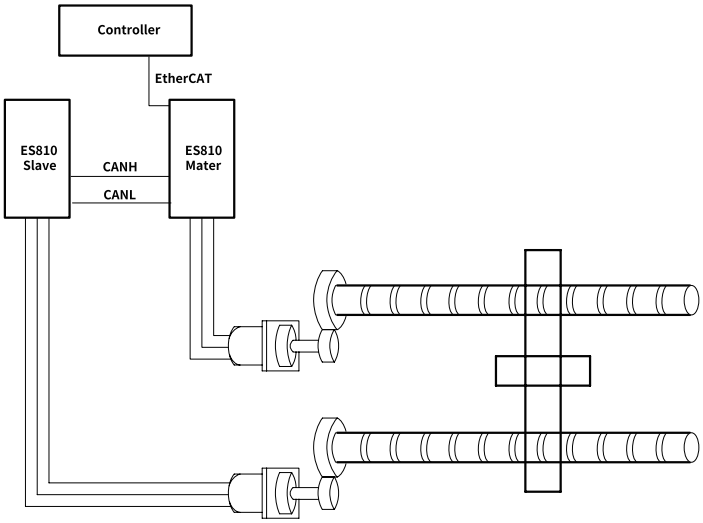


Figure A-1 Synchronization solution

1. Descriptions of the solution

1) Use the ES810 series servo drive.

2) Featuring the built-in process, the host controller sends the speed commands to the master and slave drives simultaneously through the EtherCAT. Alternatively, the controller sends the control word to the master drive. With the built-in process running of the master drive, the master and slave drives exchange data internally to implement synchronization control.

3) The host controller obtains the information of the master and slave drives through EtherCAT.

4) The master and slave drives exchange the motor speed and position information in real time through CAN communication.

2. Data frame, communication cycle, and baud rate of the CAN communication

The CAN communication baud rate is 1 Mbps.

The data includes the position reference, position feedback, speed reference, speed feedback, and fault information.

3. Drive control policy

The host controller sends the speed reference to the drive, and the position loop is realized by the PC. The master and slave drives receive the speed reference information. Therefore, the master and slave drives adopt the speed closed-loop control.

The screw size and load inertia are the same. Inertia auto-tuning and drive gain tuning are not described in this solution.

The following figure shows the control diagram.

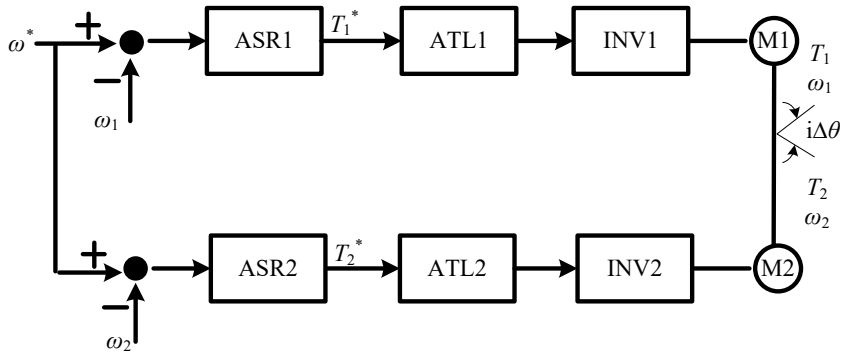


Figure A-2 Control policy

The control algorithm is described as follows:

1) The ASR indicates the speed controller, ATL indicates the current controller, INV indicates the servo drive, and M indicates the motor.

2) The master drive sends the speed command from the host controller, obtains the feedback of the master motor, and performs speed closed-loop control.

3) The master and slave drives exchange the speed and position information in real time for position synchronization control through the CAN communication.

4) The drive features the built-in position synchronization algorithm.

A.3 Operation Procedure

1. CAN Communication Wiring and Setting

1) Open the front covers of the master and slave drives, and turn on the termination resistor DIP switches 3 and 4, as shown in Figure A-3.

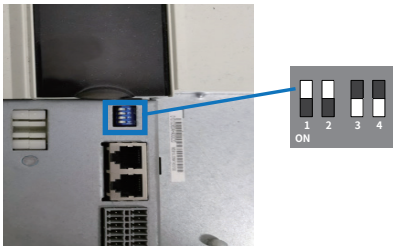


Figure A-3 Termination resistor DIP switch

2) Connect the RJ45A port of the master axis and the RJ45B port of the slave axis through the network cable, as shown in Figure A-4.

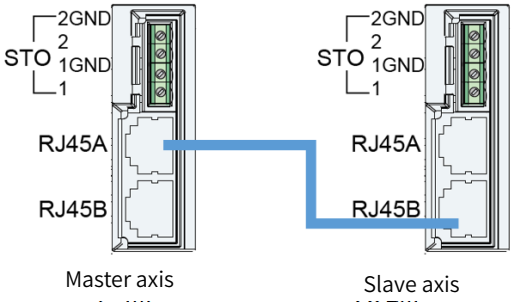


Figure A-4 CAN communication wiring

2. Parameter setting for screw synchronization

The master axis synchronizes parameters to the slave. The address of the master axis is set to 1, and that of the slave axis is set to 2 or a value other than 1.

1) Master axis:

H0C-00 = 1 (address of the master axis drive)

H0C-08 = 7 (baud rate of the CAN communication data)

H0C-20 = 1 (mode for the CAN communication between the master and slave)

H05-67 = 1 (Slave synchronized with master)

H05-68 = 1 (master axis)

H05-72 = 2 (CANID for data reception, H0C-00 of the slave)

H05-76 = 0 (Current position as the home)

H05-86 = 1 (speed reference source: 0: host controller; 1: built-in process of the drive)

2) Slave axis:

H0C-00 = 2 (axis address of the slave drive)

H0C-08 = 7 (baud rate of the CAN communication data)

H0C-20 = 1 (mode for the CAN communication between the master and slave)

H05-67 = 1 (slave synchronized with master)

H05-68 = 0 (slave axis)

H05-72 = 1 (CANID for data reception, H0C-00 of the master axis)

H05-76 = 0 (Current position as the home)

H05-86 = 1 (speed reference source: 0: host controller; 1: built-in process of the drive)

3) Other parameters:

H05-69: PD filter time for master and slave synchronization

H05-70: Regulator Kp for master and slave synchronization

H05-71: Regulator Kd for master and slave synchronization

NOTE

◆ After parameters of the master and slave axes are set, power on the drive again.

3. Host controller configuration

■ Interaction information

The following table describes parameters related to dual-screw synchronization.

Table A-1 Parameters related to dual-screw synchronization

No.	Param. No.	Param. Name	Description	Default	Value range	Master axis	Slave axis
1	H05-65	Master-slave synchronous data reception status bit	Read-only	0	0 to 65535	-	-
2	H05-66	Master-slave synchronous data transmission status bit	Read-only	0	0 to 65535	-	-
3	H05-67	Master and slave synchronization	0: Disable 1: Slave synchronized with master Note: The setting of the master and slave axes must be consistent.	0	0 to 1	1	1
4	H05-68	Master and slave axis setting	0: Slave axis 1: Master axis	0	0 to 1	1	0
5	H05-69	PD filter time for master and slave synchronization	Unit: 1 μs	0.00	0.00 to 64.00	0	0
6	H05-70	Master-slave synchronization regulator Kp	Unit: 1 Hz	0.0	0.0 to 2000.0	0	0

No.	Param. No.	Param. Name	Description	Default	Value range	Master axis	Slave axis
7	H05-71	Master-slave synchronization regulator Kd	Unit: 1%	0.0	0.0 to 2000.0	0	0
8	H05-72	Axis CANID for synchronous reception of master and slave	Address of the peer axis (value of H0C-00)	0	0 to 65535	Slave axis address	Master axis address
9	H05-73	Position transmission delay	Unit: 1 μs	0	-30000 to +30000	-	-
10	H05-74	Axis delay	Unit: 1 μs	0	-30000 to +30000	-	-
11	H05-75	Homing function for master and slave synchronization	0: Disable 1: Enable	0	0 to 1	0	0
12	H05-76	Homing mode for master and slave synchronization	0: Current position as the home 3: Last position as the home	0	0 to 4	0	0
13	H05-80	Re-homing mode for master and slave synchronization	Bit 0 to bit 3: Homing mode upon re-homing at fault Bit 5: Current loop parameter check enabled upon power-on	0x23	0x00 to 0x23	0x23	0x23
14	H05-81	Re-homing function for master and slave synchronization	0: Disable 1: Enable 2: Delayed calculation again	0	0 to 2	0	0
15	H05-82	Excessive position deviation threshold during master and slave synchronization	Unit: 0.1%	10.0	1.0 to 360.0	10.0	10.0
16	H05-83	Torque deviation Ki during master and slave synchronization	-	5.0	0.0 to 6553.5	5.0	5.0
17	H05-84	Excessive torque deviation threshold during master and slave synchronization	Unit: 1%	50.0	5.0 to 100.0	50.0	50.0

No.	Param. No.	Param. Name	Description	Default	Value range	Master axis	Slave axis
18	H05-85	Torque deviation Kp during master and slave synchronization	-	1000	0 to 65535	1000	1000
19	H05-86	Speed reference source of master and slave synchronization	0: Host controller 1: Built-in process of the drive	0	0 to 1	0	0
20	H05-87	Position offset of master and slave synchronization	-	0	-2147483648 to +2147483647	-	-
21	H06-12	Synchronization upon switching from non-enable to enable	0: Synchronized 1: Not synchronized	0	0 to 1	0	0
22	H06-33	Synchronization mode	0: Position synchronization 1: Torque synchronization.	0	0 to 1	0	0
23	H06-34	Step skipped during synchronization of paralleled screws	-	0	0 to 65535	0	0
24	H06-37	Slave speed reference source	0: Master and slave speed deviation compensation 1: Speed reference of the master axis host controller & Master/Slave axis speed deviation compensation	0	0 to 1	1	1
25	H06-39	Master and slave torque deviation limit	-	20	0 to 300	20	20
26	H06-45	Master and slave speed compensation limit	-	20	0 to 100	20	20
27	H0C-00	Drive axis address	-	1	1 to 247	-	-

No.	Param. No.	Param. Name	Description	Default	Value range	Master axis	Slave axis
28	H0C-08	CAN communication baud rate	0: 20 k 1: 50 k 2: 100 k 3: 125 k 4: 250 k 5: 500 k 6: 800 k 7: 1 M	5	0 to 7	7	7
29	H0C-20	Master and slave synchronized with CAN	0: Standard program 1: Synchronizing with CAN program	0	0 to 1	1	1

To know the status of each axis, the monitoring and display function of the status bits for the master and slave axes is added. H05_65 is the received data status bit (screw parallel connection status bit of the peer axis) for master and slave drive synchronization. H05-66 is the sent data status bit (screw parallel connection status bit of the local axis) for master and slave drive synchronization. The following table describes the specific meaning of each bit.

Table A-2 Definition of screw synchronization flag bit

No.	Bit	Definition
1	bit 0	One time of delayed calculation is done.
2	Bit 1	Delayed calculation is done.
3	Bit 2	Delayed test (local axis ready) flag bit
4	Bit 3	Channel test completion flag bit
5	Bit 4	The homing function is enabled.
6	Bit 5	Enabled internally
7	Bit 6	The position deviation initial value is calculated.
8	Bit 7	The mechanical limit is reached.
9	Bit 8	Homing is done.
10	Bit 9	Test delay is enabled/Re-homing is performed.
11	Bit 10	The servo-OFF signal is enabled.
12	Bit 11	The state is switched.
13	Bit 12 to bit 14	Current step for paralleled screws
14	bit 15	Synchronization mode

Paralleled screws are started in the following sequence:

1) Channel test: Set bit 12...bit 14 of H05-66 to 1.

2) Delay calculation: Set bit 12 to bit 14 of H05-66 to 2.

3) Homing: Set bit 12 to bit 14 of H05-66 to 3.

4) Synchronization control: Set bit 12 to bit 14 of H05-66 to 4.

3. Gain tuning parameters

For dual-axis synchronous control, ensure that the current loop, speed loop, position loop, and related feedforward gain of both axes are consistent. For the parameter settings, see the drive product manual.

After the relevant parameters are set, the system inertia auto-tuning needs to be carried out on the driver. The following conditions must be ensured for the inertia auto-tuning:

1) The homing operation of the master and slave axes is completed. Bit 12 to bit 14 of H05_66 is 4, and the master and slave drives are in the synchronous control mode.
2) The master and slave axes are in the RDY state and the EtherCAT connection is normal.
3) The moving parts are being moved, and there is enough margin to ensure that collision does not occur during the inertia auto-tuning.

The inertia auto-tuning for synchronous control only needs to be carried out on the master axis. The operation process is the same as that of the single axis. See the drive manual for instructions. After the inertia auto-tunning of the master axis is done, the value of H08-15 for the slave axis is consistent with that for the master axis.

A.4 Control Logic

Host Controller start logic:

1) Upon power-on for the first time, if the value of H05-76 (homing mode) is 0 or 3, and bit 12 to bit 14 of H05-66 is 3 after completion of channel test and delay calculation, the homing operation is required. After that, bit 12 to bit 14 of H05-66 is set to 4.
2) After the host controller detects that bit 12 to bit 14 of H05-66 for the master and slave drives is 4 (synchronization control) and no fault occurred on the master and slave drives, it sends the speed reference or H11 group control word (process parameter).

Disable logic upon fault:

1) If the master or slave axis becomes faulty, the faulty axis is disabled.
2) If the master or slave axis becomes faulty, the normal axis is disabled (motor switch) after the speed of the two axes is lower than the threshold (10 rpm) for 1s.

Parameters and process parameters

Both the master and slave drives deliver parameters such as process and torque reference limit through SDO. If some parameters are not written, the torque reference limit will be 0. This leads to a failure in synchronous control.

In normal operation, if the built-in process mode is used, process control words need to be sent only to the master axis.

Homing logic

If the host controller performs homing for the first time or detects a large deviation in the master and slave axis position, perform homing again.

Two homing modes are available, including the current position as the home and the previous position as the home.

1) The homing process with the current position as the home is shown in Figure A-5, including the screw synchronization homing and built-in process homing. The host controller does not need to carry out built-in process homing (H11-74 = 1).

NOTE

- After homing is done, H05-76 is forcibly set to 3 (previous position as the home). In this case, the homing operation does not need to be performed on the drive upon power-on again.

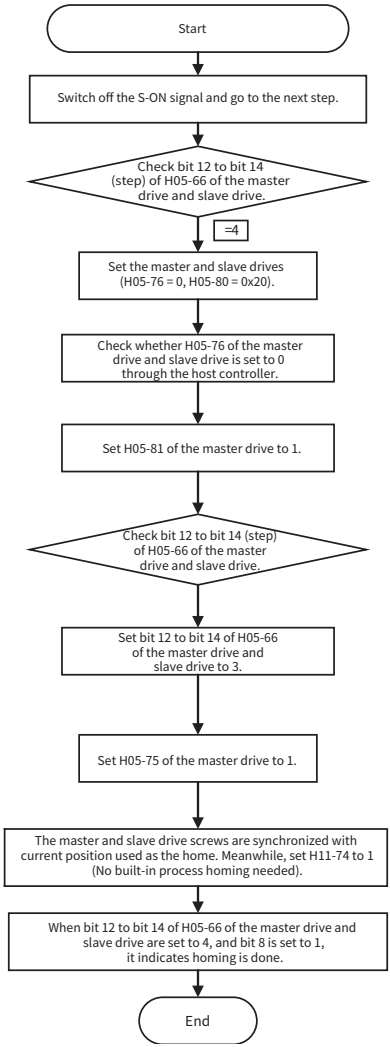


Figure A-5 Flowchart 1 for dual-screw homing mode

2) Figure A-6 shows the homing process where the previous position is used as the home.

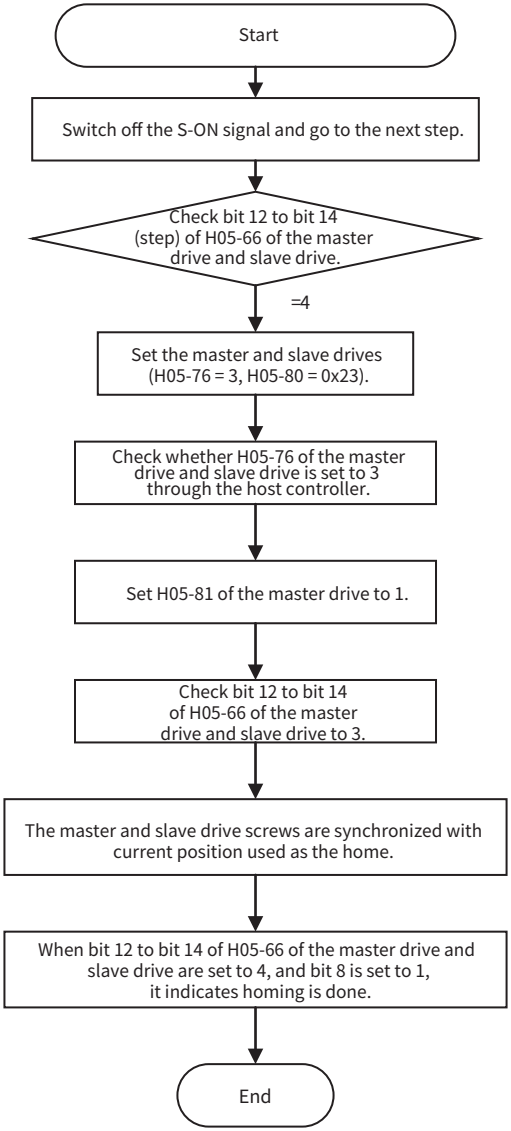


Figure A-6 Flowchart 2 for dual-screw homing mode

Stop logic

When the master axis or slave axis fails or both fail, the drive stops according to current fault situation.

1) If the master axis is faulty but the slave axis is normal, the master axis executes stop-at-fault based on the master axis fault, and the slave axis follows the master axis. The enable signal is off when the slave axis speed is lower than the switchover speed.

2) If the slave axis is faulty but the master axis is normal, the slave axis executes stop-at-fault based on the slave axis fault, and the master axis follows the slave axis. The enable signal is off when the master axis speed is lower than the switchover speed.

3) If both the master and slave axes are faulty, coast-to-stop is executed when the original stop mode upon fault is coast-to-stop (for MCU and FPGA faults). If the original stop mode is not coast-to-stop, dynamic braking stop will be executed by the master and slave axes.

4) If synchronous data transmission or reception fails between the master and slave (CAN communication fault between the master/slave axis drives), the master and slave axes execute dynamic braking stop.

Parameters related to dual-screw synchronization

No.	Display	Definition	Fault cause
1	E.E20.1	Master and slave synchronous reception failed	The CAN network cable is not connected, or the local axis cannot receive data from the peer axis due to CAN communication interference.
2	E.E20.2	Master and slave synchronous transmission failed	The CAN network cable is not connected, or the local axis cannot transmit data to the peer axis due to CAN communication interference.
3	E.E20.3	Excessive position transmission delay during master and slave synchronization	Excessive position transmission delay occurs during master and slave synchronization.
4	E.E20.4	Excessive position deviation during master and slave synchronization	The deviation between the master axis position and the slave axis position is higher than the value of H05-82.
5	E.E20.5	Excessive torque deviation during master and slave synchronization	The deviation between the master axis torque and the slave axis torque is higher than the value of H05-84.
6	A.E20.0	Current loop parameters of the master and slave axes different	The current loop parameters of the master and slave axes are different.
7	E.E25.0	Synchronous quick stop of master and slave	The host controller sends quick stop signal (1 for H03-39). The master and slave executes quick stop upon minor fault of the slave. The speed changes from high speed (set by H0759) to 0 in one ECAT cycle.

Appendix B List of Object Dictionaries

For details on the parameters of the power supply unit, see the 810 Series Power Supply Unit User Manual.

Object Group 1000h

Index (Hex)	Sub-index (Hex)	Name	Access	PDO mapping	Data type	Unit	Data range	Default
1000	00	Drive type	RO	No	UInt32	-	-	0x00020192
1008	00	Drive name	RO	No	-	-	-	ES810-ECAT
1009	00	Hardware version	RO	No	-	-	-	Software version dependent
100 A	00	Software version	RO	No	-	-	-	Hardware version dependent
1018	ID object							
	00	Highest sub-index supported	RO	No	UINT8	-	-	0x04
	01	Vendor ID	RO	No	UInt32	-	-	0x00100000
	02	Product code	RO	No	UInt32	-	-	0x01190108
	03	Revision number	RO	No	UInt32	-	-	0x00010001
1C00	Manufacturer software version							
	00	Number of Sync Manger channels	RO	No	UINT8	-	-	0x04
	01	SM0 communication type	RO	No	UINT8	-	-	0x01
	02	SM1 communication type	RO	No	UINT8	-	-	0x02
	03	SM2 communication type	RO	No	UINT8	-	-	0x03
	04	SM3 communication type	RO	No	UINT8	-	-	0x04

Index (Hex)	Sub-index (Hex)	Name	Access	PDO mapping	Data type	Unit	Data range	Default
1600	Mapping object of RPDO1							
	00	Number of mapped objects in RPDO1	RW	No	UINT8	-	0 to 0x0A	0x05
	01	1st mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	0x60400010
	02	2nd mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	0x60600008
	03	3rd mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	0x607A0020
	04	4th mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	0x60B80010
	05	5th mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	0x60FF0020
	06	6th mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	
	07	7th mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	-
	08	8th mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	-
	09	9th mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	-
	0 A	10th mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	-

Index (Hex)	Sub-index (Hex)	Name	Access	PDO mapping	Data type	Unit	Data range	Default
1610	Mapping object of RPDO11							
	00	Number of mapped objects in RPDO11	RW	No	UINT8	-	0 to 0x0A	0x05
	01	1st mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	0x68400010
	02	2nd mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	0x68600008
	03	3rd mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	0x687A0020
	04	4th mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	0x68B80010
	05	5th mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	0x68FF0020
	06	6th mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	
	07	7th mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	-
	08	8th mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	-
	09	9th mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	-
	0 A	10th mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	-

Index (Hex)	Sub-index (Hex)	Name	Access	PDO mapping	Data type	Unit	Data range	Default
1A00	Mapping object of TPDO1							
	00	Number of mapped objects in TPDO1	RW	No	UINT8	-	0 to 0x0A	0x0A
	01	1st mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	0x603F0010
	02	2nd mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	0x60410010
	03	3rd mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	0x60610008
	04	4th mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	0x60640020
	05	5th mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	0x606C0020
	06	6th mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	0x60B90010
	07	7th mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	0x60BA0020
	08	8th mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	0x60BC0020
	09	9th mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	0x60F40010
	0 A	10th mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	0x60FD0010

Index (Hex)	Sub-index (Hex)	Name	Access	PDO mapping	Data type	Unit	Data range	Default
1A10	Mapping object of TPDO11							
	00	Number of mapped objects in TPDO11	RW	No	UINT8	-	0 to 0x0A	0x0A
	01	1st mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	0x683F0010
	02	2nd mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	0x68410010
	03	3rd mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	0x68610008
	04	4th mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	0x68640020
	05	5th mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	0x686C0020
	06	6th mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	0x68B90010
	07	7th mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	0x68BA0020
	08	8th mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	0x68BC0020
	09	9th mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	0x68F40010
	0 A	10th mapping object	RW	No	UInt32	-	0 to 0xFFFFFFFF	0x68FD0010
1C12	Sync Manager 2_RPDO assignment							
	00	Sync Manager 2_ Highest sub-index assigned by RPDO	RW	No	UINT8	-	0 to 0x02	0x02
	01	Index of object 1 assigned by RPDO	RW	YES	UINT16	-	0 to 0xFFFF	0x1600
	02	Index of object 2 assigned by RPDO	RW	YES	UINT16	-	0 to 0xFFFF	0x1610
1C13	Sync Manager 2_TPDO assignment							
	00	Sync Manager 2_ Highest sub-index supported	RW	No	UINT8	-	0 to 0x2	0x02
	01	Index of object 1 assigned by TPDO	RW	YES	UINT16	-	0 to 0xFFFF	0x1A00
	02	Index of object 2 assigned by TPDO	RW	YES	UINT16	-	0 to 0xFFFF	0x1A10

Index (Hex)	Sub-index (Hex)	Name	Access	PDO mapping	Data type	Unit	Data range	Default
1C32	Sync Manager 2_sync output parameters							
	00	Sync Manager 2_ number of sync parameters	RO	No	UINT8	-	-	0x20
	01	Sync type	RO	No	UINT16	-	-	0x0002
	02	Cycle time	RO	No	UInt32	ns	-	0
	04	Sync modes supported	RO	No	UINT16	-	-	0x0004
	05	Minimum cycle time	RO	No	UInt32	ns	-	0x0001E848
	06	Calculation and copy time	RO	No	UInt32	ns	-	-
	09	Delay time	RO	No	UInt32	ns	-	-
	20	Sync error	RO	No	BOOL	-	-	-
1C33	Sync Manager 2_sync input parameters							
	00	Sync Manager 2_ number of sync parameters	RO	No	UINT8	-	-	0x20
	01	Sync type	RO	No	UINT16		-	0x0002
	02	Cycle time	RO	No	UInt32	ns	-	0
	04	Sync modes supported	RO	No	UINT16	-	-	0x0004
	05	Minimum cycle	RO	No	UInt32	ns	-	0x0001E848
	06	Calculation and copy time	RO	No	UInt32	ns	-	-
	09	Delay time	RO	No	UInt32	ns	-	-
	20	Sync error	RO	No	BOOL	-	-	-

Object Group 6000h

The parameter group 6000h contains objects supported by the servo drive in DSP402 device profile.

Index (Hex)	Sub-index (Hex)	Name	Access	PDO mapping	Data type	Unit	Data range	Default	Change mode	Effective time
603F	00	Error code	RO	TPDO	UINT16	-	-	-	-	-
6040	00	Control word	RW	RPDO	UINT16	-	0 to 0xFFFF	0	During operation	Real time
6041	00	Status word	RO	TPDO	UINT16	-	-	-	-	-
605 A	00	Quick stop option code	RW	No	INT16	-	0 to 0x07	0x02	During operation	At stop

Index (Hex)	Sub-index (Hex)	Name	Access	PDO mapping	Data type	Unit	Data range	Default	Change mode	Effective time
605C	00	Stop mode at S-OFF	RW	No	INT16	-	0 to 0x01	0	During operation	At stop
605D	00	Halt option code	RW	No	INT16	-	0x01 to 0x03	0x01	During operation	At stop
605E	00	Stop mode at No. 2 fault	RW	No	INT16	-	0 to 0x02	0x02	During operation	At stop
6060	00	Modes of operation	RW	RPDO	Int8	-	0 to 0x0A	0	During operation	Real time
6061	00	Operation mode display	RO	TPDO	Int8	-	-	-	-	-
6062	00	Position demand value	RO	TPDO	INT32	Reference unit	-	-	-	-
6063	00	Position actual value*	RO	TPDO	INT32	Encoder unit	-	-	-	-
6064	00	Position actual value	RO	TPDO	INT32	Reference unit	-	-	-	-
6065	00	Following error window	RW	RPDO	UInt32	Reference unit	0 to 0xFFFFFFFF	0x00300000	During operation	Real time
6066	00	Following error time out	RW	RPDO	UInt32	ms	0 to 0xFFFF	0	During operation	Real time
6067	00	Position window	RW	RPDO	UInt32	Reference unit	0 to 0xFFFFFFFF	0x000002DE	During operation	Real time
6068	00	Position window time	RW	RPDO	UINT16	ms	0 to 0xFFFF	0	During operation	Real time
606C	00	Velocity actual value	RO	TPDO	INT32	Reference unit/s	-	-	-	-
606D	00	Velocity window	RW	RPDO	UINT16	rpm	0 to 0xFFFF	0x0A	During operation	Real time
606E	00	Velocity window time	RW	RPDO	UINT16	ms	0 to 0xFFFF	0	During operation	Real time
606F	00	Velocity threshold	RW	RPDO	UINT16	rpm	0 to 0xFFFF	0x0A	During operation	Real time
6070	00	Velocity threshold time	RW	RPDO	UINT16	ms	0 to 0xFFFF	0	During operation	Real time
6071	00	Target torque	RW	RPDO	INT16	0.1%	0xF448 to 0x0BB8	0	During operation	Real time
6072	00	Max. torque	RW	RPDO	UINT16	0.1%	0 to 0x0BB8	0x0BB8	During operation	Real time
6074	00	Torque demand value	RO	TPDO	INT16	0.1%	-	0	-	-
6077	00	Torque actual value	RO	TPDO	INT16	0.1%	-	0	-	-
607 A	00	Target position	RW	RPDO	INT32	Reference unit	0x80000000 to 0x7FFFFFFF	0	During operation	Real time
607C	00	Home offset	RW	RPDO	INT32	Reference unit	0x80000000 to 0x7FFFFFFF	0	During operation	Real time

Index (Hex)	Sub-index (Hex)	Name	Access	PDO mapping	Data type	Unit	Data range	Default	Change mode	Effective time
607D	Software position limit									
	00	Highest sub-index supported	RO	No	UINT8	-	-	0x02	-	-
	01	Min. position limit	RW	RPDO	INT32	Reference unit	0x80000000 to 0x7FFFFFFF	0x80000000	During operation	Real time
	02	Max. position limit	RW	RPDO	INT32	Reference unit	0x80000000 to 0x7FFFFFFF	0x7FFFFFFF	During operation	Real time
607E	00	Polarity	RW	RPDO	UINT8	-	0 to 0xFF	0	During operation	Real time
607F	00	Max. profile velocity	RW	RPDO	UInt32	Reference unit/s	0 to 0xFFFFFFFF	0x06400000	During operation	Real time
6081	00	Profile velocity	RW	RPDO	UInt32	User-defined velocity unit	0 to 0xFFFFFFFF	0	During operation	Real time
6083	00	Profile acceleration	RW	RPDO	UInt32	Reference unit/s^2	0 to 0xFFFFFFFF	0x682AAAA6	During operation	Real time
6084	00	Profile deceleration	RW	RPDO	UInt32	Reference unit/s^2	0 to 0xFFFFFFFF	0x682AAAA6	During operation	Real time
6085	00	Quick stop deceleration	RW	RPDO	UInt32	User-defined acceleration unit	0 to 0xFFFFFFFF	0xAD9C71C0	During operation	Real time
6086	00	Motion profile type	RW	RPDO	INT16	-	0x8000 to 0x7FFF	0	During operation	Real time
6087	00	Torque slope	RW	RPDO	UInt32	0.1%/s	0 to 0xFFFFFFFF	0xFFFFFFFF	During operation	Real time
6091	Gear ratio									
	00	Highest sub-index supported	RO	No	UINT8	Uint8	-	0x02	-	-
	01	Motor revolutions	RW	RPDO	UInt32	-	0 to 0xFFFFFFFF	20-bit encoder: 1 23-bit encoder: 8	During operation	Real time
	02	Shaft revolutions	RW	RPDO	UInt32	-	1 to 0xFFFFFFFF	1	During operation	Real time
6098	00	Homing method	RW	RPDO	Int8	-	0x01 to 0x023	0x01	During operation	Real time
6099	Homing speed									
	00	Highest sub-index supported	RO	No	Uint8	-	-	0x02	-	-
	01	Speed during search for switch	RW	RPDO	UInt32	Reference unit/s	0 to 0xFFFFFFFF	0x001AAAAB	During operation	Real time
	02	Speed during search for zero	RW	RPDO	UInt32	Reference unit/s	10 to 0xFFFFFFFF	0x0002AAAB	During operation	Real time
609A	00	Homing acceleration	RW	RPDO	UInt32	Reference unit/s^2	0 to 0xFFFFFFFF	0x682AAAA6	During operation	Real time
60B0h	00	Position offset	RW	RPDO	INT32	Reference unit	0x80000000 to 0x7FFFFFFF	0	During operation	Real time

Index (Hex)	Sub-index (Hex)	Name	Access	PDO mapping	Data type	Unit	Data range	Default	Change mode	Effective time
60B1h	00	Velocity offset	RW	RPDO	INT32	Reference unit/s	0x80000000 to 0x7FFFFFFF	0	During operation	Real time
60B2h	00	Torque offset	RW	RPDO	INT16	0.1%	0xF448 to 0x0BB8	0	During operation	Real time
60E0h	00	Positive torque limit	RW	RPDO	UINT16	0.1%	0 to 0x0BB8	0x0BB8	During operation	Real time
60E1h	00	Negative torque limit	RW	RPDO	UINT16	0.1%	0 to 0x0BB8	0x0BB8	During operation	Real time

Index (Hex)	Sub-index (Hex)	Name	Access	PDO mapping	Data type	Unit	Data range	Default	Change mode	Effective time
60E3h	Supported homing method									
	00	Number of sub-indexes for supported homing method	RO	No	UINT8	-	-	0x1F	-	-
	01	Supported homing method 1	RO	No	UINT16	-	-	0x0301	-	-
	02	Supported homing method 2	RO	No	UINT16	-	-	0x0302	-	-
	03	Supported homing method 3	RO	No	UINT16	-	-	0x0303	-	-
	04	Supported homing method 4	RO	No	UINT16	-	-	0x0304	-	-
	05	Supported homing method 5	RO	No	UINT16	-	-	0x0305	-	-
	06	Supported homing method 6	RO	No	UINT16	-	-	0x0306	-	-
	07	Supported homing method 7	RO	No	UINT16	-	-	0x0307	-	-
	08	Supported homing method 8	RO	No	UINT16	-	-	0x0308	-	-
	09	Supported homing method 9	RO	No	UINT16	-	-	0x0309	-	-
	0 A	Supported homing method 10	RO	No	UINT16	-	-	0x030A	-	-
	0B	Supported homing method 11	RO	No	UINT16	-	-	0x030B	-	-
	0C	Supported homing method 12	RO	No	UINT16	-	-	0x030C	-	-

Index (Hex)	Sub-index (Hex)	Name	Access	PDO mapping	Data type	Unit	Data range	Default	Change mode	Effective time
60E3h	0D	Supported homing method 13	RO	No	UINT16	-	-	0x030D	-	-
	0E	Supported homing method 14	RO	No	UINT16	-	-	0x030E	-	-
	0F	Supported homing method 15	RO	No	UINT16	-	-	0x030Fh	-	-
	10	Supported homing method 16	RO	No	UINT16	-	-	0x0310	-	-
	11	Supported homing method 17	RO	No	UINT16	-	-	0x0311	-	-
	12	Supported homing method 18	RO	No	UINT16	-	-	0x0312	-	-
	13	Supported homing method 19	RO	No	UINT16	-	-	0x0313	-	-
	14	Supported homing method 20	RO	No	UINT16	-	-	0x0314	-	-
	15	Supported homing method 21	RO	No	UINT16	-	-	0x0315	-	-
	16	Supported homing method 22	RO	No	UINT16	-	-	0x0316	-	-
	17	Supported homing method 23	RO	No	UINT16	-	-	0x0317	-	-
	18	Supported homing method 24	RO	No	UINT16	-	-	0x0318	-	-
	19	Supported homing method 25	RO	No	UINT16	-	-	0x0319	-	-
	1 A	Supported homing method 26	RO	No	UINT16	-	-	0x031A	-	-
	1B	Supported homing method 27	RO	No	UINT16	-	-	0x031B	-	-
	1C	Supported homing method 28	RO	No	UINT16	-	-	0x031C	-	-

Index (Hex)	Sub-index (Hex)	Name	Access	PDO mapping	Data type	Unit	Data range	Default	Change mode	Effective time
60E3h	1D	Supported homing method 29	RO	No	UINT16	-	-	0x031D	-	-
	1E	Supported homing method 30	RO	No	UINT16	-	-	0x031E	-	-
	1F	Supported homing method 31	RO	No	UINT16	-	-	0x031F	-	-
60E6h	00	Actual position calculation method	RW	No	UINT16	-	0 to 1	0	During operation	Real time
60F4h	00	Following error actual value	RO	RPDO	INT32	Reference unit	-	-	-	-
60FCh	00	Position demand value*	RO	TPDO	INT32	Encoder unit	-	-	-	-
60FDh	00	DI state	RO	RPDO	UInt32	-	-	-	-	-
60FEh	Digital output									
	00	DO state	RO	No	UINT8	-	-	0x02	-	-
	01	Physical output	RW	RPDO	UInt32	-	0 to 0xFFFFFFFF	0	During operation	Real time
	02	Bitmask	RW	No	UInt32	-	0 to 0xFFFFFFFF	0	During operation	Real time
60FFh	00	Target velocity	RW	RPDO	INT32	Reference unit/s	0x80000000 to 0x7FFFFFFF	0	During operation	Real time
6502h	00	Supported drive modes	RO	No	UInt32	-	-	0x000003AD	-	-

Object Group 2000h

H00 Servo motor parameters

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
1	H00-00	Motor code	-	14101	-	At stop	Next power-on
3	H00-02	Customized No.	-	0.00	-	N/A	-
5	H00-04	Encoder version	-	0.0	-	N/A	-
6	H00-05	Serial-type motor code	-	0	-	N/A	-
7	H00-06	FPGA customized No.	-	0.00	-	N/A	-
9	H00-08	Serial encoder type	-	0	-	At stop	Next power-on
10	H00-09	Rated voltage	0: 220 V 1: 380 V	0	-	At stop	Next power-on
11	H00-10	Rated power	-	0.75	kW	At stop	Next power-on
12	H00-11	Rated current	-	4.70	A	At stop	Next power-on
13	H00-12	Rated torque	-	2.39	N·m	At stop	Next power-on

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
14	H00-13	Maximum torque	-	7.16	N·m	At stop	Next power-on
15	H00-14	Rated speed	-	3000	rpm	At stop	Next power-on
16	H00-15	Maximum speed	-	6000	rpm	At stop	Next power-on
17	H00-16	Moment of inertia	-	1.30	kg/m^2	At stop	Next power-on
18	H00-17	Number of PMSM pole pairs	-	4	-	At stop	Next power-on
19	H00-18	Stator resistance	-	0.500	Ω	At stop	Next power-on
20	H00-19	Stator inductance Lq	-	3.27	mH	At stop	Next power-on
21	H00-20	Stator inductance Ld	-	3.87	mH	At stop	Next power-on
22	H00-21	Linear back EMF coefficient	-	33.30	mV/rpm	At stop	Next power-on
23	H00-22	Torque coefficient Kt	-	0.51	N·m/Arms	At stop	Next power-on
24	H00-23	Electrical constant Te	-	6.54	ms	At stop	Next power-on
25	H00-24	Mechanical constant Tm	-	0.24	ms	At stop	Next power-on
29	H00-28	Absolute encoder position offset	-	8192	-	At stop	Next power-on
31	H00-30	Encoder selection (HEX)	19: 0x13 - Inovance encoder 18: 0x12 - Nikon encoder 32: 0x20 - Resolver encoder	19	-	At stop	Next power-on
32	H00-31	Encoder PPR	-	8388608	-	At stop	Next power-on
34	H00-33	Electrical angle of Z signal	-	180.0	°	N/A	-
59	H00-58	Number of resolver pole pairs	-	1	-	At stop	Real time

H01 Servo drive parameters

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
1	H01-00	MCU software version	-	0.0	-	N/A	-
2	H01-01	FPGA software version	-	0.0	-	N/A	-
3	H01-02	Servo drive series No.	-	10008	-	At stop	Next power-on
6	H01-05	Rated power of the drive unit	-	0.75	kW	N/A	-
7	H01-06	Maximum output power of the drive unit	-	0.75	kW	N/A	-

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
8	H01-07	Rated output current of the drive unit	-	5.50	A	N/A	-
9	H01-08	Maximum output current of the drive unit	-	16.90	A	N/A	-
11	H01-10	Carrier frequency	-	4000	-	At stop	Next power-on
12	H01-11	Current loop modulation frequency	0: Carrier frequency 1: 2 x carrier frequency	1	-	At stop	Next power-on
13	H01-12	Speed loop scheduling frequency-division coefficient	1: Current loop modulation frequency/1 2: Current loop modulation frequency/2 4: Current loop modulation frequency/4 8: Current loop modulation frequency/8 16: Current loop modulation frequency/16 32: Current loop modulation frequency/32	1	-	At stop	Next power-on
14	H01-13	Position loop scheduling frequency-division coefficient	1: Current loop modulation frequency/1 2: Current loop modulation frequency/2 4: Current loop modulation frequency/4 8: Current loop modulation frequency/8 16: Current loop modulation frequency/16 32: Current loop modulation frequency/32	4	-	At stop	Next power-on
16	H01-15	DC bus overvoltage protection threshold	-	420	V	N/A	-
17	H01-17	DC bus undervoltage threshold	-	350	V	At stop	Next power-on
19	H01-18	Servo drive overcurrent protection threshold	-	100	A	At stop	Next power-on

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
23	H01-22	D-axis back EMF compensation coefficient	-	60.0	%	Real time	Real time
24	H01-23	Q-axis back EMF compensation coefficient	-	100.0	%	Real time	Real time
25	H01-24	D-axis current loop proportional gain	-	1000	-	Real time	Real time
26	H01-25	D-axis current loop integral compensation factor	-	2.00	-	Real time	Real time
28	H01-27	Q-axis current loop proportional gain	-	1000	-	Real time	Real time
29	H01-28	Q-axis current loop integral compensation factor	-	1.00	-	Real time	Real time
36	H01-35	Local mode selection	0: Non-local mode 1: Local mode	0	-	At stop	Real time
37	H01-36	High torque limit of overload coefficient	0: Disable 1: Enable	1	-	At stop	Real time
44	H01-43	Overvoltage suppression	0: Disable 1: Enable	1	-	At stop	Real time
48	H01-47	MCU current reference processing time	-	75.00	ms	At stop	Next power-on
51	H01-50	Internal version of MCU software	-	0.00	-	N/A	-
52	H01-51	Internal version of FPGA software	-	0.00	-	N/A	-
53	H01-52	D-axis proportional gain in performance priority mode	-	2000	-	Real time	Real time
54	H01-53	D-axis integral gain in performance priority mode	-	2.00	-	Real time	Real time
55	H01-54	Q-axis proportional gain in performance priority mode	-	2000	-	Real time	Real time
56	H01-55	Q-axis integral gain in performance priority mode	-	1.00	-	Real time	Real time
69	H01-68	Starting voltage of overvoltage suppression	-	780.0	-	At stop	Real time

H02 Basic control parameters

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
1	H02-00	Control mode	0: Control mode 2: Torque mode 9: EtherCAT mode	9	-	At stop	Real time
2	H02-01	Absolute system selection	0: Incremental mode 1: Absolute position linear mode 2: Absolute position rotation mode	1	-	N/A	-
3	H02-02	Rotation direction selection	0: Counterclockwise (CCW) as forward direction 1: Clockwise (CW) as forward direction	0	-	At stop	Real time
4	H02-03	Output pulse phase	0: Phase A leads phase B 1: Phase A lags behind phase B	0	-	At stop	Next power-on
6	H02-05	Stop mode at S-OFF	0: Coast to stop, keeping de-energized state 1: Stop at zero speed, keeping de-energized state 2: Stop based on smooth deceleration and torque reduction, keeping de-energized state 3: Internal dynamic braking stop, keeping dynamic braking state 4: Stop based on smooth deceleration and torque reduction, keeping dynamic braking state	3	-	At stop	Real time

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
7	H02-06	Stop mode at No. 2 fault	0: Coast to stop, keeping de-energized state 1: External dynamic braking stop, keeping de-energized state 2: External dynamic braking stop, keeping dynamic braking state 3: Internal dynamic braking stop, keeping de-energized state 4: Internal dynamic braking stop, keeping dynamic braking state 5: Stop at zero speed, keeping de-energized state 6: Stop at zero speed, keeping position lock state 7: Stop based on smooth deceleration, keeping de-energized state 8: Stop based on smooth deceleration, keeping position lock state	0	-	N/A	-
8	H02-07	Stop mode at overtravel	0: Coast to stop, keeping de-energized state 1: Stop at zero speed, keeping position lock state 2: Stop at zero speed, keeping de-energized state	1	-	At stop	Real time

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
9	H02-08	Stop mode at No. 1 fault	0: Coast to stop, keeping de-energized state 1: External dynamic braking stop, keeping de-energized state 2: External dynamic braking stop, keeping dynamic braking state 3: Internal dynamic braking stop, keeping de-energized state 4: Internal dynamic braking stop, keeping dynamic braking state 5: Stop at zero speed, keeping de-energized state 6: Stop at zero speed, keeping position lock state 7: Stop based on smooth deceleration, keeping de-energized state 8: Stop based on smooth deceleration, keeping position lock state	0	-	N/A	-
10	H02-09	Delay from brake output ON to command received	-	250	ms	Real time	Real time
11	H02-10	Delay from brake output OFF to motor de-energized in the standstill state	-	150	ms	Real time	Real time
12	H02-11	Motor speed threshold at brake output OFF in rotation state	-	30	rpm	Real time	Real time
13	H02-12	Delay from S-ON OFF to brake output OFF in rotation state	-	500	-	Real time	Real time
15	H02-14	Switchover speed of stop mode and stop state	-	10	-	At stop	Real time
16	H02-15	LED alarm display	0: Output alarm information immediately 1: Not output alarm information	0	-	At stop	Real time

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
21	H02-20	Stop mode upon a fault	0: Coast to stop, regardless of the stop mode set in group H0E 1: Stop according to the stop mode set in group H0E	1	-	Real time	Real time
32	H02-31	System parameter initialization	0: No operation 1: Restore factory settings 2: Clear the fault record	0	-	At stop	Real time
42	H02-41	Manufacturer password	-	0	-	Real time	Real time
43	H02-42	Temperature sensor	0: Disable 1: KTY 2: PT1000 3: PT100	0	-	Real time	Real time
44	H02-43	Motor temperature alarm upper limit	-	90	C	Real time	Real time
45	H02-44	Motor temperature alarm lower limit	-	0	C	Real time	Real time
46	H02-45	PTC temperature alarm switch	0: Disable 1: Enable	0	-	Real time	Real time
47	H02-46	Forced start of fan	-	0	-	Real time	Real time
48	H02-47	NTC error report disabled	-	0	-	Real time	Real time

H03 Terminal input parameters

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
3	H03-02	DI1 function	0:No assignment 1: S-ON signal 2: Alarm signal reset 3: Gain switchover switch 12: Zero clamp enable signal 13: Position reference inhibited 14: Positive limit switch 15: Negative limit switch 16: Forward external torque limit 17: Reverse external torque limit 18: Forward jog 19: Reverse jog 25: Torque reference direction 26: Speed reference direction 27: Position reference direction 31: Home switch 32: Homing enable 34: Emergency stop 35: Position deviation cleared 36: Internal speed limit source 37: Pulse reference inhibited 38: Touch probe 1 39: Touch probe 2 40: Master/Slave pump configuration 1 41: Master/Slave pump configuration 2 42: S-ON DO allowed 43: BrakeErrDiTime signal being non-zero 44: DI-to-pressure holding enable 45: Braking unit state 5 46: Power-down signal of power supply unit	14	-	Real time	Real time
4	H03-03	DI1 logic selection	0: Active low 1: Active high 2: Rising edge-triggered 3: Falling edge-triggered 4: Rising/falling edge-triggered	0	-	Real time	Real time

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
5	H03-04	DI2 function	0:No assignment 1: S-ON signal 2: Alarm signal reset 3: Gain switchover switch 12: Zero clamp enable signal 13: Position reference inhibited 14: Positive limit switch 15: Negative limit switch 16: Forward external torque limit 17: Reverse external torque limit 18: Forward jog 19: Reverse jog 25: Torque reference direction 26: Speed reference direction 27: Position reference direction 31: Home switch 32: Homing enable 34: Emergency stop 35: Position deviation cleared 36: Internal speed limit source 37: Pulse reference inhibited 38: Touch probe 1 39: Touch probe 2 40: Master/Slave pump configuration 1 41: Master/Slave pump configuration 2 42: S-ON DO allowed 43: BrakeErrDiTime signal being non-zero 44: DI-to-pressure holding enable 45: Braking unit state 5 46: Power-down signal of power supply unit	14	-	Real time	Real time
6	H03-05	DI2 logic selection	0: Active low 1: Active high 2: Rising edge-triggered 3: Falling edge-triggered 4: Rising/falling edge-triggered	0	-	Real time	Real time

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
7	H03-06	DI3 function	0:No assignment 1: S-ON signal 2: Alarm signal reset 3: Gain switchover switch 12: Zero clamp enable signal 13: Position reference inhibited 14: Positive limit switch 15: Negative limit switch 16: Forward external torque limit 17: Reverse external torque limit 18: Forward jog 19: Reverse jog 25: Torque reference direction 26: Speed reference direction 27: Position reference direction 31: Home switch 32: Homing enable 34: Emergency stop 35: Position deviation cleared 36: Internal speed limit source 37: Pulse reference inhibited 38: Touch probe 1 39: Touch probe 2 40: Master/Slave pump configuration 1 41: Master/Slave pump configuration 2 42: S-ON DO allowed 43: BrakeErrDiTime signal being non-zero 44: DI-to-pressure holding enable 45: Braking unit state 5 46: Power-down signal of power supply unit	14	-	Real time	Real time
8	H03-07	DI3 logic selection	0: Active low 1: Active high 2: Rising edge-triggered 3: Falling edge-triggered 4: Rising/falling edge-triggered	0	-	Real time	Real time

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
9	H03-08	DI4 function	0:No assignment 1: S-ON signal 2: Alarm signal reset 3: Gain switchover switch 12: Zero clamp enable signal 13: Position reference inhibited 14: Positive limit switch 15: Negative limit switch 16: Forward external torque limit 17: Reverse external torque limit 18: Forward jog 19: Reverse jog 25: Torque reference direction 26: Speed reference direction 27: Position reference direction 31: Home switch 32: Homing enable 34: Emergency stop 35: Position deviation cleared 36: Internal speed limit source 37: Pulse reference inhibited 38: Touch probe 1 39: Touch probe 2 40: Master/Slave pump configuration 1 41: Master/Slave pump configuration 2 42: S-ON DO allowed 43: BrakeErrDiTime signal being non-zero 44: DI-to-pressure holding enable 45: Braking unit state 5 46: Power-down signal of power supply unit	14	-	Real time	Real time
10	H03-09	DI4 logic selection	0: Active low 1: Active high 2: Rising edge-triggered 3: Falling edge-triggered 4: Rising/falling edge-triggered	0	-	Real time	Real time

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
11	H03-10	DI5 function	0:No assignment 1: S-ON signal 2: Alarm signal reset 3: Gain switchover switch 12: Zero clamp enable signal 13: Position reference inhibited 14: Positive limit switch 15: Negative limit switch 16: Forward external torque limit 17: Reverse external torque limit 18: Forward jog 19: Reverse jog 25: Torque reference direction 26: Speed reference direction 27: Position reference direction 31: Home switch 32: Homing enable 34: Emergency stop 35: Position deviation cleared 36: Internal speed limit source 37: Pulse reference inhibited 38: Touch probe 1 39: Touch probe 2 40: Master/Slave pump configuration 1 41: Master/Slave pump configuration 2 42: S-ON DO allowed 43: BrakeErrDiTime signal being non-zero 44: DI-to-pressure holding enable 45: Braking unit state 5 46: Power-down signal of power supply unit	14	-	Real time	Real time
12	H03-11	DI5 logic selection	0: Active low 1: Active high 2: Rising edge-triggered 3: Falling edge-triggered 4: Rising/falling edge-triggered	0	-	Real time	Real time
37	H03-36	DI or DO function selection	0: DIO functions as DI5 1: DIO functions as DO3	0	-	Real time	Real time

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
38	H03-37	STO alarm reset	0: STO alarm reset manually 1: STO alarm reset automatically 2: RUN reset manually, RDY reset automatically 3: RUN reports a fault and RDY reports a fault	0	-	Real time	Real time
41	H03-40	DI not received within the period after brake DO output	-	0	ms	Real time	Real time
51	H03-50	AI1 offset	-	0	mV	Real time	Real time
52	H03-51	AI1 input filter time constant	-	2.00	ms	Real time	Real time
54	H03-53	AI1 dead zone	-	10.0	mV	Real time	Real time
55	H03-54	AI1 zero drift	-	0.0	mV	Real time	Real time
56	H03-55	AI2 offset	-	0	mV	Real time	Real time
57	H03-56	AI2 input filter time constant	-	2.00	ms	Real time	Real time
59	H03-58	AI2 offset	-	10.0	mV	Real time	Real time
60	H03-59	AI2 zero drift	-	0.0	mV	Real time	Real time
61	H03-60	AI3 offset	-	0	mV	Real time	Real time
62	H03-61	AI3 input filter time constant	-	2.00	ms	Real time	Real time
64	H03-63	AI3 dead zone	-	0.0	mV	Real time	Real time
65	H03-64	AI3 zero drift	-	0.0	mV	Real time	Real time
66	H03-65	AI3-MODE input mode selection	0: Current type 1: Voltage type	1	-	Real time	Real time
79	H03-78	Pressure sensor source	0: AI3 1: AI1	0	-	Real time	Real time
80	H03-79	AI3 range	0: 0 V to 10 V 1: -10 V to +10 V	0	-	Real time	Next power-on
81	H03-80	Speed corresponding to analog 10 V	-	3000	rpm	At stop	Real time
82	H03-81	Torque corresponding to analog 10 V	-	1.00	%	At stop	Real time

H04 Terminal output parameters

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
1	H04-00	DO1 function	0: No assignment 1: Servo ready 2: Motor rotation 3: Zero speed 4: Speed matching 5: Positioning completed 6: Proximity 7: Torque limited 8: Speed limited 9: Brake 10: Alarm 11: Fault 12: Output 3-bit alarm code 13: Output 3-bit alarm code 14: Output 3-bit alarm code 15: Interrupt positioning completed 16: Homing completed 17: Electrical homing completed 18: Torque reached 19: Speed reached 20: Initial angle auto-tuning completed 21: Dynamic braking signal output 22: Motor fan started 26: STO state output 27: Relief valve control 28: Fault delay output - Used for STO 29: Initialization done 30: S-ON DO allowed	22	-	Real time	Real time
2	H04-01	DO1 logic selection	0: Output low (L) level when active (optocoupler ON) 1: Output high (H) level when active (optocoupler OFF)	0	-	Real time	Real time
3	H04-02	DO2 function	See H04-00.	22	-	Real time	Real time
4	H04-03	DO2 logic selection	0: Output low (L) level when active (optocoupler ON) 1: Output high (H) level when active (optocoupler OFF)	0	-	Real time	Real time
5	H04-04	DO3 function	See H04-00.	22	-	Real time	Real time
6	H04-05	DO3 logic	0: Output low (L) level when active (optocoupler ON) 1: Output high (H) level when active (optocoupler OFF)	0	-	Real time	Real time

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
23	H04-22	DO source	0: DO1 1: DO2 2: DO3	0	-	At stop	Real time
40	H04-39	Motor fan started, with DO outputting high level	-	0	-	Real time	Real time
51	H04-50	AO1 signal	0: Motor speed (1 V/1000 rpm) 1: Speed reference (1 V/1000 rpm) 2: Torque reference (1 V/100 x rated torque) 3: Position deviation (0.05 V/1 reference unit) 4: Position deviation (0.05 V/1 encoder unit) 5: Position reference speed (1 V/1000 rpm) 6: Positioning completed 7: Speed feedforward (1 V/1000 rpm) 8: AI1 voltage 9: AI2 voltage 10: AI3 voltage 12: Setting output voltage magnitude	0	-	Real time	Real time
52	H04-51	AO1 offset voltage	-	0	mV	Real time	Real time
53	H04-52	AO1 override	-	1.00	-	Real time	Real time
57	H04-56	AO1-MODE output selection	0: Current output 1: Voltage output	1	-	Real time	Real time
58	H04-57	AO forced output	-	0.000	V	Real time	Real time

H05 Position control parameters

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
5	H05-04	First-order low-pass filter time constant	-	0.0	ms	At stop	Real time
7	H05-06	Moving average filter time constant of position references	-	0.0	ms	At stop	Real time

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
17	H05-16	Clear action	0: Clear position deviation upon S-OFF and fault 1: Clear position deviation pulses upon fault 2: Clear position deviation upon ClrErr signal input from DI	0	-	At stop	Real time
21	H05-20	Condition for outputting positioning completed (COIN) signal	0: Absolute position deviation lower than the value of 6067h 1: Absolute position deviation lower than the value of 6067h and the filtered position reference is 0 2: Absolute position deviation lower than the value of 6067h and the non-filtered position reference is 0	0	-	Real time	Real time
22	H05-21	Positioning completion amplitude	-	7	-	Real time	Real time
31	H05-30	Homing enable	0: Disable 1: Homing enabled through the HomingStart signal input from DI 2: Electrical homing enabled through the HomingStart signal input from DI 3: Homing started immediately upon power-on 4: Homing started immediately 5: Electrical homing started 6: Current position used as the home	0	-	Real time	Real time

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
3	H05-31	Homing mode	0: Forward homing, home switch as deceleration point and home 1: Reverse homing, home switch as deceleration point and home 2: Forward homing, motor Z signal as deceleration point and home 3: Reverse homing, motor Z signal as deceleration point and home 4: Forward homing, home switch as deceleration point, motor Z signal as home 5: Reverse homing, home switch as deceleration point, motor Z signal as home 6: Forward homing, positive overtravel switch as deceleration point and home 7: Reverse homing, negative overtravel switch as deceleration point and home 8: Forward homing, positive overtravel switch as deceleration point, motor Z signal as home 9: Reverse homing, negative overtravel switch as deceleration point, motor Z signal as home	0	-	At stop	Real time
33	H05-32	Speed of high-speed search for home switch signal	-	100	rpm	Real time	Real time
34	H05-33	Speed of low-speed search for home switch signal	-	10	rpm	Real time	Real time
35	H05-34	Acceleration/ Deceleration time for home search	-	1000	ms	Real time	Real time
36	H05-35	Home search time limit	-	50000	ms	Real time	Real time
37	H05-36	Mechanical home offset	-	0	-	Real time	Real time

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
41	H05-40	Homing method	0: H05.36 as the coordinate after homing, reverse homing applied after homing triggered again upon overtravel 1: H05.36 as the relative offset after homing, reverse homing applied after homing triggered again upon overtravel 2: H05.36 as the coordinate after homing, reverse homing applied automatically upon overtravel 3: H05.36 as the relative offset after homing, reverse homing applied automatically upon overtravel	0	-	At stop	Real time
45	H05-44	Encoder multi-turn data offset	-	0	-	At stop	Real time
47	H05-46	Multi-turn absolute position offset (low 32 bits)	-	0	-	At stop	Real time
49	H05-48	Multi-turn absolute position offset (high 32 bits)	-	0	-	At stop	Real time
66	H05-65	Master-slave synchronous data reception status bit	-	0	-	N/A	-
67	H05-66	Master-slave synchronous data transmission status bit	-	0	-	N/A	-
68	H05-67	Master and slave synchronization	0: Disable 1: Slave synchronized with master	0	-	Real time	Real time
69	H05-68	Master and slave axis setting	0: Slave axis 1: Master axis	0	-	At stop	Real time
70	H05-69	PD filter time for master and slave synchronization	-	0.00	Ms	Real time	Real time
71	H05-70	Master-slave synchronization regulator Kp	-	0.0	Hz	Real time	Real time
72	H05-71	Master-slave synchronization regulator Kd	-	0.0	%	Real time	Real time

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
73	H05-72	Axis CANID for synchronous reception of master and slave	-	0	-	At stop	Real time
74	H05-73	Position transmission delay	-	0	μs	N/A	-
75	H05-74	Axis delay	-	0	μs	N/A	-
76	H05-75	Homing function for master and slave synchronization	0: Disable 1: Enable	0	-	Real time	Real time
77	H05-76	Homing mode for master and slave synchronization	0: Current position as home 1: Find the limit position in the forward direction 2: Find the limit position in the reverse direction 3: Previous position as home	0	-	Real time	Real time
81	H05-80	Re-homing mode for master and slave synchronization	32: Current position as home 35: Previous position as home	35	-	At stop	Real time
82	H05-81	Re-homing function for master and slave synchronization	0: Disable 1: Enable 2: Delayed calculation again	0	-	Real time	Real time
83	H05-82	Excessive position deviation threshold during master and slave synchronization	-	10.0	°	At stop	Real time
84	H05-83	Torque deviation Ki during master and slave synchronization	-	5.0	-	Real time	Real time
85	H05-84	Excessive torque deviation threshold during master and slave synchronization	-	50.0	%	At stop	Real time
86	H05-85	Torque deviation Kp during master and slave synchronization	-	1000	-	Real time	Real time

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
87s	H05-86	Speed reference source of master and slave synchronization	0: Host controller 1: Built-in process of the drive	0	-	At stop	Real time
88	H05-87	Position offset of master and slave synchronization	-	0	-	Real time	Real time

H06 Speed control parameters

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
1	H06-00	Source of speed reference A	0: H06-03 1: AI1 2: AI2	0	-	At stop	Real time
2	H06-01	Source of speed reference B	0: H06-03 1: AI1 2: AI2 3: No action 4: No action 5: Multi-speed reference	0	-	At stop	Real time
3	H06-02	Speed reference source	0: Source of main speed reference A 1: Source of main speed reference B 2: A+B 3: Switched between A and B 4: Communication 5: Hydraulic control 6: Reserved 7: All-electric control	0	-	At stop	Real time
4	H06-03	Speed reference set through operating panel	-	200	rpm	Real time	Real time
5	H06-04	Jog speed setpoint	-	100	rpm	Real time	Real time
6	H06-05	Acceleration ramp time of speed reference	-	200	ms	Real time	Real time
7	H06-06	Deceleration ramp time of speed reference	-	200	ms	Real time	Real time
8	H06-07	Max. speed limit	-	6000	rpm	Real time	Real time
9	H06-08	Forward speed limit	-	6000	rpm	Real time	Real time
10	H06-09	Reverse speed limit	-	6000	rpm	Real time	Real time

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
12	H06-11	Torque feedforward control	0: No torque feedforward 1: Internal torque feedforward 2: 60B2 as external torque feedforward	1	-	Real time	Real time
13	H06-12	Synchronization upon switching from non-enable to enable	-	0	-	Real time	Real time
14	H06-13	Speed reference set through software tool	-	0	-	Real time	Real time
15	H06-14	Speed reference enable through software tool	0: Stop 1: Start	0	-	Real time	Real time
16	H06-15	Reference threshold for zero clamp speed	-	10	rpm	Real time	Real time
17	H06-16	Threshold of TGON (motor rotation) signal	-	20	rpm	Real time	Real time
19	H06-18	Threshold of speed reach signal	-	1000	rpm	Real time	Real time
20	H06-19	Threshold of zero speed output signal	-	10	rpm	Real time	Real time
27	H06-26	Speed reference filter mode	-	0	-	At stop	Real time
28	H06-27	Speed reference low-pass filter time	-	2.00	ms	At stop	Real time
29	H06-28	Speed reference smoothing filter time	-	0.00	ms	At stop	Real time
30	H06-29	Zero clamp OFF threshold	-	1	-	Real time	Real time
34	H06-33	SYNC mode	0: Position synchronization 1: Torque synchronization	0	-	Real time	Real time
35	H06-34	Step skipped during synchronization of paralleled screws	-	0	-	Real time	Real time
36	H06-35	Zero clamp delay	-	0	ms	Real time	Real time
37	H06-36	Speed dead zone	-	1	rpm	Real time	Real time

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
38	H06-37	Slave speed reference source	0: Master/slave axis speed deviation compensation 1: Master axis host controller speed reference & Master/ Slave axis speed deviation compensation	0	-	Real time	Real time
39	H06-38	Zero clamp output limit	-	50	-	Real time	Real time
40	H06-39	Excessive torque deviation during master and slave synchronization.	-	20	%	Real time	Real time
41	H06-40	Home fine-tuning (brick machine)	-	0	-	Real time	Real time
42	H06-41	Home reference position (brick machine)		0	-	Real time	Real time
44	H06-43	Home auto-tuning (brick machine)	0: Disable 1: Enable	0	-	Real time	Real time
45	H06-44	Home auto-tuning completed (brick machine)	0: Not completed 1: Completed	0	-	Real time	Real time
46	H06-45	Master and slave speed compensation limit	-	20	rpm	Real time	Real time

H07 Torque control parameters

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
4	H07-03	Torque reference set through the operating panel	-	0.0	%	Real time	Real time
6	H07-05	Torque reference filter time constant	-	0.79	ms	Real time	Real time
7	H07-06	2nd torque reference filter time constant	-	0.79	ms	Real time	Real time

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
8	H07-07	Torque limit source	0: Forward/Reverse internal torque limit 1: Forward/Reverse external torque limit (using P-CL and N-CL) 2: EtherCAT forward/reverse external torque limit 3: Smaller value between forward/reverse external torque limit and EtherCAT forward/reverse external torque limit used as torque limit (using P-CL and N-CL) 4: Switchover between forward/reverse internal torque limit and EtherCAT forward/reverse external torque limit (using P-CL and N-CL)	2	-	Real time	Real time
10	H07-09	Forward internal torque limit	-	300.0	%	Real time	Real time
11	H07-10	Reverse internal torque limit	-	300.0	%	Real time	Real time
12	H07-11	Forward external torque limit	-	300.0	%	Real time	Real time
13	H07-12	Reverse external torque limit	-	300.0	%	Real time	Real time
16	H07-15	Emergency-stop torque	-	100.0	%	At stop	Real time
18	H07-17	Speed limit source	0: Internal speed limit 1: EtherCAT external speed limit 2: 2007-14h/2007-15h used as internal speed limit, which is selected through FunIN.36	1	-	Real time	Real time
20	H07-19	Internal speed limit in torque control	-	3000	rpm	Real time	Real time
21	H07-20	Negative internal speed limit in torque control	-	3000	rpm	Real time	Real time
22	H07-21	Reference value for torque reach	-	0.0	%	Real time	Real time
23	H07-22	Output torque upon torque reach DO signal ON	-	20.0	%	Real time	Real time
24	H07-23	Output torque upon torque reach DO signal OFF	-	10.0	%	Real time	Real time
25	H07-24	Field weakening depth	-	1.15	%	Real time	Real time

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
26	H07-25	Max. permissible demagnetizing current	-	1.00	%	Real time	Real time
27	H07-26	Field weakening selection	0: Disable 1: Enable	1	-	Real time	Real time
28	H07-27	Field weakening gain	-	300	-	Real time	Real time
35	H07-34	Overload ratio increase	-	0	-	At stop	Next power-on
41	H07-40	Speed limit threshold in torque control mode	-	1.0	ms	Real time	Real time
53	H07-52	Real time power monitoring of the drive unit	-	0.00	kW	N/A	-

H08 Gain parameters

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
1	H08-00	Speed loop gain	-	25.0	Hz	Real time	Real time
2	H08-01	Speed loop integral time constant	-	31.83	ms	Real time	Real time
3	H08-02	Position loop gain	-	40.0	Hz	Real time	Real time
4	H08-03	2nd speed loop gain	-	50.0	Hz	Real time	Real time
5	H08-04	2nd speed loop integral time constant	-	15.92	ms	Real time	Real time
6	H08-05	2nd position loop gain	-	80.0	Hz	Real time	Real time
7	H08-06	Authority	0: Speed preferred 1: Performance preferred	2	-	At stop	Real time
9	H08-08	2nd gain mode setting	0: Fixed to the 1st gain set, switched between P and PI by external DI 1: Switched between the 1st and 2nd gain set according to H08-09	1	-	Real time	Real time

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
10	H08-09	Gain switchover condition	0: Fixed to the 1st gain (PS) 2: Large torque reference (PS) 3: Large speed reference (PS) 4: Large speed reference change rate (PS) 5: High-speed/low-speed threshold for speed reference (PS) 6: Large position deviation (P) 7: Position reference available (P) 8: Positioning incomplete (P) 9: Actual speed (P) 10: Position reference available + actual speed (P)	0	-	Real time	Real time
11	H08-10	Gain switchover delay	-	5.0	ms	Real time	Real time
12	H08-11	Gain switchover level	-	50	-	Real time	Real time
13	H08-12	Gain switchover hysteresis	-	30	-	Real time	Real time
14	H08-13	Position gain switchover time	-	3.0	ms	Real time	Real time
16	H08-15	Load moment of inertia ratio	-	1.00	-	Real time	Real time
19	H08-18	Time constant of speed feedforward filter	-	0.50	ms	Real time	Real time
20	H08-19	Speed feedforward gain	-	0.0	%	Real time	Real time
21	H08-20	Torque feedforward filter time constant	-	0.50	ms	Real time	Real time
22	H08-21	Torque feedforward gain	-	0.0	%	Real time	Real time
23	H08-22	Speed feedback filtering option	0: Inhibited 1: 2 times 2: 4 times 3: 8 times 4: 16 times	0	-	At stop	Real time
24	H08-23	Cutoff frequency of speed feedback low-pass filter	-	4000	-	Real time	Real time
25	H08-24	PDFF control coefficient	-	100.0	%	Real time	Real time

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
29	H08-28	Speed feedforward coefficient 2	-	0	-	Real time	Real time
47	H08-46	PI/P switchover torque	-	0	-	Real time	Real time
48	H08-47	Speed stability judgment range	-	5	-	Real time	Real time
49	H08-48	Speed stability judgment time	-	0	-	Real time	Real time

H09 Auto-tuning parameters

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
1	H09-00	Auto-tuning mode	0: Disabled, manual gain tuning applied 1: Enabled, gain parameters generated automatically based on the stiffness level 2: Positioning mode, gain parameters generated automatically based on the stiffness level	1	-	Real time	Real time
2	H09-01	Stiffness level selection	-	13	-	Real time	Real time
3	H09-02	Adaptive notch mode	0: Adaptive notches no longer updated 1: One adaptive notch activated (3rd notch) 2: Two adaptive notches activated (3rd and 4th notches) 3: Resonance point tested only, shown in H09.24 4: Adaptive notch cleared, values of 3rd and 4th notches restored to default	0	-	Real time	Real time
4	H09-03	Online inertia auto-tuning mode	0: Online auto-tuning disabled 1: Online auto-tuning enabled, changing slowly 2: Online auto-tuning enabled, changing regularly 3: Online auto-tuning enabled, changing quickly	0	-	Real time	Real time
5	H09-04	Low-frequency resonance suppression mode	0: Parameters of low-frequency resonance suppression filter set manually 1: Parameters of low-frequency resonance suppression filter set automatically	0	-	Real time	Real time

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
6	H09-05	Offline inertia auto-tuning mode	0: Positive and negative triangular wave mode 1: Jog mode	0	-	At stop	Real time
7	H09-06	Max. speed of inertia auto-tuning	-	500	rpm	At stop	Real time
8	H09-07	Time constant for accelerating to max. speed during inertia auto-tuning	-	125 m	ms	At stop	Real time
9	H09-08	Interval time after an individual inertia auto-tuning	-	800	ms	At stop	Real time
10	H09-09	Number of motor revolutions per inertia auto-tuning	-	0.00	-	N/A	-
13	H09-12	Frequency of the 1st notch	-	4000	-	Real time	Real time
14	H09-13	Width level of the 1st notch	-	2	-	Real time	Real time
15	H09-14	Depth level of the 1st notch	-	0	-	Real time	Real time
16	H09-15	Frequency of the 2nd notch	-	4000	-	Real time	Real time
17	H09-16	Width level of the 2nd notch	-	2	-	Real time	Real time
18	H09-17	Depth level of the 2nd notch	-	0	-	Real time	Real time
19	H09-18	Frequency of the 3rd notch	-	4000	-	Real time	Real time
20	H09-19	Width level of the 3rd notch	-	2	-	Real time	Real time
21	H09-20	Depth level of the 3rd notch	-	0	-	Real time	Real time
22	H09-21	Frequency of the 4th notch	-	4000	-	Real time	Real time
23	H09-22	Width level of the 4th notch	-	2	-	Real time	Real time
24	H09-23	Depth level of the 4th notch	-	0	-	Real time	Real time
25	H09-24	Auto-tuned resonance frequency	-	0	-	N/A	-

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
31	H09-30	Torque disturbance compensation gain	-	0.0	%	Real time	Real time
32	H09-31	Filter time constant of torque disturbance observer	-	0.50	ms	Real time	Real time
38	H09-38	Frequency of low-frequency resonance	-	100.0	Hz	At stop	Real time
40	H09-39	Width of low-frequency resonance suppression	-	2	-	At stop	Real time
41	H09-40	Overshoot integral limit	-	8	-	Real time	Real time
42	H09-41	Reset fault 901	0: No operation 1: Reset fault 901	0	-	Real time	Real time

H0A Fault and protection parameters

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
1	H0A-00	Power input phase loss protection	0: Enable phase loss fault and inhibit phase loss alarm 1: Enable phase loss fault and alarm 2: Disable phase loss fault and alarm	0	-	Real time	Real time
2	H0A-01	Absolute position limit	0: Disable 1: Enable 2: Enabled after homing	0	-	At stop	Real time
3	H0A-02	730 fault flag bit	-	0	-	At stop	Real time
4	H0A-03	Power-off memory	0: Disable power-off memory 1: Enable power-off memory 2: Disable power-off memory and hide control power undervoltage fault	1	-	Real time	Real time
5	H0A-04	Motor overload protection gain	-	100	-	At stop	Real time
7	H0A-06	Motor overload level	-	0	-	At stop	Real time

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
8	H0A-07	U/V/W phase sequence auto-tuning	0: Auto-tuning of the U/V/W phase sequence not performed during angle auto-tuning 1: Auto-tuning of the U/V/W phase sequence performed during angle auto-tuning	1	-	Real time	Real time
9	H0A-08	Overspeed threshold	-	0	-	Real time	Real time
13	H0A-12	Runaway protection	0: Disabled 1: Enabled	1	-	Real time	Real time
26	H0A-25	Filter time constant of speed feedback display value	-	2	ms	At stop	Real time
33	H0A-32	Time window of motor stall overtemperature protection	-	200	ms	Real time	Real time
34	H0A-33	Motor stall overtemperature protection	0: Disable 1: Enable	0	-	Real time	Real time
37	H0A-36	Encoder multi-turn overflow fault	0: Not hide 1: Hide	1	-	At stop	Real time

H0B Monitoring parameters

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
1	H0B-00	Actual motor speed	-	0	rpm	N/A	-
2	H0B-01	Speed reference	-	0	rpm	N/A	-
3	H0B-02	Internal torque reference	-	0.0	%	N/A	-
4	H0B-03	Input (DI) signal monitoring	-	0	-	N/A	-
5	H0B-04	STO 24 V ON state	-	0	-	N/A	-
6	H0B-05	DO signal monitoring	-	0	-	N/A	-
8	H0B-07	Absolute position counter	-	0	p	N/A	-
10	H0B-09	Mechanical angle	-	0	°	N/A	-
11	H0B-10	Electrical angle	-	0.0	°	N/A	-
13	H0B-12	Average load ratio	-	0.0	%	N/A	-
14	H0B-13	Input position reference counter	-	0	p	N/A	-
16	H0B-15	Encoder position deviation counter	-	0	p	N/A	-
18	H0B-17	Feedback pulse counter	-	0	p	N/A	-

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
20	H0B-19	Total operating time	-	0.0	s	N/A	-
22	H0B-21	AI1 sampling voltage (valid value)	-	0.00	V	N/A	-
23	H0B-22	AI2 sampling voltage (valid value)	-	0.00	V	N/A	-
24	H0B-23	AI3 sampling voltage (valid value)	-	0.00	V	N/A	-
25	H0B-24	Phase current RMS value	-	0.00	A	N/A	-
27	H0B-26	Bus voltage	-	0.0	V	N/A	-
28	H0B-27	Drive temperature	-	0	° C	N/A	-
34	H0B-33	Fault log	-	0	-	Real time	Real time
35	H0B-34	Fault code of the selected fault	-	0	-	N/A	-
36	H0B-35	Timestamps of the selected fault	-	0.0	s	N/A	-
38	H0B-37	Motor speed upon occurrence of the selected fault	-	0	rpm	N/A	-
39	H0B-38	Motor phase U current upon occurrence of the selected fault	-	0.00	A	N/A	-
40	H0B-39	Motor phase V current upon occurrence of the selected fault	-	0.00	A	N/A	-
41	H0B-40	Bus voltage upon occurrence of the selected fault	-	0.0	V	N/A	-
42	H0B-41	Input terminal state on selected fault	-	0	-	N/A	-
43	H0B-42	Output terminal status upon occurrence of the selected fault	-	0	-	N/A	-
44	H0B-43	Number of the group with abnormal parameters	-	0	-	N/A	-
45	H0B-44	Offset in the group with abnormal parameters	-	0	-	N/A	-
46	H0B-45	Internal fault code	-	0	-	N/A	-
52	H0B-51	Internal fault code upon occurrence of the selected fault	-	0	-	N/A	-
54	H0B-53	Position deviation counter	-	0	p	N/A	-
56	H0B-55	Actual motor speed	-	0.0	rpm	N/A	-
59	H0B-58	Mechanical absolute position (low 32 bits)	-	0	p	N/A	-
61	H0B-60	Mechanical absolute position (high 32 bits)	-	0	p	N/A	-
63	H0B-62	Effective value of drive output voltage	-	0.0	V	N/A	-
67	H0B-66	Temperature of the power supply unit	-	0	° C	N/A	-
71	H0B-70	Number of absolute encoder revolutions	-	0	p	N/A	-
72	H0B-71	Single-turn position fed back by the absolute encoder	-	0	p	N/A	-

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
78	H0B-77	Encoder position (low 32 bits)	-	0	p	N/A	-
80	H0B-79	Encoder position (high 32 bits)	-	0	p	N/A	-
82	H0B-81	Single-turn position of the rotary load (low 32 bits)	-	0	p	N/A	-
84	H0B-83	Single-turn position of the rotary load (high 32 bits)	-	0	p	N/A	-
86	H0B-85	Single-turn position of the rotary load (reference unit)	-	0	p	N/A	-
89	H0B-88	Motor temperature	-	0	° C	N/A	-
91	H0B-90	U phase current	-	0.00	A	N/A	-
92	H0B-91	V phase current	-	0.00	A	N/A	-
93	H0B-92	W phase current	-	0.00	A	N/A	-
94	H0B-93	Temperature threshold for turning on the motor fan	-	45	° C	Real time	Real time

H0C Communication parameters

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
1	H0C-00	Drive axis address	-	1	-	Real time	Next power-on
3	H0C-02	Baud rate of the serial port	0: 2400 bps 1: 4800 bps 2: 9600 bps 3: 10200 bps 4: 38400 bps 5: 115201 bps	5	-	Real time	Real time
4	H0C-03	Modbus parity check	0: No parity, 2 stop bits 1: Even parity, 1 stop bit 2: Odd parity, 1 stop bit 3: No parity, 1 stop bit	0	-	Real time	Real time
5	H0C-04	EtherCAT slave name	-	0	-	N/A	-
6	H0C-05	EtherCAT slave alias	-	0	-	At stop	Real time
9	H0C-08	CAN communication baud rate	0: 20 k 1: 50 k 2: 100 k 3: 125 k 4: 250 k 5: 500 k 6: 800 k 7: 1 M	5	-	Real time	Real time

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
14	H0C-13	Saving values written through communication to EPPROM	0: Not saving 1: Saving 2000h object dictionaries written through communication to EEPROM 2: Saving 6000h object dictionaries written through communication to EEPROM 3: Saving 2000h and 6000h object dictionaries written through communication to EEPROM	3	-	Real time	Real time
21	H0C-20	Master and slave synchronized with CAN	0: Standard program 1: Synchronizing with CAN programs	0	-	At stop	Next power-on
23	H0C-22	DC mode of ECAT	-	2	-	Real time	Next power-on
24	H0C-23	AL status code	-	0	-	N/A	-
29	H0C-28	Host controller sync cycle	-	0	-	N/A	-
30	H0C-29	XML version	-	0.0	-	N/A	-
34	H0C-33	CAN communication selection of power supply unit	0: Disable 1: Enable	0	-	Real time	Real time
35	H0C-34	Number of sync loss events	-	0	-	N/A	-
36	H0C-35	Number of sync interrupts allowed by EtherCAT	-	500	-	Real time	Real time
45	H0C-44	FPGA sync detection deviation threshold	-	3500	-	At stop	Real time
49	H0C-48	EtherCAT state machine	-	0	-	N/A	-

H0D Auxiliary function parameters

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
1	H0D-00	Software reset	0: Disable 1: Enable	0	-	At stop	Real time
2	H0D-01	Fault reset	0: No operation 1: Enable	0	-	At stop	Real time
3	H0D-02	Inertia auto-tuning	-	0	-	Real time	Real time

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
4	H0D-03	Encoder initial angle auto-tuning	0: No operation 1: Enable	0	-	At stop	Real time
5	H0D-04	Read/write in encoder ROM	0: No operation 1: Write ROM 2: Read ROM	0	-	At stop	Real time
6	H0D-05	One-key auto-tuning	0: No operation 1: Auto-tuning 1 2: Auto-tuning 2	0	-	At stop	Real time
11	H0D-10	AI automatic zero offset adjustment	0: Off 1: Automatic AI1 calibration	0	-	At stop	Real time
12	H0D-11	JOG selection	-	0	-	Real time	Real time
18	H0D-17	Forced DI/DO selection	0: No operation 1: Forced DI enabled, forced DO disabled 2: Forced DO enabled, forced DI disabled 3: Forced DI and DO enabled 4: EtherCAT-forced DO enabled, forced DI disabled	0	-	Real time	Real time
19	H0D-18	Forced DI setting	-	447	-	Real time	Real time
20	H0D-19	Forced DO setting	-	0	-	Real time	Real time
21	H0D-20	Absolute encoder reset	0: No operation 1: Reset the fault 2: Reset the fault and multi-turn data	0	-	At stop	Real time

Group H0E: Error and stop parameters

Setting range

0: Coast to stop
1: External dynamic braking stop, keeping de-energized status
2: External dynamic braking stop, keeping dynamic braking state
3: Internal dynamic braking stop, keeping de-energized status
4: Internal dynamic braking stop, keeping dynamic braking state
5: Stop at zero speed, keeping de-energized status
6: Stop at zero speed, keeping position lock status
7: Stop based on smooth deceleration, keeping de-energized status
8: Stop based on smooth deceleration, keeping position lock status
9: Stop based on smooth deceleration and torque reduction, keeping de-energized status
A: Stop based on smooth deceleration and torque reduction, keeping position lock status

Index (Decimal)	Param.	Name	Default	Unit	Change mode	Effective time
1	H0E-00	Stop mode for the 1st group of faults	0x0000	-	At stop	Real time
	Setting range: Ones (0 to A): Access to FPGA by MCU timeout (E.100.0) Tens (0 to A): Logic configuration fault (E.102.0) Hundreds (0 to A): Mismatch between FPGA and MCU models (E.103.0) Thousands (0 to A): FPGA interruption timeout (E.104.0)					
2	H0E-01	Stop mode for the 2nd group of faults	0x0000	-	At stop	Real time
	Setting range: Ones (0 to A): Current loop or software interruption timeout (E.104.1) Tens (0 to A): System parameter error cannot be reset, requiring parameters to be restored to default (E.105.0) Hundreds (0 to A): Write parameter storage fault (E.108.0) Thousands (0 to A): Read parameter storage fault (E.108.1)					
3	H0E-02	Stop mode for the 3rd group of faults	0x0000	-	At stop	Real time
	Setting range: Ones (0 to A): Manufacturer parameter error (E.111.0) Tens (0 to A): Product matching fault, no corresponding encoder (E.120.0) Hundreds (0 to A): Product matching fault, no corresponding motor (E.120.1) Thousands (0 to A): Read parameter storage fault (E.108.1)					
4	H0E-03	Stop mode for the 4th group of faults	0x0000	-	At stop	Real time
	Setting range: Ones (0 to A): Parameter not match when set to 2nd encoder motor model (E.122.0) Tens (0 to A): Product matching fault, no corresponding drive (E.123.0) Hundreds (0 to A): Data check error or no parameter saved in the motor ROM (E.136.0) Thousands (0 to A): Serial-type motor code error (E.120.2)					
5	H0E-04	Stop mode for the 5th group of faults	0x0400	-	At stop	Real time
	Setting range: Ones (0 to A): FPGA system sampling operation timeout (E.208.0) Tens (0 to A): Timeout caused by failure of MCU to timely update torque references (E.208.1) Hundreds (0 to A): Error caused by encoder communication timeout (E.208.2) Thousands (0 to A): Error caused by current sampling (7860) (E.208.3)					
6	H0E-05	Stop mode for the 6th group of faults	0x0400	-	At stop	Real time
	Setting range: Ones (0 to A): Error caused by analog/digital conversion timeout (E.208.4) Tens (0 to A): Output short-circuited to ground (E.210.0) Hundreds (0 to A): Output short-circuited to ground (E.210.1) Thousands (0 to A): Encoder battery failure (E.731.0)					
7	H0E-06	Stop mode for the 7th group of faults	0x4444	-	At stop	Real time
	Setting range: Ones (0 to A): Encoder multi-turn counting error (E.733.0) Tens (0 to A): Encoder multi-turn counting overflow (E.735.0) Hundreds (0 to A): Encoder multi-turn counting overflow (E.735.1) Thousands (0 to A): Encoder Z signal interference (E.740.0)					

Index (Decimal)	Param.	Name	Default	Unit	Change mode	Effective time
8	H0E-07	Stop mode for the 8th group of faults	0x4444	-	At stop	Real time
	Setting range: Ones: (0 to A): Encoder Z signal interference (E.740.8) Tens (0 to A): Nikon encoder (E.767.0) Hundreds (0 to A): Nikon encoder EEPROM damaged (E.765.2) Thousands (0 to A): AD sampling fault reported by FPGA (E.835.0)					
9	H0E-08	Stop mode for the 9th group of faults	0xA444	-	At stop	Real time
	Setting range: Ones: (0 to A): Encoder Z signal interference (E.740.8) Tens (0 to A): Nikon encoder (E.767.0) Hundreds (0 to A): Nikon encoder EEPROM damaged (E.765.2) Thousands (0 to A): AD sampling fault reported by FPGA (E.835.0)					
10	H0E-09	Stop mode for the 10th group of faults	0x0444	-	At stop	Real time
	Setting range: Ones (0 to A): Encoder parameter error (E.A33.0) Tens (0 to A): Encoder echo check error (E.A34.0) Hundreds (0 to A): Z disconnected (E.A35.0) Thousands (0 to A): System parameter error (E.101.0)					
11	H0E-10	Stop mode for the 11th group of faults	0x0000	-	At stop	Real time
	Setting range: Ones (0 to A): Model code check error (E.102.1) Tens (0 to A): Motor parameter mismatch upon absolute position setting (E.122.1) Hundreds (0 to A): DI function assignment fault (E.130.0) Thousands (0 to A): DO function assignment fault (E.131.0)					
12	H0E-11	Stop mode for the 12th group of faults	0x0004	-	At stop	Real time
	Setting range: Ones (0 to A): EEPROM error in reading/writing ABSENC (E.135.0) Tens (0 to A): Hardware overcurrent (E.201.0) Hundreds (0 to A): Hardware overcurrent (E.201.1) Thousands (0 to A): Hardware overcurrent (E.201.2)					
13	H0E-12	Stop mode for the 13th group of faults	0x0004	-	At stop	Real time
	Setting range: Ones (0 to A): Hardware overcurrent (E.201.3) Tens (0 to A): D/Q current overflow (E.207.0) Hundreds (0 to A): UVW wiring error, requiring any two phase cables to be swapped (E.220.0) Thousands (0 to A): UVW phase loss (E.220.1)					
14	H0E-13	Stop mode for the 14th group of faults	0x4444	-	At stop	Real time
	Setting range: Ones (0 to A): Runaway alarm upon incorrect wiring of U, V, and W phases (E.234.0) Tens (0 to A): Overvoltage (E.400.0) Hundreds (0 to A): Undervoltage (E.410.0) Thousands (0 to A): Speed exceeding the max. speed					

Index (Decimal)	Param.	Name	Default	Unit	Change mode	Effective time
15	H0E-14	Stop mode for the 15th group of faults	0x4004	-	At stop	Real time
	Setting range: Ones (0 to A): FPGA internal speed measurement overflow (E.501.0) Tens (0 to A): Offline inertia auto-tuning failure (E.600.0) Hundreds (0 to A): Angle auto-tuning failure (E.602.0) Thousands (0 to A): Encoder interference fault (E.740.2)					
16	H0E-15	Stop mode for the 16th group of faults	0x4444	-	At stop	Real time
	Setting range: Ones (0 to A): Single-turn calculation error (E.740.3) Tens (0 to A): Counting increment error (E.740.4) Hundreds (0 to A): Nikon encoder communication fault (E.755.0) Thousands (0 to A): Nikon encoder communication fault (E.755.1)					
17	H0E-16	Stop mode for the 17th group of faults	0x0000	-	At stop	Real time
	Setting range: Ones (0 to A): Angle auto-tuning timeout (E.800.0) Tens (0 to A): Parameter auto-tuning timeout (E.800.1) Hundreds (0 to A): PI auto-tuning timeout (E.800.2) Thousands (0 to A): Parameter auto-tuning canceled (E.801.0)					
18	H0E-17	Stop mode for the 18th group of faults	0xA44A	-	At stop	Real time
	Setting range: Ones (0 to A): AD sampling overvoltage of the DSP (E.834.1) Tens (0 to A): AD sampling overvoltage of the DSP (E.834.2) Hundreds (0 to A): AD sampling overvoltage of the DSP (E.834.3) Thousands (0 to A): AD zero drift error (E.836.0)					
19	H0E-18	Stop mode for the 19th group of faults	0x4400	-	At stop	Real time
	Setting range: Ones (0 to A):Excessive encoder position deviation upon power-on again (E.901.0) Tens (0 to A): Motor power cables disconnected (E.939.0) Hundreds (0 to A): Excessive speed deviation (E.044.0) Thousands (0 to A): Excessive deviation due to torque limit (E.044.1)					
20	H0E-19	Stop mode for the 20th group of faults	0x4244	-	At stop	Real time
	Setting range: Ones (0 to A): Pressure sensor disconnected (E.046.0) Tens (0 to A): S-ON command invalid (E.121.0) Hundreds (0 to A): STO signal input protection (E.300.0) Thousands (0 to A): Power supply unit fault (E.422.0)					
21	H0E-20	Stop mode for the 21st group of faults	0x4444	-	At stop	Real time
	Setting range: Ones (0 to A): Power-down fault of the power supply unit (E.423.0) Tens (0 to A): Root extraction error (E.466.0) Hundreds (0 to A): Frequency division pulse output overspeed (E.510.0) Thousands (0 to A): Drive overload (E.610.0)					

Index (Decimal)	Param.	Name	Default	Unit	Change mode	Effective time
22	H0E-21	Stop mode for the 22nd group of faults	0x4444	-	At stop	Real time
	Setting range: Ones (0 to A): Motor overload (E.620.0) Tens (0 to A): Motor overload (E.620.1) Hundreds (0 to A):Motor stall overtemperature protection (E.630.0) Thousands (0 to A): Heatsink overtemperature (E.650.0)					
23	H0E-22	Stop mode for the 23rd group of faults	0x44AA	-	At stop	Real time
	Setting range: Ones (0 to A): Motor overtemperature (PTC) (E.660.0) Tens (0 to A): Temperature too high (E.660.1) Hundreds (0 to A): Encoder battery alarm (E.730.0) Thousands (0 to A): Encoder TX-end communication check error (E.732.0)					
24	H0E-23	Stop mode for the 24th group of faults	0x4444	-	At stop	Real time
	Setting range: Ones (0 to A): Encoder Z signal interference (E.745.0) Tens (0 to A): Encoder Z signal interference (E.750.2) Hundreds (0 to A): Encoder Z signal interference (E.750.3) Thousands (0 to A): Encoder Z signal interference (E.750.4)					
25	H0E-24	Stop mode for the 25th group of faults	0x4444	-	At stop	Real time
	Setting range: Ones (0 to A): Encoder Z signal interference (E.750.5) Tens (0 to A): Encoder Z signal interference (E.750.6) Hundreds (0 to A): Encoder overtemperature (E.760.0) Thousands (0 to A): Nikon encoder limit violation (overtemperature, overspeed, and encoder EEPROM access error) (E.765.0)					
26	H0E-25	Stop mode for the 26th group of faults	0x4A40	-	At stop	Real time
	Setting range: Ones (0 to A): Three-phase imbalance (E.940.0) Tens (0 to A): Frequent parameter storage (E.942.0) Hundreds (0 to A): Limit of position reference or feedback reached (E.997.0) Thousands (0 to A): Object dictionary value setting error (E.998.0)					
27	H0E-26	Stop mode for the 27th group of faults	0x0000	-	At stop	Real time
	Setting range: Ones (0 to A): Resistance auto-tuning failure (E.A42.1) Hundreds (0 to A): Inductance auto-tuning failure (E.A42.2) Hundreds (0 to A) Back EMF auto-tuning failure (E.A42.3) Thousands (0 to A): Motor parameter auto-tuning failure (E.A42.6)					
28	H0E-27	Stop mode for the 28th group of faults	0x44AA	-	At stop	Real time
	Setting range: Ones (0 to A): Excessive position deviation (E.B00.6) Tens (0 to A): Position reference input error (E.B01.0) Hundreds (0 to A): Electronic gear ratio setting error (E.B03.0) Thousands (0 to A): Electronic gear ratio setting error (E.B03.1)					

Index (Decimal)	Param.	Name	Default	Unit	Change mode	Effective time
29	H0E-28	Stop mode for the 29th group of faults	0xA444	-	At stop	Real time
	Setting range: Ones (0 to A): Electronic gear ratio setting error (E.B03.2) Tens (0 to A): ECT electronic gear ratio setting error (E.B03.3) Hundreds (0 to A): Switchover (internal/external) not allowed during hybrid use of fully closed-loop and multi-position absolute modes (E.B04.0) Thousands (0 to A): Module protection parameter read error (E.B05.0)					
30	H0E-29	Stop mode for the 30th group of faults	0xAAAA	-	At stop	Real time
	Setting range: Ones (0 to A): Reset after saving mold protection parameters (E.B06.0) Tens (0 to A): Number of points to be collected higher than the maximum number of points 8 x 1024 (E.B07.0) Hundreds (0 to A): Mold protection (E.B08.0) Thousands (0 to A): Communication interrupted (E.D03.0)					
31	H0E-30	Stop mode for the 31th group of faults	0xAAAA	-	At stop	Real time
	Setting range: Ones (0 to A): CANopen communication timeout (E.D04.0) Tens (0 to A): CANopen communication initialized (E.D05.0) Hundreds (0 to A): CANopen communication reset (E.D06.0) Thousands (0 to A): Bus disconnected (E.D07.0)					
32	H0E-31	Stop mode for the 32th group of faults	0xAAAA	-	At stop	Real time
	Setting range: Ones (0 to A): Bus PDO transmission length error (E.D08.0) Tens (0 to A): Lower limit of software position higher than the upper limit (E.D09.0) Hundreds (0 to A): Home offset outside the software position limit (E.D10.0) Thousands (0 to A): Sync frame error exceeding 1/4 of the sync cycle (E.D11.0)					
33	H0E-32	Stop mode for the 33th group of faults	0xAAAA	-	At stop	Real time
	Setting range: Ones (0 to A): Power supply unit CAN information loss (E.D12.0) Tens (0 to A): Bus disconnected (E.E01.0) Hundreds (0 to A): Bus off (E.E02.0) Thousands (0 to A): Bus connection timeout (E.E03.0)					
34	H0E-33	Stop mode for the 34th group of faults	0xAAAA	-	At stop	Real time
	Setting range: Ones (0 to A): Expansion card internal communication timeout (E.E04.0) Tens (0 to A): Station number conflict (E.E05.0) Hundreds (0 to A): Station No. setting error (E.E06.0) Thousands (0 to A): Communication state machine error (E.E07.6)					
35	H0E-34	Stop mode for the 35th group of faults	0x4AA4	-	At stop	Real time
	Setting range: Ones (0 to A): Sync loss (E.E08.0) Tens (0 to A): System parameter error (E.E09.0) Hundreds (0 to A): Configuration error (E.E0A.0) Thousands (0 to A): ESI configuration file not burned (E.E11.6)					

Index (Decimal)	Param.	Name	Default	Unit	Change mode	Effective time
36	H0E-35	Stop mode for the 36th group of faults	0xAAA4	-	At stop	Real time
	Setting range: Ones (0 to A): ECAT initialization failed (E.E12.0) Tens (0 to A): ECAT sync cycle not being a multiple of the PWM cycle (E.E13.0) Hundreds (0 to A): Excessive deviation of the ECAT sync signal (E.E15.0) Thousands (0 to A): Synchronous reception of master and slave failed (E.E20.1)					
37	H0E-36	Stop mode for the 37th group of faults	0x4AAA	-	At stop	Real time
	Setting range: Ones (0 to A): Synchronous transmission of master and slave failed (E.E20.2) Tens (0 to A): Excessive synchronous transmission delay of master and slave (E.E20.3) Hundreds (0 to A): Excessive position deviation during master and slave synchronization (E.E20.4) Thousands (0 to A): Excessive torque deviation during master and slave synchronization (E.E20.5)					
38	H0E-37	Stop mode for the 38th group of faults	0xAAAA	-	At stop	Real time
	Setting range: Ones (0 to A): Master and slave axes faulty simultaneously (E.E20.6) Tens (0 to A): False home (E.E20.7) Hundreds (0 to A): Injection axis limit alarm (E.B09.0) Thousands (0 to A): Process parameter setting error (E.B10.0)					
39	H0E-38	Stop mode for the 39th group of faults	0xAA24	-	At stop	Real time
	Setting range: Ones (0 to A): Paralleled screw fault in torque synchronous mode (E.E21.0) Tens (0 to A): STO signal input protection, used when 03-37 = 2 (E.300.1) Hundreds (0 to A): Brake error (E.310.0) Thousands (0 to A): ESI check failed, namely XML_FLASH check failed (E.E11.0)					
40	H0E-39	Stop mode for the 40th group of faults	0x004A	-	At stop	Real time
	Setting range: Ones (0 to A): XMLEEPROM read/write failure (E.E11.1) Tens (0 to A): Pressure sensor disconnected (voltage too low) (E.046.1) Hundreds (0 to A): Braking unit DI loss (E.311.1) Thousands (0 to A): Master/Slave synchronous quick stop (E.E25.0)					
41	H0E-40	Stop mode for the 41st group of faults	0x0444	-	At stop	Real time
	Setting range: Ones (0 to A): Forward overtravel (E.010.0) Tens (0 to A): Reverse overtravel (E.010.1) Hundreds (0 to A): Forward/Reverse limit setting error (E.010.2)					

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
42	H0E-41	Stop mode upon alarm	-	0	-	At stop	Real time
43	H0E-42	Deceleration time for stop based on torque reduction	-	0.050	s	At stop	Real time
44	H0E-43	Switch for enabling stop upon alarm	0: Disable 1: Enable	0	-	At stop	Real time

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
45	H0E-44	Error reporting test	-	0	-	Real time	Real time
46	H0E-45	Stop mode switchover upon fault	0: No operation 1: First stop mode 2: Second stop mode	0	-	At stop	Real time
47	H0E-46	Deceleration time for stop based on smooth deceleration	-	0.025	s	At stop	Real time
48	H0E-47	Input error code	-	0.0	-	Real time	Real time

H11 Multi-position parameters

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
1	H11-00	Mode selection (low 16 bits) control word (high 16 bits)	Ones: Mode selection 0: Process built-in off 1: Injection 2: Back pressure 3: Injection backward 4: Mold close/open 5: Ejection pin 6: Homing 7: Hydraulic pressure Ten thousands: Control word 0: No action 1: Injection start 2: Back pressure start 3: Injection backward started before storage 4: Injection backward started after storage 5: Mold opening start 6: Mold close start 7: Ejection start 8: Ejection backward start 9: Cyclic ejection start 10: 11: Homing start 12: Initial ejection start 13: Initial ejection backward start 14: Stop halfway	0	-	Real time	Real time
3	H11-02	Homing speed	-	10.0	rpm	Real time	Real time
4	H11-03	Home position setting H32H	-	0	-	N/A	-

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
5	H11-04	Zero position setting H32L	-	0	-	N/A	-
6	H11-05	Zero position setting L32H	-	0	-	N/A	-
7	H11-06	Zero position setting L32L	-	10000	-	N/A	-
8	H11-07	Back distance after homing done	-	0.00	mm	Real time	Real time
9	H11-08	Pressure holding switchover mode (basic injection parameter)	0: Time only 1: Position time 2: Pressure time 3: Position pressure time 4: Time speed 5: Time position speed 6: Time pressure speed 7: Time position pressure speed 8: Time and external communication	0	-	Real time	Real time
10	H11-09	Pressure holding switchover pressure (basic injection parameter)	-	50.0	Mpa	Real time	Real time
11	H11-10	Pressure holding switchover position (basic injection parameter)	-	10.00	mm	Real time	Real time
12	H11-11	Pressure holding switchover speed (basic injection parameter)	-	100.0	rpm	Real time	Real time
13	H11-12	Injection time (basic injection parameter)	-	65.535	s	Real time	Real time
14	H11-13	System pressure (pressure sensor-related)	-	175.0	Mpa	Real time	Real time
15	H11-14	Max. pressure (pressure sensor-related)	-	250.0	Mpa	Real time	Real time
16	H11-15	Min. input voltage (pressure sensor-related)		0.000	V	Real time	Real time
17	H11-16	Corresponding setting of min. input of pressure sensor (pressure sensor-related)	-	0.0	Mpa	Real time	Real time
18	H11-17	Max. input voltage of pressure sensor (pressure sensor-related)	-	10.000	V	Real time	Real time
19	H11-18	Corresponding setting of max. input of pressure sensor (pressure sensor-related)	-	250.0	Mpa	Real time	Real time
20	H11-19	Max. motor speed	-	2200	rpm	At stop	Real time
21	H11-20	Max. stroke of the screw (low 16 bits of the max. position)	-	200.00	mm	At stop	Real time

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
22	H11-21	Max. stroke of the screw (high 16 bits of the max. position)	-	0	mm	At stop	Real time
23	H11-22	Max. torque allowed by the action	-	300.0	%	Real time	Real time
24	H11-23	Injection position 1 in multi-position injection	-	85.00	mm	Real time	Real time
25	H11-24	Injection position 2 in multi-position injection	-	80.00	mm	Real time	Real time
26	H11-25	Injection position 3 in multi-position injection	-	75.00	mm	Real time	Real time
27	H11-26	Injection position 4 in multi-position injection	-	65.00	mm	Real time	Real time
28	H11-27	Injection position 5 in multi-position injection	-	60.00	mm	Real time	Real time
29	H11-28	Injection pressure 1 in multi-pressure injection	-	0.5	Mpa	Real time	Real time
30	H11-29	Injection pressure 2 in multi-pressure injection	-	0.5	Mpa	Real time	Real time
31	H11-30	Injection pressure 3 in multi-pressure injection	-	0.5	Mpa	Real time	Real time
32	H11-31	Injection pressure 4 in multi-pressure injection	-	0.5	Mpa	Real time	Real time
33	H11-32	Injection pressure 5 in multi-pressure injection	-	0.5	Mpa	Real time	Real time
34	H11-33	Injection speed 1 in multi-speed injection	-	10.0	mm/s	Real time	Real time
35	H11-34	Injection speed 2 in multi-speed injection	-	10.0	mm/s	Real time	Real time
36	H11-35	Injection speed 3 in multi-speed injection	-	10.0	mm/s	Real time	Real time
37	H11-36	Injection speed 4 in multi-speed injection	-	10.0	mm/s	Real time	Real time
38	H11-37	Injection speed 5 in multi-speed injection	-	10.0	mm/s	Real time	Real time
39	H11-38	Pressure-holding pressure 1 in multi-pressure pressure holing	-	5.0	Mpa	Real time	Real time
40	H11-39	Pressure-holding pressure 2 in multi-pressure pressure holing	-	5.0	Mpa	Real time	Real time
41	H11-40	Pressure-holding pressure 3 in multi-pressure pressure holing	-	5.0	Mpa	Real time	Real time
42	H11-41	Pressure-holding pressure 4 in multi-pressure pressure holing	-	5.0	Mpa	Real time	Real time
43	H11-42	Pressure-holding pressure 5 in multi-pressure pressure holing	-	5.0	Mpa	Real time	Real time
44	H11-43	Pressure holding time 1 in multi-time pressure holding	-	0.00	s	Real time	Real time
45	H11-44	Pressure holding time 2 in multi-time pressure holding	-	0.00	s	Real time	Real time
46	H11-45	Pressure holding time 3 in multi-time pressure holding	-	0.00	s	Real time	Real time

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
47	H11-46	Pressure holding time 4 in multi-time pressure holding	-	0.00	s	Real time	Real time
48	H11-47	Pressure holding time 5 in multi-time pressure holding	-	0.00	s	Real time	Real time
49	H11-48	Pressure holding speed 1 (pressure holding speed limit)	-	0.0	mm/s	Real time	Real time
50	H11-49	Storage position 1 (storage position)	-	85.00	mm	Real time	Real time
51	H11-50	Storage position 2 (storage position)	-	0.00	mm	Real time	Real time
52	H11-51	Storage position 3 (storage position)	-	0.00	mm	Real time	Real time
53	H11-52	Storage position 4 (storage position)	-	0.00	mm	Real time	Real time
54	H11-53	Storage position 5 (storage position)	-	0.00	mm	Real time	Real time
55	H11-54	Storage back pressure 1 (storage back pressure)	-	0.5	Mpa	Real time	Real time
56	H11-55	Storage back pressure 2 (storage back pressure)	-	0.5	Mpa	Real time	Real time
57	H11-56	Storage back pressure 3 (storage back pressure)	-	0.5	Mpa	Real time	Real time
58	H11-57	Storage back pressure 4 (storage back pressure)	-	0.5	Mpa	Real time	Real time
59	H11-58	Storage back pressure 5 (storage back pressure)	-	0.5	Mpa	Real time	Real time
60	H11-59	Forward speed limit (back pressure speed limit)	-	10.0	mm/s	Real time	Real time
61	H11-60	Back speed limit (back pressure speed limit)	-	10.0	mm/s	Real time	Real time
62	H11-61	Exit protection pressure gain	-	80.0	%	Real time	Real time
63	H11-62	Multi-pressure control enable	-	0	-	Real time	Real time
64	H11-63	Zero pressure filling time	-	0.000	s	Real time	Real time
65	H11-64	Pressure holding switchover pressure (pressure holding switchover state)	-	0.0	Mpa	N/A	-
66	H11-65	Injection backward position before storage	-	5.00	mm	Real time	Real time
67	H11-66	Injection backward position after storage	-	85.00	mm	Real time	Real time
68	H11-67	Injection backward speed before storage	-	10.0	mm/s	Real time	Real time
69	H11-68	Injection backward speed after storage	-	10.0	mm/s	Real time	Real time
70	H11-69	Number of teeth on the motor end	-	36	-	Real time	Real time
71	H11-70	Number of teeth on the screw end	-	36	-	Real time	Real time
72	H11-71	Screw lead	-	16.00	-	Real time	Real time

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
73	H11-72	Homing completion flag big	-	0	-	N/A	-
74	H11-73	No pressure limit displacement	-	0.00	mm	Real time	Real time
75	H11-74	Current position as home	0: Not changed 1: This position set as home	0	-	Real time	Real time
76	H11-75	Screw position	-	0.00	mm	N/A	-
78	H11-77	Injection time display	-	0.000	s	N/A	-
79	H11-78	Pressure holding time display	-	0.000	s	N/A	-
80	H11-79	Storage time display	-	0.000	s	N/A	-
81	H11-80	Injection backward time display	-	0.000	s	N/A	-
82	H11-81	Increasing acceleration percentage of the ascending segment of S-curve (percentage to the total time of ascending segment)	-	30	%	Real time	Real time
83	H11-82	Increasing deceleration percentage of the ascending segment of S-curve (percentage to the total time of ascending segment)	-	30	%	Real time	Real time
84	H11-83	Increasing acceleration percentage of the descending segment of S-curve (percentage to the total time of descending segment)	-	30	%	Real time	Real time
85	H11-84	Increasing deceleration percentage of the descending segment of S-curve (percentage to the total time of descending segment)	-	30	%	Real time	Real time
86	H11-85	Switchover pressure protection gain	-	20.0	%	Real time	Real time
87s	H11-86	Increasing acceleration percentage of injection S-curve	-	30	%	Real time	Real time
88	H11-87	Pressure relief setpoint time after pressure holding ends		0.050	s	Real time	Real time
89	H11-88	Injection pressure display	-	0.00	%	N/A	-
90	H11-89	Display of the position for switching to pressure holding	-	0.00	mm	N/A	-
91	H11-90	Display of the pressure for switching to pressure holding	-	0.00	Mpa	N/A	-
92	H11-91	Injection screw speed display	-	0.0	mm/s	N/A	-
93	H11-92	Display of the deceleration point for switching to pressure holding	-	0.00	mm	N/A	-

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
94	H11-93	Starting detection position upon switchover from pressure to pressure holding	-	10.00	mm	Real time	Real time
95	H11-94	Display of max. injection speed	-	900.0	mm/s	N/A	-
96	H11-95	Display of the speed for switching to pressure holding (pressure holding switchover state)	-	0.0	rpm	N/A	-
97	H11-96	Display of min. position of injection (pressure holding switchover state)	-	0.00	mm	N/A	-
98	H11-97	Percentage of speed upper limit in pressure protection	-	0	%	Real time	Real time
99	H11-98	Smoothing the switchover speed of electric injection pressure loop	-	0	-	Real time	Real time

H12 Multi-reference (speed) parameters

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
1	H12-00	Injection multi-position 1 (pre-injection)	-	85.00	mm	Real time	Real time
2	H12-01	Injection multi-position 2 (pre-injection)	-	80.00	mm	Real time	Real time
3	H12-02	Injection multi-position 3 (pre-injection)	-	75.00	mm	Real time	Real time
4	H12-03	Injection multi-position 4 (pre-injection)	-	65.00	mm	Real time	Real time
5	H12-04	Injection multi-position 5 (pre-injection)	-	60.00	mm	Real time	Real time
6	H12-05	Injection multi-speed 1 (pre-injection)	-	10.0	mm/s	Real time	Real time
7	H12-06	Injection multi-speed 2 (pre-injection)	-	10.0	mm/s	Real time	Real time
8	H12-07	Injection multi-speed 3 (pre-injection)	-	10.0	mm/s	Real time	Real time
9	H12-08	Injection multi-speed 4 (pre-injection)	-	10.0	mm/s	Real time	Real time
10	H12-09	Injection multi-speed 5 (pre-injection)	-	10.0	mm/s	Real time	Real time
11	H12-10	Protection pressure (pre-injection)	-	0.5	Mpa	Real time	Real time
12	H12-11	Injection time (pre-injection)	-	0.000	s	Real time	Real time
13	H12-12	Pressure loop PID injection pressure loop KP	-	2.100	-	Real time	Real time
14	H12-13	Pressure loop PID injection pressure loop KI	-	0.200	-	Real time	Real time
15	H12-14	Pressure loop PID injection pressure loop KD	-	0.000	-	Real time	Real time

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
16	H12-15	Pressure loop PID pressure holding pressure loop KP	-	2.100	-	Real time	Real time
17	H12-16	Pressure loop PID pressure holding pressure loop KI	-	0.200	-	Real time	Real time
18	H12-17	Pressure loop PID pressure holding pressure loop KD	-	0.000	-	Real time	Real time
19	H12-18	Pressure loop PID back pressure loop KP	-	2.100	-	Real time	Real time
20	H12-19	Pressure loop PID back pressure loop KI	-	0.200	-	Real time	Real time
21	H12-20	Pressure loop PID back pressure loop KD	-	0.000	-	Real time	Real time
22	H12-21	Injection end position (pre-injection)	-	20.00	mm	Real time	Real time
23	H12-22	Starting slope of injection pressure reference	-	0.100	s	Real time	Real time
24	H12-23	Injection pressure reference switchover slope	-	0.100	s	Real time	Real time
25	H12-24	Injection pressure reference end slop	-	0.100	s	Real time	Real time
26	H12-25	Starting slope of holding pressure reference	-	0.100	s	Real time	Real time
27	H12-26	Pressure holding pressure reference switchover slope	-	0.100	s	Real time	Real time
28	H12-27	Pressure holding pressure reference end slope	-	0.100	s	Real time	Real time
29	H12-28	Starting slope of back pressure reference	-	0.100	s	Real time	Real time
30	H12-29	Back pressure reference switchover slope	-	0.100	s	Real time	Real time
31	H12-30	Back pressure reference end slope	-	0.100	s	Real time	Real time
32	H12-31	Starting slope of injection speed reference	-	0.050	s	Real time	Real time
33	H12-32	Injection speed reference switchover slope	-	0.050	s	Real time	Real time
34	H12-33	Starting slope of injection backward speed reference	-	0.050	s	Real time	Real time
35	H12-34	End slope of injection backward speed reference	-	0.050	s	Real time	Real time
36	H12-35	Number of injection segments (pre-injection)	-	1	-	Real time	Real time
37	H12-36	S-curve filter time for pressure reference rise (S-curve filter time of pressure reference)	-	0.000	s	Real time	Real time
38	H12-37	S-curve filter time for pressure reference down (S-curve filter time of pressure reference)	-	0.000	s	Real time	Real time
39	H12-38	Pressure protection speed rise time	-	0.000	s	Real time	Real time
40	H12-39	Pressure protection speed down time	-	0.000	s	Real time	Real time

Index (Decimal)	Param.	Name	Value	Default	Unit	Change mode	Effective time
41	H12-40	End slope of storage backward	-	0.200	s	Real time	Real time
42	H12-41	End slope of injection speed reference	-	0.100	s	Real time	Real time
43	H12-42	Starting slope of storage backward	-	10.0	s	Real time	Real time
44	H12-43	Number of injection segments	-	1	-	Real time	Real time
45	H12-44	Number of pressure holding segments	-	1	-	Real time	Real time
46	H12-45	Number of back pressure segments	-	1	-	Real time	Real time
47	H12-46	Number of mold opening segments	-	1	-	Real time	Real time
48	H12-47	Number of mold close segments	-	3	-	Real time	Real time
49	H12-48	Number of ejection segments	-	1	-	Real time	Real time
50	H12-49	Number of ejection backward segments	-	1	-	Real time	Real time
51	H12-50	Number of initial ejection segments	-	0	-	Real time	Real time
52	H12-51	Number of initial ejection backward segments	-	0	-	Real time	Real time
53	H12-52	Pressure holding speed rise time	-	0.000	s	Real time	Real time
54	H12-53	Pressure holding speed down time	-	0.000	s	Real time	Real time
56	H12-55	Action completion flag	-	0	-	N/A	-
57	H12-56	Arrival error threshold	-	0.01	-	Real time	Real time
58	H12-57	Relief speed limit	-	0.0	-	Real time	Real time
62	H12-61	Pressure holding speed 2 (pressure holding speed limit)	-	0.0	rpm	Real time	Real time
63	H12-62	Pressure holding speed 3 (pressure holding speed limit)	-	0.0	rpm	Real time	Real time
64	H12-63	Pressure holding speed 4 (pressure holding speed limit)	-	0.0	rpm	Real time	Real time
65	H12-64	Pressure holding speed 5 (pressure holding speed limit)	-	0.0	rpm	Real time	Real time
66	H12-65	Lower limit of global mold protection torque deviation (low-pressure mold protection)	-	0	%	Real time	Real time
67	H12-66	Upper limit of global mold protection torque deviation (low-pressure mold protection)	-	0	%	Real time	Real time
68	H12-67	Valid length (low-pressure mold protection)	-	8192	-	Real time	Real time
69	H12-68	Low-pressure mold protection filter time constant	-	2.00	s	Real time	Real time

H15 Mold-open/close parameters

Index (Decimal)	Param.	Name	Setpoint	Default	Unit	Change mode	Effective time
1	H15-00	Multi-position 1 in mold opening (low 16 bits)	-	0.00	mm	Real time	Real time
2	H15-01	Multi-position 1 in mold opening (high 16 bits)	-	0	mm	Real time	Real time
3	H15-02	Multi-position 2 in mold opening (low 16 bits)	-	0.00	mm	Real time	Real time
4	H15-03	Multi-position 2 in mold opening (high 16 bits)	-	0	mm	Real time	Real time
5	H15-04	Multi-position 3 in mold opening (low 16 bits)	-	0.00	mm	Real time	Real time
6	H15-05	Multi-position 3 in mold opening (high 16 bits)	-	0	mm	Real time	Real time
7	H15-06	Multi-position 4 in mold opening (low 16 bits)	-	0.00	mm	Real time	Real time
8	H15-07	Multi-position 4 in mold opening (high 16 bits)	-	0	mm	Real time	Real time
9	H15-08	Multi-position 5 in mold opening (low 16 bits)	-	0.00	mm	Real time	Real time
10	H15-09	Multi-position 5 in mold opening (high 16 bits)	-	0	mm	Real time	Real time
11	H15-10	Multi-speed 1 in mold opening	-	0.0	%	Real time	Real time
12	H15-11	Multi-speed 2 in mold opening	-	0.0	%	Real time	Real time
13	H15-12	Multi-speed 3 in mold opening	-	0.0	%	Real time	Real time
14	H15-13	Multi-speed 4 in mold opening	-	0.0	%	Real time	Real time
15	H15-14	Multi-speed 5 in mold opening	-	0.0	%	Real time	Real time
16	H15-15	Multi-position reference rise time in mold opening	-	0.150	s	Real time	Real time
17	H15-16	Multi-position reference switchover time in mold opening	-	0.150	s	Real time	Real time
18	H15-17	Multi-position reference down time in mold opening	-	0.150	s	Real time	Real time
19	H15-18	Multi-position 1 in mold close (low 16 bits)	-	0.00	mm	Real time	Real time
20	H15-19	Multi-position 1 in mold close (high 16 bits)	-	0	mm	Real time	Real time
21	H15-20	Multi-position 2 in mold close (low 16 bits)	-	0.00	mm	Real time	Real time
22	H15-21	Multi-position 2 in mold close (high 16 bits)	-	0	mm	Real time	Real time
23	H15-22	Multi-position 3 in mold close (low 16 bits)	-	0.00	mm	Real time	Real time
24	H15-23	Multi-position 3 in mold close (high 16 bits)	-	0	mm	Real time	Real time
25	H15-24	Multi-position 4 in mold close (low 16 bits)	-	0.00	mm	Real time	Real time

Index (Decimal)	Param.	Name	Setpoint	Default	Unit	Change mode	Effective time
26	H15-25	Multi-position 4 in mold close (high 16 bits)	-	0	mm	Real time	Real time
27	H15-26	Multi-position 5 in mold close (low 16 bits)	-	0.00	mm	Real time	Real time
28	H15-27	Multi-position 5 in mold close (high 16 bits)	-	0	mm	Real time	Real time
29	H15-28	Multi-speed 1 in mold close	-	0.0	%	Real time	Real time
30	H15-29	Multi-speed 2 in mold close	-	0.0	%	Real time	Real time
31	H15-30	Multi-speed 3 in mold close	-	0.0	%	Real time	Real time
32	H15-31	Multi-speed 4 in mold close	-	0.0	%	Real time	Real time
33	H15-32	Multi-speed 5 in mold close	-	0.0	%	Real time	Real time
34	H15-33	Multi-position reference rise time in mold close	-	0.150	s	Real time	Real time
35	H15-34	Multi-position reference switchover time in mold close	-	0.150	s	Real time	Real time
36	H15-35	Multi-position reference down time in mold close	-	0.150	s	Real time	Real time
37	H15-36	High-pressure torque in mold close	-	300.0	%	Real time	Real time
38	H15-37	Low-pressure torque in mold close	-	150.0	%	Real time	Real time
39	H15-38	Slow torque in mold opening 1	-	100.0	%	Real time	Real time
40	H15-39	Slow protection time in mold opening 1	-	0.000	s	Real time	Real time
41	H15-40	High-pressure protection time in mold close	-	0.000	s	Real time	Real time
42	H15-41	Low-pressure protection time in mold close	-	0.000	s	Real time	Real time
43	H15-42	Timing of mold opening	-	0.000	s	N/A	-
44	H15-43	Timing of mold close	-	0.000	s	N/A	-
45	H15-44	Timing of high-pressure protection time in mold close	-	0.000	s	N/A	-
46	H15-45	Timing of low-pressure protection time in mold close	-	0.000	s	N/A	-
47	H15-46	Min. error distance between segments	-	20.00	mm	Real time	Real time

H18 Ejector pin parameters

Index (Decimal)	Param.	Name	Setpoint	Default	Unit	Change mode	Effective time
9	H18-08	Ejector pin motion mode	0: Stop 1: Set number of ejections 2: Vibrating	0	-	Real time	Real time

Index (Decimal)	Param.	Name	Setpoint	Default	Unit	Change mode	Effective time
10	H18-09	Ejector pin times	-	1	-	Real time	Real time
11	H18-10	Ejector pin vibration mode	-	0	-	Real time	Real time
12	H18-11	Ejector pin vibration time	-	0.00	s	N/A	-
13	H18-12	Ejector pin vibration distance	-	0.00	mm	Real time	Real time
14	H18-13	Ejection delay mode	-	0	-	Real time	Real time
15	H18-14	Ejection delay time	-	0.000	s	Real time	Real time
16	H18-15	Ejection multi-position 1	-	0.00	mm	Real time	Real time
17	H18-16	Ejection multi-position 2	-	0.00	mm	Real time	Real time
18	H18-17	Ejection multi-position 3	-	0.00	mm	Real time	Real time
19	H18-18	Initial ejection multi-position 1	-	0.00	mm	Real time	Real time
20	H18-19	Initial ejection multi-position 2	-	0.00	mm	Real time	Real time
21	H18-20	Injection multi-speed 1	-	0.0	%	Real time	Real time
22	H18-21	Injection multi-speed 2	-	0.0	%	Real time	Real time
23	H18-22	Injection multi-speed 3	-	0.0	%	Real time	Real time
24	H18-23	Initial ejection multi-speed 1	-	0.0	%	Real time	Real time
25	H18-24	Initial ejection multi-speed 2	-	0.0	%	Real time	Real time
26	H18-25	Rise time of multi-position reference for ejection	-	0.150	s	Real time	Real time
27	H18-26	Switchover time of multi-position reference for ejection	-	0.150	s	Real time	Real time
28	H18-27	Fall time of multi-position reference for ejection	-	0.150	s	Real time	Real time
29	H18-28	Ejection backward delay mode	-	0	-	Real time	Real time
30	H18-29	Ejection backward delay time	-	0.000	s	Real time	Real time
31	H18-30	Multi-position 1 in ejection backward	-	0.00	mm	Real time	Real time
32	H18-31	Multi-position 2 in ejection backward	-	0.00	mm	Real time	Real time
33	H18-32	Multi-position 3 in ejection backward	-	0.00	mm	Real time	Real time
34	H18-33	Multi-position 1 in initial ejection backward	-	0.00	mm	Real time	Real time
35	H18-34	Multi-position 2 in initial ejection backward	-	0.00	mm	Real time	Real time
36	H18-35	Multi-speed 1 in ejection backward	-	0.0	%	Real time	Real time
37	H18-36	Multi-speed 2 in ejection backward	-	0.0	%	Real time	Real time

Index (Decimal)	Param.	Name	Setpoint	Default	Unit	Change mode	Effective time
38	H18-37	Multi-speed 3 in ejection backward	-	0.0	%	Real time	Real time
39	H18-38	Multi-speed 1 in initial ejection backward	-	0.0	%	Real time	Real time
40	H18-39	Multi-speed 2 in initial ejection backward	-	0.0	%	Real time	Real time
41	H18-40	Rise time of multi-position reference for ejection backward	-	0.150	s	Real time	Real time
42	H18-41	Switchover time of multi-position reference for ejection backward	-	0.150	s	Real time	Real time
43	H18-42	Fall time of multi-position reference for ejection backward	-	0.150	s	Real time	Real time
44	H18-43	Rise time of ejector pin vibration reference	-	0.003	s	Real time	Real time
45	H18-44	Fall time of ejector pin vibration reference	-	0.003	s	Real time	Real time
46	H18-45	Ejector pin action time	-	0.000	s	Real time	Real time
49	H18-48	Open circuit detection current lower limit of melting pressure sensor	-	50	%	At stop	Real time

H19 Oil pressure control parameters

Index (Decimal)	Param.	Name	Setpoint	Default	Unit	Change mode	Effective time
1	H19-00	Oil pressure control mode	0: EtherCAT 1: EtherCAT 2: Analog reference 3: EtherCAT 4: EtherCAT 5: EtherCAT 6: CANopen reference	0	-	At stop	Real time
2	H19-01	Max. speed	-	2000	rpm	At stop	Real time
3	H19-02	System oil pressure	-	175.0	bar	At stop	Real time
4	H19-03	Max. oil pressure	-	250.0	bar	At stop	Real time
5	H19-04	Rise time of 1st group of oil pressure references	-	0.125	s	Real time	Real time
6	H19-05	1st group of oil pressure control Kp	-	210.0	-	Real time	Real time
7	H19-06	1st group of oil pressure control Ti	-	0.040	-	Real time	Real time
8	H19-07	1st group of oil pressure control Td	-	0.000	-	Real time	Real time
9	H19-08	Max. reverse speed	-	10.0	%	Real time	Real time
10	H19-09	Base flow	-	0.5	%	Real time	Real time

Index (Decimal)	Param.	Name	Setpoint	Default	Unit	Change mode	Effective time
11	H19-10	Base pressure	-	0.5	bar	Real time	Real time
12	H19-11	2nd group of oil pressure control Kp	-	310.0	-	Real time	Real time
13	H19-12	2nd group of oil pressure control Ti	-	0.200	-	Real time	Real time
14	H19-13	2nd group of oil pressure control Td	-	0.000	-	Real time	Real time
15	H19-14	3rd group of oil pressure control Kp	-	210.0	-	Real time	Real time
16	H19-15	3rd group of oil pressure control Ti	-	0.100	-	Real time	Real time
17	H19-16	3rd group of oil pressure control Td	-	0.000	-	Real time	Real time
18	H19-17	4th group of oil pressure control Kp	-	210.0	-	Real time	Real time
19	H19-18	4th group of oil pressure control Ti	-	0.100	-	Real time	Real time
20	H19-19	4th group of oil pressure control Td	-	0.000	-	Real time	Real time
21	H19-20	Max. torque at zero speed in multi-pump mode	-	0.0	%	Real time	Real time
22	H19-21	Oil pressure sensor pressure signal fault detection time	-	0.300	s	Real time	Real time
23	H19-22	Lower limit of pressure sensor fault detection current - Injection pressure holding	-	100	%	At stop	Real time
24	H19-23	Upper limit of pressure sensor fault detection speed	-	100	%	At stop	Real time
25	H19-24	Oil pressure error integral limit	-	5000		Real time	Real time
26	H19-25	Rising S-curve filter time of 1st group of oil pressure references	-	0.001	s	Real time	Real time
27	H19-26	Falling S-curve filter time of 1st group of oil pressure references	-	0.001	s	Real time	Real time
28	H19-27	Overshoot suppression detection level of 1st group of oil pressure	-	200	-	Real time	Real time
29	H19-28	1st group of oil pressure overshoot suppression coefficient	-	200	-	Real time	Real time
30	H19-29	Oil pressure loop gain coefficient of injection molding machine	-	10.0	-	Real time	Real time
31	H19-30	Torque upper limit for switching from oil pressure to speed mode	-	160.0	-	Real time	Real time
32	H19-31	Delay of 1st group of oil pressure references	-	0.000	s	Real time	Real time

Index (Decimal)	Param.	Name	Setpoint	Default	Unit	Change mode	Effective time
33	H19-32	Min. input of injection molding machine slave	-	10.0	-	Real time	Real time
34	H19-33	Corresponding setting of min. input of injection molding machine slave	-	0.0	-	Real time	Real time
35	H19-34	Medium point input of injection molding machine slave	-	20.0	-	Real time	Real time
36	H19-35	Corresponding setting of medium point of injection molding machine slave	-	20.0	-	Real time	Real time
37	H19-36	Max. input of injection molding machine slave	-	100.0	-	Real time	Real time
38	H19-37	Corresponding setting of max. input of injection molding machine slave	-	100.0	-	Real time	Real time
44	H19-43	Pressure deviation of a non-operating slave pump in multi-pump CAN communication mode	-	5.0	-	Real time	Real time
45	H19-44	Flow lower limit of a non-operating slave pump in multi-pump CAN communication mode	-	10.0	-	Real time	Real time
46	H19-45	Stop judgment delay when the slave pump receives no speed reference	-	1.000	-	Real time	Real time
47	H19-46	Deceleration time before stop when the slave pump receives no speed reference	-	0.200	s	Real time	Real time
48	H19-47	Pressure sensor open circuit detection voltage	-	0.000	V	Real time	Real time
49	H19-48	Keiki integral calculation coefficient	-	0.08	-	Real time	Real time

H1A Oil pressure control parameters

Index (Decimal)	Param.	Name	Setpoint	Default	Unit	Change mode	Effective time
1	H1A-00	Torque reference filter time	-	0.002	s	Real time	Real time
2	H1A-01	Pressure difference for stopping pressure loop adjustment	-	0.05	-	Real time	Real time
3	H1A-02	Fall time of 1st group of oil pressure references	-	0.150	s	Real time	Real time
4	H1A-03	Rise time of 1st group of flow	-	0.030	s	Real time	Real time
5	H1A-04	Fall time of 1st group of flow	-	0.100	s	Real time	Real time
6	H1A-05	Multi-PID selection	-	0	-	Real time	Real time

Index (Decimal)	Param.	Name	Setpoint	Default	Unit	Change mode	Effective time
7	H1A-06	Pump flow compensation	-	0	-	Real time	Real time
9	H1A-08	Minimum relief pressure in reverse run (zero speed applied for pressure lower than this setpoint)	-	0.0	-	Real time	Real time
10	H1A-09	Max. allowable time of pressure relief in reverse run (ER63 reported if timeout)	-	0.000	-	Real time	Real time
11	H1A-10	Ascending S-curve filter time of 2nd group of oil pressure references	-	0.001	s	Real time	Real time
12	H1A-11	Descending S-curve filter time of 2nd group of oil pressure references	-	0.001	s	Real time	Real time
13	H1A-12	Rise time of 2nd group of flow references	-	0.030	s	Real time	Real time
14	H1A-13	Fall time of 2nd group of flow references	-	0.100	s	Real time	Real time
15	H1A-14	Rise time of 2nd group of oil pressure references	-	0.125	s	Real time	Real time
16	H1A-15	Fall time of 2nd group of oil pressure references	-	0.150	s	Real time	Real time
17	H1A-16	2nd group of oil pressure overshoot suppression detection level	-	200	-	Real time	Real time
18	H1A-17	2nd group of oil pressure overshoot suppression coefficient	-	50	-	Real time	Real time
19	H1A-18	Delay of 2nd group of oil pressure references	-	0.000	s	Real time	Real time
20	H1A-19	Swashplate switchover flow setting	-	100	%	Real time	Real time
21	H1A-20	Swashplate switchover oil pressure setting	-	5.0	%	Real time	Real time
22	H1A-21	Swashplate switchover delay	-	10.0	-	Real time	Real time
23	H1A-22	Oil pressure deviation threshold of oil pressure suppression cancellation	-	100	-	Real time	Real time
24	H1A-23	Maximum value of integral limit deviation	-	450	-	Real time	Real time
25	H1A-24	Integral limit mode selection	-	0	-	Real time	Real time
26	H1A-25	Pressure loop output upper limit rise	-	20	-	Real time	Real time
27	H1A-26	Oil pressure PID algorithm selection	-	3	-	Real time	Real time
30	H1A-29	1st group of impact overshoot suppression pressure feedback and reference percentage threshold	-	700	-	Real time	Real time

Index (Decimal)	Param.	Name	Setpoint	Default	Unit	Change mode	Effective time
31	H1A-30	1st group of impact overshoot suppression coefficient Kd	-	40	-	Real time	Real time
32	H1A-31	2nd group of impact overshoot suppression pressure feedback and reference percentage threshold	-	700	-	Real time	Real time
33	H1A-32	2nd group of impact overshoot suppression coefficient Kd	-	40	-	Real time	Real time
34	H1A-33	Min. input value of AI1	-	0.02	V	Real time	Real time
35	H1A-34	Corresponding setting of AI1 minimum input	-	0.0	%	Real time	Real time
36	H1A-35	Max. input of AI1	-	10.00	V	Real time	Real time
37	H1A-36	Corresponding setting of AI1 maximum input	-	100.0	%	Real time	Real time
38	H1A-37	AI1 filter time	-	0.010	s	Real time	Real time
39	H1A-38	Min. input value of AI2	-	0.02	V	Real time	Real time
40	H1A-39	Corresponding setting of AI2 minimum input	-	0.0	%	Real time	Real time
41	H1A-40	Max. input of AI2	-	10.00	V	Real time	Real time
42	H1A-41	Corresponding setting of AI2 maximum input	-	100.0	%	Real time	Real time
43	H1A-42	AI2 filter time	-	0.005	s	Real time	Real time
44	H1A-43	Min. input value of AI3	-	0.02	V	Real time	Real time
45	H1A-44	Corresponding setting of AI3 minimum input	-	0.0	%	Real time	Real time
46	H1A-45	Max. input of AI3	-	10.00	V	Real time	Real time
47	H1A-46	Corresponding setting of AI3 maximum input	-	100.0	%	Real time	Real time
48	H1A-47	AI3 filter time	-	0.000	s	Real time	Real time
49	H1A-48	Pressure feedback filter time	-	0.005	s	Real time	Real time

H1B: Overload test parameters

Index (Decimal)	Param.	Name	Setpoint	Default	Unit	Change mode	Effective time
1	H1B-00	Pressure reference sent by ECAT	-	0.0	kg	Real time	Real time
2	H1B-01	Flow reference sent by ECAT	-	0.0	%	Real time	Real time
3	H1B-02	ECAT single/multi-pump control word	-	0	-	Real time	Real time
4	H1B-03	ECAT slave pump configuration (high bit)	-	0	-	Real time	Real time

Index (Decimal)	Param.	Name	Setpoint	Default	Unit	Change mode	Effective time
5	H1B-04	ECAT slave pump configuration (low bit)	-	0	-	Real time	Real time
6	H1B-05	Oil pressure feedback (display)	-	0.0	-	N/A	-
7	H1B-06	Oil pressure feedback (from host controller)	-	0.0	-	Real time	Real time
8	H1B-07	Slave pump rotation speed reference (from master pump)	-	0.0	-	Real time	Real time
9	H1B-08	Slave pump speed reference sent by master pump (display)	-	0.0	-	N/A	-
10	H1B-09	Motor direction of rotation	-	1	-	Real time	Real time
11	H1B-10	Runaway fault judgment time	-	0.0	s	Real time	Real time
12	H1B-11	Runaway speed deviation setting	-	10.00	-	Real time	Real time
47	H1B-46	Runaway protection judgment time upon incorrect phase sequence	-	30	-	At stop	Real time

Revision History

Date	Version	Description
Dec 2017	A00	◆ First release.
July 2019	A01	◆ Updated the logo. ◆ Added with a barcode on the back cover.
October 2020	A02	◆ Deleted the service hotline.
June 2024	A03	◆ Updated Appendix A. ◆ Updated nameplate and certification information.

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