



DE2405E

EtherCAT Field Bus

Closed Loop Step Manual



Safety

In order to use this product safely, the user should be familiar with and observes the following important items before proceeding with storage, installation, wiring, operation, inspection or maintenance for the product.

Precautions

Improper operation may cause accidents, please be sure to read this instruction carefully before using this product.

The manual contents may be subject to change due to product improvements without notice.

Note: The following tips when reading this manual:

- Only technical personnel can install, debug or maintain the product.
- Make sure that the wire connections are correct before the power-on.
- Error voltage or power polarity may damage the drive or cause other accidents.

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DE2405E

EtherCAT Closed Loop Step Drive

1 PRODUCTION INTRODUCTION

1.1 Description

The DE2405E is a EtherCAT closed-loop step drive with a bus communication function added to the DE series high-performance step-closed-loop drive, adapted for closed loop step motors with 42 and 57 flanges. With EtherCAT bus communication interface and EtherCAT slave station techonoly, real-time control of the step system at 100Mb/s and real-time data transmission can be realized. The drive has rich input and output interfaces and supports CSP, PP, CSV, PV, HM operation mode. Compared to the traditional pulse type

of drives, this drive is especially suitable for long-distance, multi-axis linkage applications, which can greatly reduce the wiring and enhance the reliability of the drive operation.

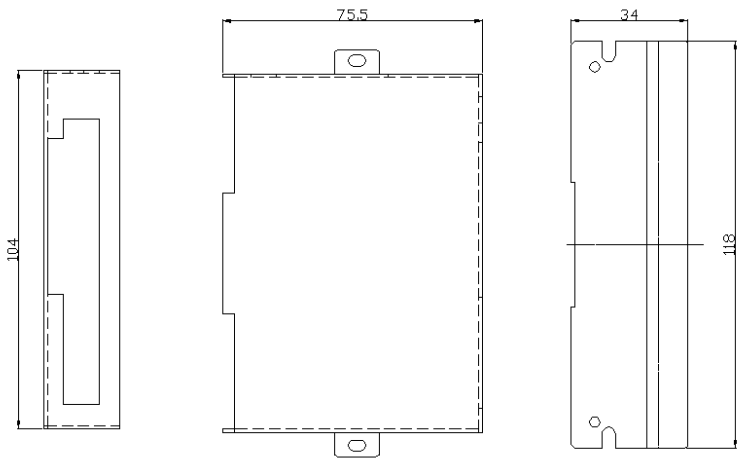
1.2 Features

- Working voltage: DC20-50V.
- Support the EtherCAT communication protocol and the address is automatically assigned through the main station.
- 4 single-terminal common anticathode isolation input function with maximum input frequency of 10KHz, input voltage of 5V.
- 2 ways optical coupling isolation output with maximum output capacity of 50mA, maximum pressure resistance of 30Vdc.

1.3 Application

Suitable for various of multi-axial linkage controlling small or medium-sized automation equipment such as machine hand, packing machines, etc.

1.4 Installation Dimension



1.5

Working Environment

Cooling		Natural Cooling or Forced Cooling
Working Environment	Environment	Avoid corrosive gases,dust,oil,magnetic field
	Temperature	0~50℃
	Humidity	40~90%RH
Storage Temperature		-20℃~65℃
Weight		0.3Kgs

2 DRIVE SPECIFICATION

Max output current	4A	Monitor function	speed / position / instruction pulse accumulation/positional
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			deviation / motor current/IO interface state
Main power	20VDC-50VDC	Control Method	Position control
Protection funtion	over voltage / over current / over heat / over positioning,etc	Control input	1 : Negative limit 2 : possitive limit 3 : Origin
Control output	IO port function can be customized by master station	Display	External display board can be connected
Position control	Input way	Bus communication	

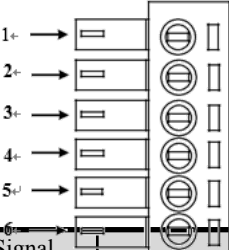
3 DRIVE TERMINAL INTRODUCTION

3.1 Terminal Introduction

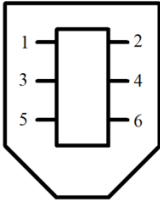
3.1.1 Definition

Symbol	Description
CN4	Power supply and motor cable terminal
CN3	Encoder cable terminal
CN2A	EtherCAT input terminal
CN2B	EtherCAT output terminal
CN1	IO input and output terminal

3.1.2 CN4 Terminal

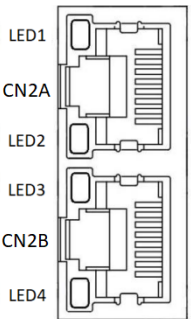
		
Pin No.	Signal	Introduction
1	A+	Positive interface of motor A phase
2	A-	Negative interface of motor A phase
3	B+	Positive interface of motor B phase
4	B-	Negative interface of motor B phase
5	V-	Negative interface of DC power supply
6	V+	Positive interface of DC power supply

3.1.3 CN3 Encoder Cable Terminal

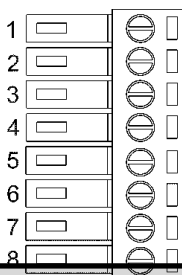
		
Pin No.	Signal	Introduction

1	EB+	Positive interface of encoder B phase
2	EB-	Negative interface of encoder B phase
3	EA+	Positive interface of encoder A phase
4	EA-	Negative interface of encoder A phase
5	VCC	Positive interface of encoder 5V power supply
6	GND	Negative interface of encoder 5V power supply

3.1.4 CN2 EtherCAT Communication Terminal

Symbol	Picture	Pin No.	Signal	Name
CN2		1, 9	E_TX+	Positive end of EtherCAT data sending
		2, 10	E_TX-	Negative end of EtherCAT data sending
		3, 11	E_RX+	Positive end of EtherCAT data received
		4, 12	/	/
		5, 13	/	/
		6, 14	E_RX-	Negative end of EtherCAT data received
		7, 15	/	/
		8, 16	/	/
		Connector cover	PE	shield grounded
Remark	1) LED1 shows the state of“Link/Activity IN”with orange. 2) LED3 shows the state of“Link/Activity OUT”with orange. 3) LED2 and LED4 show the state of“RUN”with green.			

3.1.5 CN1 Input And Output Terminal



Pin No.	Definition	Introduction
1	DI COM+	Positive common port of

		IO input
2	DI1	IO input port 1
3	DI2	IO input port 2
4	DI3	IO input port 3
5	DI4	IO input port 4
6	DO_COM-	Positive common port of IO output
7	DO1	IO output port 1
8	DO2	IO output port 2

DE2405E has 4 input terminals and 2 output terminals. The definition can be customized by 0x2003 and 0x2004 groups of parameters (The input terminal is active low by default). Only the input signal whose function number defined by the terminal is No. 33 and above will be sent to the master station and it can be obtained through Digital Inputs of object of 0x60fd in the object dictionary.

Definition	Symbol	Function
33	NLIMIT	Negative limit
34	PLIMIT	Positive limit
35	HOME	Zero signal
37	PROBE1	Probe 1
38	PROBE2	Probe 2

3.2 EtherCAT Bus Communication

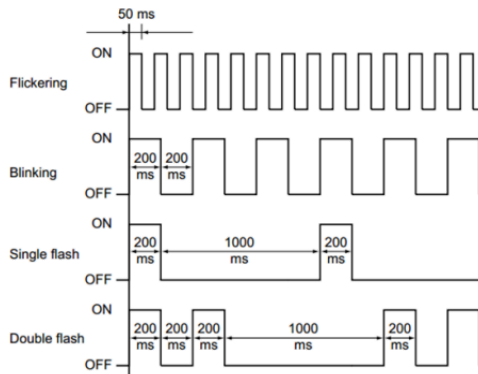
3.2.1 Communication specification

	Item	Description
EtherCAT	Physical Layer	100BASE-TX
	Communication Connector	RJ45 × 2 (Terminal CN3A=IN, CN3B=OUT)
	Network Topology	Field bus type
	Baud Rate	2 × 100 Mbps (Full duplex)
	Frame Data Length	1484 bytes (max)
	Synchronization Manager	SM0: mailbox reception (master to slave) SM1: mailbox sending (slave to master) SM2: process data output (master to slave) SM3: process data input (slave to master)
	Synchronous Mode	DC Synchronization (SYNC0) Free Run
	Communication Object	SDO: service data object PDO: process data object
	LED Indication	L/A IN (Link/Activity IN) × 1 L/A OUT (Link/Activity OUT) × 1 RUN × 2
	Communication Protocol Standard	CoE: CANopen over EtherCAT
	Equipment Agreement Standard	IEC61800-7 CiA402 Drive Profile
CiA402 Operation Mode	Cyclic synchronization position mode (CSP)、Cyclic synchronous velocity mode (CSV)、Cyclic synchronous torque mode (CST)、Profile position mode (PP)、Profile velocity mode (PV)、Profile torque mode (PT)、Homing mode (HM)	

3.2.2 LED State Instruction

Name	Color	State	Description
RUN	Green	OFF	Initial state
		Blinking	Pre-operational state
		Single flash	Safe-operational state
		ON	Operational state
L/A IN	Orange	OFF	Physical layer link not established
		ON	Physical layer link establishment
		Flickering	Interactive data after link establishment
L/A OUT	Orange	OFF	Physical layer link not established
		ON	Physical layer link establishment
		Flickering	Interactive data after link establishment

The status of the indicator light is described as follows:



Pic 3.3 Light

flashing time

3.2.3 Communication Object

The drive parameters include communication parameters, manufacturer parameters and 402 parameters. Among them, the parameters related to stepping drives are mainly in the 0x2008 group of parameters.

Address	Name	Read/Write	Default Value	Range	Introduction
1000h	device type	R	0x00040192		
1001h	wrong register	R	0		
1008h	device name		DE2405E		
1009h	Hardware version		V1.0		

100Ah	software release		V1.0		
1018h+01	Manufacturer ID	R	0x00445653		
1018h+02	Product code	R	0x00000001		
1018h+03	Modified coding	R	0x00000001		
1018h+04	serial number	R	0x00000001		
1600h	RXPDO mapping object0	RW			RPDO number and content can be configured
1701h	RXPDO mapping object258	R	0x60400010 0x607A0020 0x60B80010 0x60FE0120		
1702h	RXPDO mapping object259	R	0x60400010 0x607A0020 0x60FF0020 0x60710010 0x60600008 0x60B80010 0x607F0020		
1703h	RXPDO mapping object 260	R	0x60400010 0x607A0020 0x60FF0020 0x60600008 0x60B80010 0x60E00010 0x60E10010		
1704h	RXPDO mapping object261	R	0x60400010 0x607A0020 0x60FF0020 0x60710010 0x60600008 0x60B80010 0x607F0020 0x60E00010 0x60E10010		
1705h	RXPDO mapping object 262	R	0x60400010 0x607A0020 0x60FF0020 0x60600008 0x60B80010 0x60E00010 0x60E10010 0x60B20010		
1A00h	TXPDO mapping object0	RW			TPDO number and content can be configured

1B01h	TXPDO mapping object258	R	0x603F0010 0x60410010 0x60640020 0x60770010 0x60F40020 0x60B90010 0x60BA0020 0x60BC0020 0x60FD0020		
1B02h	TXPDO mapping object259	R	0x603F0010 0x60410010 0x60640020 0x60770010 0x60610008 0x60B90010 0x60BA0020 0x60BC0020 0x60FD0020		
1B03h	TXPDO mapping object260	R	0x603F0010 0x60410010 0x60640020 0x60770010 0x60F40020 0x60610008 0x60B90010 0x60BA0020 0x60BC0020 0x60FD0020		
1B04h	TXPDO mapping object261	R	0x603F0010 0x60410010 0x60640020 0x60770010 0x60610008 0x60F40020 0x60B90010 0x60BA0020 0x60BC0020 0x606C0020		
1C12h	RXPDO distribution	RW	0	0x1600 0x1701~ 0x1705	
1C13h	TXPDO distribution	RW	0	0x1A00 0x1B01~ 0x1B04	

2001h	Basic control parameters				
2001h+4	Position command smoothing filter	RW	200	1-1000	
2002h	communicational parameter				
2002h+1	Communication virtual input	RW	0	0-1	Set to 1 to effectively set the input port function number
2002h+2	Communication virtual output	RW	0	0-1	Set to 1 to effectively set the output port function number
2002h+3	fixed address	RW	0	0-32767	
2003h	Function number of input terminals				
2003h+1	Digital input DI1 function	RW	1	0-99	
2003h+2	Digital input DI2 function	RW	2	0-99	
2003h+3	Digital input DI3 function	RW	3	0-99	
2003h+4	Digital input DI4 function	RW	4	0-99	
2003h+5	Digital input DI5 function	RW	5	0-99	
2003h+6	Digital input DI6 function	RW	6	0-99	
2003h+7	Digital input DI7 function	RW	7	0-99	
2003h+8	Digital input DI8 function	RW	8	0-99	
2004h	Output terminal function number				
2004h+1	Digital output DO1 function	RW	18	0-48	
2004h+2	Digital output DO2 function	RW	19	0-48	
2004h+3	Digital output DO3 function	RW	2	0-48	
2004h+4	Digital output DO4 function	RW	3	0-48	
2004h+5	Digital output	RW	5	0-48	

	DO5 function				
2004h+6	Digital output DO6 function	RW	8	0-48	
2005h	Accessibility parameter				
2005h+1	Fault reset	RW	0	0-1	
2005h+2	Whether the soft limit turn on	RW	0	0-1	
2005h+3	Whether the parameters are saved to eeprom	RW	1	0-1	
2006h	Monitoring parameters				
2006h+1	Drive current	RO			
2006h+2	Drive temperature	RO			
2006h+3	busbar voltage	RO			
2008h	Step in mode Parameter 1				
2008h+1	Lock current	RW	10	1-80	Set the output current of the drive when the motor stops
2008h+2	Running current	RW	30	1-80	Set the output current of the drive when the motor is running
2008h+3	Restore default parameters	RW	0	0-1	Set to 1 to automatically restore the factory parameters, and automatically change to 0
2008h+4	Current loop ratio	RW	2000	1000-9000	If the motor noise is large, this parameter can be adjusted appropriately
2008h+5	Current loop integral	RW	45	1-1000	
2008h+6	Instruction filtering	RW	256	1-2048	Increasing this parameter can make the motor run smoothly

2008h+7	Subdivision	RW	4000	1-10000	Set the number of pulses per revolution of the drive. For closed-loop mode, this value is divided by 4, which corresponds to the default number of encoder lines
2008h+8	Operating mode	RW	2	1-2	1.: Open loop step mode 2 : Closed loop step mode
2008h+9	Current gain compensation speed	RW	250	0-2000	
2008h+A	Current gain compensation coefficient	RW	7	0-20	
2008h+B	Position current gain factor	RW	100	1-3000	Position loop gain, appropriately increasing can increase rigidity
2008h+C	Input port effective level	RW	15	0-15	Default high level is active
2008h+D	Output port effective level	RW	15	0-15	Default normally open
2008h+E	Disconnection alarm detection threshold	RW	80	0-300	There is no motor alarm when detecting that the motor line current is less than this value. It is easy to alarm when using a small motor. This value can be reduced and set to 0 to not alarm.
2009h	Step mode 2				
2009h+1	Position out of tolerance alarm threshold	RW	4000	40-8000	If the following error exceeds this value, the drive will give alarm No. 4, if alarm No. 4 appears, this value can be increased appropriately.
2009h+2	Position loop gain	RW	100	10-2000	The greater the value, the greater the rigidity of the drive, and the setting value is too large, which will cause the motor to vibrate.

2009h+3	Speed loop ratio	RW	400	1-9000	The greater the value, the greater the rigidity of the drive, and the setting value is too large, which will cause the motor to vibrate.
2009h+4	Speed loop integral	RW	25	10-900	Integral time constant of speed loop regulator
2009h+5	Speed loop filter coefficient	RW	12	1-32	
2009h+6	Gear ratio numerator	RW	1	1-9999	
2009h+7	Gear ratio denominator	RW	1	1-9999	
2009h+8	Motor running direction	RW	0	0-1	0: Rotate in the positive direction; 1: Rotate in the opposite direction.
2009h+9	Secondary filtering	RW	100	1-1000	The larger the value is set, the smoother the operation and the slower the response.
2009h+A	Max current loop gain	RW	9999	50-9999	
2009h+B	Low speed input port Filter time	RW	10	1-9999	
2009h+C	Max speed numerator	RW	1	0-9999	
2009h+D	Max speed denominator	RW	3	0-9999	
2009h+E	Min speed denominator	RW	4	0-9999	
2009h+F	High-speed input filter time	RW	200	1-9999	
2009h+10	Whether no motor alarm is on	RW	0	0-1	It is not turned on by default. If it is turned on, in the open loop mode, it will detect whether the motor is disconnected or not during the zero point and running.
2009h+11	Aging mode	RW	0	0-1	For internal testing

2009h+12	Encoder line number	RW	1000	1-9999	
2009h+13	Feedforward coefficient	RW	0	0-200	The larger the setting value, the faster the response, and too large it is easy to vibrate

Address	Name	Read/Write	Default Value	Range	Introduction	Address
603Fh	Recent error code	R	TPDO	0	Unsigned 16 bits	The last error code.
6040h	Control word	RW	RPDO	0	Unsigned 16 bits	Control word
6041h	Status word	R	TPDO	0	Unsigned 16 bits	Status word
605Ah	Quick stop code	RW	NO	1	Signed 16 bits	1:It enters the unenabling state after the slope stops. 2:Stops quickly and enters into the unenbaling state. 5:Slope shutdown completed and maintained in a fast stop state. 6:The fast stop is completed and maintained in the fast stop state. Other: invalid
6060h	Mode setting	RW	RPDO	8	Unsigned 8 bits	Working modes: 1:Profile position mode 3:Profile velocity mode 4:Profile torque mode 6:Homing mode 8:Periodic synchronization position mode 9:Periodic synchronous velocity mode 10:Periodic synchronous torque mode
6061h	Code check	R	TPDO	0	Unsigned 8 bits	Display the working state of the drive.
6062h	Position instruction	R	TPDO	0	Signed 32 bits	Instruction unit

6063h	position feedback	R	TPDO	0	Signed 32 bits	Actual position of motor (encoder unit)
6064h	physical location	R	TPDO	0	Signed 32 bits	Display the actual motor position (instruction unit)
6067h	Position arrival threshold	RW	RPDO	130	Unsigned 32 bits	Encoder unit
606Ch	actual velocity	R	TPDO	0	Signed 32 bits	Display the actual motor speed (instruction unit)
6071h	Target torque	RW	RPDO	0	Signed 16 bits	Input value of torque value in torque mode (thousand value)
6072h	max torque	RW	RPDO	3000	Signed 16 bits	The input torque value in torque mode
6077h	Actual torque	R	TPDO	0	Signed 16 bits	Display the actual motor torque
607Ah	target position	RW	RPDO	0	Signed 32 bits	Target position in position mode (instruction unit)
607Ch	Origin offset	RW	RPDO	0	Signed 32 bits	Origin offset
607Dh+01	Min position limit	RW	RPDO	-2000000000	Signed 32 bits	Reverse limit
607Dh+02	Max position limit	RW	RPDO	2000000000	Signed 32 bits	Forward limit
607Fh	Max speed	RW	RPDO	600000	Signed 32 bits	The max running speed
6081h	Ladder velocity	RW	RPDO	250000	Unsigned 32 bits	Speed value in uniform speed stage of profile position mode,inc/s
6083h	Ladder acceleration	RW	RPDO	250000	Unsigned 32 bits	Acceleration of ladder curve
6084h	Ladder deceleration	RW	RPDO	250000	Unsigned 32 bits	Deceleration of ladder curve(acceleration value)
6085h	Quick stop deceleration	RW	RPDO	300000	Unsigned 32 bits	The deceleration for emergency stop 605A in the of selescion in 1 or 5.
6087h	Torque slope	RW	RPDO	1	Unsigned 32 bits	Torque variation of per unit time (1ms)
6091h+2	Gear ratio: shaft accuracy	RW	RPDO	10000	Unsigned 32 bits	The number of instructions for the external shaft to control the motor to turn a rotate.

6098h	Homing mode	RW	RPDO	17	Signed 8 bits	Look for origin mode (support for 17 and 18, forward and reverse limit switches)
6099h+01	Homing mode high speed	RW	RPDO	20000	Unsigned 32 bits	Search for the velocity value of the origin signal in high speed (instruction / s)
6099h+02	Homing mode low speed	RW	RPDO	4000	Unsigned 32 bits	Search for the velocity value of the Origin signal in low speed (instruction / s)
609Ah	Homing accelerated/ decelerated speed	RW	RPDO	200000	Unsigned 32 bits	Acceleration and deceleration for origin mode (instruction / S2)
60B8h	Probe function	RW	RPDO	0x3131	Unsigned 16 bits	Set probe function. (Details are in the see the functional description of the probe)
60B9h	Probe state	R	TPDO	0	Unsigned 32 bits	Display probe action status.(Details are in the see the functional description of the probe)
60BAh	Probe 1 rising along latch position	R	TPDO	0	Signed 32 bits	Probe 1 rising along latch position
60BBh	Probe 1 falling down latch position	R	TPDO	0	Signed 32 bits	Probe 1 falling down latch position
60BCh	Probe 2 rising along latch position	R	TPDO	0	Signed 32 bits	Probe 2 rising along latch position
60BDh	Probe 2 falling down latch position	R	TPDO	0	Signed 32 bits	Probe 2 falling down latch position
60E0h	Forward torque limit	RW	RPDO	3000	Signed 16 bits	The torque limit of limiting the forward rotation (permillage)
60E1h	Reverse torque limit	RW	RPDO	3000	Signed 16 bits	The torque limit of limiting the reversed rotation (permillage)
60F4h	Position error	R	TPDO		Signed 32	Position error

					bits	(instruction unit)
60FDh	Input IO status	R	TPDO		Unsigned 32 bits	bit0:origin signal bit1:forward limit bit2:negative limit bit3:emergency stop bit4:probe1 function (High speed input port1) bit5:probe2 function (High speed input port2)
60FE+01	Physical output	RW	RPDO	0	Unsigned 32 bits	
60FEh+02	Physical output enable	RW	NO		Unsigned 32 bits	Not used
60FFh	Target speed	RW	RPDO		Signed 32 bits	Target speed in speed mode. (instruction unit / s)
6502h	Supported operations mode	R	NO		Unsigned 32 bits	The supported operation modes pf the drive.

3.3 Parameter Function Description

No.	Name	Function Description	Range	Default
P-00	Current loop ratio	Current loop ratio	1000--9000	2000
P-01	Current loop integral	Current loop integral	10--100	45
P-02	Location is out of tolerance	Location is out of tolerance	40--8000	4000
P-03	Position loop gain	Position loop gain	10--2000	100
P-04	Command pulse filter coefficient	Command pulse filter coefficient	1--2048	256
P-05	Speed loop ratio	Speed loop ratio	1--9000	400
P-06	Speed loop integral	Speed loop integral	10--900	25
P-07	Speed loop filter coefficient	Speed loop filter coefficient	1--32	12
P-08	Maximum motor	Maximum motor current	10--80	40

	current			
P-09	Encoder line number		-	-
P-10	-	-	-	-
P-11	Pulse effective edge	0: counting on rising edge 1: counting on falling edge	0-1	0
P-12	Electronic gear ratio numerator	Electronic gear ratio numerator	1--9999	1
P-13	Electronic gear ratio denominator	Electronic gear ratio denominator	1--9999	1
P-14	Pulse mode selection	0: single pulse. 1 double pulse	0-1	0
P-15	Inverted direction	0 is not inverted by default, the positive direction remains the same as the encoder rotation direction (counterclockwise), while 1 is inverted	0-1	0
P-16	-	-	-	
P-17	-	-	-	-
P-18	Software version number	Software version number		2022
P-19	Initial current	Static lock current	10--80	20
P-20	Customer version number	-	-	0
P-21	Subdivision	Number of pulses for one motor revolution	1--9999	4000
P-23	Secondary instruction filtering	Increase motor running smoothness	1-1000	100
P-27	Position current gain	The gain value of the given current corresponding to the position difference	20-1200	100
P-28	Control method selection	Select the control method of the controller: 0: bus. 1: pulse	0-1	0
P-29	Modbus slave address		1-255	1
P-30	Modbus baud rate	The default is 96, the baud rate is 9600	3-1152	96
P-31	Modbus parity	0: No parity; 1:odd; 2: even	0-2	0
P-32	Drive operating mode	1: open loop ; 2 : closed loop	1-2	2
P-33	Modbus word length		8-9	8

P-34	Modbus stop bit		1-2	1
P-35	Restore default parameters	Set the value to 356 to restore the default	0-10000	0
P-36	Maximum current gain		50-9999	9999
P-37	Current gain speed		0-2000	250
P-38	Current gain factor		0-20	7
P-39	Servo mode position loop forward feedback	Increase the response speed of the drive, but when the value is set too large, it will cause the motor to shake	0-200	0
P-40	Function code of input port 0	Select the function code corresponding to input 0	0-99	33
P-41	Function code of input port 1	Select the function code corresponding to input 1	0-99	34
P-42	Function code of input port 2	Select the function code corresponding to input 2	0-99	35
P-43	Function code of input port 3	Select the function code corresponding to input 3	0-99	36
P-44	Function code of output port 0	Select the function code corresponding to output 0	0-99	18
P-45	Function code of output port 1	Select the function code corresponding to output 1	0-99	19
P-46	Low speed input port filter time	Unit: ms	1-9999	10
P-47	maximumspeed numerator		0-9999	1
P-48	Maximum speed denominator		0-9999	3
P-49	Minimum speed denominator		0-9999	4
P-50	High-speed input filter	Filter coefficient of IO port 1 and IO port 2, unit 50us	1-9999	200
P-55	Input port effective level	Input port 0-3 effective level selection	0-15	15
P-57	Output port effective level	Output port 0-1 effective level selection	0-3	3
P-58	Whether the limit function is turned on	1: When the positive and negative limits are valid, it	0-1	0

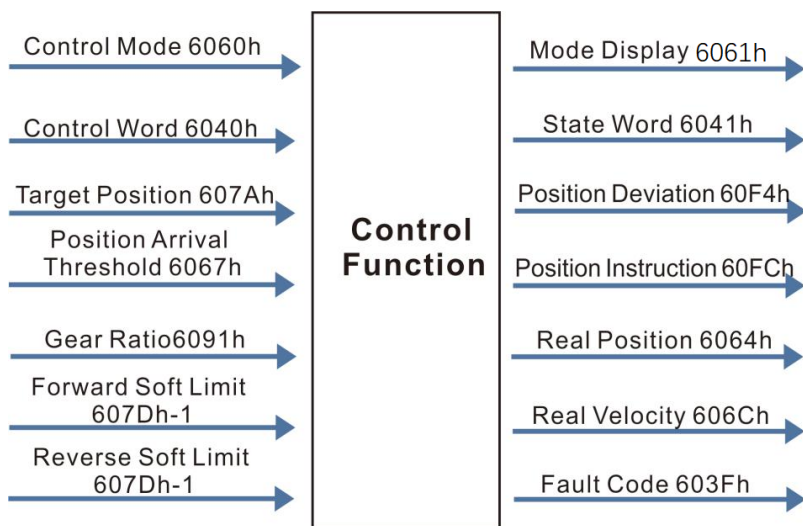
		cannot continue to run in the corresponding direction. 0: The limit number does not restrict the motor running		
P-62	Ethercat slave fixed address	When the master station selects fixed addressing, this value sets the slave station number	1-65535	1
P-66	No motor detection threshold		0-300	80
P-67	Whether no motor alarm is on	0: close; 1: open	0-1	1
Note: After the parameter is modified, it needs to be powered on again to be effective.				

4 CONTROL MODE

4.1 Cycle Synchronous Position Mode CSP

4.1.1 Control Diagram

In the cycle synchronization position mode, the controller completes the position instruction and then sends the planned target position 607Ah to the servo driver in the way of cycle synchronization. Position, speed and torque control are completed by the servo driver.



Pic4.1 The input/output objects of cycle position mode.

4.1.2 Related Object

Control Word 6040h		
Bit	Name	Description
0	Servo ready	Bit0-bit3 are 1 which means it starts working.
1	Turn on the main circuit	

2	Emergency stop	
3	Servo running	
Remark: CSP mode only supports absolute location instructions.		
State Word 6041h		
Bit	Name	Description
10	Target arrival	0:Not reached the target position; 1: Reached the target position.
11	Software internal position overrun	0:The location instruction is not in excess of the limit. 1:Position instruction overrun
12	Follow instructions from the station	0:The station does not follow the instruction. 1:The station follow the instruction.
13	Following error	0:There is no fault with excessive position deviation. 1:Excessive position deviation fault occurs.

4.1.3 Recommended Configuration

In cycle position mode,the basic configuration is as follows:

RPDO	TPDO	Remark
6040: control word	6041: state word	required
607A: target position	6064: position feedback	required
6060: mode selection	6061: running mode display	required

4.2 Profile Position Mode PP

4.2.1 Related Object

This mode is mainly used for point-to-point positioning applications. In this mode, the controller gives the target position (absolute or relative), the speed of the position curve, acceleration and deceleration. The trajectory generator of the servo will generate the target position curve instruction according to the setting and the drive completes position control,

speed control, torque control.

Control Word 6040		
Bit	Name	Description
0	Servo ready	4 bits are 1 which means the servo current main circuit is charging and in enabling state.
1	Turn on the main circuit	
2	Emergency stop	
3	Servo running	
4	New target position	From 0 to 1 , it indicates that there is a new location.
5	Updated immediately	0:Not immediately 1:Immediately
6	Absolute position / relative position	0:The target position is absolute position. 1:The target position is relative position
State Word 6041		
Bit	Name	Description
10	Target arrival	0:Not reached the target position. 1:Reached the target position.
12	Target position updated	0:The target location can be updated. 1:The target location can not be updated.
13	Following error	0:There is no fault with excessive position deviation. 1:Excessive position deviation fault occurs

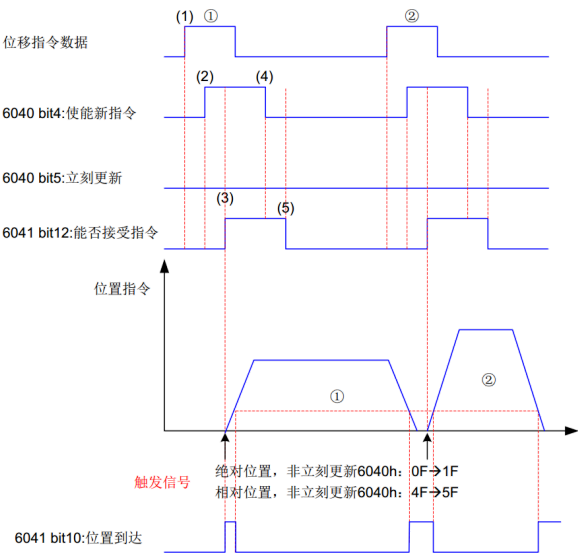
Index	Sub Index	Name	Visit	Data Type	Unit	Range	Default Value
603F	00	error code	RO	UINT16	-	0-65535	0
6040	00	control word	RW	UINT16	-	0-65535	0
6041	00	status word	RO	UINT16	-	0-65535	0
6060	00	operator mode	RW	INT8	-	0-10	8
6061	00	mode display	RO	INT8	-	0-10	0
6062	00	position instruction	RO	INT32	instruction unit	-	-
6063	00	position feedback	RO	INT32	encoder unit	-	-
6064	00	position feedback	RO	INT32	instruction unit	-	-
6067	00	position arrival threshold	RW	UINT32	encoder unit	0-65535	130
606C	00	actual velocity	RO	INT32	instruction unit/s	-	0
6077	00	actual torque	RO	INT16	0.1%	-3000~3000	0
607A	00	target location	RW	INT32	instruction unit	$-2^{31} \sim 2^{31}-1$	0
607F	00	maximum speed	RW	UINT32	instruction unit/s	$0 \sim 2^{32}-1$	600000
6081	00	profile velocity	RW	UINT32	instruction unit/s	$0 \sim 2^{32}-1$	250000
6083	00	profile acceleration	RW	UINT32	instruction unit/s ²	$0 \sim 2^{32}-1$	250000
6091	02	axial resolution	RW	UINT32	-	$1 \sim 2^{32}-1$	10000
60FC	00	position instruction	RO	INT32	encoder unit	-	-
60E0	00	forward torque limit	RW	UINT16	0.1%	0-3000	3000

60E1	00	reverse torque limit	RW	UINT16	0.1%	0-3000	3000
------	----	----------------------	----	--------	------	--------	------

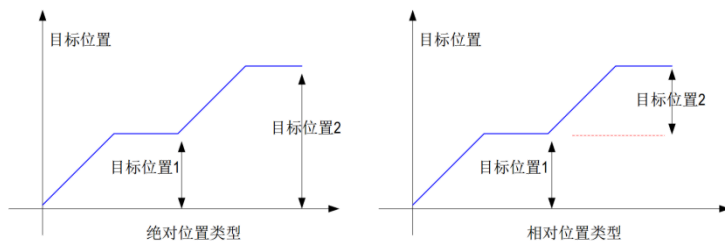
4.2.2 Position Curve Generator

Control command timing---non-immediate update type

- a) The upper computer first updates and modifies the other attributes of the displacement command as needed (acceleration time 6083, deceleration time 6084, maximum operating speed 6081, target displacement 607A).
- b) The upper computer sets bit4 of 6040 from 0 to 1, indicating that the slave station has a new displacement command that needs to be enabled.
- c) After receiving the rising edge of bit 4 of 6040, the slave station judges whether it can receive the new displacement command:
 - If the initial state of bit 5 of 6040 is 0, and bit 12 of 6041 is 0 at this time, it indicates that the slave station can receive a new displacement command①; after the slave station receives the new displacement command, bit 12 of 6041 is set from 0 to 1, indicating the new The displacement command ① has been received, and the current slave station is in a state where it cannot continue to receive new displacement commands.
- d) After the upper computer receives the bit 12 of the status word 6041 becomes 1, it can release the displacement command data, and set the bit 4 of the control word 6040 from 1 to 0, indicating that there is no new position command at present. Because bit 4 of 6040 is valid for edge change, this operation will not interrupt the displacement instruction being executed.



Pic 4.3 Non-immediate update type timing diagram and motor operating curve



Pic 4.4 The difference between absolute position command and relative position command

4.2.3 Recommended configuration

RPDO	TPDO	备注
6040: control word	6041: state word	Required
607A: target position	6064: position feedback	Required
6081: profile speed		Required
6083: profile acceleration		Required
6060: mode selection	6061: running mode display	Required

4.3 Homing Mode HM

The homing mode is used to find the mechanical origin and locate the position relationship between the mechanical origin and the mechanical zero.

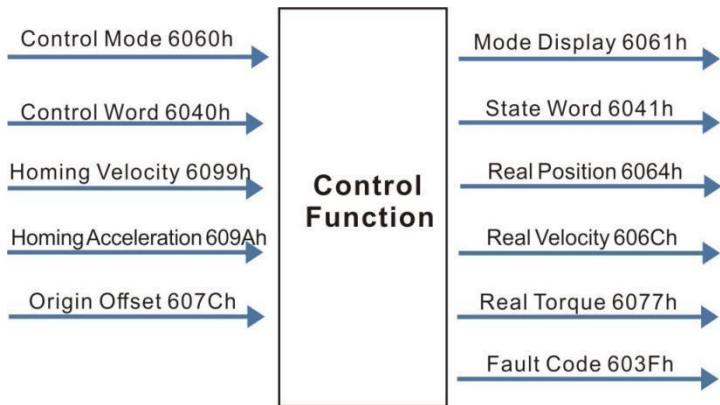
Mechanical origin: a fixed position on the machine, which can correspond to a certain origin switch and the Z signal of the motor.

Mechanical zero: mechanical absolute zero position..

When the homing is finished, the stop position of the motor is the mechanical origin, and the 607Ch automatically sets the relationship between the mechanical origin and the mechanical zero:

Mechanical origin = mechanical zero +607Ch (origin offset)

When 607Ch=0, the mechanical origin coincides with the mechanical zero.



Pic 4.5 Input and output objects of the origin return mode

Control Word 6040		
Bit	Name	Description
0	Servo ready	4 bits are 1, indicating that the servo is charged by the current main circuit and is in an enabling state.
1	Turn on the main circuit	
2	Emergency stop	
3	Servo running	

4	Homing	0-->1 : Homing. 1-->0 : The drive received the homing signal.
Control Word 6041		
Bit	Name	Description
10	Target Arrival	0: The target position has not been reached 1: The target location has been reached
12	Homing	0: Receiving zero return signal 1: The zero return is in progress, and the zero return signal cannot be received
13	Homing Fault	0: Receiving zero return signal 1: The zero return is in progress, and the zero return signal cannot be received

The basic configuration is as follows:

RPDO	TPDO	备注
6040: control word	6041 : status word	Required
6098: homing mode		Optional
6099-01: search limit switch signal speed		Optional
6099-02: search homing signal speed		Optional
609A: homing acceleration		Optional
	6064: position feedback 606C: speed feedback 6077: torque feedback	Optional
6060: mode selection	6061: running mode display	Required

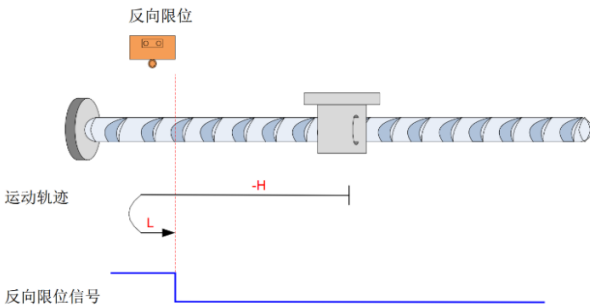
The zero return modes currently supported by DE2405E series servos and introduction as below:

1) 6098h=17

Mechanical origin: reverse overtravel switch.

Deceleration point:: reverse overtravel switch.

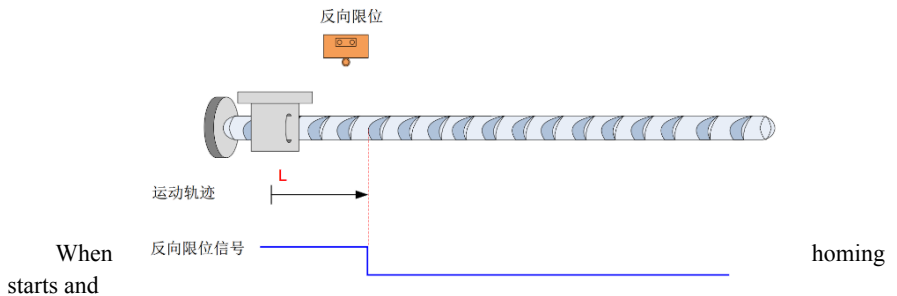
a) The deceleration point signal is invalid when homing starts.



Note: In the figure, "H" stands for high speed 6099-1h and "L" stands for low speed 6099-2 h.

When homing starts and N-OT =0, it reverses with high speed.. When it encounters N-OT rising edge, it decelerates, reverses and forwards with low speed.. When encountering the falling edge of N-OT, it stops running.

b) The deceleration point signal is effective when homing starts.



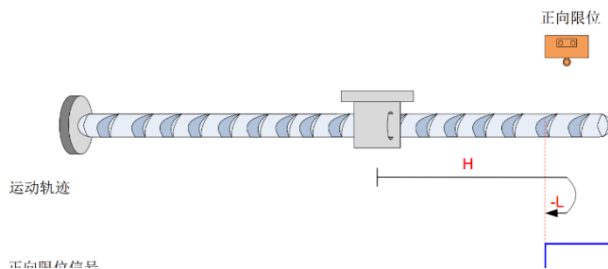
N-OT=1, it starts to homing at low speed directly, and stops at the falling edge of N-OT.

2) 6098h=18

Origin: forward over-range switch.

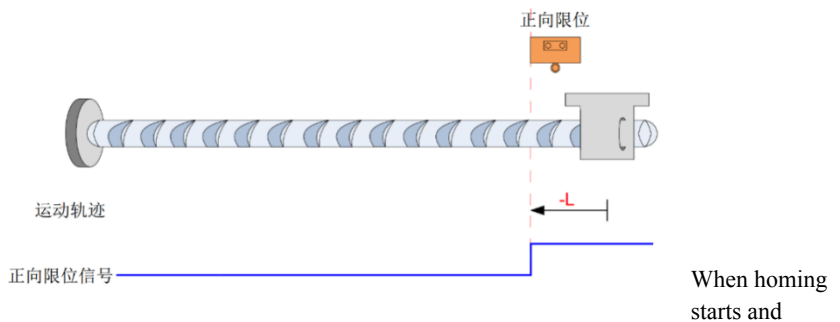
Deceleration point: forward over-range switch.

a)The deceleration point signal is invalid when homing starts.



When homing starts and $P-OT=0$, it forwards with high speed. When encountering the rising edge of $P-OT$, it decelerates, reverses and operates at low speed. When encountering the falling edge of $P-OT$, it stops.

b) The deceleration point signal is effective when homing starts.



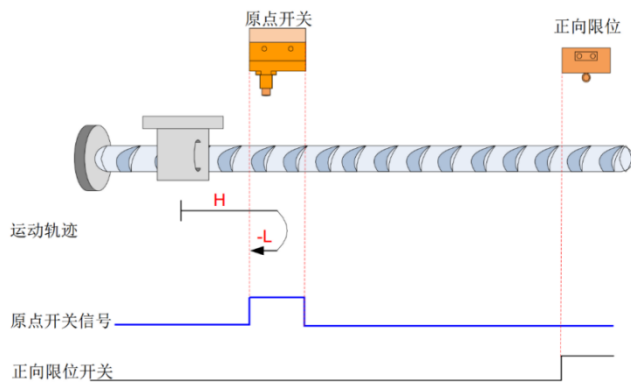
$P-OT=1$, it reverses with low speed directly. And when encountering the falling edge of $P-OT$, it shuts down.

3) 6098h=23

Origin: Origin switch.

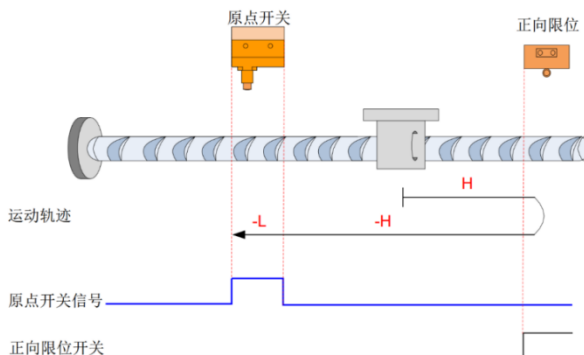
Deceleration point: Origin switch.

a) The deceleration point signal is invalid when zeroing starts and it did not encounter the forward limit switch.



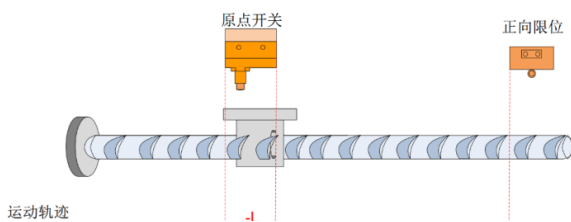
When homing starts and HW=0, it forwards with high speed and does not encounter limit switch. When encountering rising edge of HW, it slows down and reverse with low speed. When encountering the falling edge of HW, it shuts down.

b) The deceleration point signal is invalid when returning to zero starts, and the forward limit switch is encountered.



When homing starts and HW=0, it forwards with high speed and encounters limit switch. Then it automatically reverses and runs at high speed. When encountering rising edge of HW, it slows down and keeps reversing with low speed. When encountering the falling edge of HW, it shuts down.

c) The deceleration point signal is effective when returning to zero starts.



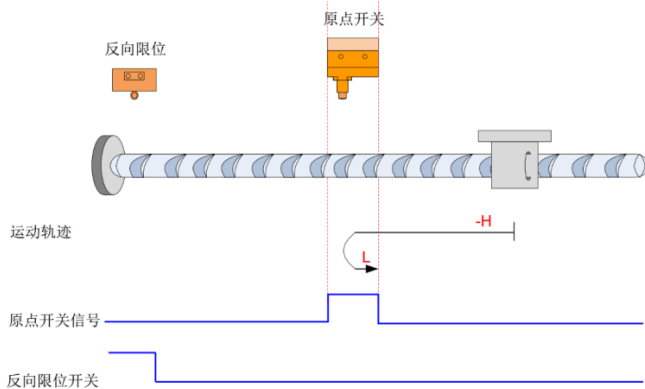
When homing starts and $HW=1$, it starts zeroing at a reverse low speed directly. When encountering the falling edge of HW , it shuts down.

4) 6098h=27

Origin: Origin switch.

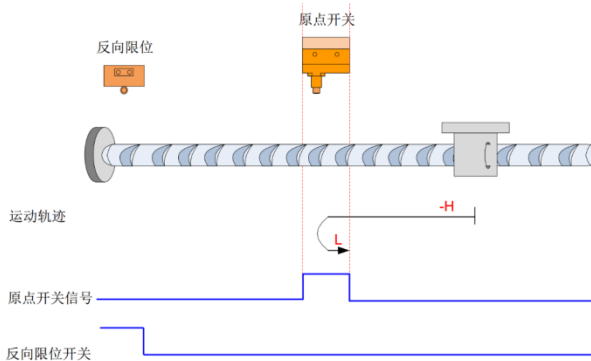
Deceleration point: Origin switch.

a) The deceleration point signal is invalid when returning to zero starts and did not encounter limit switch.



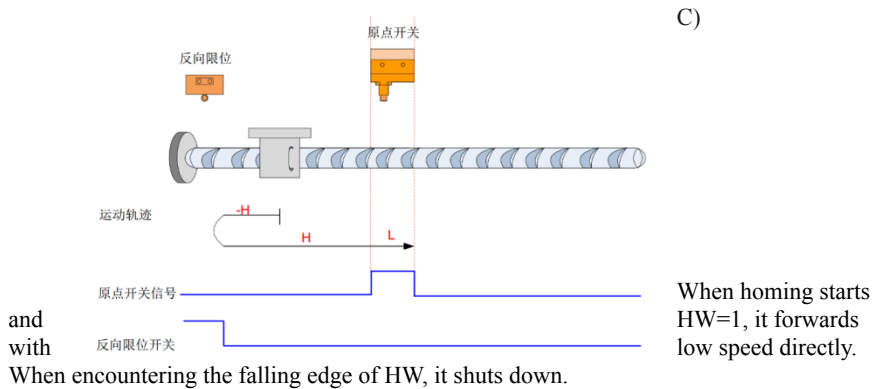
When homing starts and $HW=0$, it returns to zero with reversed high speed and does not encounter limit switch. When encountering rising edge of HW , it slows down, reverse and forwards with low speed. When encountering the falling edge of HW , it shuts down.

b) The deceleration point signal is invalid when returning to zero starts and the reverse limit switch is encountered.



When homing starts and HW=0, it returns to zero with reversed high speed and encounters limit switch. Then it automatically reverses and runs at high speed. When encountering rising edge of HW, it slows down and keeps forwarding with low speed. When encountering the falling edge of HW, it shuts down.

c) The deceleration point signal is valid when zeroing.



5) 6098h=35

The current position is cleared.

5 FAULT ERROR

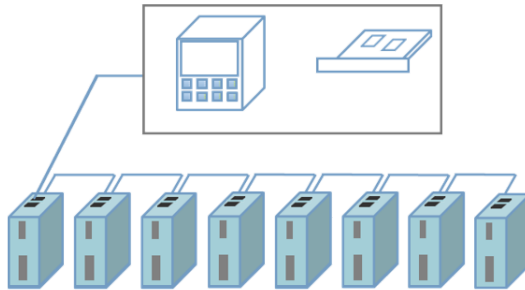
The green LED is the power indicator. When the drive is powered on, the LED is always on; when the drive is powered off, the LED is turned off. The red LED is a fault indicator. When a fault occurs, the indicator flashes in a cycle of 5 seconds; when the fault is cleared by the user, the red LED is always off.

ALM Number of indicator flashes	Failure description
Keep lighting	Overcurrent alarm
2	Overvoltage alarm
3	Overheating alarm
4	Position out of tolerance alarm
5	Motor disconnection alarm
Keep flashing	Abnormal network communication alarm

When the drive fails, the drive will stop and prompt the corresponding fault code. The fault can be cleared only when the user needs to power off and power on again.

6 DE2405E APPLICATION DESCRIPTION

6.1 Drive Wiring



Pic 6.1 Drive wiring diagram

Note:

When the EtherCAT interface is connected to other drives, it must put in with ECAT IN and put out with ECAT OUT.

Cables and conductors shall be fixed to avoid close proximity to the heat sink of the drive and motor, so as to avoid heat and reducing the insulation performance.

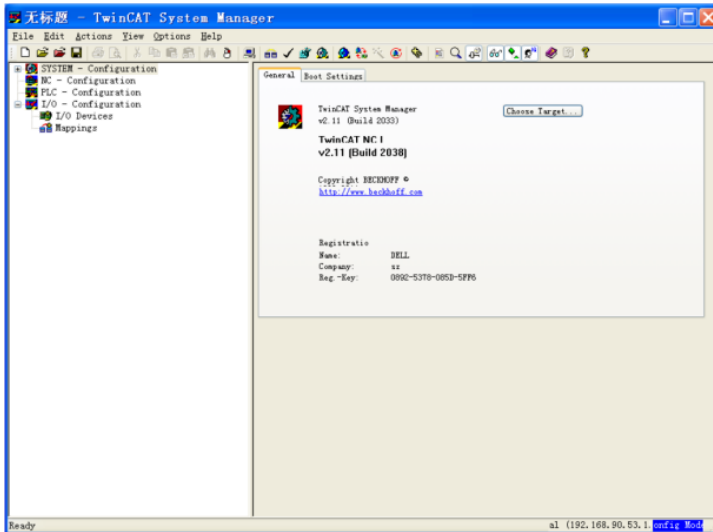
6.2 Cooperate with TwinCAT master station application case

1) Install TwinCAT software

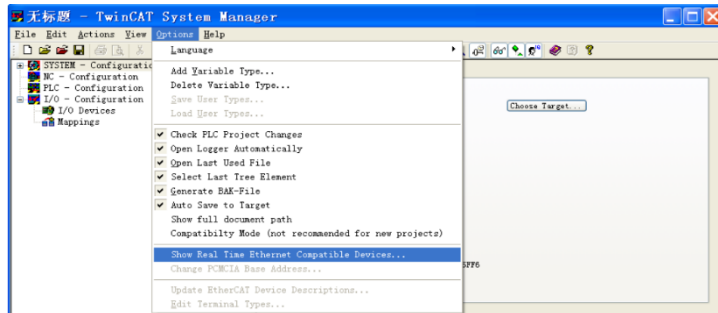
The twinCAT software in the official website of Beckhoff company supports up to 32-bit win7 systems and does not support win7 64-bit systems.

- Windows xp system: it is recommended install tc2110_2230

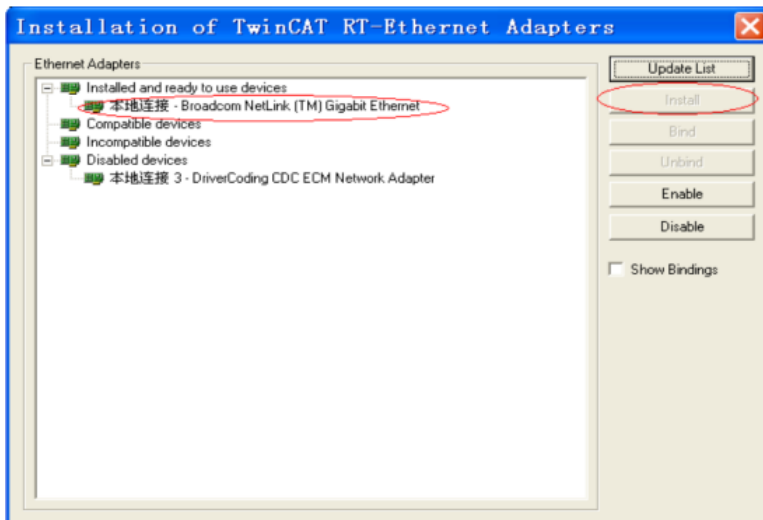
- Windows 7 32-bit system: it is recommended to install tc2110_2248
Note: About the network card, please choose a 100 megabit Ethernet card with a Intel chip. Other brands of network cards, there is a risk of not supporting EtherCAT operation.
2) Copy the EtherCAT configuration file (DVS_ETHCAT_V1.0.xml) of ECAT100E to the TwinCAT installation directory:\TwinCAT\IO\EtherCAT.
3) Open TwinCAT.



- 4) Install TwinCAT network card drive.

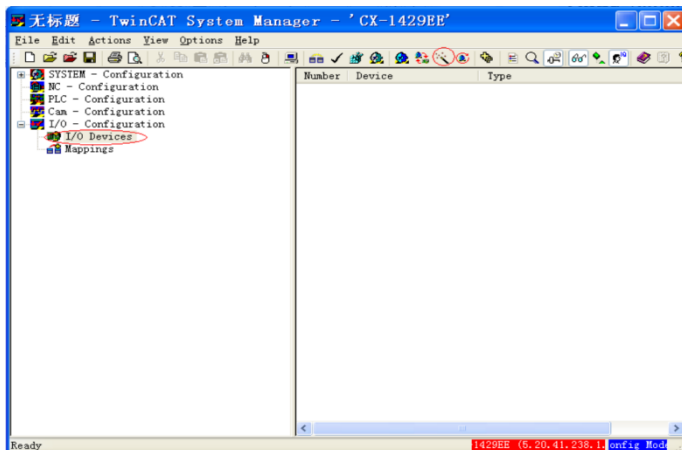


Open the menu "Show Real Time Ethernet Compatible Devices..." in the figure above, and pop out the dialog box in the figure below. After selecting the local website in the "Incompatible devices" column, click "install". After the installation is complete, the installed network card will appear in the "Installed and ready to use devices" column as shown below.



5) Device search

After you create a new project page, right-click I / O Devices to start searching for the device, as shown in the following figure:



6) Select "OK"(确定).



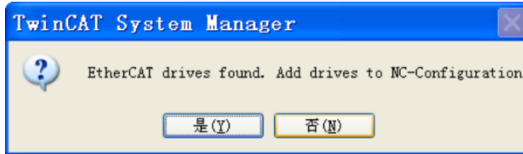
7) Select "OK".



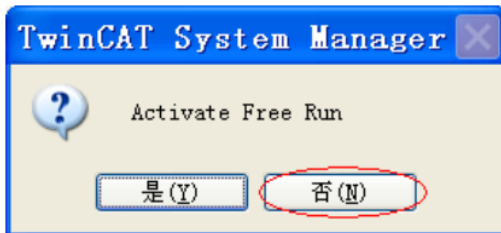
8) Select "Yes"("是").



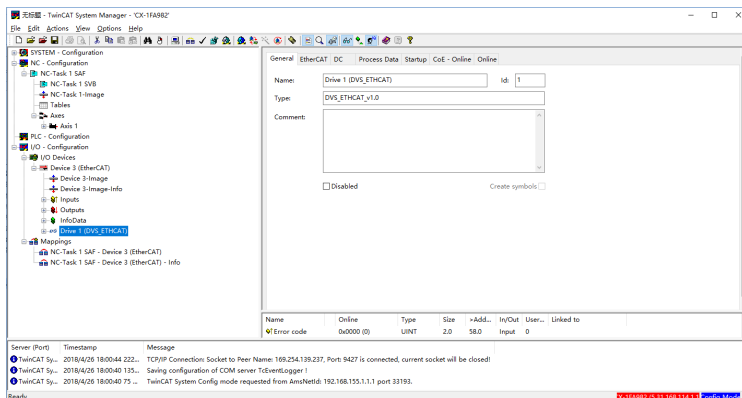
9) Select “Yes”(“是”).



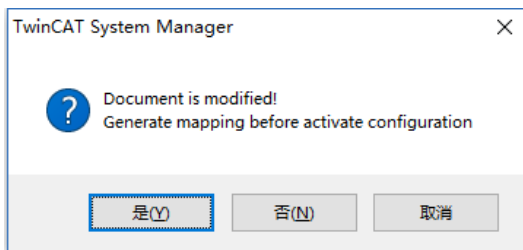
10) Select “No”(“否”).



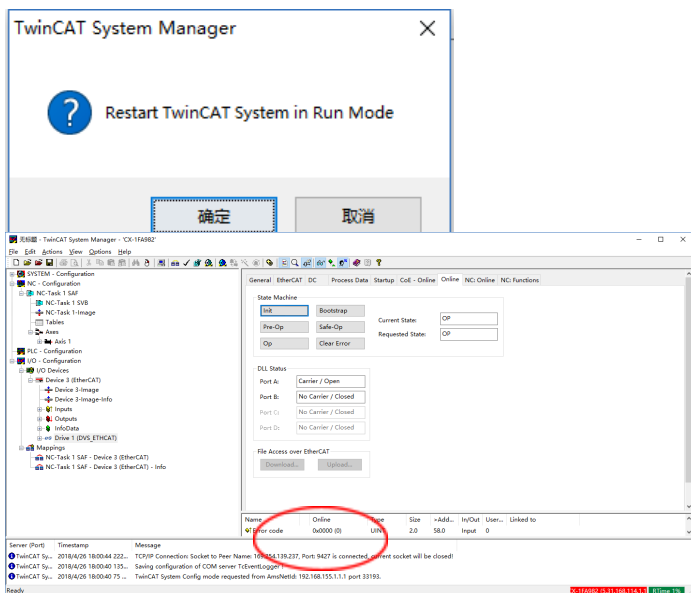
11) The device has been finished to search here as shown in the following figure:



12) According to the default configuration, please click activate and switch to run mode: click “Yes”.

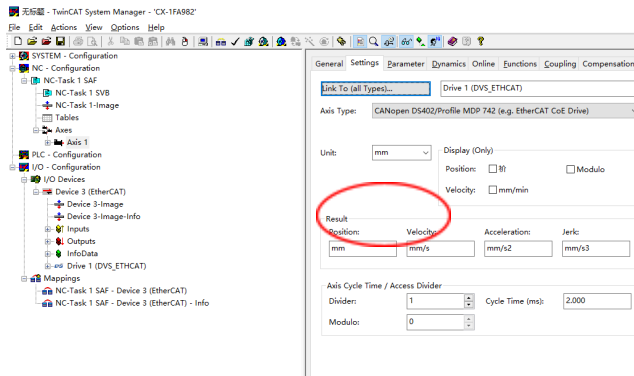


13) According to the default configuration, click activate and switch to run mode: click “ Yes”. After "OK", on the "Online" interface, you can see the device entering the OP state, while the running lamp of the driver is kept in the green state.

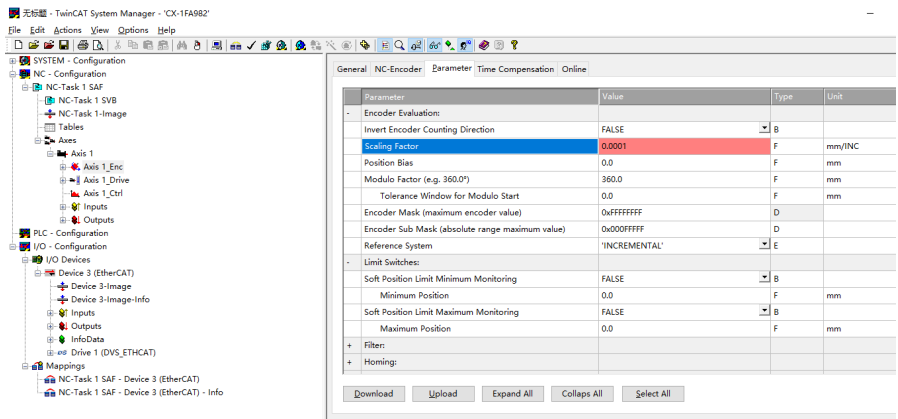


14) Control servo through NC or PLC program.

A. Set units when testing, units : mm.



B. Set quantitative(scaling) factor.

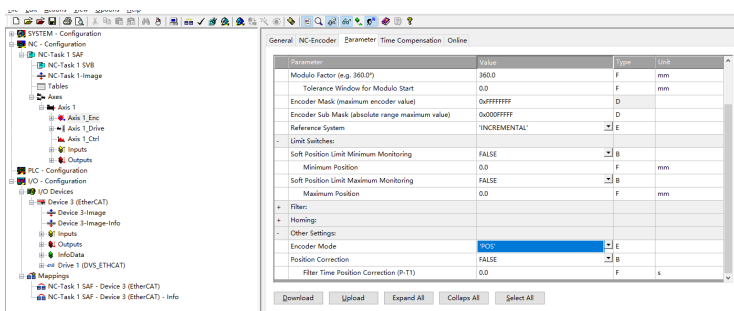


Scaling Factor: The distance corresponding to the encoder pulse of each position feedback. For example, if the motor rotates 1 circle with 10,000 pulses, and the motor rotates one circle corresponds to 1mm, the Scaling Factor is $1/10000=0.0001\text{mm/Inc}$.

Tip: For no-load debugging, it is customary to set one circle to 60mm, so that the speed of 1mm/s is equivalent to 1 circle/min. Because the motor's rated speed unit is rpm, it

is more intuitive to use rpm as the speed unit during debugging. The quantization factor is set as 60/10000 during the test.

C. Set encoder feedback mode to pos.



Other

settings:

Encoder mode and there are three options:

- Pos: The encoder is only used to calculate the position and is used when the position loop is in the drive.
- PosVelo: The encoder is only used to calculate position and speed when the position ring is used in TWinCAT NC.
- PosVeloAcc: TWinCAT NC uses encoders to determine position, speed and acceleration.
- Pos: The upper computer is only responsible for sending the position instruction. The servo runs in the periodic synchronous position mode (6060 =8), and the position loop is calculated internally.
- PosVelo: The upper computer establishes the position loop and outputs the speed instruction. The servo runs in the cycle synchronous velocity mode (6060 =9).

d) JOG test

Temporarily shield system deviation. Click "Set" to jump out of the dialog box, and then click "All". After that, the servo drive is enabled. Through F1 ~F4, it can realize point motion operation.

