# 2CS3E Series

# Dual-axis EtherCAT Closed Loop Stepper Drive User Manual


For models of 2CS3E-D503, 2CS3E-D507



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## Notice

Read this manual carefully before any assembling and using. Incorrect handling of products in this manual can result in injury and damage to persons and machinery. Strictly adhere to the technical information regarding installation requirements.



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- **Thank you for purchasing Leadshine 2CS3E series products**
- **Please read this manual carefully before operating**
- **Please keep this manual appropriately**

**2CS3E Passed the ETC Laboratory Conformance Tested**

EtherCAT ® is a registered trademark and patented technology, licensed by Beckhoff Automation GmbH, Germany.

## Record of Revisions

| Manual Reversion | Data | Description of Release |
|---|---|---|
| V1.0 | 05/23/2023 | Initial Release |

# Safety Precautions

## Overall Notes


- Do not remove the housing with the drive powered on. Cables. Connectors and optional equipment.
- Please disconnect the power supply for at least 2 minutes and make sure the power indicator is off before wiring and checking. Even if the power is disconnected, voltage may remain inside the drive. Therefore, do not touch the power terminals while the power indicator is on.


- Please use the power supply specifications (number of phases.) that match the product. Voltage. Frequency. AC/DC).
- Be sure to connect the ground terminal of the driver (mounting surface) and motor to the ground pole.
- Do not damage or drag the cable, do not overstress the cable, do not hang heavy objects on the cable, or get caught in the cabinet door.
- Please do not disassemble the product yourself. Repair or modification.
- When the machine is connected to the machine and starts to operate make sure that the machine is ready for emergency stop.
- Do not touch the inside of the drive.


- The heat sink of the driver may be hot when the power is on or when the power is just cut off. The motor, etc. may be in a high temperature. Take safety measures such as installing a cover to prevent accidental touching by hands and parts (cables, etc.).
- Use double-insulated or reinforced insulation for control power.
- Do not use in places where water can be splashed. Corrosive environments. Do not use the product in the vicinity of flammable gases and combustible materials.
- Do not use damaged. Drivers and motors with missing parts.
- Please set up an emergency stop circuit externally to ensure that the power can be cut off and the operation can be stopped immediately in case of an abnormality.
- If the product is used under poor power conditions, install protection equipment (AC reactor, etc.) to ensure that the input power is supplied within the specified voltage variation range.
- Please use a noise filter to reduce the influence of electromagnetic interference.
- The driver and motor should be used in the specified combination.

## Precautions for Storage and Transportation


- Please follow the Commands on the packaging for storage and do not overload the product.
- Please place this product in the following environment:
  - ➞No direct sunlight in the place.
  - ➞Ambient temperature does not exceed the product specification.
  - ➞Humidity does not exceed product specifications. Without condensation.
  - ➞No corrosive gases. Place of flammable gas.
  - ➞Dust. The place where there is less salt and metal powder.
  - ➞No water. Oil. The place where the splash of medicine, etc. occurs.
  - ➞Vibration or shock does not exceed product specifications.
  - ➞No equipment generating strong magnetic fields in the vicinity.

## Precautions for Installation


- Please install the drive in a cabinet that provides fire protection. Electrical protection in the control cabinet.
- Please install the driver and motor in a position with sufficient weight resistance.
- Please install this product in the following environment:
  - ➞No direct sunlight in the place.
  - ➞Ambient temperature does not exceed the product specification.
  - ➞Humidity does not exceed product specifications. Without condensation.
  - ➞No corrosive gases. Place of flammable gas.
  - ➞Dust. Dust. The place where there is less salt and metal powder.
  - ➞No water. Oil. The place where the splash of medicine, etc. occurs.
  - ➞Vibration or shock does not exceed product specifications.
  - ➞No equipment generating strong magnetic fields in the vicinity.
- Do not block the air inlet and exhaust ports, and do not allow foreign objects to enter the drive and motor.
- Do not step on the product or place heavy objects on the drive.
- Please install the driver in the specified direction.
- Make sure to keep the specified intervals between the inner surfaces of the drive control cabinet and other machines.

## Precautions for Wiring


- Do not pass the magnetic contactor in the wiring between the drive and the motor.
- Please connect the power terminal and motor terminal firmly.
- Keep a minimum distance of 10mm between the drive and the control cabinet or other equipment.
- Allow at least 30mm of wiring space above and below the driver.
- Signal cable. The encoder cable should be a twisted shielded cable with the shield grounded at both ends.
- The wiring length of the encoder is up to 20m.
- Reduce the frequency of power on/off as much as possible.

## Precautions during operation


- To prevent accidents, perform a test run of the servo motor at no load (without the driver connected).
- When you install the machine and start operation, please set the user parameters in advance to match the machine.
- Positive limit (POT) during JOG operation and zero return operation. The signal of negative limit (NOT) is not valid.
- When using the motor on a vertical axis, please provide a safety device to avoid dropping the work-piece in case of alarm or over travel.
- When an alarm occurs, please reset it after investigating the cause and making sure it is safe.
- Do not use the brake of the holding motor for normal braking.

# Table of Contents

# 1 Introduction

## 1.1 Product Introduction

The newly released 2CS3E series drives support CANopen over EtherCAT (CoE) control and CiA 402 operating modes including Profile Position (PP), Profile Velocity (PV), Homing (HM) and Cyclic Synchronous Position (CSP). The products can be matched with many brands of EtherCAT controller/PLC such as Beckhoff, Omron, Trio, Keneyce etc.

The 2CS3E series is highly reliable and affordable and performs excellently in many industrial applications such as solar equipment, textile, civil, robotics, power generation equipment, 3C, packaging...

## 1.2 Features

- No loss of step, No hunting, No torque reservation
- CANopen over EtherCAT (CoE) with full support of CiA402, 100Mbps full-duplex.
- Support operation modes: Profile Position, Profile Velocity, Cyclic Synchronous Position, Homing
- 2*4 configurable digital inputs, 2*2 optically isolated digital outputs include brake output
- Low noise and vibration, smooth motion
- 20-50VDC supply voltage for 2CS3E-D503 and 2CS3E-D507, max 7A output current
- USB port for parameters configuration
- Encoder resolution: 1000 / 2500 / 5000 line for NEMA11/17/23/24/ 34 CS motors
- Three 7-segment display velocity or slave ID or operation mode or error code
- Protections for over voltage, over current and position following error, encoder cable error, etc.

## 1.3 EtherCAT Compare with Step/Direction

### 1.3.1 Stronger anti-disturbance ability

Traditional step/direction transmission cables have lower reliability for the reason of EMC interference, whereas EtherCAT communication with shielded cables have stronger anti-interference ability, and inbuilt error detection. Limit and handling mechanisms can also bring more reliable transmission and longer communication distance.

### 1.3.2 Enhanced performance

EtherCAT is the fastest industrial Ethernet technology by and large, and it also synchronizes with nanosecond accuracy. This is a huge benefit for all applications in which target system is controlled or measured via the bus system.

### 1.3.3 Simple wiring and long communication distance

In step/direction control mode, the controller/PLC needs to connect with each drive to send control signals, which may lead to intensive signal cables and wiring complexity if many drives are required. While in EtherCAT applications, the controller/PLC just needs to connect with one of the drives and then line topology with others. Additionally, the EtherCAT communication allows longer distance up to 100 meters maximum.

### 1.3.4 Lower cost

EtherCAT delivery has the features of industrial Ethernet at a price similar or even below that of traditional control mode. The only hardware required by the master device is an Ethernet port, instead of some expensive interface cards or co-processors. Since EtherCAT doesn't require high-speed pulse modules or other active infrastructure components, the costs for these components and their installation, configuration, and maintenance are also eliminated.

Their connection typologies are as below:

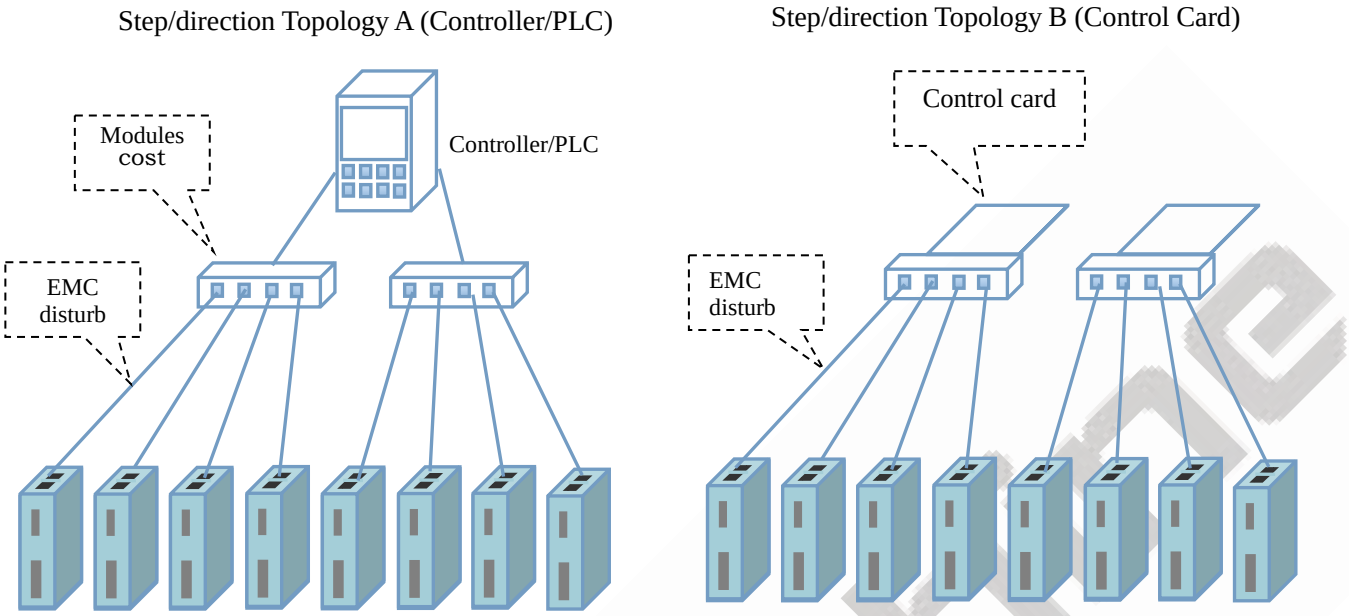



**Figure 1.1: Step/direction Topology**

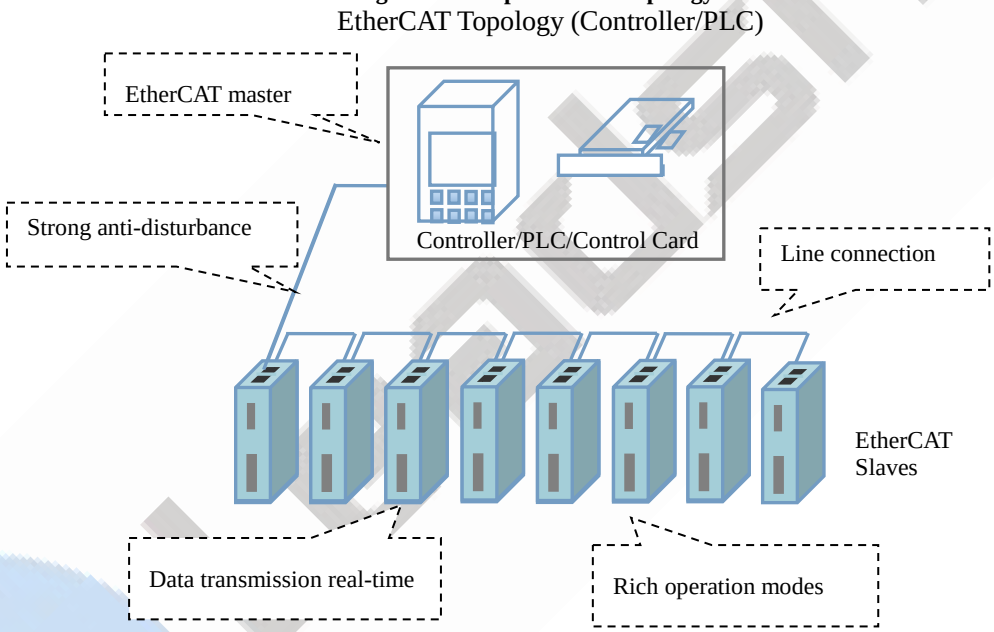



**Figure 1.2: EtherCAT Topology**

## 1.4 Check Product

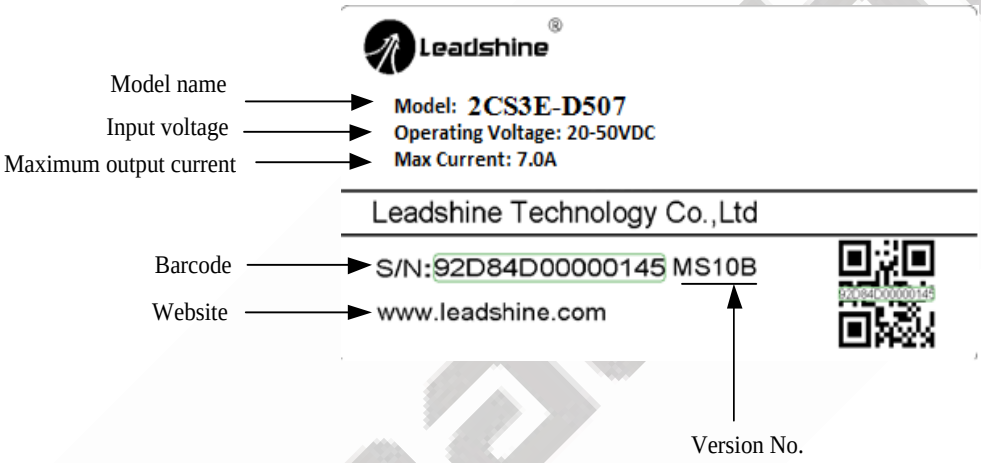
### 1.4.1 Arrival inspection

- Check whether the surface of the product is damaged or not during transportation.
- Check the nameplate models of the drive and motor are what you have ordered.
- Cheek if it is fully equipped with accessories. Accessories include power supply and motor output connector, control I/O signal connector.

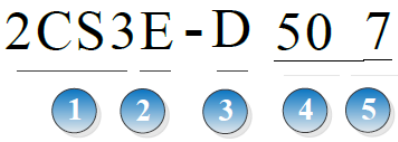
CAUTION

- Neither the damaged nor missing accessories of stepper system are allowed to install.
- Contact Leadshine or local distributor if any failure was found.

### 1.4.2 Nameplate information

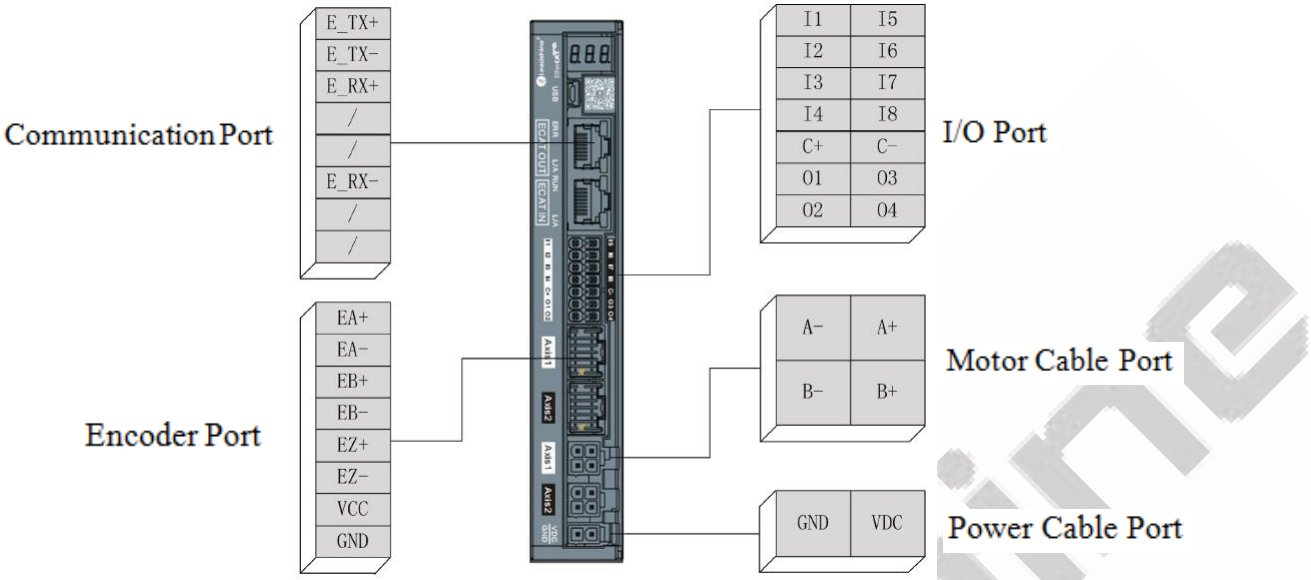



### 1.4.3 Part number

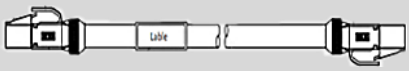



1. Series Name
   2CS: Dual-axis closed loop stepper drives
2. Communication Mode
   3E: EtherCAT
3. Product Type
   D: Drive
4. Maximum Operating Voltage
   50: 50V
5. Maximum Output Current
   3: 2.2A
   7:7.0A

### 1.4.4 Parts description




### 1.4.5 Accessories Information

| Name | Necessary | Picture | Description | Need to cost extra |
|---|---|---|---|---|
| Power supply cable | Yes |  | Power supply cable with 1.5m length | No |
| Motor extension cable (CABLEM-RZ*M*) | Yes |  | Optional length: 1.5m,3m,5m,8m, 10m,12m,15m | Yes |
| Encoder extension cable (CABLEM-BM*M*) | Yes |  | Optional length: 1.5m, 3m, 5m,8m, 10m,12m,15m | Yes |
| I/O signal terminal | Yes |  | 22-pin terminal | No |
| Tuning Cable | No, can use 3rd party cable |  | Micro-USB cable | Yes |
| Network cable | Yes, can use 3rd party cable |  | Optional length: 0.1m, 0.2m, 0.3m, 0.4m, 1m, 1.5m, 2m, 3m,5m,7m, 10m,15m, 20m | Yes |

Note:

- Micro-USB cable is not necessary; you can also modify parameters by master station PC software.
- Network cable is necessary, but you can also buy shielded network cable through 3rd party.
- Power supply connector: 39012020, 39000038, Molex
- Motor extension cable connector: 39012040, 39000038, Molex
- Motor encoder cable connector: 513531200, 561349000, Molex

# 2 Installation

## 2.1 Storage and Installation Conditions

### 2.1.1 Storage condition

- Correctly packaged and store in a clean and dry environment where direct sunlight is avoided.
- Store within an ambient temperature ranging from -20℃ to +65℃.
- Store within a relative humidity ranging from 40% to 90% and non-condensed.
- Avoid any type of exposure to corrosive gases.

### 2.1.2 Operating ambience conditions

- Temperature ranging from 0℃ to 50℃. The ambient temperature of drive for long-term reliability should be under 40℃. Please install the drive in a well-ventilated area.
- Operation within a relative humidity ranging from 40% to 90% and non-condensed.
- Vibration lower than 0.15mm at a frequency of 10Hz-55Hz.

CAUTION

- DO NOT mount the drive and motor in a location subjected to corrosive or flammable gases, and combustibles.
- Please mount the drive and motor in an indoor electric control cabinet without liquid where direct sunlight is avoided.
- DO NOT mount the drive and motor in a location subjected to airborne dust.
- Please ensure grounding wires are securely connected

## 2.2 Mechanical Specification

Unit: mm, 1inch=25.4mm

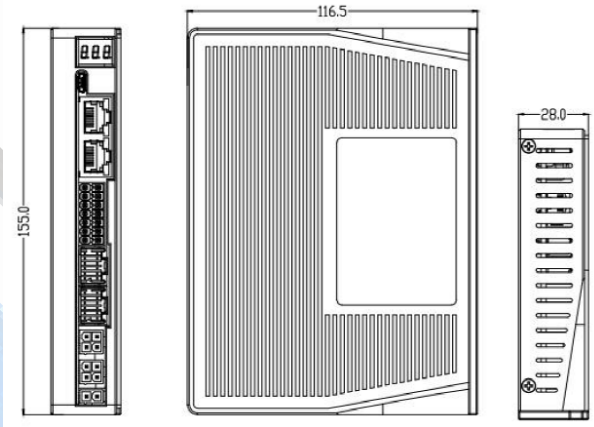



**Figure 2.1: 2CS3E series mechanical drawing**

## 2.3 Installation Direction and Space

- The mounting of drive, wiring and motor should be under the regulations of EN 61800-5-1.
- Incorrect installation may result in a drive malfunction or premature failure of the drive and /or motor. Please follow the guidelines in this manual when installing
- The drive should be mounted perpendicular to the wall or in the control panel.
- In order to ensure the drive is well ventilated, ensure that the all ventilation holes are not obstructed and sufficient free space is given to the drive, and a cooling fan is mounted in the control panel.

- Please ensure grounding wires are securely connected.

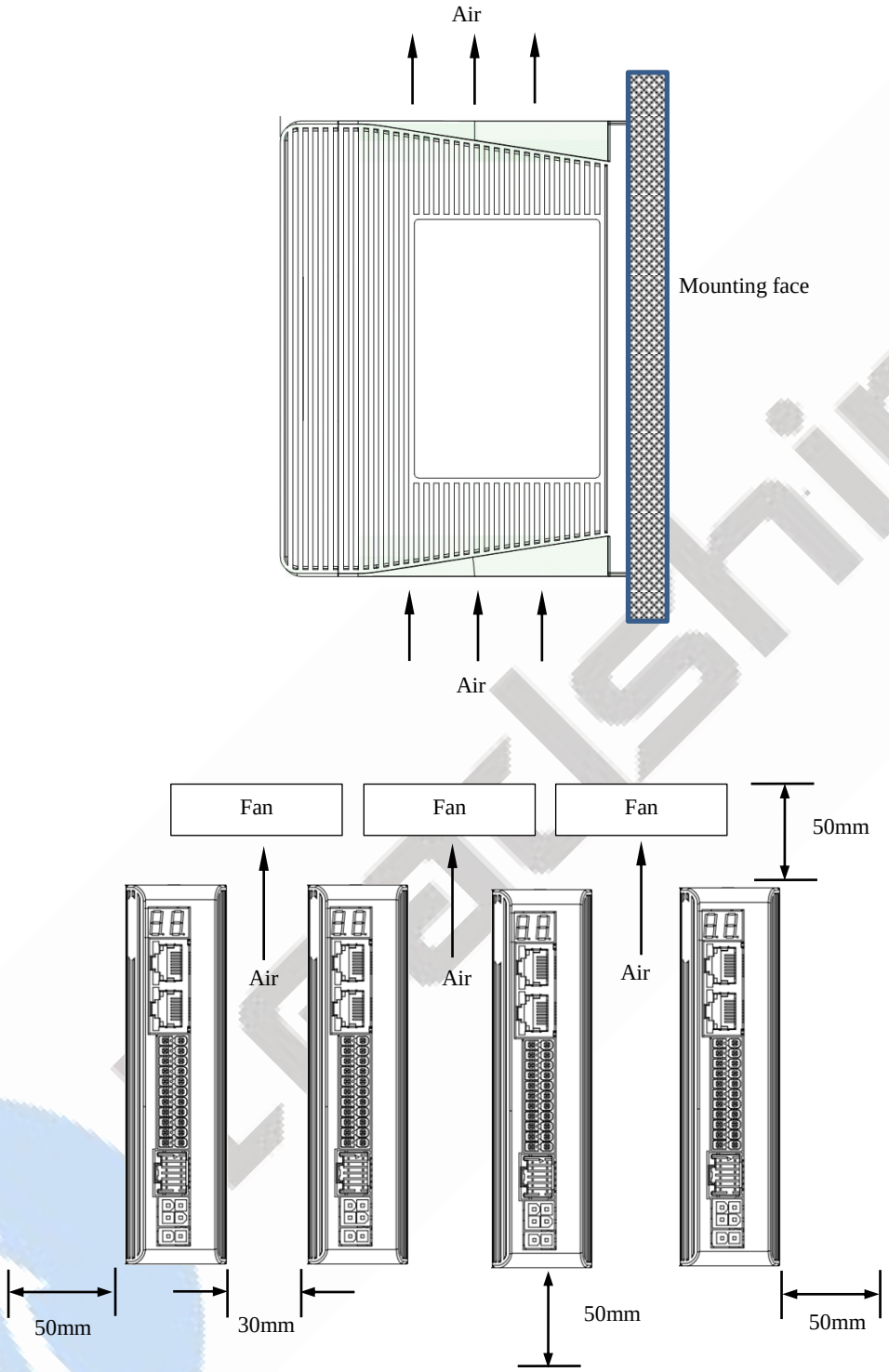



**Figure 2.2: 2CS3E series installation drawing**

# 3 Production Specifications

## 3.1 Electrical and Operating Specifications

### 3.1.1 EtherCAT Specifications

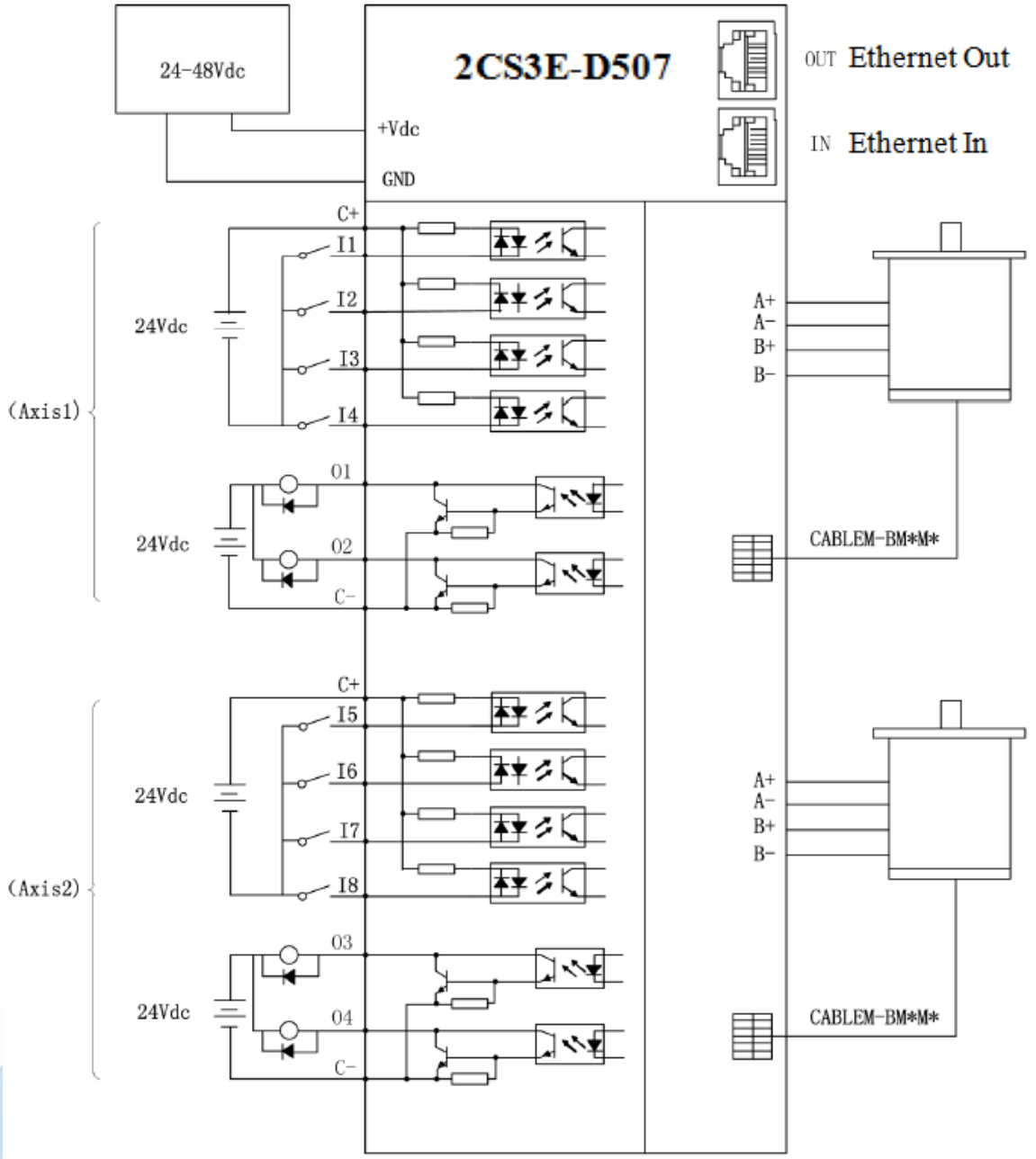
| Name | Description |
|---|---|
| Physical Layer | Ethernet-100BASE-TX |
| Communication Connector | RJ45*2 (shielded)<br>ECAT IN: EtherCAT Input<br>ECAT OUT: EtherCAT Output |
| Topology | Line, Tree |
| Baud Rate | 100Mbps (full-duplex-channel) |
| Frame Data Length | 1484 bytes (Max) |
| Synchronization Manager | SM0：email received (from master station to slave station )slave<br>SM1：email sent (from slave station to master station)<br>SM2：process data output (from master station to slave station)<br>SM3：process data input (from slave station to master station) |
| Supported Protocol | CoE：CANopen over EtherCAT |
| Synchronization mode | DC Synchronization (SYNC0)<br>Free Run |
| Communication Event | SDO<br>PDO<br>EMCY |
| Application Layer Specifications | IEC61800-7 CiA402 Drive Profile |
| Supported Operation Mode | CSP: Cyclic Synchronous Position Mode<br>PP: Profile Position Mode<br>PV: Profile Velocity Mode<br>HM: Homing Mode |
| Cycle Time | 250us, 500us, 750us, 1ms, 2ms, 3ms, 4ms, 5ms…, 20ms |

### 3.1.2 Electrical and Operating Specifications

| Name | 2CS3E-D503 | 2CS3E-D507 |
|---|---|---|
| Supply Voltage | 20-50VDC | 20-50VDC |
| Output Current (Peak) | 0.5-2.2A | 1.0-7.0A |
| Size (H*W*L mm) | 155*116.5*28 | |
| Weight (kg) | 0.65 | |

| | | |
|---|---|---|
| Matched Motor | NEMA 11, 14, 17 | NEMA 17, 23, 24 |
| Input Signals | Home Input, Positive Limit, Negative Limit, Touch Probe, GPIOs | |
| Output Signals | Brake, Alarm, In Position, GPIOs | |
| Protection Functions | Over Current, Over Voltage, Position Following Error, Encoder Cable Error, etc. | |
| PC Software | Leadshine Motion Studio (coming soon) | |
| Operating Environment | Environment | Avoid dust, oil ,fog and corrosive gases |
| | Operating Temperature | 0-50℃ (32 F – 122 F) |
| | Storage Temperature | -20℃-65℃ (-4 F – 149 F) |
| | Humidity | 40-90%RH |
| | Vibration | 10-55Hz/0.15mm |
| | Mount | Vertical or horizontal mounting |

## 3.2 Wiring Instructions




Note:

- There are two EtherCAT communication ports above, one of them is input port which connects with master station or previous slave, and the other is output port which connects with the following slave.
- Brake output on the drive can connect with brake outlet on the motor directly.
- Encoder extension cable with Z signal is named: CABLEM-BM*M*Z

### 3.2.1 Power Supply Cable & Motor Cable

- Wire diameter: +VDC, GND, A+, A-, B+, B- terminal wire diameter≥0.3mm$^2$ (AWG15-22)
- A noise filter which can improve anti-interference performance is recommended to be connected between power supply and drive.

### 3.2.2 I/O Signal Cable

- Wire diameter: I1~I8, O1~O4, COM, 24VB and COM terminal wires diameter≥0.12mm$^2$ (AWG24-26)
- Recommend to adopt shielded twisted pair cable with a length of less than 3 meters (the shorter the better).

- Wiring: As far as possible away from the power line wiring, in order to prevent interference
- Please connect surge absorber to inductive device, such as anti-parallel diode for DC coil, parallel RC-snubbers circuit for AC coil.

### 3.2.3 EtherCAT Communication Cable

It is recommended to use shielded Ethernet network cables that do not exceed 100 meters.

CAUTION

- DO NOT hot plug in and out.
- Be sure to turn off power and wait for at least 5 minutes, and then you can transport, wiring and inspect the drives and motors.

## 3.3 Interface Specifications

### 3.3.1 Connector Definition

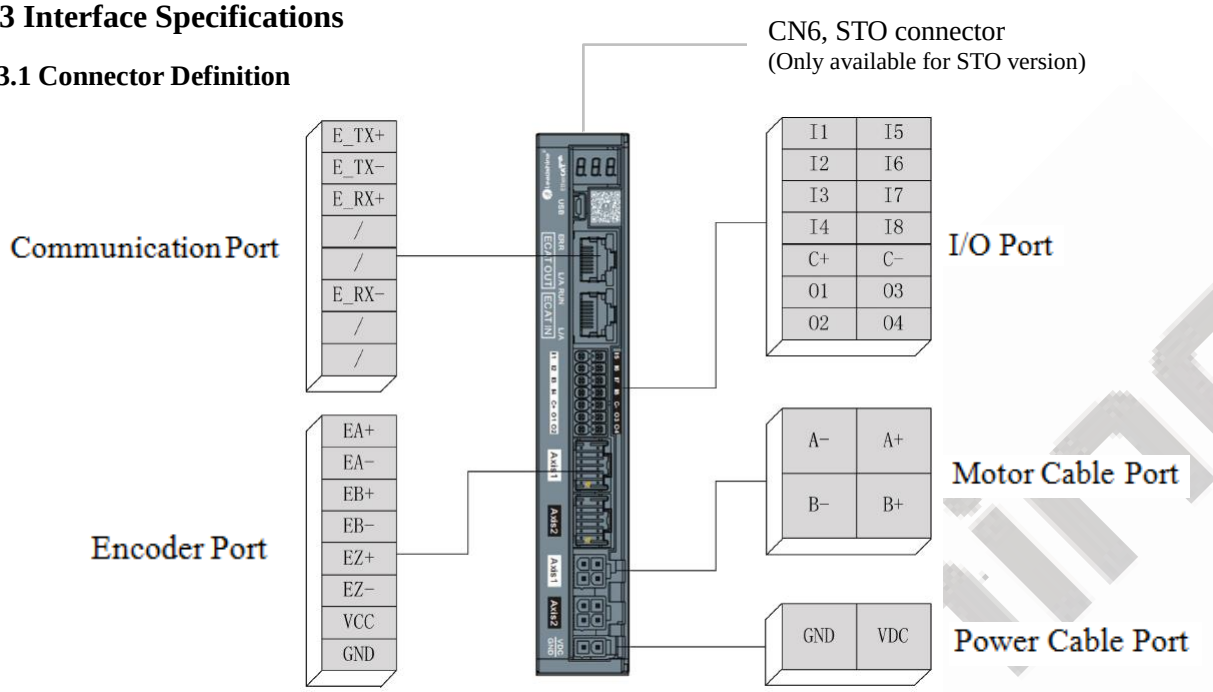
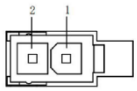


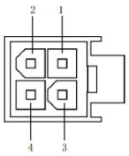

**Figure 3.2: 2CS3E series connectors**

| Name | Description |
|---|---|
| CN1 | Input power connector |
| CN2 | Motor cable connector |
| CN3 | Encoder input signals connector |
| CN4 | Digital input and output connector |
| CN5 | EtherCAT communication connector |
| CN6 | STO connector (Only available for STO version) |

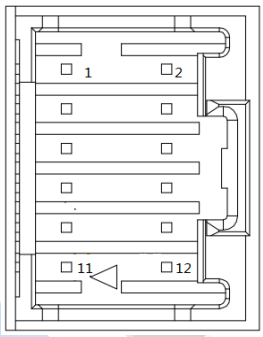
### 3.3.2 CN1-Input Power Connector

| Name | Pic | PIN | Signal | Description |
|---|---|---|---|---|
| CN1 |  | 1 | VDC | 20~50VDC |
| | | 2 | GND | GND |

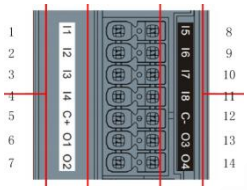
### 3.3.3 CN2-Motor Connector

| Name | Pic | PIN | Signal | Description |
|---|---|---|---|---|
| CN2 |  | 1 | A+ | Motor phase A+ |
| | | 2 | A- | Motor phase A- |
| | | 3 | B+ | Motor phase B+ |
| | | 4 | B- | Motor phase B- |

### 3.3.4 CN3-Encoder Input Signals Connector

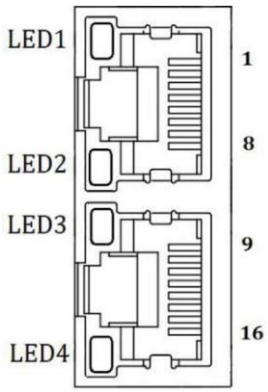
| Name | Pic | PIN | Signal | Description |
|---|---|---|---|---|
| CN3 |  | 1 | EA+ | Encoder signal of phase A+ |
| | | 2 | EA- | Encoder signal of phase A- |
| | | 3 | EB+ | Encoder signal of phase B+ |
| | | 4 | EB- | Encoder signal of phase B- |
| | | 5 | EZ+ | Encoder Z+ signal |
| | | 6 | EZ- | Encoder Z- signal |
| | | 7 | VCC | Encoder +5V voltage |
| | | 8 | GND | Encoder ground |
| | | 9 | U | Reserved |
| | | 10 | V | Reserved |
| | | 11 | W | Reserved |
| | | 12 | PE | Shield ground |

### 3.3.5 CN4-I/O Signals Connector

| Name | Pic | PIN | Signal | I/O | Description |
|---|---|---|---|---|---|
| CN4 |  | 1 | I1 | I-Axis1 | Probe (default) configurable, single-ended, 12~24V |
| | | 2 | I2 | I-Axis1 | HOME (default) configurable, single-ended, 12~24V |
| | | 3 | I3 | I-Axis1 | POT (default) configurable, single-ended, 12~24V |
| | | 4 | I4 | I-Axis1 | NOT (default) configurable, single-ended, 12~24V |
| | | 5 | C+ | Common | Command port of input signals for axis1 and axis2 |
| | | 6 | O1 | O-Axis1 | Alarm (default) configurable, common-cathode |
| | | 7 | O2 | O-Axis1 | Brake (default) configurable, common-cathode |
| | | 8 | I5 | I-Axis2 | Probe (default) configurable, single-ended, 12~24V |
| | | 9 | I6 | I-Axis2 | HOME (default) configurable, single-ended, 12~24V |
| | | 10 | I7 | I-Axis2 | POT (default) configurable, single-ended, 12~24V |
| | | 11 | I8 | I-Axis2 | NOT (default) configurable, single-ended, 12~24V |
| | | 12 | C- | Common | Command port of output signals for axis1 and axis2 |
| | | 13 | O3 | O-Axis2 | Alarm (default) configurable, common-cathode |
| | | 14 | O4 | O-Axis2 | Brake (default) configurable, common-cathode |

Remark: I/O interface and corresponding parameter setting refer to chapter 4.1.3

### 3.3.6 CN5-EtherCAT Communication Connector

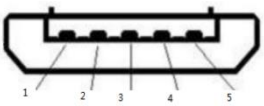
| Name | Pic | PIN | Signal | Description |
|---|---|---|---|---|
| CN5 |  | 1, 9 | E_TX+ | EtherCAT TxD+ |
| | | 2, 10 | E_TX- | EtherCAT TxD- |
| | | 3, 11 | E_RX+ | EtherCAT RxD+ |
| | | 4, 12 | / | / |
| | | 5, 13 | / | / |
| | | 6, 14 | E_RX- | EtherCAT RxD- |
| | | 7, 15 | / | / |
| | | 8, 16 | / | / |
| | | Cover | PE | Shield earthing |
| Note | (1) LED1 as'Link/Activity IN' indicator, green<br>(2) LED3 as'Link/Activity OUT' indicator, green<br>(3) LED2 as'RUN' indicator, green<br>(4) LED4 as'ERR' indicator, red | | | |

This LED informs EtherCAT communication status. RUN LED, ERROR LED positions at the front side of product and, Link/Activity LED individually positions at the top of right corner of EtherCAT ports..

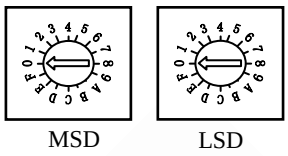
| Name | Color | Statue | Description |
|---|---|---|---|
| LED1 | Green | OFF | Link not established in physical layer |
| | | ON | Link established in physical layer |
| | | Flickering | In operation after establishing link |
| LED3 | Green | OFF | Link not established in physical layer |
| | | ON | Link established in physical layer |
| | | Flickering | In operation after establishing link |

Table 3.3 Link/Activity LED status

### 3.3.7 CN6-Micro USB Tuning Port

| Name | Pic | PIN | Signal |
|---|---|---|---|
| CN6 |  | 1 | GND |
| | | 2 | Reserved |
| | | 3 | Data+ |
| | | 4 | Data- |
| | | 5 | V_Bus |

### 3.3.8 Salve ID (Site Alias) Setting




The Salve ID (also called Site Alias) of 2CS3E series can be set by the following 3 methods:

- **Setting via Rotary Switches**

When Object (2151h) is set to value '0', user can set a value non-zero via the two rotary switches as the salve ID, activated after restarting the power supply. The specific definition is as below:

The salve ID of drives comes from the constituent hexadecimal value by rotary switch 1 (MSD) and rotary switch 2 (LSD). For example, when the MSD is set value 'A' , and the LSD is set value '8' , the ID is 168 (decimalism).

- **Setting via Reading ESC(EtherCAT Salve Controller)**

When Object (2151h) is set to value '2' and MSD, LSD rotary switches are set to 0, the EtherCAT master will configure site alias to the address of EEPROM 0004h of ESC automatically.

- **Setting via Object (2150h)**

When Object (2151h) is set to value '1', the value written in Object (2150h) is as the site alias, activated after saving parameter and restarting the power supply.

### 3.3.9 Three 7-Segment

There are two 7-Segments with two LED indicators on the front of 2CS3E-D507 (turn on when drive is enabled).The displayed content of after initialization can be set by Object (214b-00h):

- 2-Velocity
- 0-State machine / operation mode
- 1-Slave ID

When an error occurs, the 7-Segment displays only the alarm code, please refer to chapter 5.2

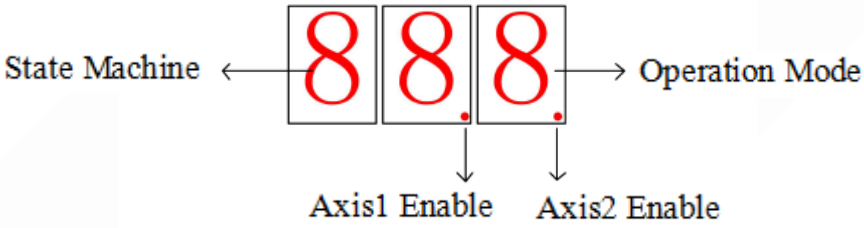



**Figure 3.3: Two 7-Segments**

## 3.4 I/O Interface and Corresponding Parameters Setting

### 3.4.1 Digital Input

- **Wiring**

There are two types of input signals: single-ended and differential.the connections are as below:

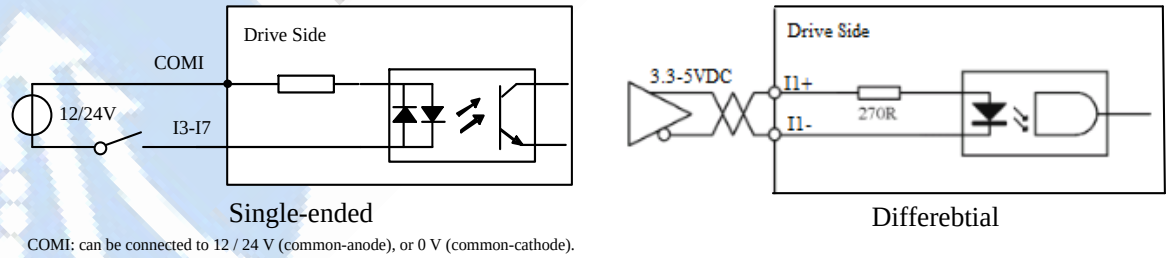



**Figure 3.4: Input Interface Connection**

Note:

(1) Controller/PLC/Control card should provide input DC power 12-24V, current ≥ 100mA.

(2) If the polarity of input DC power is reversed, the EtherCAT stepper drive won't work; you need to turn the wiring.

### 3.4.2 Digital Output

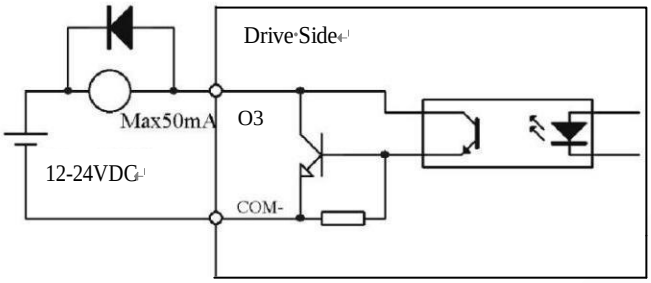



**Figure 3.5: Output Interface Wiring**

Note:

(1) The power supply (12-24VDC) above is provided by user, and if the polarity of power supply is reversed, it will damage the drive.

(2) Digital output is OC output with the maximum capacity of 100mA/30V (recommended 50mA/25V), the provided power supply should be under 30V (recommended 24V), and otherwise it will cause damage to the drive.

### 3.4.3 Brake Output

This driver has a special brake output, built-in a fly-wheel diode, driving current up to 500 mA, can directly drive the motor brake without relays. The connection is below:

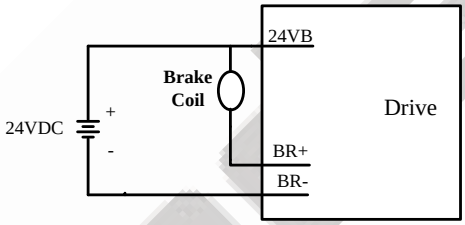



**Figure 3.6: Brake output connection**

# 4 EtherCAT Object Dictionary

Each 2CS3E series product support two axes, except the parameters of 1000h~1FFFh are common parameters for axis1 and axis2, other parameters are working independently, the relation between these parameters show as follow:

**Axis2 address (hex) = Axis1 address (hex) + 0x800**

For example:

| | Axis1 | Axis2 |
|---|---|---|
| Peak current | 0x2000 | 0x2800 |
| Target position | 0x607A | 0x687A |

## 4.1 Communication Object

The 2CS3E Series drives follows the EtherCAT standard protocol, can communicate with the master stations which also supports the EtherCAT standard protocol.

| Index | Sub-index | Name | Access | Type | Range | Axis-1 default Value | Unit | Remark |
|---|---|---|---|---|---|---|---|---|
| 1000 | 0 | Device type | R | UINT | 0-32767 | 0x40912 | - | Refer to CIA 402 profile |
| 1001 | 0 | Error register | R | USINT | 0-255 | 0 | -- | Refer to Chapter 5.1 |
| 1008 | 0 | Device name | R | UINT | 0-32767 | 2CS3E-D | - | - |
| 1010 | 00 | Number of sub-index | R | UINT | 0-32767 | 4 | - | - |
| | 01 | Save all parameters | R/W | UDINT | 0-0xFFFFFFFF | 0 | - | Need to write 0x65766173 or 1702257011 (decimal) into sub-index. It will return 1 if save successfully |
| | 02 | Save communication parameters | R/W | UDINT | 0-0xFFFFFFFF | 0 | - | |
| | 03 | Save motion parameters | R/W | UDINT | 0-0xFFFFFFFF | 0 | - | |
| | 04 | Save factory parameters | R/W | UDINT | 0-0xFFFFFFFF | 0 | - | |
| 1011 | 00 | Number of sub-index | R | UINT | 0-32767 | 4 | - | - |
| | 01 | Restore all parameters to Axis-1 default setting | R/W | UDINT | 0-0xFFFFFFFF | 0 | - | Need to write 0x64616f6c or 1684107116 (decimal) into sub-index. It will return 1 if save successfully |
| | 02 | Reset communication parameters to factory setting | R/W | UDINT | 0-0xFFFFFFFF | 0 | - | |
| | 03 | Reset motion parameters to factory setting | R/W | UDINT | 0-0xFFFFFFFF | 0 | - | |
| | 04 | Reset user parameters to factory setting | R/W | UDINT | 0-0xFFFFFFFF | 0 | - | |
| 1018 | 00 | Number of sub-index | R | UINT | 0-32767 | 4 | - | - |
| | 01 | Vendor ID | R | UINT | 0-32767 | 4321 | - | Leadshine code |
| | 02 | Product code | R | UINT | 0-32767 | 100 | - | - |
| | 03 | Revision number | R | UINT | 0-32767 | 1 | - | - |
| | 04 | Series number | R | UINT | 0-32767 | 1 | - | - |
| 1600 | 0 | Number of sub-index | R/W | UINT | 0-32767 | 3 | - | Axis-1 default number of 1st mapping object |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 01-08 | 1st RXPDO-Map object | R/W | UDINT | 0-0xFFFFFFFF | - | - | Axis-1 default number of 1st RXPDO-Map object |
| 1601 | 0 | Number of sub-index | R/W | UINT | 0-32767 | 6 | - | Axis-1 default number of 2nd mapping object |
| | 01-08 | 2nd RXPDO-Map object | R/W | UDINT | 0-0xFFFFFFFF | - | - | Axis-1 default number of 2nd RXPDO-Map object |
| 1602 | 0 | Number of sub-index | R/W | UINT | 0-32767 | 5 | - | Axis-1 default number of 3rd mapping object |
| | 01-08 | 3rd RXPDO-Map object | R/W | UDINT | 0-0xFFFFFFFF | - | - | Axis-1 default number of 3rd RXPDO-Map object |
| 1603 | 0 | Number of sub-index | R/W | UINT | 0-32767 | 7 | - | Axis-1 default number of 4th mapping object |
| | 01-08 | 4th RXPDO-Map object | R/W | UDINT | 0-0xFFFFFFFF | - | - | Axis-1 default number of 4th RXPDO-Map object |
| 1610 | 0 | Number of sub-index | R/W | UINT | 0-32767 | 3 | - | Axis-2 Axis-1 default number of 1st mapping object |
| | 01-08 | 1st TXPDO-Map object | R/W | UDINT | 0-0xFFFFFFFF | - | - | Axis-2 default number of 1st RXPDO-Map object |
| 1611 | 0 | Number of sub-index | R/W | UINT | 0-32767 | 6 | - | Axis-2 default number of 2nd mapping object |
| | 01-08 | 2nd RXPDO-Map object | R/W | UDINT | 0-0xFFFFFFFF | - | - | Axis-2 default number of 2nd RXPDO-Map object |
| 1612 | 0 | Number of sub-index | R/W | UINT | 0-32767 | 5 | - | Axis-2 default number of 3rd mapping object |
| | 01-08 | 3rd RXPDO-Map object | R/W | UDINT | 0-0xFFFFFFFF | - | - | Axis-2 default number of 3rd RXPDO-Map object |
| 1613 | 0 | Number of sub-index | R/W | UINT | 0-32767 | 7 | - | Axis-2 default number of 4th mapping object |
| | 01-08 | 4th RXPDO-Map object | R/W | UDINT | 0-0xFFFFFFFF | - | - | Axis-2 default number of 4th RXPDO-Map object |
| 1A00 | 0 | Number of sub-index | R/W | UINT | 0-32767 | 7 | - | Axis-1 default number of 1st mapping object |
| | 01-08 | 1st TXPDO-Map object | R/W | UDINT | 0-0xFFFFFFFF | - | - | Axis-1 default number of 1st TXPDO-Map object |
| 1A01 | 0 | Number of sub-index | R/W | UINT | 0-32767 | 0 | - | Axis-1 default number of 2nd mapping object |
| | 01-08 | 2nd TXPDO-Map object | R/W | UDINT | 0-0xFFFFFFFF | - | - | Axis-1 default number of 2nd RXPDO-Map object |
| 1A10 | 0 | Number of sub-index | R/W | UINT | 0-32767 | 7 | - | Axis-1 default number of 1st mapping object |
| | 01-08 | 1st TXPDO-Map object | R/W | UDINT | 0-0xFFFFFFFF | - | - | Axis-1 default number of 1st TXPDO-Map object |
| 1A11 | 0 | Number of sub-index | R/W | UINT | 0-32767 | 0 | - | Axis-1 default number of 2nd mapping object |
| | 01-08 | 2nd TXPDO-Map object | R/W | UDINT | 0-0xFFFFFFFF | - | - | Axis-1 default number of 2nd RXPDO-Map object |
| 1C00 | 0 | Number of sub-index | R | UINT | 0-32767 | 4 | - | - |
| | 01 | Output type of email | R | UINT | 0-32767 | 1 | - | - |
| | 02 | Input type of email | R | UINT | 0-32767 | 2 | - | - |
| | 03 | Output type of process data | R | UINT | 0-32767 | 3 | - | - |
| | 04 | Input type of process data | R | UINT | 0-32767 | 4 | - | - |
| 1C12 | 0-04 | RXPDO assign | R/W | UINT | 0-32767 | 1600 | - | - |
| 1C13 | 0-02 | TXPDO assign | R/W | UINT | 0-32767 | 1A00 | - | - |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 1C32 | 0-0A | RXPDO administrative parameters | R | UINT | 0-32767 | - | - | - |
| 1C33 | 0-0A | TXPDO administrative parameters | R | UINT | 0-32767 | - | - | - |

The parameters can be configured by master station's PC software or Leadshine Motion Studio.

## 4.2 Manufacture Specific Object

Explanation for index and sub-index

| Index | Sub- index | Name | Access for which axis |
|---|---|---|---|
| 2000 | 00 | Peak current | For axis1 |
| 2800 | 00 | | For axis2 |
| 2001 | 00 | Microstep resolution | For axis1 |
| 2801 | 00 | | For axis2 |

| Index | Sub-index | Name | Access | Type | Range | Axis-1 default value | Unit | Remark |
|---|---|---|---|---|---|---|---|---|
| 2000 | 00 | Peak current | R/W | DINT | 0-70 | 60 | 0.1A | Drive's max output current.<br>2CS3E-D503 is 25 by default;<br>2CS3E-D507 is 60 by default. |
| 2800 | 00 | | | | | | | |
| 2001 | 00 | Microstep resolution | R/W | DINT | 200-51200 | 10000 | Pulse | Required number of pulse to rotate 1 revolution of motor.<br>But it is recommended to modify via 6092+01 |
| 2801 | 00 | | | | | | | |
| 2010 | 01 | Internal filtering time | R/W | DINT | 0-512 | 100 | 0.1ms | Internal smoothing time for control command. |
| 2810 | 01 | | | | | | | |
| 2012 | 00 | Soft-starting time | R/W | DINT | 1-60 | 1 | 100ms | Internal smoothing time for starting current. |
| 2812 | 00 | | | | | | | |
| 2013 | 00 | Auto-tuning at power on | R/W | DINT | 0-1 | 1 | -- | 1: Yes. 0: No |
| 2813 | 00 | | | | | | | |
| 2019 | 01 | In-position pulse compensation | R/W | DINT | 0-1 | 1 | -- | 0: With compensation, the value of 6064 = 607A in position;<br>1: Without compensation |
| 2819 | 01 | | | | | | | |
| 2019 | 02 | In-position mode at disabled state | R/W | DINT | 0-1 | 0 | -- | 0: Not allowed in-position signal output when disabled;<br>1: Allowed in-position signal output when disabled; |
| 2819 | 02 | | | | | | | |
| 201A | 01 | Locking current percentage of power on | R/W | DINT | 0-100 | 100 | % | Usually keep the Axis-1 default value. |
| 281A | 01 | | | | | | | |
| 201A | 02 | Closed loop holding current percentage | R/W | DINT | 0-100 | 50 | % | Multiply by the value of object 0x2000, the drive output current will change between these according to the load. |
| 281A | 02 | | | | | | | |
| 201B | 00 | Locking duration time | R/W | DINT | 0-1500 | 200 | ms | Appropriately reduce this value if you want to shorten the time of locking shaft. |
| 281B | 00 | | | | | | | |
| 201C | 00 | Max time to close brake | R/W | DINT | 100-10000 | 1000 | ms | Usually keep the Axis-1 default value |
| 281C | 00 | | | | | | | |
| 281D | 00 | | | | | | | |
| 2024 | 00 | Control Mode | R/W | DINT | 0~10 | 2 | -- | 0: Open Loop Control;<br>2: Closed Loop Control |
| 2824 | 00 | | | | | | | |
| 2025 | 01 | Speed point for open loop switching closed loop | R/W | DINT | 0~200 | 18 | 0.1r/s | - |
| 2825 | 01 | | | | | | | |
| 2025 | 02 | Delay for open loop switching closed loop | R/W | DINT | 0~32767 | 5 | ms | - |
| 2825 | 02 | | | | | | | |
| 2025 | 03 | Speed point for closed loop switching open loop | R/W | DINT | 0~200 | 12 | 0.1r/s | - |
| 2825 | 03 | | | | | | | |
| 2025 | 04 | Delay for closed loop switching open loop | R/W | DINT | 0~32767 | 250 | ms | - |
| 2825 | 04 | | | | | | | |
| 2025 | 05 | Feedback speed point for closed loop switching open loop | R/W | DINT | 0~200 | 50 | 0.1r/s | - |
| 2825 | 05 | | | | | | | |
| 2029 | 00 | Encoder resolution | R/W | DINT | 200-51200 | 4000 | Pulse | 4 times the encoder resolution.<br>But it is recommended to modify by 0x608F+01 |
| 2829 | 00 | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 2030 | 00 | Allowed max position following error pulses | R/W | DINT | 0~32767 | 4000 | Pulse | 4000 indicates the error of one turn |
| 2830 | 00 | | | | | | | |
| 2032 | 00 | Distance to send "In Position" output signal | R/W | DINT | 0-1000 | 4 | Pulse | - |
| 2832 | 00 | | | | | | | |
| 2033 | 00 | Delay of in-position error de-jitter | R/W | DINT | 0-1000 | 3 | ms | - |
| 2833 | 00 | | | | | | | |
| 2051 | 00 | Motor running direction | R/W | DINT | 0-1 | 0 | -- | 0: CCW direction<br>1: CW direction<br>But it is recommended to modify by 0x607E |
| 2851 | 00 | | | | | | | |
| 2056 | 00 | Alarm detection selection | R/W | DINT | 0~65535 | 65535 | -- | Bit setting:<br>=1: Yes; =0: No<br>Bit0: over-current (invalid)<br>Bit1: over-voltage<br>Bit2: Position following error<br>Bit3: Encoder wiring error<br>Bit4: over speed alarm |
| 2856 | 00 | | | | | | | |
| 2057 | 00 | Reset alarm | R/W | DINT | 0~1 | 0 | -- | Write value 1 to clear the alarm. But it is recommended to write value 128(Decimal) to 0x6040 |
| 2857 | 00 | | | | | | | |
| 2073 | 00 | Power on automatic operation | R/W | DINT | 0-1 | 0 | -- | 0:Normal standby of the motor after power on<br>1:After powering on, start self running and then standby |
| 2873 | 00 | | | | | | | |
| 2090 | 01 | Current loop Kp | R/W | DINT | 0~32767 | 1500 | -- | -- |
| 2890 | 01 | | | | | | | |
| 2090 | 02 | Current loop Ki | R/W | DINT | 0~32767 | 200 | -- | -- |
| 2890 | 02 | | | | | | | |
| 2090 | 03 | Current loop Kc | R/W | DINT | 0~32767 | 300 | -- | -- |
| 2890 | 03 | | | | | | | |
| 2091 | 01 | Speed Loop Kp | R/W | DINT | 0~10000 | 30 | - | |
| 2891 | 01 | | | | | | | |
| 2091 | 02 | Speed Loop Ki | R/W | DINT | 0~10000 | 3 | - | |
| 2891 | 02 | | | | | | | |
| 2092 | 01 | Position Loop Kp | R/W | DINT | 0~100 | 25 | - | |
| 2892 | 01 | | | | | | | |
| 214b | 00 | LED initial state setting | R/W | DINT | 0~100 | 0 | -- | 0: State machine/operation mode<br>1: Node address<br>2: speed |
| 294b | 00 | | | | | | | |
| 2150 | 00 | Slave ID | R/W | DINT | 0-256 | 0 | -- | Valid when 0x2151= 1; |
| 2950 | 00 | | | | | | | |
| 2151 | 00 | Slave ID resource | R/W | DINT | 0-10 | 0 | -- | 0: DIP switches<br>1: Setting by 0x2150<br>2: ESC |
| 2951 | 00 | | | | | | | |
| 2152 | 01 | Input SI1 | R/W | DINT | 0-65535 | 0x17 | -- | Default probe 1,valid after restart |
| 2952 | 01 | | | | | | | |
| 2152 | 02 | Input SI2 | R/W | DINT | 0-65535 | 0x16 | -- | Default homing,valid after restart |
| 2952 | 02 | | | | | | | |
| 2152 | 03 | Input SI3 | R/W | DINT | 0-65535 | 0x01 | -- | Default POT,valid after restart |
| 2952 | 03 | | | | | | | |
| 2152 | 04 | Input SI4 | R/W | DINT | 0-65535 | 0x02 | -- | Default NOT,valid after restart |
| 2952 | 04 | | | | | | | |
| 2155 | 00 | Input and output IO state | R | DINT | 0-65535 | 0 | -- | Low-8 bit IN state<br>High-8 bit OUT state |
| 2955 | 00 | | | | | | | |
| 2156 | 01 | Output SO1 | R/W | DINT | 0-65535 | 0x01 | -- | Default alarm,valid after restart |
| 2956 | 01 | | | | | | | |
| 2156 | 02 | Output SO2 | R/W | DINT | 0-65535 | 0x03 | -- | Default brake,valid after restart |
| 2956 | 02 | | | | | | | |
| 2232 | 00 | Synchronous compensation1 | R/W | DINT | 0—50 | 2 | -- | -- |
| 2A32 | 00 | | | | | | | |
| 2233 | 00 | Synchronous compensation2 | R/W | DINT | 0—500 | 100 | -- | -- |
| 2A33 | 00 | | | | | | | |
| 2234 | 00 | Number of PWM lagging cycles | R/W | DINT | 0—500 | 2 | -- | -- |
| 2A34 | 00 | | | | | | | |
| 225C | 00 | Special function register | R/W | DINT | 0~0xffff | 0 | -- | Bit1=1: Set motor running direction by 0x607E<br>Bit2=1: Set virtual input by 0x5012-03 |
| 2A5C | 00 | | | | | | | |
| 22A9 | 00 | Limit Mode | R/W | DINT | 0-10 | 0 | -- | 0: Stop normally<br>1: Invalid<br>2: Alarm, error code 260 |
| 2AA9 | 00 | | | | | | | |
| 22B4 | 00 | Quick stop selection | R/W | DINT | 0-1 | 0 | -- | 0: Alarm, error code 570,<br>1: Refer to 0x605A |
| 2AB4 | 00 | | | | | | | |
| 22EF | 00 | Offset value when motor locking | R/W | DINT | 0-32767 | 2000 | P | Encoder unit |
| 2AEF | 00 | | | | | | | |
| 22F0 | 00 | Z signal pulse width | R/W | DINT | 0-32767 | 10 | ms | Z signal pulse width refer to 60FD |
| 2AF0 | 00 | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 22F1 | 00 | Homing mode in-position pulse setting | R/W | DINT | 0-32767 | 1 | P | Encoder unit |
| 2AF1 | 00 | | | | | | | |
| 2C03 | 03 | | | | | | | |
| 3100 | 01 | Control software version | R | UINT | 0-32767 | 001 | -- | -- |
| | 02 | Firmware version | R | UINT | 0-32767 | 001 | -- | |
| | 03 | EtherNet/IP protocol version | R | UINT | 0-32767 | 101 | -- | -- |
| 3FFE | 01-0B | Alarm record | R | DINT | 0~32767 | -- | -- | 0x3FFE+01 is the current error code (current alarm) or the most recent error code (currently no alarm);<br>0x3FFE+02-0E are followed by the historical error code.-- |
| 47FE | 01-0B | | | | | | | |
| 4003 | 01 | Delay of closing brake | R/W | UINT | 0-1500 | 250 | ms | -- |
| 4803 | 01 | | | | | | | |
| 4003 | 02 | Delay of loosening brake | R/W | UINT | 0-1500 | 250 | ms | -- |
| 4803 | 02 | | | | | | | |
| 4003 | 03 | Max speed to close brake | R/W | UINT | 0-500 | 10 | 0.1r/s | -- |
| 4803 | 03 | | | | | | | |
| 4500 | 00 | Current error ID | R | DINT | 0-32767 | -- | -- | -- |
| 4D00 | 00 | | | | | | | |
| 5000 | 03 | Internal enable state | R | DINT | 0~32767 | -- | -- | 0: Disabled<br>1: Enabled |
| 5800 | 03 | | | | | | | |
| 5000 | 04 | Reach the target state | R | UINT | 0~32767 | -- | -- | Bit0=0: Not reach<br>Bit0=1: Reach<br>Bit1=0: No stall<br>Bit1=1: Stalled |
| 5800 | 04 | | | | | | | |
| 5002 | 01 | ESC ID | R/W | UINT | 0~32767 | -- | -- | Write 0, return the ID data in ESC to 0x5002-02；<br>Write 0x12, return the current ID setting by DIP switches |
| 5802 | 01 | | | | | | | |
| 5002 | 02 | ESC data | R | UINT | 0~32767 | -- | -- | Return Node ID data |
| 5802 | 02 | | | | | | | |
| 5004 | 0F | Sync0 Synchronization interface parameters | R/W | UINT | 0~32767 | 0x1FF | -- | Bit0 =1: RPDO mapping can't be written by SDO;<br>Bit0 =0: RPDO mapping can be written by SDO;<br>Bit1=1: Detect the number of PDO mapping;<br>Bit1=1: Don't detect the number of PDO mapping;<br>Bit2=1: Send 0xF directly to enable;<br>Bit2=0: Send 0xF can't be enabled. |
| 5804 | 0F | | | | | | | |
| 5005 | 00 | DC compensation base value | R/W | UINT | 0~32767 | 500 | -- | -- |
| 5805 | 00 | | | | | | | |
| 5006 | 00 | Synchronization error detection | R/W | UINT | 0~32767 | 0 | -- | -- |
| 5806 | 00 | | | | | | | |
| 5011 | 00 | Internal actual location | R | UDINT | 0~32767 | -- | -- | -- |
| 5811 | 00 | | | | | | | |
| 5012 | 01 | Homing arrival position | R/W | DINT | 0~32767 | 0 | -- | -- |
| 5812 | 01 | | | | | | | |
| 5012 | 02 | Homing trigger position | R/W | DINT | 0~32767 | 0 | -- | -- |
| 5812 | 02 | | | | | | | |
| 5012 | 03 | Homing virtual input | R/W | UDINT | 0~32767 | 0 | -- | When 0x225C=4, activate the virtual input function; 60FD different bits, corresponding to different virtual inputs;<br>Inputs / Bit of 60FD<br>Probe signal 1 / Bit 26=1<br>Home switch / Bit 2=1<br>Positive limit / Bit 1=1<br>Negative limit / Bit 0=1<br>Z signal (index signal) / Bit 31=1<br>For example: 0x225C=4 and start homing, set 0x5012-03=4, Home switch input; set 0x5012-03=2, Positive limit input; set 0x5012-03=2, Negative limit input |
| 5812 | 03 | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 5012<br>5812 | 04<br>04 | Homing setting | R/W | UINT | 0~32767 | 0x4054 | -- | Bit0=0: Homing protection is not turned on;<br>Bit0=1: Homing protection is turned on;<br>(Homing protection: when start homing, If the limit signal takes effect, bit0=0 means homing normally, bit0=1 means stop homing as limit protection )<br><br>Bit2=0: The value of current position after in position = 0x607C;<br>Bit2=1: The value of 0x607C is used as the motion offset, and finally 0x6064 = 0;<br>Bit3=0: 0x6064= 0x607C after in position;<br>Bit3=1: 0x6064 = 0x607C after in position; |
| 5015<br>5815 | 05<br>05 | Handling of limit position collision | R/W | UINT | 0~32767 | 1 | -- | Bit6=0:The value of 0x6041 bit12 is used as the collision limit clear status<br>Bit6=1:The value of 0x6041 bit12 is used as the collision limit not clear status |
| 5400<br>5C00 | 01<br>01 | Minimum synchronization period | R/W | UINT | 250~2000 | 500 | us | -- |
| 5400<br>5C00 | 02<br>02 | Maximum synchronization period | R/W | UINT | 250~20000 | 8000 | us | -- |
| 5503<br>5D03 | 04<br>04 | Special function register | R/W | UINT | 0~65535 | 7 | -- | Bit0 = 2: Asynchronous mode, the host will track 0x607A-00 in real time;<br>Bit0=3 or=7: Asynchronous mode, the host does not track 0x607A-00in real time. |

## 4.3 I/O Configuration Object

The configuration of input ports includes three parts: function setting, filter time and polarity setting. Therefore, **the relevant object dictionary value (Decimal) = Input port function setting value + Filter time setting value + Input port polarity setting value.**
The configuration of output ports includes two parts: function setting and polarity setting. Therefore,**the relevant object dictionary value (Decimal) = Output port function setting value + Output port polarity setting value.**
It is recommended to use Leadshine free tuning software MotionStudio for parameter settings, which will be very simple. In Leadshine MotionStudio, digital input (DI) and digital output (DO) are displayed as SI and SO.

### 4.3.1 Input Ports Function Value

| Index | Sub-index | Name | Access | Type | Range | Axis-1 default value | Unit | Remark |
|---|---|---|---|---|---|---|---|---|
| 2152<br>2952 | 01<br>01 | Input1 function | R/W | DINT | 0-65535 | 0x17 (Decimal 23) | -- | Axis-1 default is touch probe1, take effect changes need restart power |
| 2152<br>2952 | 02<br>02 | Input2 function | R/W | DINT | 0-65535 | 0x18 (Decimal 24) | -- | Axis-1 default is HOME, take effect changes need restart power |
| 2152<br>2952 | 03<br>03 | Input3 function | R/W | DINT | 0-65535 | 0x16 (Decimal 22) | -- | Axis-1 default is POT, take effect changes need restart power |
| 2152<br>2952 | 04<br>04 | Input4 function | R/W | DINT | 0-65535 | 0x01 (Decimal 1) | -- | Axis-1 default is NOT, take effect changes need restart power |

**Note:**

(1) After configuring the input and output functions through the master station software or MotionStudio, it needs to save and restart the power to take effect.

(2) If the function configuration of the two input ports is repeated, the input port with the smaller number is valid, and the other input port will be set to GPIO automatically. For example: SI3 and SI4 are configured as positive limit, after saving and restarting, SI3 function as positive limit, SI4 function as GPIO.

There are two object dictionaries that can be used to monitor input ports:
0x2155 is used to monitor whether the input port is connected to a valid signal;
0x60FD is used to monitor whether the input port is configured with a function

- **0x2155 Corresponding Input Port Table:**

| Input port | Index +Sub index | Axis-1 default Function Value | Axis-1 default Function | Physical State Read State1 (3) |
|---|---|---|---|---|
| IN1 | 0x2152+01 (1)<br>0x2952+01 | 0x17 | Probe1 | 0x2155.00=1 (2) |
| IN2 | 0x2152+02<br>0x2952+02 | 0x18 | HOME | 0x2155.01=1 |

| | | | | |
|---|---|---|---|---|
| IN3 | 0x2152+03<br>0x2952+03 | 0x16 | POT | 0x2155.02=1 |
| IN4 | 0x2152+04<br>0x2952+04 | 0x01 | NOT | 0x2155.03=1 |

**Note:**

(1) 0x2152+01 indicate that the index is 0x2152, and sub-index is 01.

(2) 0x2155.01 indicates that the index is 0x2155, and bit is bit1.

(3) Read State1: when IN1~IN7 inputs are valid, at this time, it has nothing to do with whether the function is configured, bit0~bit5 of 0x2155 will change to value 1. For example, when only IN5 input port is valid, bit 4 of 0x2155 will be value 1, then 0x2155=F (Decimal 16).

- **0x60FD Corresponding Function Table:**

| Input Function | Setting Value | Logic state<br>Read state2 (1) |
|---|---|---|
| Invalid | 0x00 | - |
| Probe1 | 0x17 (Decimal 23) | 0x60FD.26=1<br>0x68FD.26=1 |
| Probe2 | 0x18 (Decimal 24) | 0x60FD.27=1<br>0x68FD.27=1 |
| Home (ORG) | 0x16 (Decimal 22) | 0x60FD.02=1<br>0x68FD.02=1 |
| Positive limit (POT) | 0x01 (Decimal 1) | 0x60FD.01=1<br>0x68FD.01=1 |
| Negative limit (NOT) | 0x02 (Decimal 2) | 0x60FD.00=1<br>0x68FD.00=1 |
| Quick Stop (EMG) | 0x14 (Decimal 20) | 0x60FD.23=1<br>0x68FD.23=1 |
| GPIO (SI-MON) | 0x19 (Decimal 25) | When IN1 is set to GPIO → 60FD.04=1/ 68FD.04=1<br>When IN2 is set to GPIO → 60FD.05=1/ 68FD.05=1<br>When IN3 is set to GPIO → 60FD.06=1/ 68FD.06=1<br>When IN4 is set to GPIO → 60FD.07=1/ 68FD.07=1 |

Note:

(1) Read State2: when inputs function is valid, at this time, it has nothing to do with which input port, bit0~bit26 of 0x60FD will change to value 1. For example: when IN5 input port is set to POT and input signal is valid, then bit0 of 0x60FD will be value 1.

(2) When input function is set to GPIO, at this time, different input ports correspond to different bit of 0x60FD.

### 4.3.2 Input Ports Filter Time & Polarity Value

| Filter Time | Setting Value (Decimal ) |
|---|---|
| 1ms | 0 |
| 2ms | 256 |
| 3ms | 512 |
| 4ms | 768 |
| 5ms | 1024 |
| 6ms | 1280 |
| 8ms | 1536 |
| 10ms | 1792 |
| 15ms | 2048 |
| 20ms | 2304 |
| 30ms | 2560 |
| 40ms | 2816 |
| 50ms | 3072 |
| 100ms | 3328 |
| 200ms | 3584 |
| 500ms | 3840 |

| Polarity | Setting Value |
|---|---|
| Normally open (NO) | 0 |
| Normally closed (NC) | 128 |

-

**Therefore, Value of 0x2152 (Decimal) = Input port function value + Filter time value + Polarity value.**
**For Example:**

1. IN1 needs to be set as quick stop function, filtering time is 20ms and polarity is NC(normal-closed):
   0x2152+01 = 20+128+2304=2452(0x994)
2. Need to set the polarity of IN3, IN4, IN5 to NC:
   0x2152+03 =128+22 =150(0x96)
   0x2152+04 =128+1 =129(0x81)
   0x2152+05 =128+2 =130(0x82)

### 4.3.3 Output Ports Function & Polarity Value

| Index | Sub-index | Name | Access | Type | Range | Axis-1 default value | Unit | Remark | Status monitoring 1 of output |
|---|---|---|---|---|---|---|---|---|---|
| 2156 | 01 | Output1 function | R/W | DINT | 0-65535 | 0x01 | -- | Axis-1 default is alarm output, take effect changes need restart power | 0x2155+00 |
| 2956 | 01 | | | | | | | | 0x2955+00 |
| 2156 | 02 | Output2 function | R/W | DINT | 0-65535 | 0x04 | -- | Axis-1 default is brake output, take effect changes need restart power | 0x2155+01 |
| 2956 | 02 | | | | | | | | 0x2955+02 |

More detail:

| **Output Port Function** | **Setting Value** |
|---|---|
| Reserved | 0 |
| Alarm (ALM) | 1 |
| Servo-on (Ready) | 2 (invalid) |
| Brake (BRK) | 3 |
| In-position (INP) | 4 (invalid) |
| Main control output | 5 |

| **Polarity** | **Setting Value** |
|---|---|
| Normally open (NO) | 0 |
| Normally closed (NC) | 128 |

**Therefore, Value of 0x2156 (Decimal) = Output port function value + Polarity value.**
**For Example:**
OUT1 needs to be set as alarm function and polarity is NC:
0x2156+01= 1+128=129(0x81)

### 4.3.4 Main Control Output Function

Main control output is also called general output and User-defined output, and its usage is as follows:

| **Name** | **Index+ Sub-index** | **Polarity** | | **Open main control output (60FE+01)** | **Enable main control output (60FE+02)** |
|---|---|---|---|---|---|
| | | NO (normal-open) | NC (normal-closed) | | |
| OUT1 | 2156+01 | 0x05 | 0x85 | bit16 (0x10000) | bit16 (0x10000) |
| | 2956+01 | | | | |
| OUT2 | 2156+02 | 0x05 | 0x85 | bit17 (0x20000) | bit17 (0x20000) |
| | 2956+02 | | | | |

For example, when OUT2 is set to main control output function and polarity is NC, the operation steps are as below:

- Set Object (2156+02h) to value 0x05 to main control output function;
- Set both 60FE+01 and 60FE+02 to value 0x20000, then it is available.

## 4.4 Motion Objects

| **Index** | **Name** | **Access** | **Type** | **Range** | **Axis-1 default value** | **Unit** | **Remark** |
|---|---|---|---|---|---|---|---|
| 603F | Error code | R | UINT | 0-65535 | 0 | -- | Refer to chapter 5.2 |
| 683F | | | | | | | |
| 6040 | Control word | R/W | UINT | 0-65535 | 0 | -- | Refer to chapter 6.1 |
| 6840 | | | | | | | |
| 6041 | Status word | R | UINT | 0-65535 | 0 | -- | Refer to chapter 6.1 |
| 6841 | | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 605A<br>685A | Quick stop type selection | R/W | UINT | 0-65535 | 6 | -- | 0: After stopping immediately, switch on disable state;<br>1: After decelerating to stops at a speed value of 0x6084, switch on disable state;<br>2: After decelerating to stops at a speed value of 0x6085, switch on disable state;<br>3: After decelerating to stops at a speed value of 0x60C6, switch on disable stat;<br>4: After stopping immediately, switch on quick stop state;<br>5: After decelerating to stops at a speed value of 0x6084, switch on quick stop state;<br>6: After decelerating to stops at a speed value of 0x6085, switch on quick stop state;<br>7: After decelerating to stops at a speed value of 0x60C6, switch on quick stop stat; |
| 605D<br>685D | Asynchronous mode halt selection | R/W | INT | 0~65535 | 1 | -- | 1: After decelerating to stops at a speed value of 0x6084, keep operation enable state;<br>2: After decelerating to stops at a speed value of 0x6085, keep operation enable state;<br>3: After decelerating to stops at a speed value of 0x60C6, keep operation enable state;<br>4: After stopping immediately, keep operation enable state. |
| 6060<br>6860 | Operation mode | R/W | USINT | 0-255 | 8 | -- | 1: PP mode,<br>3: PV mode,<br>6: Home mode, |
| 6061<br>6861 | Operation mode display | R | USINT | 0-255 | 8 | -- | - |
| 6062<br>6862 | Position command | R | DINT | -2147483648 ~2147483647 | 0 | Pulse | - |
| 6064<br>6864 | Position actual value | R | DINT | -2147483648 ~2147483647 | 0 | Pulse | - |
| 6067<br>6867 | Distance to send "In Position" output signal | R/W | UINT | 0-1000 | 4 | Pulse | It is recommended to use this object in preference, Can also set by 0x2032, |
| 606B<br>686B | Velocity command | R | DINT | -2147483648 ~2147483647 | 0 | P/s | - |
| 606C<br>686C | Velocity actual value | R | DINT | -2147483648 -2147483647 | 0 | P/S | - |
| 607A<br>687A | Target position | R/W | DINT | -2147483648 ~2147483647 | 0 | P | Target position under PP mode |
| 607C<br>687C | Home offset | R/W | DINT | -2147483648 ~2147483647 | 0 | P | The value of difference between zero position and mechanical zero point under Homing mode .<br>If the value is set to10000, it means that at homing mode 19, the motor reaches the Home switch and stops immediately, then reverses at low speed until it leaves the Home switch, at last stops at a distance of 10000P. |
| 607D+01<br>687D+01 | Software negative limit | R/W | DINT | -2147483648 ~2147483647 | 0 | P | New target positions are checked against these limits. The limits are relative to the machine home position, which is the result of homing. As Axis-1 default the software position limits are switched off. Changed values must be saved and the drive must be restarted to take enable the new the software limits. |
| 607D+02<br>687D+02 | Software positive limit | R/W | DINT | -2147483648 ~2147483647 | 0 | P | |
| 607E<br>687E | Motor direction | R/W | USINT | 0~255 | 0 | -- | Need to set 0x225C first |
| 60FF<br>68FF | Target velocity | R/W | DINT | -2147483648 ~2147483647 | 0 | P/S | Profile velocity under PV mode |
| 6080<br>6880 | Max velocity limit | R/W | UDINT | -2147483648 ~2147483647 | 3000 | rpm | - |
| 6081<br>6881 | Max profile velocity | R/W | DINT | -2147483648 ~2147483647 | 50000 | -- | Max. Allowable velocity under PP mode |
| 6082 | Start velocity | R/W | DINT | -2147483648 | 0 | -- | Start velocity under PP mode |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 6882 | | | | ~2147483647 | | | |
| 6083<br>6883 | Profile acceleration | R/W | DINT | -2147483648<br>~2147483647 | 4000 | P/S^2 | Acceleration under PP and PV mode |
| 6084<br>6884 | Profile deceleration | R/W | DINT | -2147483648<br>~2147483647 | 4000 | P/S^2 | Deceleration under PP and PV mode |
| 6085<br>6885 | Quick stop deceleration | R/W | DINT | -2147483648<br>~2147483647 | 4000000<br>00 | P/S^2 | Deceleration of quick stop under PP, PV and Home mode |
| 608F+<br>01<br>688F+<br>01 | Encoder resolution | R/W | UINT | 4000-20000 | 4000 | Count | It is recommended to use this object in preference, can also set by 0x2029, |
| 6092+<br>01<br>6892+<br>01 | Microstep resolution | R/W | DINT | 200-51200 | 10000 | Pulse | It is recommended to use this object in preference,can also be modified via 0x2001, |
| 6098<br>6898 | Homing method | R/W | USIN<br>T | 1-100 | 19 | - | Methods of searching zero position under homing mode, refer to Appendix A |
| 6099+<br>01<br>6899+<br>01 | Fast homing velocity | R/W | DINT | -2147483648<br>~2147483647 | 50000 | P/S | Speed during search for limit switch signal |
| 6099+<br>02<br>6899+<br>02 | Slow homing velocity | R/W | DINT | -2147483648<br>~2147483647 | 25000 | P/S | Speed during search for Home switch |
| 607C<br>687C | Home offset | R/W | DINT | -2147483648<br>~2147483647 | 0 | P | The value of difference between zero position and mechanical zero point under Homing mode |
| 609A<br>689A | Homing acceleration | R/W | USIN<br>T | -2147483648<br>~2147483647 | 25000 | P/S^2 | Acc / Dec velocity under Home mode |
| 60B0<br>68B0 | Position offset | R/W | DINT | -2147483648<br>~2147483647 | 0 | P | Position offset under PP mode |
| 60B8<br>68B8 | Touch probe control word | R/W | UINT | 0-65535 | 0 | - | Set touch probe function, refer to chapter 6.3 |
| 60B9<br>68B9 | Touch probe statue word | R | UINT | 0-65535 | 0 | - | Status of touch probe 1/2, refer to chapter 6.3 |
| 60BA<br>68BA | Touch probe 1 positive value | R | DINT | -2147483648<br>~2147483647 | 0 | P | Data value sensed by touch probe 1 at rising edge |
| 60BB<br>68BB | Touch probe 1 negative value | R | DINT | -2147483648<br>~2147483647 | 0 | P | Data value sensed by touch probe 1 at falling edge |
| 60BC<br>68BC | Touch probe 2 positive value | R | DINT | -2147483648<br>~2147483647 | 0 | P | Data value sensed by touch probe 2 at rising edge |
| 60BD<br>68BD | Touch probe 2 negative value | R | DINT | -2147483648<br>~2147483647 | 0 | P | Data value sensed by touch probe 2 at falling edge |
| 60C2+<br>01<br>68C2+<br>01 | Interpolation time period value | R/W | USIN<br>T | 0-255 | 2 | -- | Only for internal tuning. |
| 60C2+<br>02<br>68C2+<br>02 | Interpolation time unit | R/W | SINT | -128-127 | 0 | -- | |
| 60D5<br>68D5 | Touch probe 1 rising edge counter | R | UINT | 0-65535 | 0 | -- | Frequency for capture of touch probe 1 rising edge |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 60D6<br>68D6 | Touch probe 1 falling edge counter | R | UINT | 0-65535 | 0 | -- | Frequency for capture of touch probe 1 falling edge |
| 60D7<br>68D7 | Touch probe2 rising edge counter | R | UINT | 0-65535 | 0 | -- | Frequency for capture of touch probe 2 rising edge |
| 60D8<br>68D8 | Touch probe 2 falling edge counter | R | UINT | 0-65535 | 0 | -- | Frequency for capture of touch probe 2 falling edge |
| 60FD<br>68FD | Digital input statue | R | UDINT | 0- 4294967296 | 0 | -- | Statue of digital input signals, refer to chapter 4.3.1 |
| 60FE+01<br>68FE+01 | Open physical output | R/W | UDINT | 0- 4294967296 | 0 | -- | Able to control user output through this object, refer to chapter 4.3.4 |
| 60FE+02<br>68FE+02 | Enable physical output | R/W | UDINT | 0- 4294967296 | 0 | -- | |

## 4.5 XML File or ESI File

EtherCAT Slave Information file (XML File or ESI file) is needed to connect controller with EtherCAT Master.

This file is provided by Leadshine, described slave device information as XML format based on EtherCAT specifications. Please follow the EtherCAT Master software manual for importing method.

Some master stations require files in a specific format and do not recognize XML format, please contact the master technical engineer of master station.

# 5 Three 7-Segment and Error Code

## 5.1 Three 7-Segment

2CS3E has three 7-Segment with a LED indicate respectively (the right LED will be on when the drive is enabled), and the contents displayed are different in the initialization status and operational status.

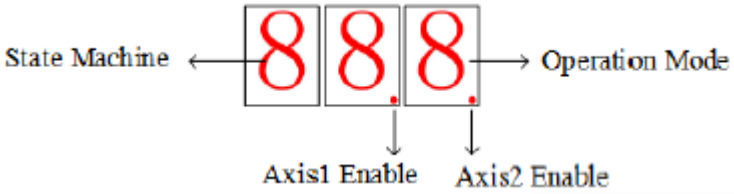



**Figure 5.1: Two 7-Segment display**

### 5.1.1 Initialization Status

After the drive is powered on, the three 7-Segment displays are fully lit by 0.5s, followed by a number (max FF) in hex showing the actual node address of the drive. Then the displayed number will be flashing for 5S.

If the node address of the drive is changed during initialization status or running status, the segment displays will be flashing and back to the former status after 5s.

### 5.1.2 Operational Status

The drive goes into operational status after initialization, and the contents displayed on the 7-Segment are configurable, can be set to three types and set by Object (214b-00h).

| Index | Value | Name | Description |
|---|---|---|---|
| 214b-00h | 2 | Velocity | Unit: rps |
| | 0 | Status Machine & Operation Mode | (1) 1st 7-Segment displays the information of status machine in hex<br>• 1: Initialization<br>• 2: Pre-operation<br>• 4: Safe Operation<br>• 8: Operation<br>(2) 2nd 7-Segment displays the information of operation mode in hex<br>• 1: PP (Profile Position)<br>• 3: PV (Profile Velocity)<br>• 6: HM (Homing)<br>• 8: CSP (Cyclic Synchronous Position) |
| | 1 | Salve ID | The Salve ID will be displayed always |

Note: If change the node address through rotary switches MSD and LSD during the status of operation, the 7-Segment tube will blinking display the new node address in the time of 5S, then restore the information it had displayed.

## 5.2 Error Code

(1) Object **0x3FFE+01** indicates the current failure alarm, and other sub-index indications are historical alarms.
(2) Object **0x1001** and **0x603F** indicate the current failure alarm, The error code read by 0x603F is IEC 61800 specification; the error code read by 0x1001 is CIA specification.
(3) Error code read by some master station is displayed in decimal. At this time, please convert it to hexadecimal and then refer to the error code table as below. For example, the master station reports error code of 8721, the corresponding hexadecimal number is 0x2211, so the alarm information in the reference table is over-current alarm.

**Error code table**

| 0x3FFE Value | 0x603F Value | Description | Trouble Shooting |
|---|---|---|---|
| 0x0e0 | 0x2211 | Over-current | 1. Check whether the wiring is short-circuited, or the motor is short-circuited.<br>2. Switch power supply alarm caused; replace other power supply for a try. |

| | | | |
|---|---|---|---|
| 0x0c0 | 0x3211 | Over-voltage | 1. Check the voltage of power supply;<br>2. If over-voltage occurs in motion, the acceleration and deceleration time can be increased |
| 0x0a0 | 0x3150 | EEPROM error in phase A | 1. Reset parameters to the factory and restart power supply<br>2. If it still exists, the hardware failure |
| 0x0a1 | 0x3151 | EEPROM error in phase B | |
| 0x1a0 | 0x8402 | Over-speed | 1. Reduce command speed value;<br>2. Write 0x10 to the object 0x2056 to clear the alarm. |
| 0x240 | 0x5530 | Save error | 1. Reset parameters to the factory and restart power supply<br>2. If it still exists, the hardware failure |
| 0x260 | 0x7329 | Limit switched alarm | Refer to 0x22A9+00 |
| 0x570 | 0x5441 | Quick stop alarm | Refer to 0x22B4+00 |
| 0x5f0 | 0x7122 | Auto-tuning error | 1. Restart the drive;<br>2. If it still exists, disable auto-tuning by 0x2013 |
| - | 0x7321 | Encoder wring error | 1. The drive is not connected to a motor;<br>2. If alarm is occurred when connect a motor, please check the encoder wiring or a cable break. |
| 0x816 | 0x8216 | Invalid mailbox configuration in pre-operation state | Check the network cable |
| 0x81b | 0x821B | Watchdog timeout | Check the network cable |
| - | 0x8611 | Position following error | 1. Set the value of Object 2024h to “0” to make motor run in open loop mode, If alarm disappears, it means encoder wiring error;<br>2. Motor torque is not enough or motor speed is too high; |
| 0x836 | 0x8736 | Invalid DC synchronization period | Decrease the value of the synchronization period or increase the value of 0x5400+02 |
| 0x870 | 0x5201 | Unsupported operation mode | Check the value of 0x6061 and correct it to the supported operation mode; |
| 0x801 | 0x8201 | ESM state machine transition failed | Alarms related to the master station, without accurate solution. |
| 0x802 | 0x5510 | Memory overflow | |
| 0x807 | 0x8207 | The mapping object does not exist | |
| 0x808 | 0x8208 | PDO mapping object length error | |
| 0x809 | 0x8209 | PDO mapping object has no mapping attribute | |
| 0x811 | 0xA001 | Invalid ESM conversion request | |
| 0x812 | 0xA002 | Unknown ESM conversion request | |
| 0x813 | 0x8213 | Boot state request protection | |
| 0x815 | 0x8215 | Email configuration with invalid boot status | |
| 0x818 | 0x8211 | No valid input data | |
| 0x819 | 0x8212 | No valid output data | |
| 0x81c | 0x821C | Invalid sync manager type | |
| 0x81d | 0x821D | Invalid output configuration | |
| 0x81e | 0x821E | Invalid input configuration | |
| 0x821 | 0xA003 | Waiting for the initial state of ESM | |
| 0x822 | 0xA004 | Waiting for ESM pre-operation state | |
| 0x823 | 0xA005 | Waiting for ESM safe operation status | |
| 0x824 | 0x8224 | Invalid process data input mapping | |
| 0x825 | 0x8225 | Invalid process data output mapping | |
| 0x827 | 0x8727 | Free running mode is not supported | |
| 0x828 | 0x8728 | Does not support synchronous mode | |
| 0x82b | 0x8210 | Invalid input and output | |
| 0x82c | 0x872C | Fatal sync error | |
| 0x82d | 0x872D | No synchronization errors | |
| 0x82e | 0x872E | Synchronization period is too small | |

| | | | |
|---|---|---|---|
| 0x830 | 0x8730 | Invalid DC synchronization configuration | |
| 0x832 | 0x8732 | DC phase locked loop failure | |
| 0x833 | 0x8733 | DC sync IO error | |
| 0x834 | 0x8734 | DC synchronization timeout | |
| 0x835 | 0x8735 | Invalid DC cycle | |
| 0x850 | 0x5550 | EEPROM inaccessible | |
| 0x851 | 0x5551 | EEPROM error | |
| 0x852 | 0x5552 | The hardware is not ready | |

## 5.3 Alarm Clearing

After the 2CS3E drive alarms, the power should be cut off first to check the fault, especially the over-current and over-voltage faults. Some alarms (except over-voltage and over-current) can be cleared when the drive is holding on, the step is as follows:

- Write 0x80 (decimal 128) to the object 0x6040 to clear the current alarm (except over-voltage and over-current). This method is recommended as a priority;
- Or write 1 to the object 0x2093 to clear the historical alarm records. At this time, all sub-indexes of 0x3FFE are cleared;

# 6 Common Functions

## 6.1 Saving Parameters and Resetting Drive

To save all storable parameters into EEPROM through Object 0x1010, need to write "0x65766173" into sub-index 01h. To reset the drive to Axis-1 default parameters through Object 0x1011, need to write "0x64616F6C" into sub-index 01h. After writing the save command, do not turn off the power immediately, wait around 10s to ensure that all parameters have been saved successfully. The below table is the description of Object (1010h) and Object (1011h).

**Table 6.1: Object (1010h) and Object (1011h)**

| Action | Index Sub-index | Write Command (hex) | Return Value | Description |
|---|---|---|---|---|
| Save Objects (2000h-5000h) | 1010+04 | 0x65766173 | Return 1 | Save Manufacture Specific Objects |
| Save Objects (6000h) | 1010+03 | 0x65766173 | Return 1 | Save Motion Objects |
| Save Objects (1000h) | 1010+02 | 0x65766173 | Return 1 | Save Communication Objects |
| Save all Objects | 1010+01 | 0x65766173 | Return 1 | Save all Objects |
| Restore Objects (2000h-5000h) | 1011+04 | 0x64616F6C | Return 1 | Reset Manufacture Specific Objects |
| Restore Objects (6000h) | 1011+03 | 0x64616F6C | Return 1 | Save Motion Objects |
| Restore Objects (1000h) | 1011+02 | 0x64616F6C | Return 1 | Reset Communication Objects |
| Restore all Objects | 1011+01 | 0x64616F6C | Return 1 | Reset all Objects |

## 6.2 Control Word and Operation Modes

2CS3E supports both synchronous mode and asynchronous mode. In the synchronous mode, master station processes trajectory planning and outputs cyclical instructions. Drives follow the planning instructions given by master station in synchronous cycle, making it suitable for synchronous motion of multiple axes. 2CS3E synchronous motion mode supports CSP mode. In CSP mode, master station completes trajectory planning and sends it to 2CS3E. The drive wills execution the synchronous cyclic position instructions immediately once they has arrived. The 2CS3E supports following synchronous cycles: 250 us, 500 us, 750us, 1000 us, 2000 us, 4000 us, and 8000 us.

In asynchronous motion mode, master station is only responsible for sending motion parameters and control commands. 2CS3E drives will process trajectory planning according to the motion parameters after receives control command from master station and the movements between each axis are asynchronous. 2CS3E asynchronous mode includes Profile Position mode(PP), Profile Velocity mode(PV)and Homing mode(HM).

In both control modes, EtherCAT data transmission between master and slave station is achieved through object dictionary. The transmission types contain PDO and SDO and only one can be chosen in general cases. According to control needs, it is classified in three levels by data transmission real time capability and importance:

Must> Recommend > Can.

- "Must" indicates under this mode, the object dictionary has to be PDO mode;
- "Recommend" indicates under the set mode, the object dictionary is suggested to be configured as PDO mode to achieve real-time capability but SDO transmission can be allowed if the controlling is not quite demanding;
- "Can" indicates under this mode, object dictionary data transmission is generally through SDO mode and PDO communication mode won't be necessary.

The object dictionary of each control mode is shown as below:

**Table 6.2: Objects Dictionary related to each operation mode (Take axis1 as example)**

| Operation Modes | Index + Sub-index | Name | Data Type | Access | Unit | PDO Configuration | SDO Configuration |
|---|---|---|---|---|---|---|---|
| CSP Mode (8) | 6040+00 | Control Word | U16 | RW | — | Must | - |
| | 607A+00 | Target Position | I32 | RW | P | Must | - |
| | 6041+00 | Status Word | U16 | RO | — | Must | - |
| | 6064+00 | Actual Position | I32 | RO | P | Must | - |
| | 606C+00 | Actual Velocity | I32 | RO | P /S | Can | Can |
| PP Mode (1) | 607A+00 | Target Position | I32 | RW | P | Recommend | Can |
| | 6081+00 | Max Profile Velocity | U32 | RW | P | Can | Can |
| PV Mode (3) | 60FF+00 | Target Velocity | I32 | RW | P | Recommend | Can |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| PP Mode (1) And PV Mode (3) General | 6040+00 | Control Word | U16 | RW | — | Recommend | Can |
| | 6083+00 | Profile Acceleration | I32 | RW | $P/S^2$ | Can | Can |
| | 6084+00 | Profile Deceleration | U32 | RW | $P/S^2$ | Can | Can |
| Homing Mode (6) | 6040+00 | Control Word | U16 | RW | — | Recommend | Can |
| | 6098+00 | Homing Method | I8 | RW | — | Can | Can |
| | 6099+01 | Fast Homing Velocity | U32 | RW | P /S | Can | Can |
| | 6099+02 | Slow Homing Velocity | U32 | RW | P /S | Can | Can |
| | 609A+00 | Homing Acceleration | U32 | RW | $P /S^2$ | Can | Can |
| | 607C+00 | Homing Offset | U32 | RW | P | Can | Can |
| PP, PV and HOME Mode General | 6041+00 | Status Word | U16 | RO | — | Recommend | Can |
| | 6064+00 | Actual Position | I32 | RO | P | Recommend | Can |
| | 606C+00 | Actual Velocity | I32 | RO | P /S | Can | Can |
| All operation modes General | 60B8+00 | Touch Probe Control Word | U16 | RW | — | Recommend | Can |
| | 60B9+00 | Touch Probe Status Word | U16 | RO | — | Recommend | Can |
| | 60BA+00 | Touch Probe 1 Positive Value | I32 | RO | P | Can | Can |
| | 60FD+00 | Digital Input Status | U32 | RO | — | Recommend | Can |
| | 603F+00 | Latest Error Code | U16 | RO | P | Recommend | Can |
| Other Related | 6060+00 | Operation Mode | I8 | RW | — | Can | Can |
| | 60B0+00 | Position Offset | I32 | RW | — | Can | Can |
| | 6082+00 | Start Velocity | U32 | RW | P /S | Can | Can |
| | 6085+00 | Quick Stop Deceleration | U32 | RW | $P/S^2$ | Can | Can |
| | 6061+00 | Displayed Operation Mode | I8 | RO | — | Can | Can |

No matter using which operation mode, it cannot be separated from the reading and writing of Control Word (6040h) and Status Word (6041h). Master and slave stations use these two object dictionaries as a medium to send instructions and monitor status. Following contents will highlight the definitions of each bit of the two object dictionaries.

The bit definition of Control Word (6040 h) is as shown in Table 6.3. The table A is about bit4, bit5, bit6 and bit8, whose definition depend on the operation mode, and mainly cover the execution, stop, etc. of each operation mode. The table B is about bit0-3 and bit7, which manages the state transition of the 402 state machine. The definition of. Status Word (6041h) is as shown in Table 6.4. The bit0 -7 mainly show the state machine transition state, while the bit8-15 mainly shows the status of execution or stop in each operation mode. The typical state transition of enable is as follows:

Initiation (00h) -> power-on (06h) -> start (07h) -> enable (0fh) -> execute or pause (depending on operation mode to send related control instructions of bit4-6 and bit8). The state transition that triggers the running control in each control mode is shown in Table 6.5.

**Table 6.3A: Control Word (6040h) Bit Definition**

| Mode<br>Bit | 15-9 | 8 | 6 | 5 | 4 |
|---|---|---|---|---|---|
| General | - | Pause | Depending on the operation mode | | |
| CSP mode (8) | - | Invalid | Invalid | Invalid | Invalid |
| PP mode (1) | - | Deceleration stop | Absolute / Relative | Immediate trigger | New position point |
| PV mode (3) | - | Deceleration stop | Invalid | Invalid | Invalid |
| HM mode (6) | - | Deceleration stop | Invalid | Invalid | Starting motion |

**Table 6.3B: Control Word (6040h) Bit Definition**

| Mode<br>Bit | 7 | 3 | 2 | 1 | 0 | Type value | Action |
|---|---|---|---|---|---|---|---|
| General | Wrong reset | Permitted operation | Quick stop | Voltage output | Start | | |
| CSP mode (8) | 0 | 0(x) | 1 | 1 | 0 | 06h | Get power |
| PP mode (1) | 0 | 0 | 1 | 1 | 1 | 07h | Start |
| PV mode (3) | 0 | 0(x) | 0 | 1 | 0(x) | 02h | Quick |
| HM mode (6) | 0 | 1 | 1 | 1 | 1 | 0fh | Enable |
| - | 1 | 0(x) | 0(x) | 0(x) | 0(x) | 80h | Clear error |
| - | 0 | 0 | 0 | 0 | 0 | 0 | Initiation |

Additional information on other bits:

- Bit 2 is quick stop, trigger logic is 0 effective, notice to separate from other trigger logic.
- Bit 7 is error reset, trigger logic is rising edge effective.
- Bit 5 is immediate trigger, trigger logic is rising edge effective.

**Table 6.4 Status Word(6041h) Bit Definition**

| Mode<br>Low 8 bits | 7 | 6 | 5 | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|---|---|---|
| Shared | Reserved | Not started | Quick stop | Power on | Error | Permitted operation | Start | Ready to start |
| Mode / high 8 bits | 15 | 14 | 13 | 12 | 10 | 8 | 11 | 9 |
| Shared | Depending on the operation mode | | | | | | Limit validity | Distance |
| CSP mode (8) | Invalid | Invalid | Invalid | Following effective | Invalid | Emergency stop | It will be set when the hardware limit effective | 0 below PreOP status |
| PP mode (1) | Trigger response | Parameter has 0 | Invalid | New position point response | Position arrival | Emergency stop | | |
| PV mode (3) | Invalid | Parameter has 0 | Invalid | Speed is 0 | Velocity arrival | Quick stop | | |
| HM mode (6) | Trigger response | Parameter has 0 | Homing error | Homing find | Position arrival | Emergency stop | | |

Additional information on other bits:

- When the drive is put into power, the bit 4 will be set.
- Bit 5 quickly stops activation, which is valid under logic 0, contrary to the logic of other bits.
- Bit 9 remote, showing the state of the communication state, 0 below ProOP, at this time the control word (6040 h) command will not be executed.
- Bit 11 limit is set only, when the hardware limit is valid.
- Bit 8 abnormal stop is generally valid in hardware limit, deceleration stop and fast stop trigger state.
- Bit 12 follows the master station, if the driver does not enable or no longer follow instructions from the master station under CSP, this position is 0.

**Table 6.5: State transition of each mode control operation**

| Mode<br>Action | | PreOP | Initialization | Get power | Start | Enable | Start operation | Change position | Stop | Alarm |
|---|---|---|---|---|---|---|---|---|---|---|
| CSP mode (8) | 6040 | Create a communication OP state and activate the NC axis | -- | 06h | 07h | 1fh | Master station send instruction | Master station control | Master station stop position instruction | Over-voltage |
| | 6041 | | -- | 631h | 633h | 1637h | 1237h | 1237h | 1637h | 638h |
| PP mode (1) | 6040 | Create a communication OP state, setting motion | 00h | 06h | 07h | 0fh | 2fh | 3fh | 13fh | Over-voltage |
| | 6041 | | 650h | 631h | 633h | 8637h | 8637h | 1237h | 737h | 638h |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | parameters | | | | | | | | |
| PV mode (3) | 6040 | Create a communication OP state, setting motion parameters | 00h | 06h | 07h | 0fh | Immediate operation after enabling | Change the speed | 10fh | Over-voltage |
| | 6041 | | 650h | 631h | 633h | 637h | 637h | 237h->637h | 737h | 638h |
| HM mode (6) | 6040 | Create a communication OP state, setting motion parameters | 00h | 06h | 07h | 0fh | 1fh | Error / Completion | 11fh | Over-voltage |
| | 6041 | | 650h | 631h | 633h | 8737h | 237h | 2637h / 1637h | 737h | 638h |

Additional information on other bits:

- When the PP mode changes the position, it needs to give the bit5 rising edge of the control word to start the new position motion.

## 6.3 Touch Probe

Touch probe function is to capture and record the actual position of the motor by using the input signal with the touch probe function. The 2CS3E driver has two inputs I/O signals to support the probe function and can be enabled at the same time. The probe function related object dictionaries are shown in Table 6.6.

**Table 6.6： Related Object Dictionaries of Touch Probe**

<table>
<tr><td>Index</td><td colspan="8">Bit Definition</td></tr>
<tr><td rowspan="4">60B8h</td><td>7-6</td><td>5</td><td>4</td><td>3-2</td><td>1</td><td>0</td></tr>
<tr><td>-</td><td>Touch Probe 1 falling edge trigger</td><td>Touch Probe 1 rising edge trigger</td><td>-</td><td>Touch Probe 1 mode</td><td>Touch Probe 1 enable</td></tr>
<tr><td>15-14</td><td>13</td><td>12</td><td>11-10</td><td>9</td><td>8</td></tr>
<tr><td>-</td><td>Touch Probe 2 falling edge trigger</td><td>Touch Probe 2 rising edge trigger</td><td>-</td><td>Touch Probe 2 mode</td><td>Touch Probe 2 enable</td></tr>
<tr><td colspan="9"></td></tr>
<tr><td rowspan="4">60B9h</td><td>7</td><td>6</td><td>5-3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>Actual level of touch probe 2</td><td>Actual level of Touch Probe 1</td><td></td><td>Touch Probe 1 falling edge trigger complete</td><td>Touch Probe 1 rising edge trigger complete</td><td>Touch Probe 1 action</td></tr>
<tr><td colspan="3">15-11</td><td>10</td><td>9</td><td>8</td></tr>
<tr><td colspan="3">-</td><td>Touch Probe 2 falling edge trigger complete</td><td>Touch Probe 2 rising edge trigger complete</td><td>Touch Probe 2 action</td></tr>
<tr><td>60BAh</td><td colspan="8">Touch Probe 1 rising edge capture data value register</td></tr>
<tr><td>60BBh</td><td colspan="8">Touch Probe 1 falling edge capture data value register</td></tr>
<tr><td>60BCh</td><td colspan="8">Touch Probe 2 rising edge capture data value register</td></tr>
<tr><td>60BDh</td><td colspan="8">Touch Probe 2 falling edge capture data value register</td></tr>
<tr><td>60FDh</td><td colspan="8">The state of bit26 is bit 1 and bit 2 AND logic of Object (60B9h); The state of bit27 is bit 9 and bit 10 AND logic of Object (60B9h)</td></tr>
<tr><td>2152h</td><td colspan="8">It can be configured as probe 1 or probe 2 by writing its sub-indexes 01h and 02h to 17 or 18.</td></tr>
</table>

Additional information on other bits:

- The bit0 and bit8 of Object (60B8h): start/stop control bit of Touch Probe 1 and Touch Probe 2 respectively, and the rising edge is effective.
- The bit1 and bit9 of Object (60Bh): Touch Probe modes are divided into single mode and continuous mode.
  - Single mode: After a Touch Probe is activated, it is captured only under the first trigger signal. In order to capture the new position value again, the bit0 /bit8 of the Object (60B8h) must be given a rising edge signal to restart the probe action.
  - Continuous mode: After a Touch Probe is activated, the capture action is carried out under each trigger signal.

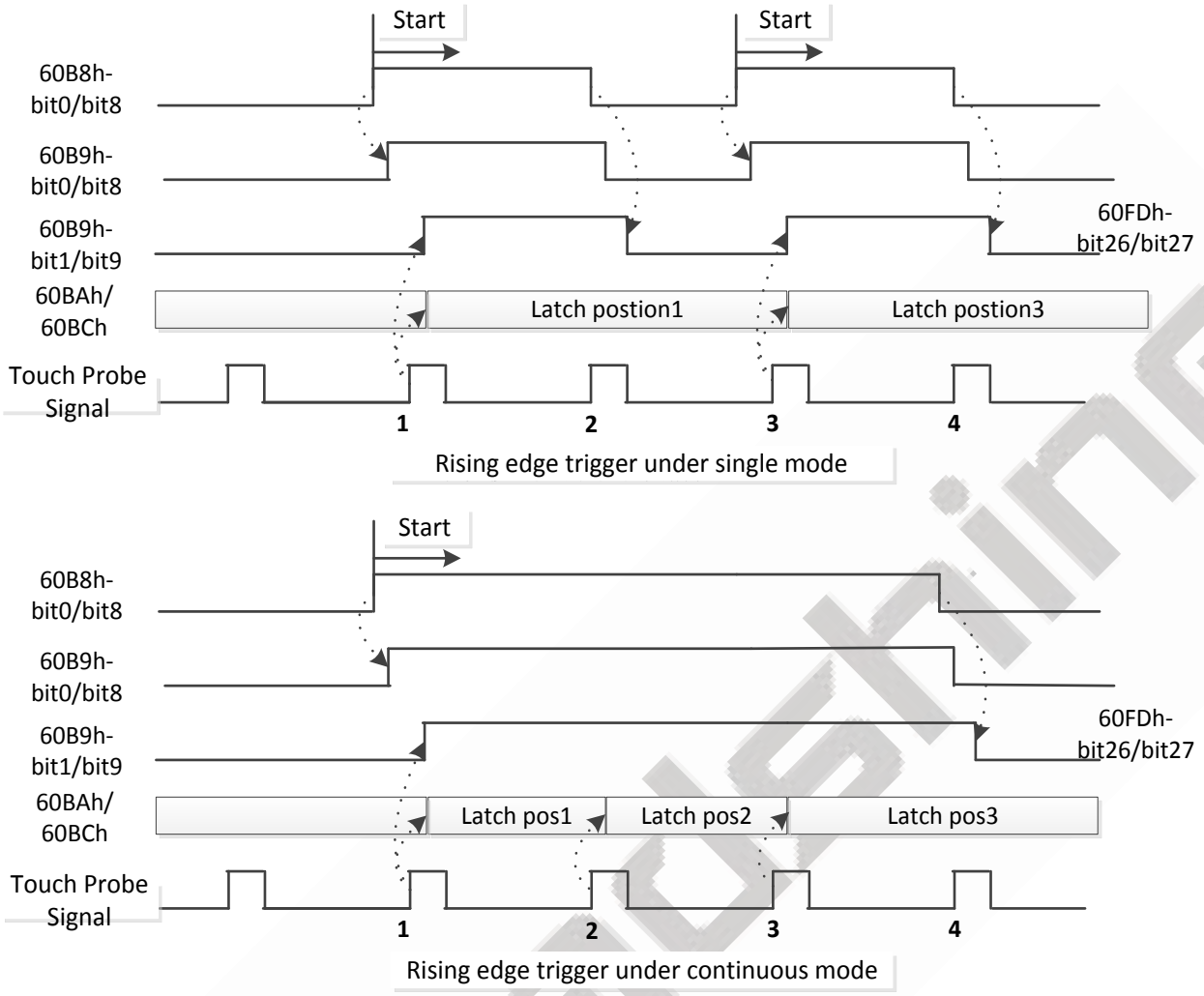


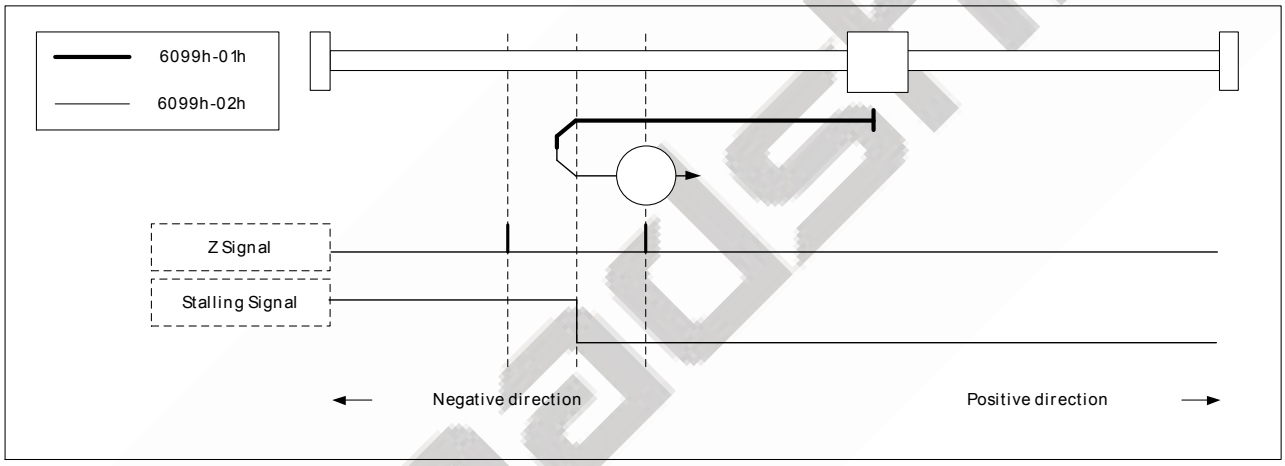

**Figure 6.1: Touch Probe Mode**

# Appendix A: Homing Methods

The 2CS3E series drives support homing method -1, -2, 1 - 14, 17 - 34, and method 35 & 37. Specific definition and the process of homing methods described below.

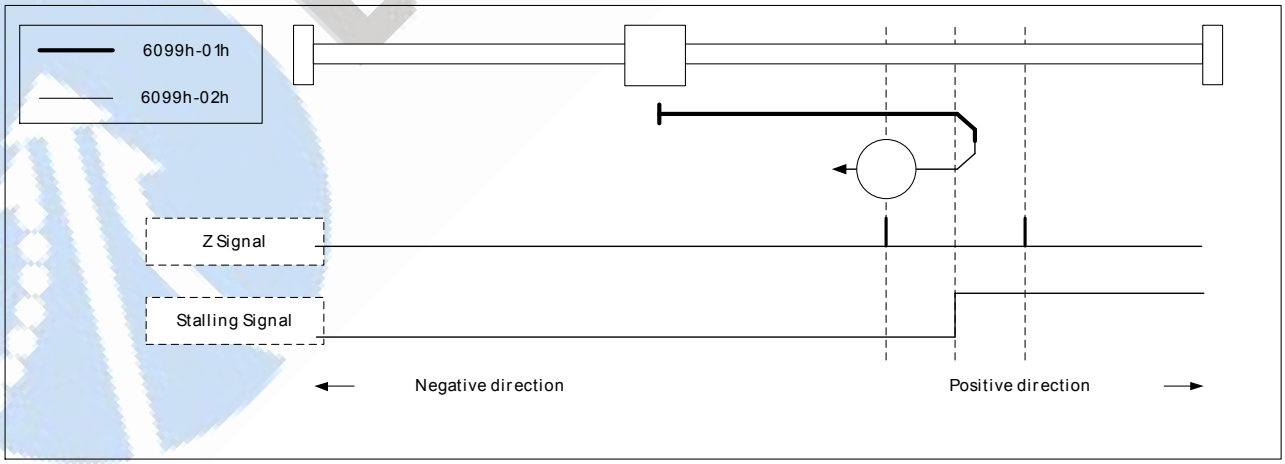
**Z Signal:** Index signal, Bit31 of Object 60FDh set to 1;
**Stalling Signal:** After the motor is stalled, if the position error is greater than the value of Object 22EFh (Axis-1 default = 2000 ), the stalling signal is triggered (bit1 of Object 5000+04h set to 1);
**Zero Position:** a fixed position on the machine can correspond to a definite digital input signal, or to a Z signal
**Zero Point of Machine:** mechanical absolute zero position
**Home offset:** difference between zero position and zero point of machine, the value of Object 607Ch (Axis-1 default = 0 ), , Zero position= zero point + home offset
**Home Switch:** homing switch input signal
**Negative Limit:** negative limit switch input signal
**Positive Limit:** positive limit switch input signal

- **Method -1 requires Z signal and Stalling Signal.**
  During the motor running in negative direction, when reaching the stalling signal, it will slow down and stop, then run in reverse, at last stops immediately when reaching the first Z signal. ( Z signal as the zero position)




Method -1

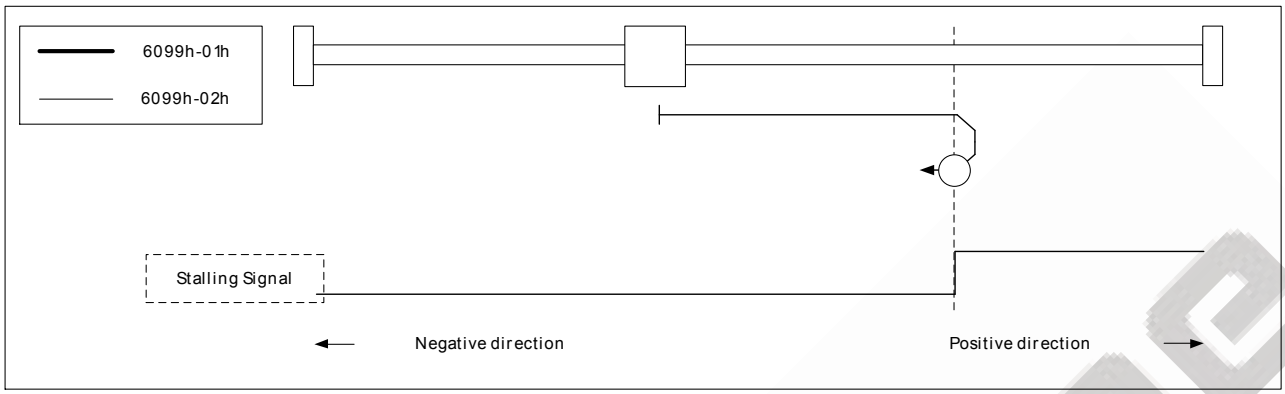
- **Method -2 requires Z signal and Stalling Signal.**
  During the motor running in positive direction, when reaching the stalling signal, it will slow down and stop, then run in reverse, at last stops immediately when reaching the first Z signal. ( Z signal as the zero position)




Method -2

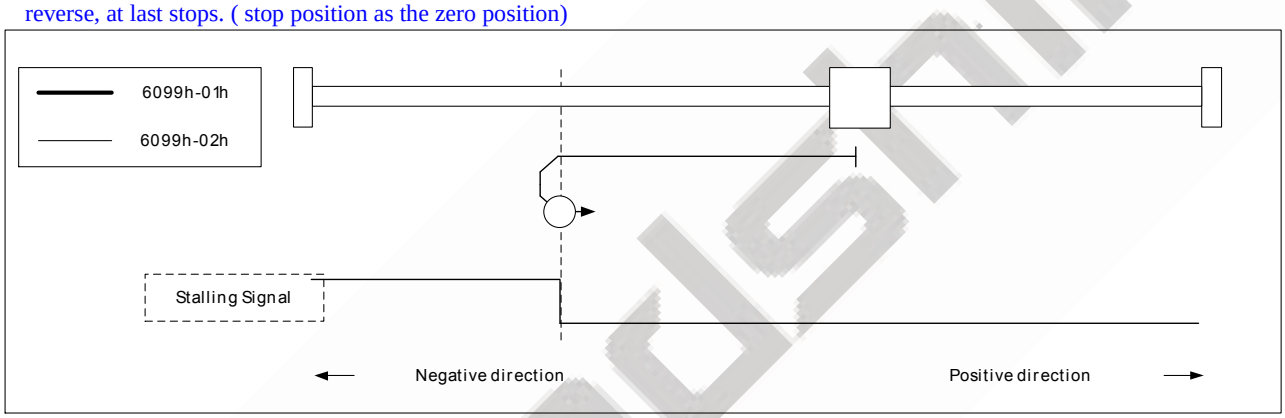
- **Method -3 requires Stalling Signal.**
  During the motor running in positive direction, when reaching the stalling signal, it will slow down and stop, then run in

reverse, at last stops. ( stop position as the zero position)



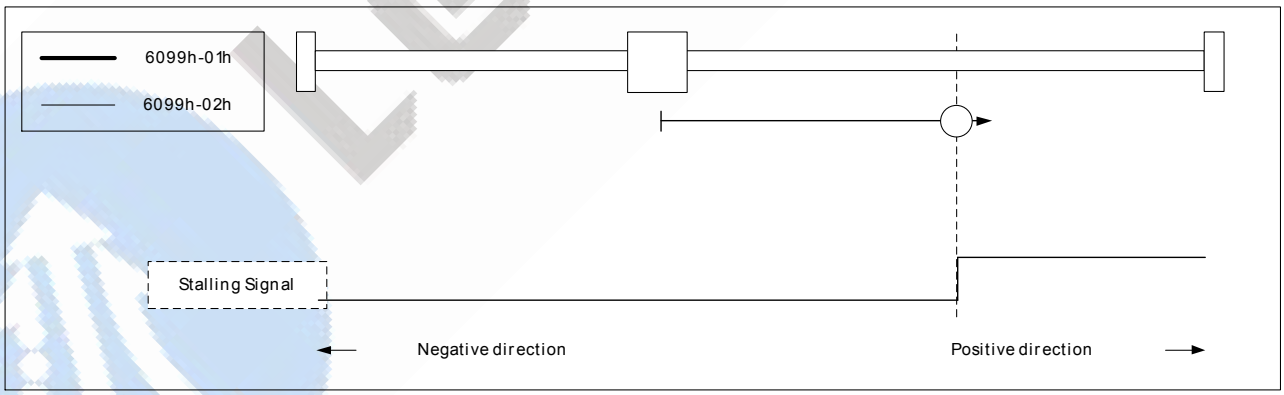

Method -3

- **Method -4 requires Stalling Signal.**
  During the motor running in negative direction, when reaching the stalling signal, it will slow down and stop, then run in reverse, at last stops. ( stop position as the zero position)



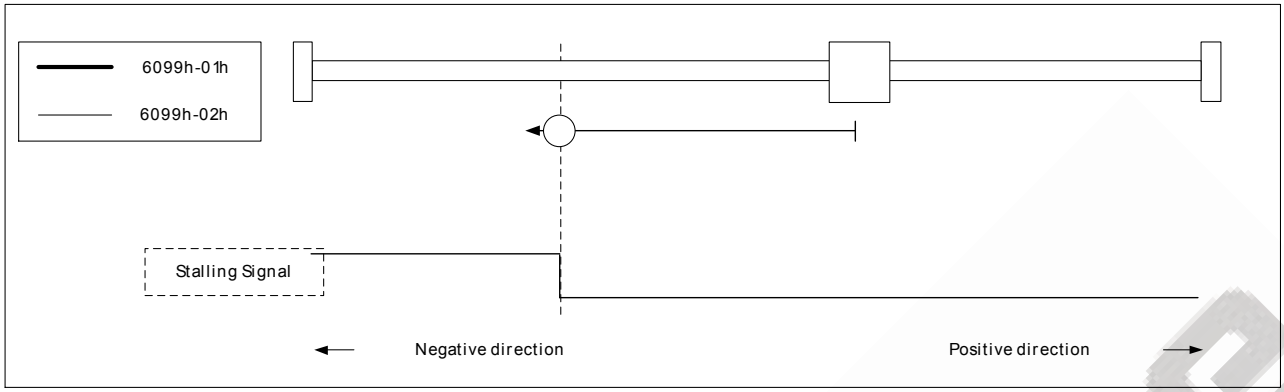

Method -4

- **Method -5 requires Stalling Signal.**
  During the motor running in positive direction, when reaching the stalling signal, it will stop immediately. ( Stalling Signal as the zero position)



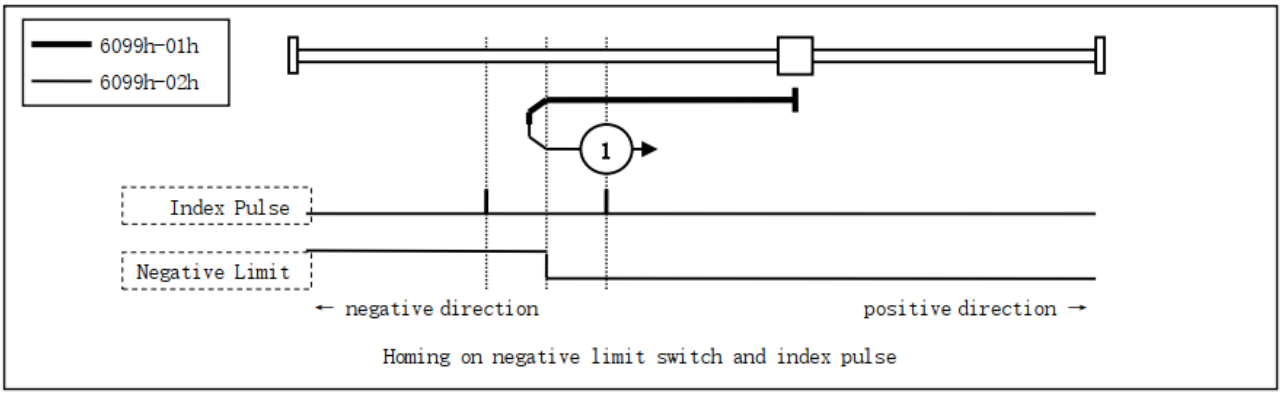

Method -5

- **Method -6 requires Stalling Signal.**
  During the motor running in negative direction, when reaching the stalling signal, it will stop immediately. ( Stalling Signal as the zero position)



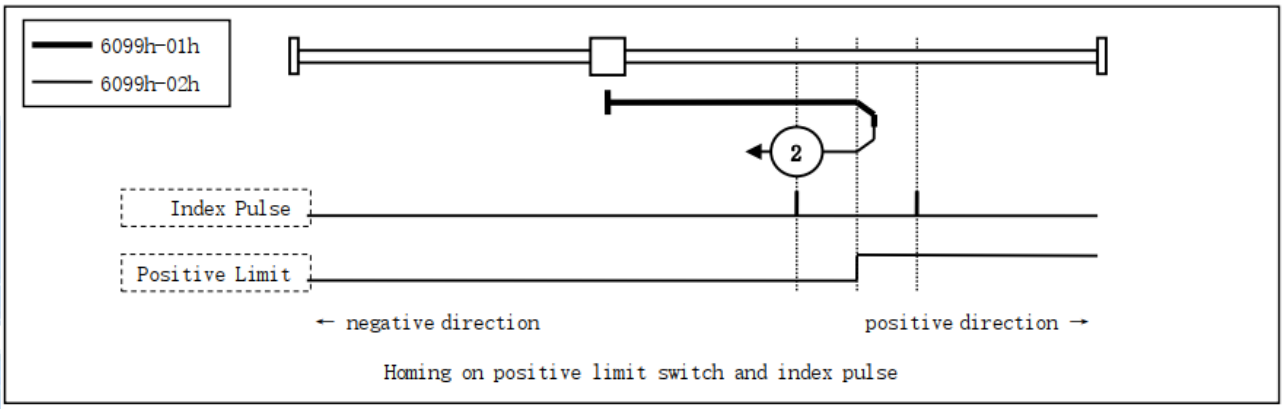

Method -6

- **Method 1 requires Z signal and Negative Limit.**
  The load is located on the right side of the negative limit switch, and the motor running in negative direction. When reaching the negative limit signal, it will slow down and stop, then run in reverse, at last stops immediately when reaching the first Z signal. ( Z signal as the zero position)



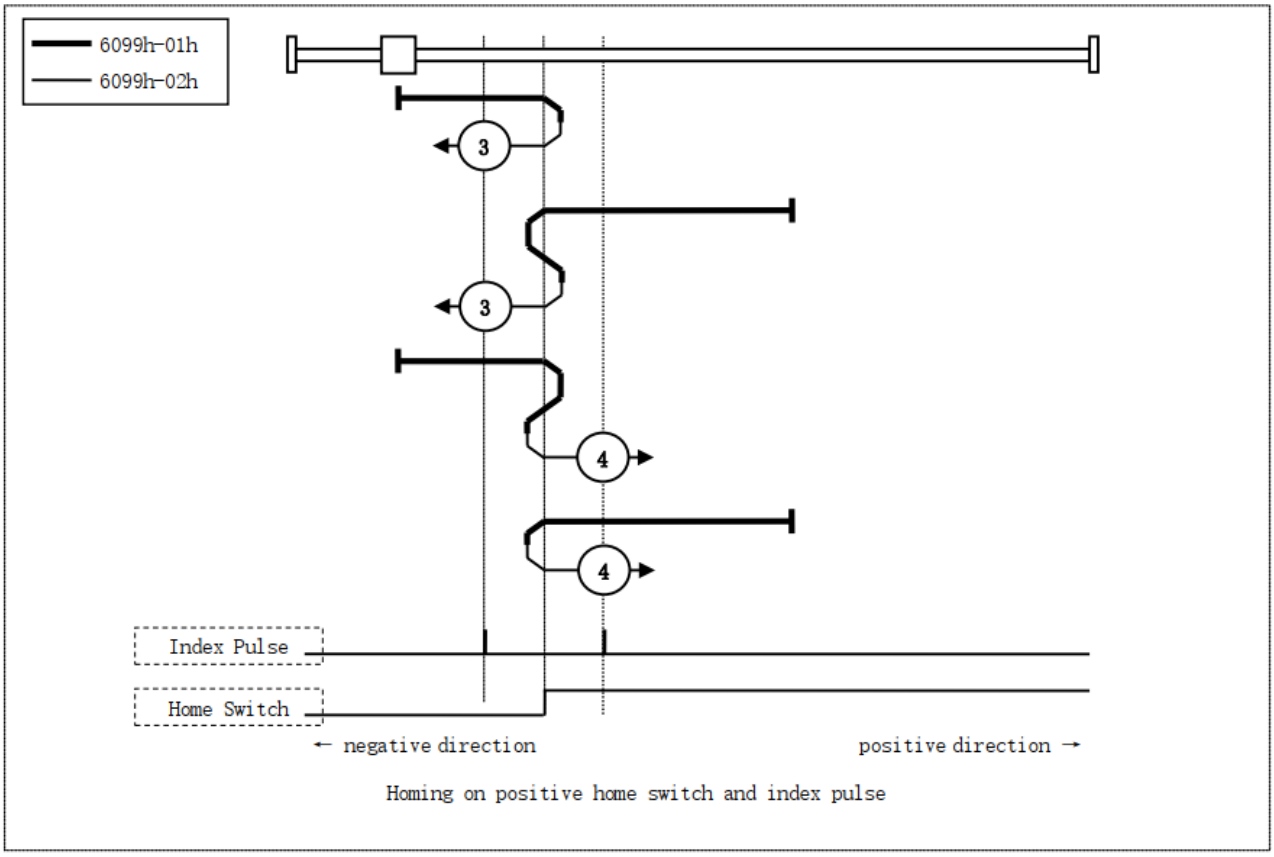

Method 1

- **Method 2 requires Z signal and Negative Limit.**
  The load is located on the left side of the positive limit switch, and the motor running in positive direction. When reaching the positive limit signal, it will slow down and stop, then run in reverse, at last stops immediately when reaching the first Z signal. ( Z signal as the zero position)

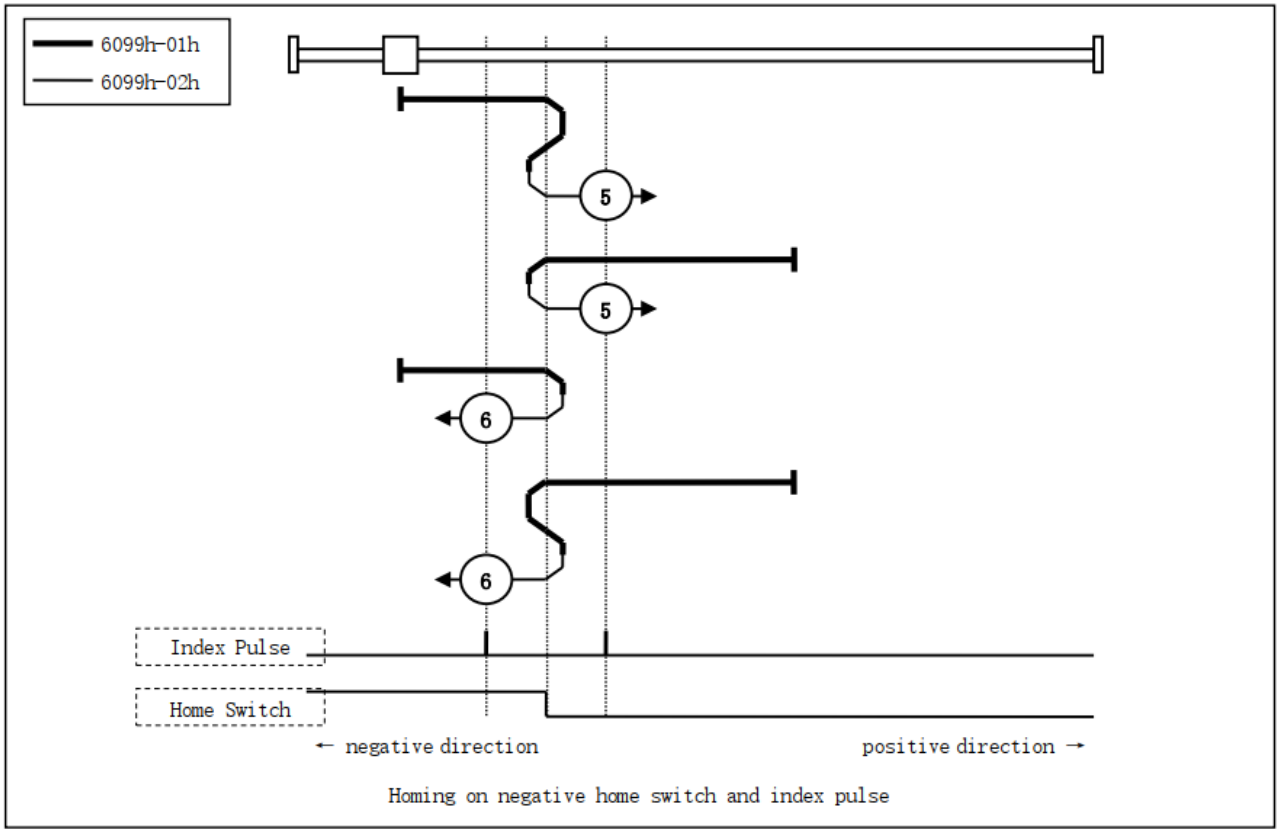



Method 2

- **Method 3 , 4, 5, 6 require Z signal and Home Switch**

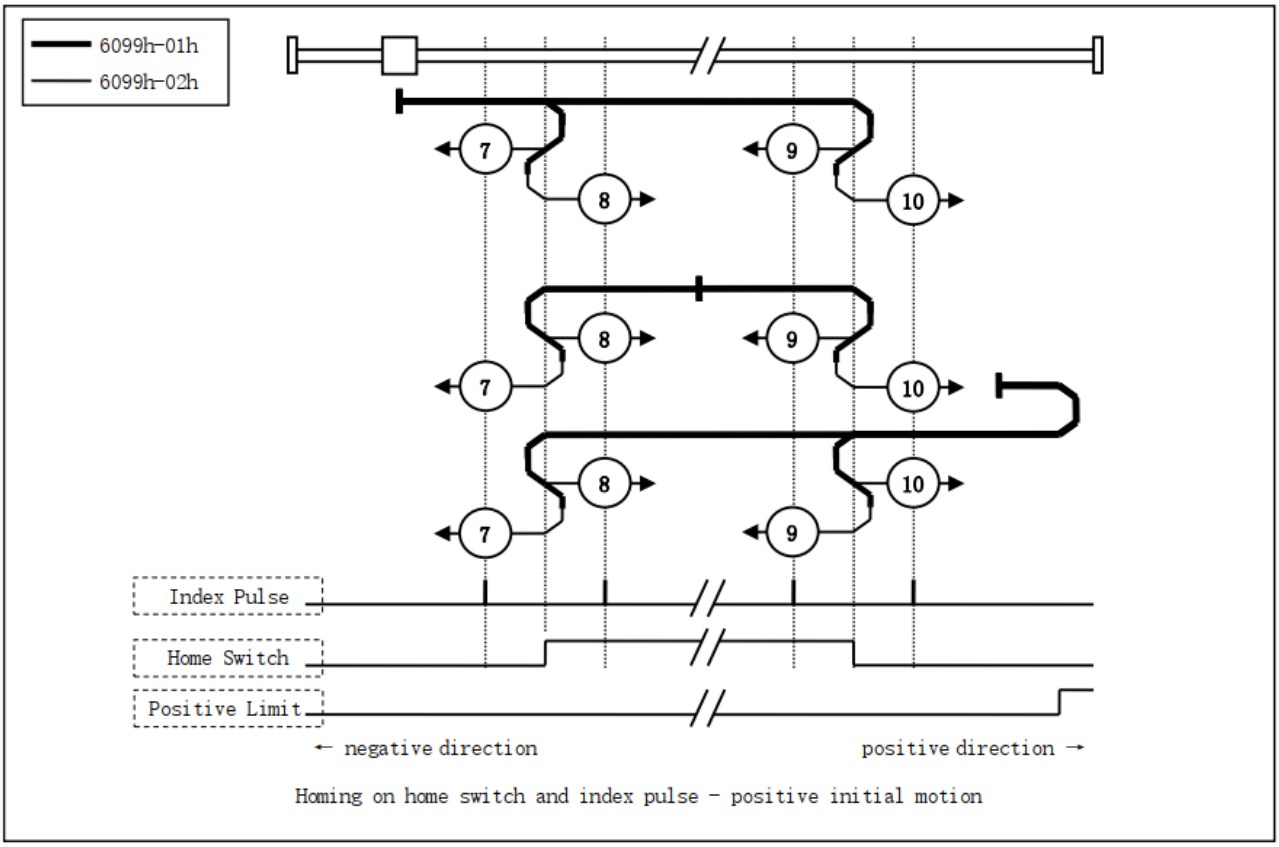



Method 3 & 4



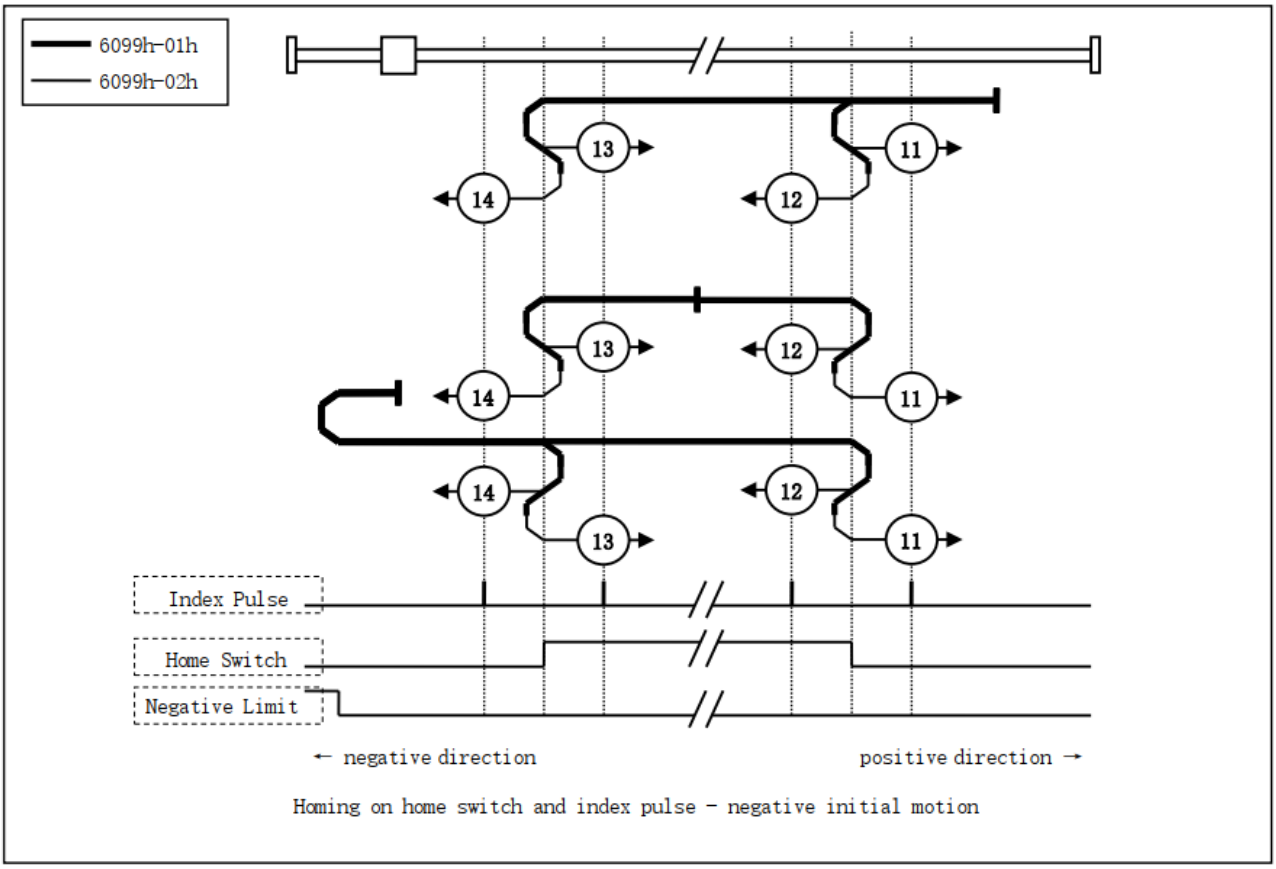

Method 5 & 6

- **Method 7 , 8, 9, 10 require Z signal, Home Switch or Positive Limit**



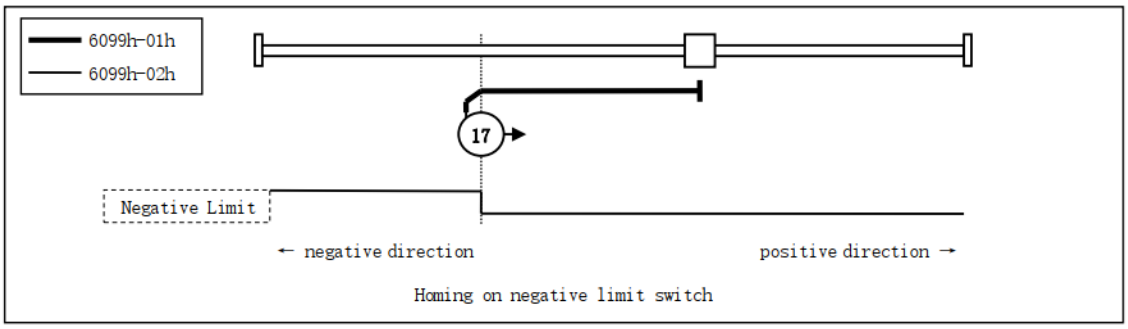

Method 7, 8, 9, 10

- **Method 11 , 12, 13, 14 require Z signal, Home Switch or Negative Limit**



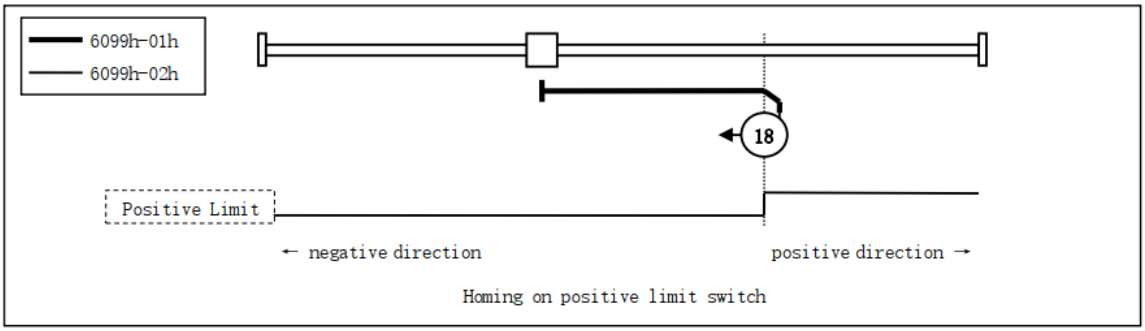

Method 11, 12, 13, 14

- **Method 17 requires negative limit switch, and method 18 requires positive limit switch.**
  The load is located on the right side of the negative limit switch, and the motor running in negative direction. When the motor reaching the negative limit signal for the first time, it will slow down and stop, then run in reverse, at last stops immediately when reaching the negative limit signal for the second time.



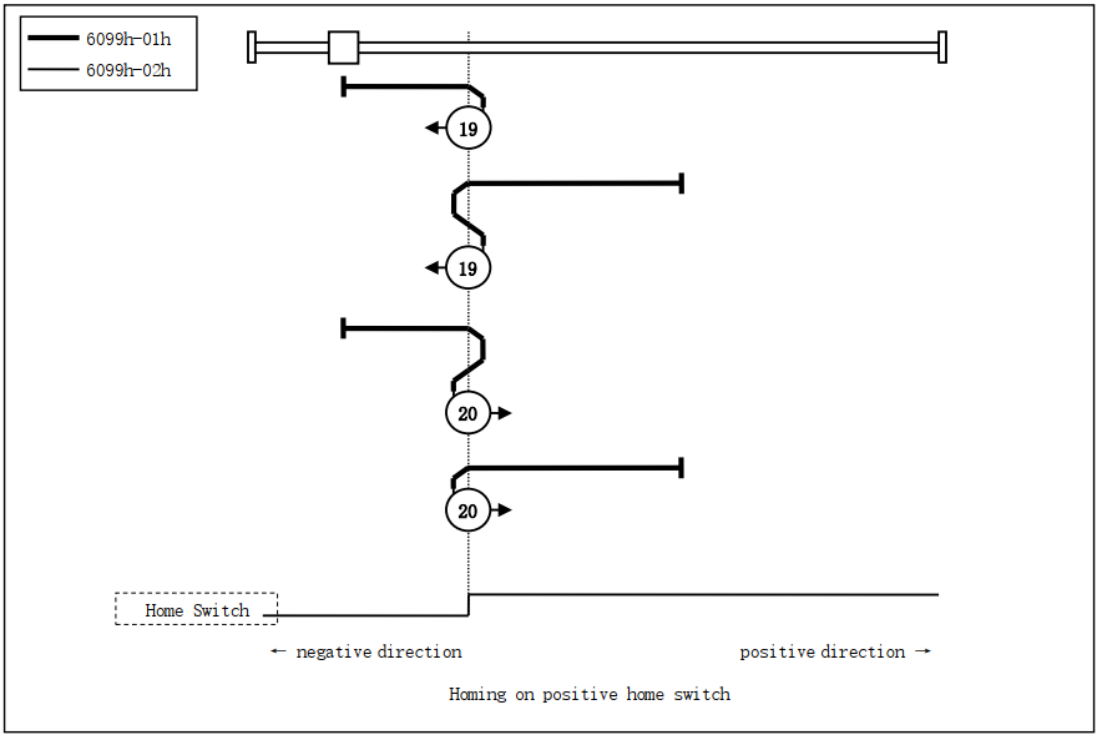

Method 17

- **Method 18 requires positive limit switch.**
  The load is located on the left side of the positive limit switch, and the motor running in positive direction. When the motor reaching the positive limit signal for the first time, it will slow down and stop, then run in reverse, at last stops immediately when reaching the positive limit signal for the second time.



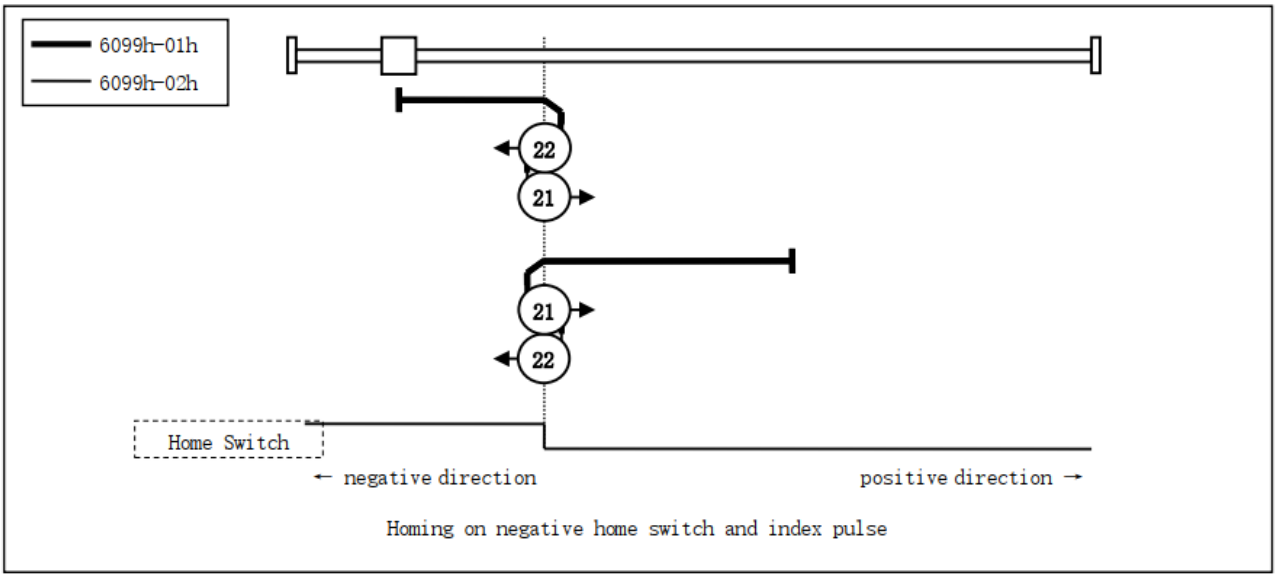

Method 18

- **Method 19, 20, 21, 22 require home switch**



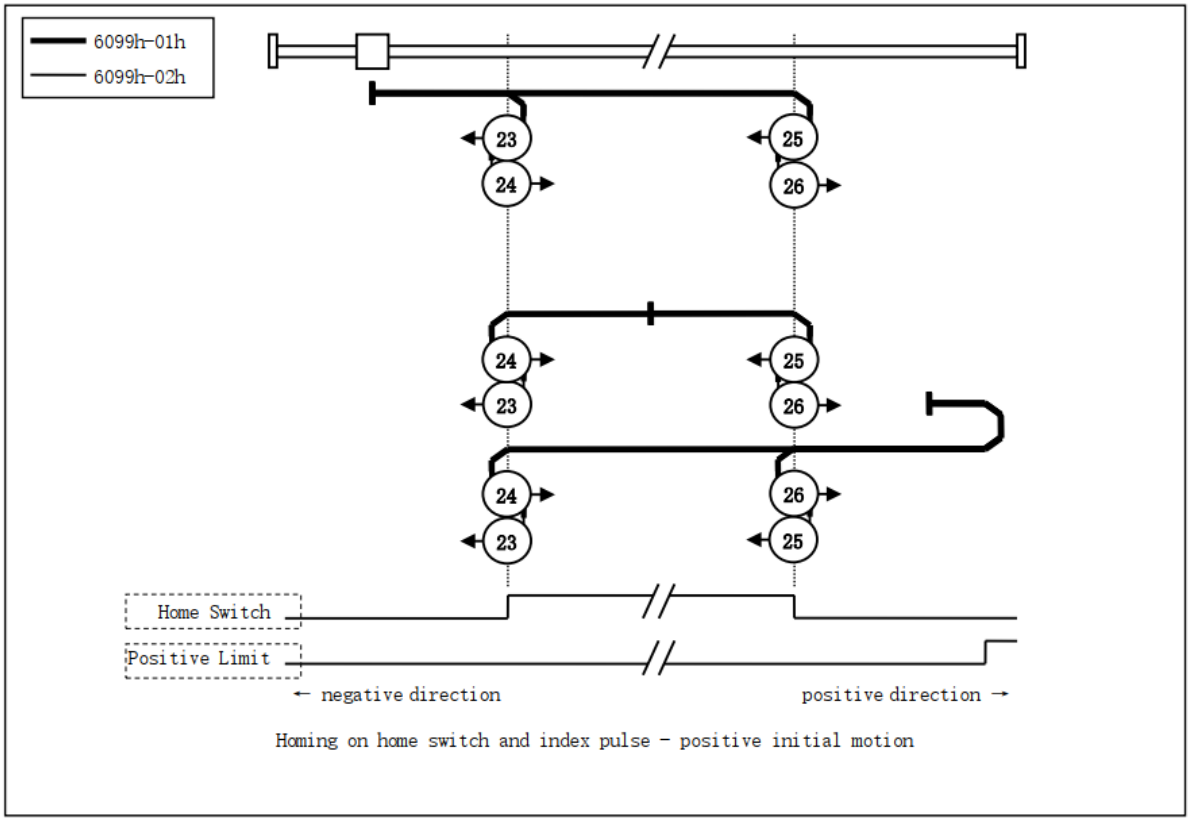

Method 19 & 20

- **Method 21 & 22 Description: The load is located on the home switch**



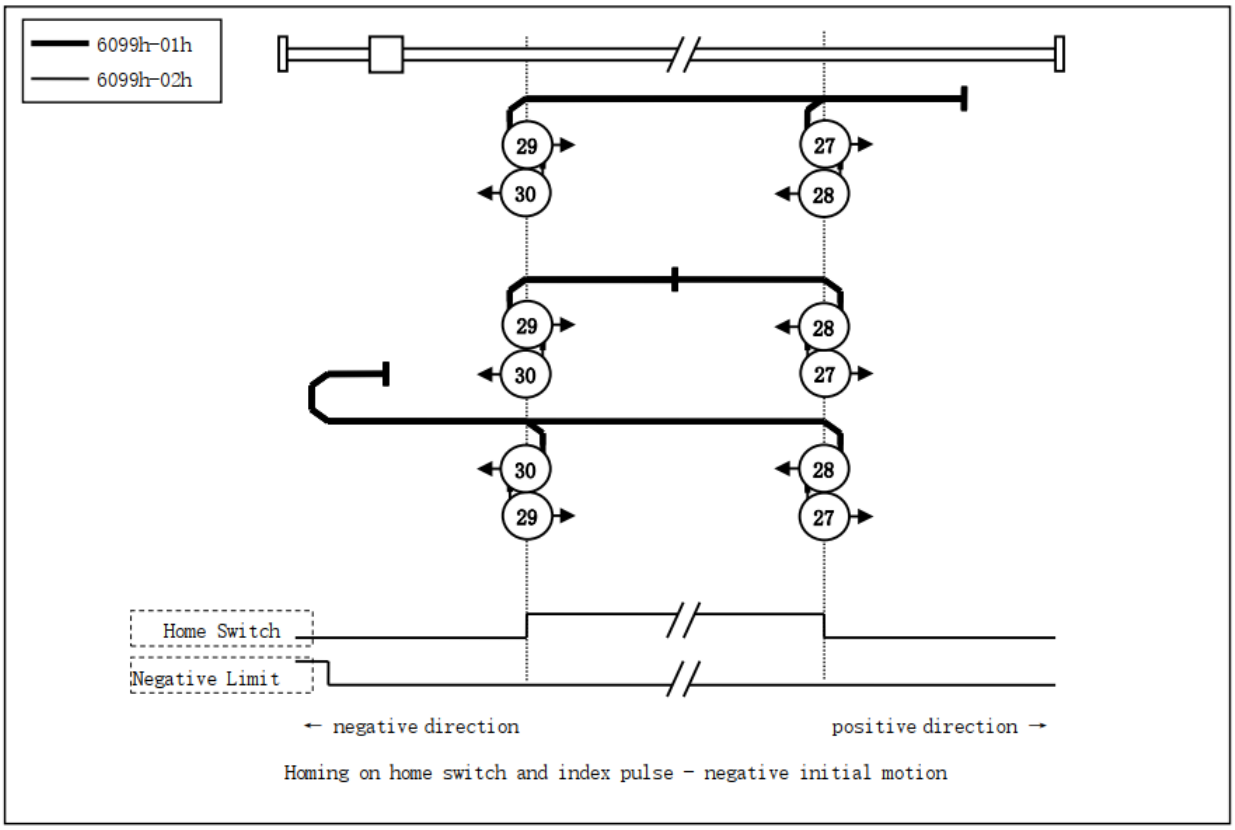

Method 21 & 22

- **Method 23, 24, 25, 26 require the home switch and positive limit switch.**



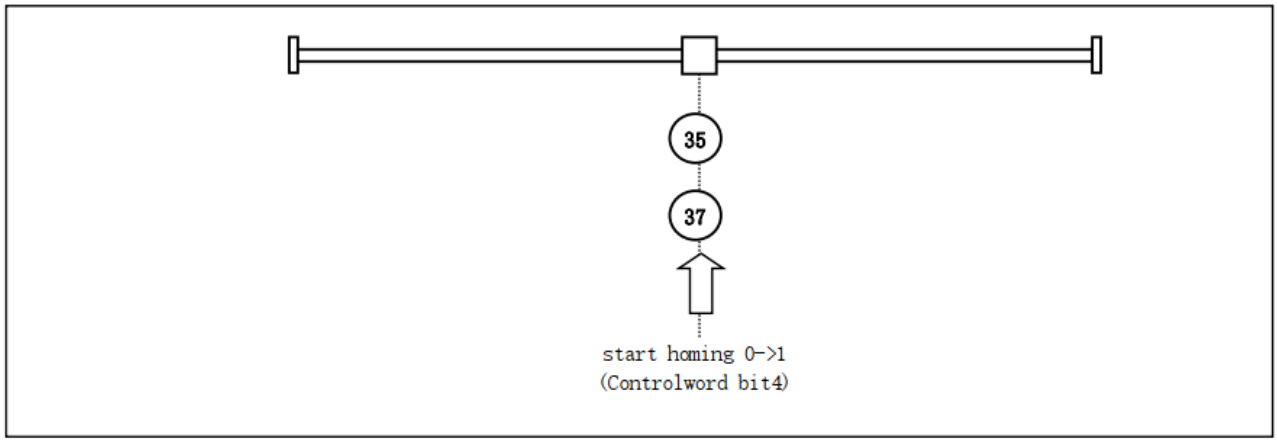

Method 23 & 24 & 25 & 26

- **Method 27, 28, 29, 30 require the home switch and negative limit switch.**




Method 27, 28, 29, 30

- **Method 35 & 37 use the current position as the zero position, preferred method 37**




Method 35 & 37

# Appendix B: Object Dictionaries

| Index | Sub-index | Name | Access | Type | Range | Axis-1 default Value | Unit | Remark |
|---|---|---|---|---|---|---|---|---|
| 1000 | 0 | Device type | R | UINT | 0-32767 | 0x40912 | - | Refer to CIA 402 profile |
| 1001 | 0 | Error register | R | USINT | 0-255 | 0 | -- | Refer to Chapter 5.1 |
| 1008 | 0 | Device name | R | UINT | 0-32767 | CL3C-X | - | - |
| 1010 | 00 | Number of sub-index | R | UINT | 0-32767 | 4 | - | - |
| | 01 | Save all parameters | R/W | UDINT | 0-0xFFFFFFFF | 0 | - | Need to write 0x65766173 or 1702257011 (decimal) into sub-index. It will return 1 if save successfully |
| | 02 | Save communication parameters | R/W | UDINT | 0-0xFFFFFFFF | 0 | - | |
| | 03 | Save motion parameters | R/W | UDINT | 0-0xFFFFFFFF | 0 | - | |
| | 04 | Save factory parameters | R/W | UDINT | 0-0xFFFFFFFF | 0 | - | |
| 1011 | 00 | Number of sub-index | R | UINT | 0-32767 | 4 | - | - |
| | 01 | Restore all parameters to Axis-1 default setting | R/W | UDINT | 0-0xFFFFFFFF | 0 | - | Need to write 0x64616f6c or 1684107116 (decimal) into sub-index. It will return 1 if save successfully |
| | 02 | Reset communication parameters to factory setting | R/W | UDINT | 0-0xFFFFFFFF | 0 | - | |
| | 03 | Reset motion parameters to factory setting | R/W | UDINT | 0-0xFFFFFFFF | 0 | - | |
| | 04 | Reset user parameters to factory setting | R/W | UDINT | 0-0xFFFFFFFF | 0 | - | |
| 1018 | 00 | Number of sub-index | R | UINT | 0-32767 | 4 | - | - |
| | 01 | Vendor ID | R | UINT | 0-32767 | 4321 | - | Leadshine code |
| | 02 | Product code | R | UINT | 0-32767 | 8X00 | - | - |
| | 03 | Revision number | R | UINT | 0-32767 | 1 | - | - |
| | 04 | Series number | R | UINT | 0-32767 | 1 | - | - |
| 1600 | 0 | Number of sub-index | R/W | UINT | 0-32767 | 3 | - | Axis-1 default number of 1st mapping object |
| | 01-08 | 1st RXPDO-Map object | R/W | UDINT | 0-0xFFFFFFFF | - | - | Axis-1 default number of 1st RXPDO-Map object |
| 1601 | 0 | Number of sub-index | R/W | UINT | 0-32767 | 6 | - | Axis-1 default number of 2nd mapping object |
| | 01-08 | 2nd RXPDO-Map object | R/W | UDINT | 0-0xFFFFFFFF | - | - | Axis-1 default number of 2nd RXPDO-Map object |
| 1602 | 0 | Number of sub-index | R/W | UINT | 0-32767 | 5 | - | Axis-1 default number of 3rd mapping object |
| | 01-08 | 2nd RXPDO-Map object | R/W | UDINT | 0-0xFFFFFFFF | - | - | Axis-1 default number of 3rd RXPDO-Map object |
| 1603 | 0 | Number of sub-index | R/W | UINT | 0-32767 | 7 | - | Axis-1 default number of 4th mapping object |
| | 01-08 | 3rd RXPDO-Map object | R/W | UDINT | 0-0xFFFFFFFF | - | - | Axis-1 default number of 4th RXPDO-Map object |
| 1A00 | 0 | Number of sub-index | R/W | UINT | 0-32767 | 7 | - | Axis-1 default number of 1st mapping object |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 01-08 | 1st TXPDO-Map object | R/W | UDINT | 0-0xFFFFFFFF | - | - | Axis-1 default number of 1st TXPDO-Map object |
| 1A01 | 0 | Number of sub-index | R/W | UINT | 0-32767 | 0 | - | Axis-1 default number of 2nd mapping object |
| | 01-08 | 2nd TXPDO-Map object | R/W | UDINT | 0-0xFFFFFFFF | - | - | Axis-1 default number of 2nd TXPDO-Map object |
| 1C00 | 0 | Number of sub-index | R | UINT | 0-32767 | 4 | - | - |
| | 01 | Output type of email | R | UINT | 0-32767 | 1 | - | - |
| | 02 | Input type of email | R | UINT | 0-32767 | 2 | - | - |
| | 03 | Output type of process data | R | UINT | 0-32767 | 3 | - | - |
| | 04 | Input type of process data | R | UINT | 0-32767 | 4 | - | - |
| 1C12 | 0-04 | RXPDO assign | R/W | UINT | 0-32767 | 1600 | - | - |
| 1C13 | 0-02 | TXPDO assign | R/W | UINT | 0-32767 | 1A00 | - | - |
| 1C32 | 0-0A | RXPDO administrative parameters | R | UINT | 0-32767 | - | - | - |
| 1C33 | 0-0A | TXPDO administrative parameters | R | UINT | 0-32767 | - | - | - |

| Index | Sub-index | Name | Access | Type | Range | Axis-1 default value | Unit | Remark |
|---|---|---|---|---|---|---|---|---|
| 2000 | 00 | Peak current | R/W | DINT | 1-100 | 60 | 0.1A | Drive's max output current. |
| 2800 | 00 | | | | | | | |
| 2001 | 00 | Microstep resolution | R/W | DINT | 200-51200 | 10000 | Pulse | Required number of pulse to rotate 1 revolution of motor.<br>But it is recommended to modify via 6092+01 |
| 2801 | 00 | | | | | | | |
| 2010 | 01 | Internal filtering time | R/W | UINT | 0-32767 | 100 | 0.1ms | Internal smoothing time for control command. |
| 2810 | 01 | | | | | | | |
| 2012 | 00 | Soft-starting time | R/W | UINT | 10-3000 | 1 | ms | Internal smoothing time for starting current. |
| 2812 | 00 | | | | | | | |
| 2013 | 00 | Auto-tuning at power on | R/W | UINT | 0-2 | 1 | -- | 1: Yes. 0: No |
| 2813 | 00 | | | | | | | |
| 2019 | 01 | In-position pulse compensation | R/W | UINT | 0-1 | 1 | -- | 0: With compensation, the value of 6064 = 607A in position;<br>1: Without compensation |
| 2819 | 01 | | | | | | | |
| 2019 | 02 | In-position mode at disabled state | R/W | UINT | 0-1 | 0 | -- | 0: Not allowed in-position signal output when disabled;<br>1: Allowed in-position signal output when disabled; |
| 2819 | 02 | | | | | | | |
| 201A | 01 | Locking current percentage of power on | R/W | UINT | 0-100 | 100 | % | Usually keep the Axis-1 default value. |
| 281A | 01 | | | | | | | |
| 201A | 02 | Closed loop holding current percentage | R/W | UINT | 0-100 | 50 | % | Multiply by the value of object 0x2000, the drive output current will change between these according to the load. |
| 281A | 02 | | | | | | | |
| 201B | 00 | Locking duration time | R/W | UINT | 0-1500 | 200 | ms | Appropriately reduce this value if you want to shorten the time of locking shaft. |
| 281B | 00 | | | | | | | |
| 201C | 00 | Max time to close brake | R/W | UINT | 100-10000 | 1000 | ms | Usually keep the Axis-1 default value |
| 281C | 00 | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 201D | 00 | Zero speed point | R/W | UINT | 0-500 | 10 | 0.1r/s | - |
| 281D | 00 | | | | | | | |
| 2024 | 00 | Control Mode | R/W | UINT | 0~10 | 2 | -- | 0: Open Loop Control;<br>2: Closed Loop Control |
| 2824 | 00 | | | | | | | |
| 2025 | 01 | Speed point for open loop switching closed loop | R/W | UINT | 0~200 | 18 | 0.1r/s | - |
| 2825 | 01 | | | | | | | |
| 2025 | 02 | Delay for open loop switching closed loop | R/W | UINT | 0~32767 | 12 | ms | - |
| 2825 | 02 | | | | | | | |
| 2025 | 03 | Speed point for closed loop switching open loop | R/W | UINT | 0~200 | 5 | 0.1r/s | - |
| 2825 | 03 | | | | | | | |
| 2025 | 04 | Delay for closed loop switching open loop | R/W | UINT | 0~32767 | 250 | ms | - |
| 2825 | 04 | | | | | | | |
| 2025 | 05 | Feedback speed point for closed loop switching open loop | R/W | UINT | 0~200 | 50 | 0.1r/s | - |
| 2825 | 05 | | | | | | | |
| 2029 | 00 | Encoder resolution | R/W | UINT | 4000-20000 | 4000 | Count | 4 times the encoder resolution.<br>But it is recommended to modify by 0x608F+01 |
| 2829 | 00 | | | | | | | |
| 2030 | 00 | Allowed max position following error pulses | R/W | UINT | 0~32767 | 4000 | Count | 4000 indicates the error of one turn |
| 2830 | 00 | | | | | | | |
| 2032 | 00 | Distance to send "In Position" output signal | R/W | UINT | 0-1000 | 4 | Pulse | - |
| 2832 | 00 | | | | | | | |
| 2033 | 00 | Delay of in-position error de-jitter | R/W | UINT | 0-1000 | 3 | ms | - |
| 2833 | 00 | | | | | | | |
| 2047 | 00 | Over voltage point | R | UINT | 0-1000 | 75 | V | - |
| 2847 | 00 | | | | | | | |
| 2048 | 00 | Bus-voltage | R | UINT | 0-65535 | - | V | - |
| 2848 | 00 | | | | | | | |
| 2051 | 00 | Motor running direction | R/W | DINT | 0-1 | 0 | -- | 0: CCW direction<br>1: CW direction<br>But it is recommended to modify by 0x607E |
| 2851 | 00 | | | | | | | |
| 2056 | 00 | Alarm detection selection | R/W | DINT | 0~65535 | 65535 | -- | Bit setting:<br>=1: Yes; =0: No<br>Bit0: over-current (invalid)<br>Bit1: over-voltage<br>Bit2: Position following error<br>Bit3: Encoder wiring error<br>Bit4: over speed alarm |
| 2856 | 00 | | | | | | | |
| 2057 | 00 | Reset alarm | R/W | UINT | 0~65535 | 0 | -- | Write value 1 to clear the alarm. But it is recommended to write value 128(Decimal) to 0x6040 |
| 2857 | 00 | | | | | | | |
| 2090 | 01 | Current loop Kp | R/W | DINT | 0~32767 | 1500 | -- | -- |
| 2890 | 01 | | | | | | | |
| 2090 | 02 | Current loop Ki | R/W | DINT | 0~32767 | 300 | -- | -- |
| 2890 | 02 | | | | | | | |
| 2090 | 03 | Current loop Kc | R/W | DINT | 0~32767 | 300 | -- | -- |
| 2890 | 03 | | | | | | | |
| 2091 | 01 | Speed Loop Kp | R/W | UINT | 0~10000 | 25 | - | |
| 2891 | 01 | | | | | | | |
| 2091 | 02 | Speed Loop Ki | R/W | UINT | 0~10000 | 3 | - | |
| 2891 | 02 | | | | | | | |
| 2092 | 01 | Position Loop Kp | R/W | UINT | 0~100 | 25 | - | |
| 2892 | 01 | | | | | | | |
| 2150 | 00 | Slave ID | R/W | UINT | 0-256 | 1 | -- | Valid when 0x2151= 1; |
| 2151 | 00 | Slave ID resource | R/W | UINT | 0-10 | 0 | -- | 0: DIP switches<br>1: Setting by 0x2150<br>2: ESC |
| 2232 | 00 | Synchronous compensation1 | R/W | DINT | 0—65535 | 2 | -- | -- |
| 2A32 | 00 | | | | | | | |
| 2233 | 00 | Synchronous compensation2 | R/W | DINT | 0—65535 | 100 | -- | -- |
| 2A33 | 00 | | | | | | | |
| 225C | 00 | Special function register | R/W | DINT | 0~32767 | 0 | -- | Bit1=1: Set motor running direction by 0x607E<br>Bit2=1: Set virtual input by 0x5012-03 |
| 2A5C | 00 | | | | | | | |
| 22A9 | 00 | Limit Mode | R/W | DINT | 0-10 | 0 | -- | 0: Stop normally<br>1: Invalid<br>2: Alarm, error code 260 |
| 2AA9 | 00 | | | | | | | |
| 22B4 | 00 | Quick stop selection | R/W | DINT | 0~32767 | 0 | -- | 0: Alarm, error code 570,<br>1: Refer to 0x605A |
| 2AB4 | 00 | | | | | | | |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 3100 | 01 | Control software version | R | UINT | | | -- | |
| | 02 | Firmware version | R | UINT | | | -- | |
| | 03 | EtherNet/IP protocol version | R | UINT | | | -- | |
| 3FFE | 01-0B | Alarm record | R | USINT | 0~32767 | -- | -- | 0x3FFE+01 is the current error code (current alarm) or the most recent error code (currently no alarm);<br>0x3FFE+02-0E are followed by the historical error code. |
| 47FE | 01-0B | | | | | | | |
| 4003 | 01 | Delay of closing brake | R/W | UINT | 0-1500 | 250 | ms | |
| 4803 | 01 | | | | | | | |
| 4003 | 02 | Delay of loosening brake | R/W | UINT | 0-1500 | 250 | ms | |
| 4803 | 02 | | | | | | | |
| 4003 | 03 | Max speed to close brake | R/W | UINT | 0-500 | 10 | 0.1r/s | |
| 4803 | 03 | | | | | | | |
| 5000 | 03 | Internal enable state | R | UINT | 0~32767 | -- | -- | 0: Disabled<br>1: Enabled |
| 5800 | 03 | | | | | | | |
| 5000 | 04 | Reach the target state | R | UINT | 0~32767 | -- | -- | Bit0=0: Not reach<br>Bit0=1: Reach<br>Bit1=0: No stall<br>Bit1=1: Stalled |
| 5800 | 04 | | | | | | | |
| 5002 | 01 | ESC ID | R/W | UINT | 0~32767 | 0 | -- | Write 0, return the ID data in ESC to 0x5002-02；<br>Write 0x12, return the current ID setting by DIP switches |
| 5802 | 01 | | | | | | | |
| 5002 | 02 | ESC data | R | UINT | 0~32767 | 408 | -- | Return Node ID data |
| 5802 | 02 | | | | | | | |
| 5004 | 0F | Sync0 Synchronization interface parameters | R/W | UINT | 0~32767 | -- | -- | Bit0 =1: RPDO mapping can't be written by SDO;<br>Bit0 =0: RPDO mapping can be written by SDO;<br>Bit1=1: Detect the number of PDO mapping;<br>Bit1=1: Don't detect the number of PDO mapping;<br>Bit2=1: Send 0xF directly to enable;<br>Bit2=0: Send 0xF can't be enabled. |
| 5804 | 0F | | | | | | | |
| 5005 | 00 | DC compensation base value | R/W | UINT | 0~32767 | 500 | -- | -- |
| 5805 | 00 | | | | | | | |
| 5006 | 00 | Synchronization error detection | R/W | UINT | 0~32767 | 0 | -- | -- |
| 5806 | 00 | | | | | | | |
| 5011 | 00 | Internal actual location | R | UDINT | 0~32767 | -- | -- | -- |
| 5811 | 00 | | | | | | | |
| 5012 | 01 | Homing arrival position | R/W | DINT | 0~32767 | 0 | -- | -- |
| 5812 | 01 | | | | | | | |
| 5012 | 02 | Homing trigger position | R/W | DINT | 0~32767 | 0 | -- | -- |
| 5812 | 02 | | | | | | | |
| 5012 | 03 | Homing virtual input | R/W | UDINT | 0~32767 | 0 | -- | When 0x225C=4, activate the virtual input function; 60FD different bits, corresponding to different virtual inputs;<br>Inputs / Bit of 60FD<br>Probe signal 1 / Bit 26=1<br>Home switch / Bit 2=1<br>Positive limit / Bit 1=1<br>Negative limit / Bit 0=1<br>Z signal (index signal) / Bit 31=1<br>For example: 0x225C=4 and start homing, set 0x5012-03=4, Home switch input; set 0x5012-03=2, Positive limit input; set 0x5012-03=2, Negative limit input |
| 5812 | 03 | | | | | | | |
| 5012 | 04 | Homing setting | R/W | UINT | 0~32767 | 5 | -- | Bit0=0: Homing protection is not turned on;<br>Bit0=1: Homing protection is turned on;<br>(Homing protection: when start homing, If the limit signal takes effect, bit0=0 means homing normally, bit0=1 means stop |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 5812 | 04 | | | | | | | homing as limit protection )<br><br>Bit2=0: The value of current position after in position = 0x607C;<br>Bit2=1: The value of 0x607C is used as the motion offset, and finally 0x6064 = 0;<br>Bit3=0: 0x6064= 0x607C after in position;<br>Bit3=1: 0x6064 = 0x607C after in position; |
| 5400<br>5C00 | 01<br>01 | Minimum synchronization period | R/W | UINT | 250~2000 | 250 | us | -- |
| 5400<br>5C00 | 02<br>02 | Maximum synchronization period | R/W | UINT | 250~20000 | 10000 | us | -- |
| 5503<br>5D03 | 04<br>04 | Special function register | R/W | UINT | 0~65535 | 2 | -- | Bit0 = 0: Asynchronous mode, the host will track 0x607A-00 in real time;<br>Bit0=1: Asynchronous mode, the host does not track 0x607A-00in real time. |

| Index | Sub-index | Name | Access | Type | Range | Axis-1 default value | Unit | Remark |
|---|---|---|---|---|---|---|---|---|
| 2152<br>2952 | 01<br>01 | Input1 function | R/W | DINT | 0-65535 | 0x17 (Decimal 23) | -- | Axis-1 default is touch probe1, take effect changes need restart power |
| 2152<br>2952 | 02<br>02 | Input2 function | R/W | DINT | 0-65535 | 0x18 (Decimal 24) | -- | Axis-1 default is HOME, take effect changes need restart power |
| 2152<br>2952 | 03<br>03 | Input3 function | R/W | DINT | 0-65535 | 0x16 (Decimal 22) | -- | Axis-1 default is POT, take effect changes need restart power |
| 2152<br>2952 | 04<br>04 | Input4 function | R/W | DINT | 0-65535 | 0x01 (Decimal 1) | -- | Axis-1 default is NOT, take effect changes need restart power |
| 2156<br>2956 | 01<br>01 | Output1 function | R/W | DINT | 0-65535 | 0x01 | -- | Axis-1 default is alarm output, take effect changes need restart power |
| 2156<br>2956 | 02<br>02 | Output2 function | R/W | DINT | 0-65535 | 0x04 | -- | Axis-1 default is brake output, take effect changes need restart power |

| **Index** | **Name** | **Access** | **Type** | **Range** | **Axis-1 default value** | **Unit** | **Remark** |
|---|---|---|---|---|---|---|---|
| 603F<br>683F | Error code | R | UINT | 0-65535 | 0 | -- | Refer to chapter 5.2 |
| 6040<br>6840 | Control word | R/W | UINT | 0-65535 | 0 | -- | Refer to chapter 6.1 |
| 6041<br>6841 | Status word | R | UINT | 0-65535 | 0 | -- | Refer to chapter 6.1 |
| 605A<br>685A | Quick stop type selection | R/W | UINT | 0-65535 | 6 | -- | 0: After stopping immediately, switch on disable state;<br>1: After decelerating to stops at a speed value of 0x6084, switch on disable state;<br>2: After decelerating to stops at a speed value of 0x6085, switch on disable state;<br>3: After decelerating to stops at a speed value of 0x60C6, switch on disable stat;<br>4: After stopping immediately, switch on quick stop state;<br>5: After decelerating to stops at a speed value of 0x6084, switch on quick stop state;<br>6: After decelerating to stops at a speed value of 0x6085, switch on quick stop state;<br>7: After decelerating to stops at a speed value of 0x60C6, switch on quick stop stat; |
| 605D<br>685D | Asynchronous mode halt selection | R/W | INT | 0~65535 | 1 | -- | 1: After decelerating to stops at a speed value of 0x6084, keep operation enable state;<br>2: After decelerating to stops at a speed value of 0x6085, keep operation enable state;<br>3: After decelerating to stops at a speed value of 0x60C6, keep operation enable state;<br>4: After stopping immediately, keep operation enable state. |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 6060<br>6860 | Operation mode | R/W | USINT | 0-255 | 8 | -- | 1: PP mode,<br>3: PV mode,<br>6: Home mode, |
| 6061<br>6861 | Operation mode display | R | USINT | 0-255 | 8 | -- | - |
| 6062<br>6862 | Position command | R | DINT | -2147483648<br>~2147483647 | 0 | Pulse | - |
| 6064<br>6864 | Position actual value | R | DINT | -2147483648<br>~2147483647 | 0 | Pulse | - |
| 6067<br>6867 | Distance to send "In Position" output signal | R/W | UINT | 0-1000 | 4 | Pulse | It is recommended to use this object in preference, Can also set by 0x2032, |
| 606B<br>686B | Velocity command | R | DINT | -2147483648<br>~2147483647 | 0 | P/s | - |
| 606C<br>686C | Velocity actual value | R | DINT | -2147483648<br>-2147483647 | 0 | P/S | - |
| 607A<br>687A | Target position | R/W | DINT | -2147483648<br>~2147483647 | 0 | P | Target position under PP mode |
| 607C<br>687C | Home offset | R/W | DINT | -2147483648<br>~2147483647 | 0 | P | The value of difference between zero position and mechanical zero point under Homing mode .<br>If the value is set to10000, it means that at homing mode 19, the motor reaches the Home switch and stops immediately, then reverses at low speed until it leaves the Home switch, at last stops at a distance of 10000P. |
| 607D+01<br>687D+01 | Software negative limit | R/W | DINT | -2147483648<br>~2147483647 | 0 | P | New target positions are checked against these limits. The limits are relative to the machine home position, which is the result of homing. As Axis-1 default the software position limits are switched off. Changed values must be saved and the drive must be restarted to take enable the new the software limits. |
| 607D+02<br>687D+02 | Software positive limit | R/W | DINT | -2147483648<br>~2147483647 | 0 | P | |
| 607E<br>687E | Motor direction | R/W | USINT | 0~255 | 0 | -- | Need to set 0x225C first |
| 60FF<br>68FF | Target velocity | R/W | DINT | -2147483648<br>~2147483647 | 0 | P/S | Profile velocity under PV mode |
| 6080<br>6880 | Max velocity limit | R/W | UDINT | -2147483648<br>~2147483647 | 3000 | rpm | - |
| 6081<br>6881 | Max profile velocity | R/W | DINT | -2147483648<br>~2147483647 | 50000 | -- | Max. Allowable velocity under PP mode |
| 6082<br>6882 | Start velocity | R/W | DINT | -2147483648<br>~2147483647 | 0 | -- | Start velocity under PP mode |
| 6083<br>6883 | Profile acceleration | R/W | DINT | -2147483648<br>~2147483647 | 4000 | P/S^2 | Acceleration under PP and PV mode |
| 6084<br>6884 | Profile deceleration | R/W | DINT | -2147483648<br>~2147483647 | 4000 | P/S^2 | Deceleration under PP and PV mode |
| 6085<br>6885 | Quick stop deceleration | R/W | DINT | -2147483648<br>~2147483647 | 400000000 | P/S^2 | Deceleration of quick stop under PP, PV and Home mode |
| 608F+01<br>688F+01 | Encoder resolution | R/W | UINT | 4000-20000 | 4000 | Count | It is recommended to use this object in preference, can also set by 0x2029, |
| 6092+01<br>6892+01 | Microstep resolution | R/W | DINT | 200-51200 | 10000 | Pulse | It is recommended to use this object in preference,can also be modified via 0x2001, |
| 6098<br>6898 | Homing method | R/W | USINT | 1-100 | 19 | - | Methods of searching zero position under homing mode, refer to Appendix A |
| 6099+01<br>6899+01 | Fast homing velocity | R/W | DINT | -2147483648<br>~2147483647 | 50000 | P/S | Speed during search for limit switch signal |
| 6099+02 | Slow homing | R/W | DINT | -2147483648 | 25000 | P/S | Speed during search for Home switch |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 6899+02 | velocity | | | ~2147483647 | | | |
| 607C<br>687C | Home offset | R/W | DINT | -2147483648<br>~2147483647 | 0 | P | The value of difference between zero position and mechanical zero point under Homing mode |
| 609A<br>689A | Homing acceleration | R/W | USINT | -2147483648<br>~2147483647 | 25000 | P/S^2 | Acc / Dec velocity under Home mode |
| 60B0<br>68B0 | Position offset | R/W | DINT | -2147483648<br>~2147483647 | 0 | P | Position offset under PP mode |
| 60B8<br>68B8 | Touch probe control word | R/W | UINT | 0-65535 | 0 | - | Set touch probe function, refer to chapter 6.3 |
| 60B9<br>68B9 | Touch probe statue word | R | UINT | 0-65535 | 0 | - | Status of touch probe 1/2, refer to chapter 6.3 |
| 60BA<br>68BA | Touch probe 1 positive value | R | DINT | -2147483648<br>~2147483647 | 0 | P | Data value sensed by touch probe 1 at rising edge |
| 60BB<br>68BB | Touch probe 1 negative value | R | DINT | -2147483648<br>~2147483647 | 0 | P | Data value sensed by touch probe 1 at falling edge |
| 60BC<br>68BC | Touch probe 2 positive value | R | DINT | -2147483648<br>~2147483647 | 0 | P | Data value sensed by touch probe 2 at rising edge |
| 60BD<br>68BD | Touch probe 2 negative value | R | DINT | -2147483648<br>~2147483647 | 0 | P | Data value sensed by touch probe 2 at falling edge |
| 60C2+01<br>68C2+01 | Interpolation time period value | R/W | USINT | 0-255 | 2 | -- | Only for internal tuning. |
| 60C2+02<br>68C2+02 | Interpolation time unit | R/W | SINT | -128-127 | 0 | -- | |
| 60D5<br>68D5 | Touch probe 1 rising edge counter | R | UINT | 0-65535 | 0 | -- | Frequency for capture of touch probe 1 rising edge |
| 60D6<br>68D6 | Touch probe 1 falling edge counter | R | UINT | 0-65535 | 0 | -- | Frequency for capture of touch probe 1 falling edge |
| 60D7<br>68D7 | Touch probe2 rising edge counter | R | UINT | 0-65535 | 0 | -- | Frequency for capture of touch probe 2 rising edge |
| 60D8<br>68D8 | Touch probe 2 falling edge counter | R | UINT | 0-65535 | 0 | -- | Frequency for capture of touch probe 2 falling edge |
| 60FD<br>68FD | Digital input statue | R | UDINT | 0- 4294967296 | 0 | -- | Statue of digital input signals, refer to chapter 4.3.1 |
| 60FE+01<br>68FE+01 | Open physical output | R/W | UDINT | 0- 4294967296 | 0 | -- | Able to control user output through this object, refer to chapter 4.3.4 |
| 60FE+02<br>68FE+02 | Enable physical output | R/W | UDINT | 0- 4294967296 | 0 | -- | |

# Appendix C: Connectors

| Pic | Description | Brand&Specification | Model | Number | Package Inside |
|---|---|---|---|---|---|
|  | Power&Motor Connector for 2CS3E-D503, 2CS3E-D507 | **MOLEX** 2PIN, 13A | 39012020 | 1 | No |
| | | **MOLEX** 4PIN, 13A | 39012040 | 1 | No |
|  | | **MOLEX** | 39000038 | 4 | No |
|  | Power&Motor Connector for 2CS3E-D1008 | **DEGSON** 2PIN, 5.0mm | 2EDGK-5.0-02P-13-1000AH | 1 | Yes |
| | | **DEGSON** 4PIN, 5.0mm | 2EDGK-5.0-04P-13-1000AH | 1 | Yes |
|  | Encoder Connector | **MOLEX** | 513531200 | 1 | No |
|  | | **MOLEX** | 561349000 | 8 | No |
|  | I/O Connector | **ANYTEK** 2*11PIN, 3.5mm | NL22100200G0G | 1 | Yes |

Note: For 2CS3E Series drives, motor connector and encoder connector are on the extension cable

# Appendix D: FAQs

- **Communicate errors.**

  ► If it is the first time to use this EtherCAT drive, check whether the version of XML file is correct. Most masters support scanning slave, it is recommended to create configuration in scanning way.

  ► Some masters require the connection of the network cable according to the ECAT IN and ECAT OUT.

  ► Check whether the PDO synchronization period set by master and slave is the same.

  ► The PDO synchronization period (Ethercat communication period) not supported by 2CS3E, such as 1.1ms, 0.9ms, etc. The common PDO synchronization period is 250us/500us/ 1ms/2ms/4ms, etc.

  ► Some masters require DIP switches to be set to the same node ID as the configuration setting.

  ► The network cable is faulty or has poor contact, replace the cable. Or check the problem by swapping it with the network cable on a normally connected node.

  ► The EtherCAT drive is faulty, replace the cable. Or check the problem by swapping it with a normally worked drive.

- **Drive cannot be enabled**

  ► Check the status of the drive. Under normal conditions, the PWR green light of the driver is on for a long time and the ALM red light is off. the L/A green light of the ECAT IN and ECAT OUT network ports blinks rapidly, the run green light is on for a long time and the Err red light is off.

  ► PDO configuration or PDO mapping error. It needs to configure PDO or PDO mapping correctly.

  ► Check if the value of object 0x6040 is 16#F and if bit0~bit3 of object 0x6041 is 0111.

  ► Check the master for warnings or errors. Clear the master station alarm or warning.

  ► If the master station shows enable complete, but the motor is not enabled. Check whether the motor wire is connected wrongly or disconnected. Or check if the output current of drive is set correctly.

- **Alarm when send instruction to slave**

  ► Check the drive for alarms. Check if the drive ALM red light and ERR red light are flashing, if there is an alarm, check the drive instruction manual and locate the problem according to the alarm instructions.

  ► The operation mode is not correct. Check if object 0x6060 is 8 (CSP mode).

  ► PDO configuration exception. Some masters need to check if the slave's object 0x6061 returns the correct value. If 0x6061 is not configured, the slave may not work or the master may alarm.

  ► The limit switch is activated. Check that the limit switch input is the same as the logic set by the master. Is the polarity of the slave input port the same as the limit switch used. The limit switch is not damaged. Whether the wiring between the limit switch and the slave is correct. The bit bit of object 0x60FD is mapped incorrectly with the master.

- **Motor does not turn**

  ► The controller instruction is not sent to the driver. Check if the value of 0x607A (Target position) has changed, if not, then maybe the program has an exception.

  ► Limit switch is activated. Check if the limit switch logic status is consistent with the set by the master. Or whether the polarity of the slave input port is consistent with the limit switch. Or whether the limit switch is damaged. Or whether the wiring between the limit switch and the slave is correct. Or the mapping between the bit of 0x60FD and the master is wrong.

  ► The control instruction is normal, but the motor does not turn. It may be that the output current setting is too small. Or the load is too heavy. Or the starting speed is too large. Or the acceleration time is too short. Or the motor is damaged. All of the above can be tested by letting the motor unload and setting the motor speed to 60rpm with acceleration time 200ms to check the problem.

- **Homing Error**

► Wrong homing method. There are three modes of homing, when using the master homing mode, the operation mode object 0x6060 = 8; when using the slave homing mode, the 0x6060 = 6; when using the master-slave combination homing method, the 0x6060 value is first 8 and then 6. Please check master manufacturer for Axis-1 default homing mode, and then check the selected homing method, the relevant parameters are correct, and the limit switch needed in the selected homing method is normal.

► Stop on the limit switch and keep processing Busy state. Some master stations are master-slave combination homing mode (Panasonic and Keyence), the 0x6060 value is first 8 and then 6. If there is no configuration 0x6060 in PDO or wrong configuration, then will cause homing error.

- **Occasional dropouts during operation**

► Always a certain drive dropouts. Maybe network cable problem: Poor contact between network cable and drive interface. Or the OUT port of the last drive has a problem. Or the drive itself has problem. All of the above can be tested by swapping the drive or swapping the network cable.

► Random drive dropouts. Interference problem: Poor quality of network cable, it is recommended to use a Category 5 Fast Ethernet cable or above, industrial grade network cable with twisted pair shielding. Ensure that the equipment is well grounded. When laying out the electrical cabinet, strong and weak power need to be separated. Keep away from high power strong interference devices such as plasma generators, laser generators, VFD etc.