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Chapter 1 EtherCAT protocol

1.1 EtherCAT overview

EtherCAT (Ethernet for Control Automation Technology) is a real-time industrial Ethernet technology developed by BECKHOFF and offers the following advantages:

- (1) High speed: Transmission rates up to 2 x 100 Mbit/s (full duplex mode) using Fast Ethernet technology.
- (2) Flexible: Supports various topologies such as linear and ring; inter-station distance can reach 100m, and the number of nodes can theoretically reach 65536.
- (3) Compatible: Conforms to Ethernet specifications, allowing the use of standard Ethernet devices such as switches.
- (4) Synchronization: Uses ASIC to achieve hard real-time and achieve clock synchronization accuracy of less than 1µs.
- (5) High efficiency: Data refresh cycle of less than 100µs can be achieved, which is suitable for closed-loop control of the servo.

EtherCAT has a master-slave communication architecture, where the master can use a general-purpose Ethernet controller and the slaves require a special communication chip called EtherCAT Slave Controller (ESC). The PLC or controller is the master and the servo drives are the slaves.

EtherCAT uses the physical layer of standard Ethernet, modifies the data link layer to transfer data using a specialized protocol, and defines the application layer. Figure 1-1 shows a model of a Kinco Servo EtherCAT slave supporting clock synchronization and CANopen protocol, as detailed in the subsequent chapters.



Figure 1-1 Kinco servo EtherCAT slave model

\rightarrow

Note

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

1.2 EtherCAT specifications

Table 1-1 describ	es the specification	of Kinco servo	EtherCAT	communication

Table 1-1 EtherCAT communication specification

Item		Specification		
	Transmission standard	IEEE 802.3		
	Transmission interface	2 x RJ45 (IN、OUT)		
	Transmission medium	100 Base-TX standard Ethernet cable		
Physical	Transmission distance	100 m		
Layer	Transmission rate	2 x 100 Mbit/s (full duplex)		
	Topological structure	Linear, circular		
	Number of nodes	No more than 100		
	EtherCAT frame length	44 bytes \sim 1498 bytes		
Communication standard		IEC 61158 type 12, IEC 61784 type 12		
DC (Distribu Synchrono Refresh Layer Number of Number of Synchrono	DC (Distributed Clock)	64 bit		
	Synchronous jitter	Less than 1µs		
	Refresh time	100 axes about 100 μs		
	Number of FMMU	8		
	Number of Sync Manager	8		
	Size of DPRAM	8KB		
	Communication mode	Free Run		
	Communication mode	DC mode, synchronized to SYNC0		
	Application standard	IEC 61800-7-201 (DS 402), IEC 61800-7-301		
	Application Layer	CoE (CANopen over EtherCAT)		
	function	FoE (File Access over EtherCAT)		
Application Layer	CoE communication	Variable PDO mapping		
	COE communication	SDO request, SDO response		
		Cyclic synchronous position mode (CSP)		
	CoE extended operating mode	Cyclic synchronous velocity mode (CSV)		
		Cyclic synchronous torque mode (CST)		

See Table 1-2 for Kinco servo EtherCAT interface.

Table 1-2 EtherCAT interface

RJ45 pin definition	Pin number	Name	Description
	1	TD+	Data transmitting +
	2	TD-	Data transmitting -
	3	RD+	Data receiving +
	6	RD-	Data receiving -

1.3 EtherCAT system

The EtherCAT system consists of a master and a number of slaves. The master initiates the communication, the slave processes the received message and extracts or inserts relevant data into the message, and then transmits the message to the next slave. The last slave returns the fully processed message and passes it in reverse order to the first slave and finally to the master, as shown in Figure 1-2.



Figure 1-2 EtherCAT system operation

To make a network connection, connect the EtherCAT port of master to the IN port of slave, and the OUT port of slave to the IN port of the next slave, as shown in Figure 1-3.



Figure 1-3 EtherCAT system topology

1.4 Distributed Clock

Distributed Clock enables all EtherCAT devices to use the same system time, and the servo slaves generate synchronized interrupt signals based on the synchronized system time to execute tasks. This is key to achieving strictly synchronized and coordinated motion of multiple servos for precise contour trajectory control.

Each DC slave has a local clock. EtherCAT specifies that the clock of the first DC slave connected to the master is the reference clock, and the clocks of the other slaves and the master are slave clocks, which need to be synchronized to the reference clock, as shown in Figure 1-4. The distributed clock automatically calculates the transmission delay, initial offset from the reference clock to all slave clocks and dynamic clock drift and compensates them to ensure that the local system time of all slaves remains consistent.



Figure 1-4 Distributed Clock

Kinco servo can select DC synchronization cycle of 1ms, 2ms, 4ms and 8ms, which is set by ECAN Sync Cycle [301101]:

Search	3011			Search
Index	Sub.	Name	Data Type Unsigned8	Attribute RWSL
3011	01	ECAN_Sync_Cycle		
5. 1010-1010-1010-1010	Value		Unit	
	0 DEC			
Help Informa ECAN sync cy D: 1ms 1: 2ms	tion of:ECAI /cle time	N_Sync_Cycle		

When using DC mode, the servo needs to turn on synchronization mode, which is set via the ECAN Sync Clock [301102]:

A & A day of the
Attribute
RWSL

In DC mode, the servo local cycle is triggered by the synchronization signal SYNC0. The distributed clock and synchronization signal configuration related registers are shown in Table 1-3. The distributed clock is initialized, configured, started running and maintained by the master.

Table 1-3 ESC Distributed Clock related registers

Address	bit	Description	
0x0910:0x0917	0~63	Local system time	
0x0920:0x0927	0~63	Offset of the local clock and reference clock	
0x0928:0x092B	0~31	Transmission delay between reference and slave clocks	
00021	0	0: Invalid; 1: Activate cycle run	
0x0981	1	0: Invalid; 1: Enable SYNC0 synchronization signal	
0x0990:0x0997	0~63	Cycle run start time	
0x09A0:0x09A3	0~31	SYNC0 cycle time	

1.5 EtherCATState Machine

EtherCAT State Machine (ESM) is responsible for coordinating the communication between master and slaves.

The Kinco servo supports all 5 ESM states:

- (1) Init (I)
- (2) Pre-Operational (P)
- (3) Safe-Operational (S)
- (4) Operational (O)
- (5) Boot-Strap (B)

Table 1-4 describes the meanings of ESM status

State	Meaning	
	• No communication between master and slave at the application layer	
Init	Master initializes ESC configuration related registers	
	Master configures mailbox channel parameters	
Bra Operational	Mailbox communication is possible	
Pre-Operational	No process data communication	
	Mailbox communication is possible	
Safe-Operational	• Slave transmits input process data (TxPDO)	
	• The output process data (RxPDO) sent by master is invalid	
Omerational	Mailbox communication is possible	
Operational	Input process data and output process data are valid	
Boot-Strap	• Mailbox communication available, but only for downloading firmware via FoE protocols	

The ESM is shown in Figure 1-5, and the slave transitions states according to the following rules:

- When changing from Init state to Op state, the sequence "Init → Pre-Op → Safe-Op → Op" must be followed.
- (2) Cross-over transitions are allowed when returning from Op state.
- (3) Bootstrap state only allows interchanges with Init state.



Figure 1-5 EtherCAT State Machine

The meaning of each transition in Figure 1-5 is shown in Table 1-5.

Transition	Meaning			
	Master configures mailbox channel parameters and			
ID	starts mailbox communication			
IP IP	Master configures Distributed Clock related registers			
	Master configures slave address registers			
PI	Stop mailbox communication			
	Master initializes process data mapping using mailbox			
	Master configures SM channel used for process data			
PS	communication			
	Master configures FMMU			
	• Start updating input process data (TxPDO)			
SP	• Stop updating input process data (TxPDO)			
SO	• Start updating output process data (RxPDO)			
OS	• Stop updating output process data (RxPDO)			
OP	Stop process data communication			
CI.	Stop process data communication			
SI	Stop mailbox communication			
OI.	Stop process data communication			
01	Stop mailbox communication			
IB	• Start boot mode			
BI	• Restart the slave.			

Master writes the target state to the slave AL (Application Layer) control register to change the slave state; reads the slave AL status register to get the actual state of slave, the related ESC registers are shown in Table 1-6.

Table 1-6	ESC	application	layer	related	registers
-----------	-----	-------------	-------	---------	-----------

Address	Length (B)	Description
0x0120:0x0121	2	Application layer control
0x0130:0x0131	2	Application layer status
0x0134:0x0135	2	Application layer status code

Chapter 2 CoE Protocol

Kinco's EtherCAT servo supports the DS 402 guild regulation(CoE) in the CANopen protocol, as shown in Figure 2-1. The CoE uses email to access the object dictionary for device configuration and aperiodic parameter reading and writing ; Use process data communication to periodically transmit instruction data and status data. The relevant terms are explained as follows——

(1) Object dictionary: Use object to describe the full functionality of the CANopen device, it is a list of all parameters of the device.

(2) SDO: Service Data Object is used for aperiodic mailbox communication.

(3) PDO: Process Data Objects is used for periodic process data communication.

(4) SM: Sync Manager is used to ensure the consistency and security of data exchange between master and slave.



Figure 2-1 Coe based Kinco servo slave model

2.1 CoE object dictionary

CoE complies with the CANopen protocol and has the same definition in its object dictionary. Related communication objects 0x1C00 to 0x1C4F for EtherCAT communication are extended for setting SM channels and PDO allocation. See Table 2-1.

Table	2 - 1	CoE	obiect	dictionary	definition
TUDIC	<u> </u>	COL	001000	are cronary	del mi cion

Index	Definition
0x0000:0x0FFF	Data type description
0x1000:0x1018	Device type and identifier
0x1600:0x17FF	RxPDO mapping Subindex 0: Number of object Subindex 1: The first output data object of the mapping : Subindex n: The last output data object of the mapping

	TxPDO mapping
	Subindex 0: Number of object
0x1A00:0x1BFF	Subindex 1: The first input data object of the mapping
	- ÷
	Subindex n: The last input data object of the mapping
	SM Channel type
	0: Mailbox output, aperiodic data communication
0x1C00	1: Mailbox input, aperiodic data communication
	2: Process data output, periodic data communication
	3: Process data input, periodic data communication
	PDO assignment of SM channel during process data communication
0x1C10:0x1C2F	Subindex 0: Numbe of assigned PDO
	Subindex 1~n: PDO mapping object index
0x1C30:0x1C4F	SM channel parameter
0x2000:0x5FFF	Data object are defined by kinco
0x6000:0x9FFF	Data object are defined by DS 402 guild regulation

2.2 **Process data communication**

Real-time is the ability to complete a task in a certain amount of time. As a real-time industrial Ethernet, EtherCAT periodically transmits real-time data, known as process data communication. Process data is divided into output process data (RxPDO) and input process data (TxPDO). RxPDO contains the command data updated by the master station, and TxPDO contains the status data updated by the slave station, as shown in Figure 2-2.



Figure 2-2 Process data communication

For the user, the actual data objects that need to be used are PDO entries, such as control word, target location, status word, actual location, etc. As shown in Figure 2-3, the data communication process is as follows:

- (1) Select the desired PDO entry.
- (2) Perform PDO mapping
- (3) Perform PDO allocation, that is, configure the synchronization manager.



Figure 2-3 Configuring process data communication (using output data as an example)

For example, if you compare PDO entries to desired goods, then the data objects 0x1600 and 0x1A00 are trucks. Mapping PDO entries to 0x1600 and 0x1A00 is the equivalent of loading goods onto a truck. After the goods are loaded, roads are needed. The CoE builds one one-way street (SM2 channel and SM3 channel) from the primary station to the secondary station and from the secondary station to the primary station. Using data objects 0x1C12 and 0x1C13, PDO allocation is equivalent to putting a truck on the corresponding road.

Kinco servo supports variable PDO mapping, as shown in Table 2-2, including 3 sets of RxPDO and 2 sets of TxPDO, which can be configured through CoE communication and the PDO content can be changed.

Variable PDO mapping	Index	Default PDO entry
	0x1600	Target_Position [607A00] Controlword [604000] Touch_Probe_Function [60B800]
RxPDO	0x1601	Target_Position [607A00] Controlword [604000] Operation_Mode [606000] Profile_Acc [608300] Profile_Dec [608400] Touch_Probe_Function [60B800]
	0x1602	Profile_Speed [608100] Target_Speed [60FF00]
TyPDO	0x1A00	Pos_Actual [606400] Status word [604100] Error_Code [603F00] Operation_Mode_Buff [606100] Touch_Probe_Status [60B900] Touch_Probe_Rising1 [60BA00] Digital_Input [60FD00]
IXEDO	0x1A01	Pos_Actual [606400] Status word [604100] Operation_Mode_Buff [606100] Speed_Real [606C00] Dout2_Function [201010] Error_State [260100] Error_State2 [260200]

Table 2-2 PDO mapping

CoE uses data object 0x1C10:0x1C2F to define the PDO mapping object list of the SM channel. The output process data uses the SM2 channel and is allocated by PDO defined by data object 0x1C12. The input process data uses the SM3 channel and is assigned by the PDO defined by the data object 0x1C13, as shown in Table 2-3.

Table 2-3 PDO assignment

PDO allocation (Sync Manager configuration)	Index	Subindex	PDO mapping index
SM2	0x1C12	0x01	0x1600 or 0x1601 or 0x1602
SM3	0x1C13	0x01	0x1A00 or 0x1A01

After configuring process data communication, in KincoServo PC software, click Driver \rightarrow ECAN Configuration \rightarrow RPDO/TPDO, and you can see the configured PDO:

Ś F	PDOSet				X	K\$ 1	FPDOSet				
RP	DO1 RPD		03 RPDO4 RPDO5 RP	DO6 RPDO7 RPDO8		T	PDO1 TPI	002 TPD	003 TPDO4 TPDO5 T	PDO6 TPDO7 TPDO8	
N	Index	Туре	Name	Value	Unit	N	Index	Туре	Name	Value	Unit
0	160000	uint8	Group RX1 PDO	3	DEC	0	1A0000	uint8	Group_TX1_PDO	7	DEC
1	160001	uint32	RX1 PDO1	607A0020	HEX	1	1A0001	uint32	TX1_PDO1	60640020	HEX
2	160002	uint32	RX1 PDO2	60400010	HEX	2	1A0002	uint32	TX1_PDO2	60410010	HEX
3	160003	uint32	RX1 PDO3	60880010	HEX	3	1A0003	uint32	TX1_PDO3	603F0010	HEX
4	160004	uint32	RX1 PDO4	0000000	HEX	4	1A0004	uint32	TX1_PDO4	60610008	HEX
5	160005	uint32	RX1 PDO5	0000000	HEX	5	140005	uint32	TX1_PD05	60B40020	HEX
6	160006	uint32	RY1 PDO6	0000000	HEY	7	140000	uint32	TX1_PD00	60ED0020	
7	160007	uint32	RX1 PD07	0000000	HEX	1/8	140007	uint32	TX1_PD07	0000000	HEY
2	160008	uint32	RY1 PDOR	0000000	HEY	9	180001	uint32	TX1 ID	27722	HEX
0	140001	uint32	RV1 ID	22222		10	180002	uint8	TX1 Transmission	?????	DEC
10	140002	uint0	PV1_Transmission		DEC	11	180003	uint16	TX1 Inhibit Time	?????	DEC
10	140002	uinto	DV1_Indistrission		DEC	12	180005	uint16	TX1 Event timer	?????	DEC
111	1140003		KAT INNUL INNE	(((()	IDEC I I						

2.3 Mailbox data communication

Mailbox communication uses SM0 and SM1 channels to access entries in the object dictionary through SDO for communication configuration, device configuration, and aperiodic parameter reading and writing.

SDO transfers are divided into download and upload. Download transfers are often used by the master to set the parameters of the slave , and upload transfers are often used by the master to read the performance parameters of the slave . Take SDO download as an example, the master sends the SDO download request to the slave SMO channel, the slave reads the mailbox data, executes the corresponding processing, and writes the response data to the SM1 channel; The master then reads the SM1 channel to obtain the data and judge the execution result of the slave.

Kinco servo supports SDO request service and SDO response service.

2.4 DS402 guild regulation

Figure 2-4 shows the CoE servo driver structure based on DS402 guild regulation. The following briefly describes the device control state machine and periodic synchronization working mode of DS402 guild regulation.



Figure 2-4 CoE servo drive structure

2.4.1 Device control state machine

The DS 402 guild regulation defines the device control state machine of the servo drive, as shown in Figure 2-5. The state of the servo must be changed according to certain rules. The master controls the operating state of the servo by modifying the control word [604000], and obtains the current state of the servo by reading the status word [604100]. The specific meanings of the control word and the status word are described in the Object parameter List section of the Servo user manual.



Figure 2-5 Drive control state machine

Table 2-4 and Table 2-5 describe the meaning of each state and transition.

Table 2-4 Device control state machine status description

Status	Description	Tl	ne bit of	the statu	s word [604100]	
Status	Description	Bit6	Bit5	Bit3	Bit2	Bit1	Bit0
Not ready to switch on	The controller is powered on, but initialization is not complete	0	×	0	0	0	0
Switch on disabled	Server initialization is complete	1	×	0	0	0	0
Not ready to switch on	The control power is on, the power switch is off, and the motor has no torque	0	1	0	0	0	1
Switched on	The power is on, the motor has no torque	0	1	0	0	1	1
Operation enabled	The servo driver controls the motor according to the configuration, and the motor has torque	0	1	0	1	1	1
Quick stop	Servo stops as set	0	0	0	1	1	1
Fault reaction	Servo error occurred, stop the machine according to the error setting, the motor has torque	0	×	1	1	1	1
Fault	Error status, the motor has no torque	0	×	1	0	0	0

T	Description	The bit o	of the cont	rol word	l [604000]	
Transition	Description	Bit7	Bit3	Bit2	Bit1	Bit0
0	Automatic transition after power-on or reset					
1	Automatic transfer					
2	Get the power cut command from the master	0	×	1	1	0
3	Get the power on command from the master	0	×	1	1	1
4	Get the enable servo run command from the master	0	1	1	1	1
5	Get a stop servo run command from the master	0	0	1	1	1
6	Get the power cut command from the master	0	×	1	1	0
7		0	×	×	0	×
/	Get an quickly stop or power cut command from the master	0	×	0	1	×
8	Cat the name out common d from the moster	0	×	1	1	0
9	Get the power cut command from the master	0	×	×	0	×
10		0	×	×	0	×
10	Get an quickly stop or power cut command from the master	0	×	0	1	×
11	Get the quickly stop command from the master	0	×	0	1	×
12	After the quickly stop function is executed, the power off command is obtained from the master	0	×	×	0	×
13	Fault					
14	Automatic transfer					
15	Get the error reset command from the master	rising edge	×	×	×	×
16	Not recommended	0	1	1	1	1

Table 2-5 Device control state machine transition description

2.4.2 Operation mode

The periodic synchronous operation mode is an extension of the CoE to the DS 402, including CSP (8 mode), CSV (9 mode), and CST (10 mode). The master sets the servo operating mode by writing the operating mode [606000], and the servo uses the effective operating mode [606100] to represent the actual operating mode.

Search		606000		Search
Index	Sub.	Name	ame Data Type	
6060	00	Operation_Mode	Integer8	RWLM
	Value		Unit	
	8		DEC	
1:Position C 3:Speed Cor 6:Homing m 7:Interpolat 8:CSP	ontrol ntrol ode ion mode			

The periodic synchronous operation mode uses Bit12 of the status word [604100], as shown in Table 2-6.

Bit	Value	Description
	0	CSP: Ignore target positionCSV: Ignore target speed
12		• CST: Ignore target torque
12		• CSP: Target position valid
	1	• CSV: Target speed valid
		• CST: Target torque valid

Table 2-6 Definition of status word bit 12 in periodically synchronized running mode

Figure 2-6 shows the cyclic synchronous position mode (CSP) structure. The master sends periodically synchronized position command values to the servo, and the servo performs position control, speed control, and torque control. The servo can provide the actual position value, the actual speed value and the actual torque value to the master.



Figure 2-6 Cyclic synchronous position mode

Figure 2-7 shows the cyclic synchronous velocity mode(CSV). The master periodically sends target speed instructions to the servo, the servo performs speed control and torque control, and the position loop can be realized by the master . The servo can provide the actual position value, the actual speed value and the actual torque value to the master .



Figure 2-7 Cyclic synchronous velocity mode

Figure 2-8 shows the structure of the Cyclic synchronous torque mode (CST). The main periodically sends target torque instructions to the servo, which performs torque control. The servo can provide the actual position value, the actual speed value and the actual torque value to the master. Cyclic synchronous torque mode can also be extended for torque limits and speed limits to limit dynamic values.



Figure 2-8 Cyclic synchronous torque mode

Chapter 3 Application cases

3.1 Kinco AX500 controller application

When AX500 controller communicates with a single drive, directly use the network cable to connect the EtherCAT port of the controller and the IN port of the drive; when the controller connects with multiple drives, connect the OUT port of the previous drive to the IN port of the next drive, as shown in Figure 3-1.



Figure 3-1 Kinco AX500 controller connecting drives

1. Create a new CODESYS project

(1) Start CODESYS \rightarrow "New Project".



- (2) The following options are available in "New Project":
 - ① Select "Standard project".
 - 2 Fill in the project name, such as "Project1".
 - 3 Select the location to save the project.

Lit	raries			21
	Jetts	Empty project HM	I project Standard S project project pro	tandard oject w
A project c	ontaining one device,	one application, and an empt	y implementation for PLC_PRG	
Name	Project1			

- (4) Select the controller AX500.
- (5) Select a programming language, such as Structured Text (ST).

One program A program F A cyclic task A reference	nmable device as specified below LC_PRG in the language specified below which calls PLC_PRG to the newest version of the Standard library c	urrently installed.
Device	AX500 (Kinco Automation(Shanghai) Co., Ltd.)	
PLC_PRG in	Structured Text (ST)	

6 After adding the controller, the master "EtherCAT_A" of type EtherCAT Master SoftMotion is automatically added.

2. Install the servo XML file

(1) Click "Tools" \rightarrow "Device Repository..." in the menu bar.



(2) Click "Install...".



(3) Find the XML file for the drive and install it. The installation is completed as shown below.

ocation	System Repository			~	Edit Locations
	(C:\ProgramData\CODESYS\Dev	ices)			
stalled [evice Descriptions				
String for	a full text search	Vendor	<all vendors=""></all>	~	Install
Name				^	Uninstall
	🕏 🧰 KEBA				Export
	Kinco Electric (Shenzhen	Ltd.			
	Kinco Servos				
	Mixe FD Drive RX				
	Kolimorgen			~	

3. Add a servo slave

"Add Device ".

(1) The EtherCAT master has been added automatically, right click on "EtherCAT A (EtherCAT A) " \rightarrow

Project1.project - CODESYS	
File Edit View Project	Build Online Debug Tools Window Help
월 1월	1883 × 林 信 構 信 単 単 単 単 陽 物・ 合
Devices	→ # X
Project1 Project Project Project Projecti Projectio Proje	% Cut Pac Copy Paste Paste (G) Refactoring Tation Properties T_Task Add Object PRG Add Folder Insert Device Insert Device
SoftMotion General A	xis Pool Scan for Devices s), 0 warning(

(2) To add a slave, find the servo drive and double-click to add it.

ction	un device. OI	Indate device
itring for a full text search	Vendor	<all vendors=""></all>
Name	Ltd.	/endor

Note: Multiple slaves can be added here, the number added depends on the actual number of drives in the network.

(3) To add a CiA402 axis, right-click on the slave \rightarrow "Add SoftMotion CiA402 Axis".



4. Connect the controller

(1) Double-click "Device (AX500) " \rightarrow "Communication Settings" \rightarrow "Scan Network".

Devices 🗸 🗸 🗙	EtherCAT_A axis	Kinco_FD_RX	Device X			
Project1 Project1 Device (AX500)	Communication Settings 2	Scan Network Gateway -	Device +			
回日 PLC Logic 回 () Application	Applications					
Library Manager	Backup and Restore	-				
Task Configuration EtherCAT_Task_A	Files		Inclusion of the	•	•	•
MainTask DIC_PRG	Log		Gateway	~	AX500 (active)	~
LocalBus (LocalBus Adapter)	PLC Settings		IP-Address: localhost		Device Name: AX500	
EtherCAT_A (EtherCAT_A)	PLC Shell		Port		Device Address:	
axis (SM_Drive_GenericDSP402)	Users and Groups				Target ID:	
- & SoftMotion General Axis Pool	Access Rights				17DD 00B2 Target Type:	
	Symbol Rights				4102	
	Licensed Software Metrics				Kinco Electric (Shenzhen) Ltd.	
	IEC Objects				Target Version: 3.5.18.30	

(2) Click on "Scan Network", select "AX500", and then OK.

🚑 Gateway-1	Device Name:	Scan Network
AX500 [0064]	AX500	Wink
	Device Address:	
	0064	
	Block driver:	
	UDP	
	Number of channels:	
	8	
	Target ID:	
	17DD 00B2	
	Target Name:	
	Kinco ARM 64-linux SM	
		~

Note: Make sure that the IP of the controller is in the same network segment as the IP of the computer's network card.

- (3) Slaves can also be added by online scanning once the controller is connected:
 - (1) Right-click "EtherCAT_A (EtherCAT_A) " \rightarrow "Scan for Devices... ".

Devices	•	• • • × EtherCAT_A	Device x			
Project1 Project1 Device (AX500)		Communication Settings	Scan Network Gate	way - Device -		
PLC Logic		Applications		-		1000
Library Manager DLC_PRG (PRG)		Backup and Restore				
Task Configuration EtherCAT_Task_A		Files	-		•	··· •
MainTask		Log		Gateway-1	~	AX500 (active)
LocalBus (LocalBus Adapter)	TCP Sk	PLC Settings lave)		IP-Address: localhost		Device Name: AX500
EtherCAT_A (EtherCAT_A)	x	PLC Shell Cut	1	Port: 1217		Device Address: 0064
		Copy				Target ID: 17DD 0082
	×	Delete				Target Type: 4102
	G	Properties				Target Vendor: Kinco Electric (Shenzhen) Ltd.
		Add Object Add Folder Add Device Insert Device				Target Version: 3.5.18.30
	Г	Scan for Devices				
	ď	Disable Device Update Device Edit Object Edit Object With				
		Edit IO mapping Import mappings from CSV Export mappings to CSV				

(2) Click "Scan Device", select the scanned device, click "Copy to project", the slave will be added to the device tree on the left.

	Device type	Alias Address		
Kinco_FD_RX	FD Brive_RX	0		

Note: This method of adding a slave is an alternative to the method in step 3.

5. Set the EtherCAT communication parameters

(1) Double click "EtherCAT_A(EtherCAT_A) " \rightarrow "General" \rightarrow "Distributed Clock", you can set the

synchronization cycle, the following figure is 1ms.

→ ∓ X	EtherCAT_A 🗙 🍫 axis	Kinco_FD_RX
Device (AX500)	General	Autoconfig master/slaves
Ill PLC Logic Application	Sync Unit Assignment	EtherCAT NIC Settings
Library Manager	Overview	Destination address (MAC) FF-FF-FF-FF-FF Broadcast Redundancy
EtherCAT Task A	Log	Source address (MAC) 00-00-00-00-00 Select Network name EtherCAT A
AainTask	EtherCAT Parameters	Select network by MAC Select network by name
LocalBus (LocalBus Adapter)	EtherCAT I/O Mapping	▲ Distributed Clock ▷ Options
EtherCAT_A (EtherCAT_A)	EtherCAT IEC Objects	Cycle time 1000 🖨 µs
Kinco_FD_RX (FD Drive_RX) Axis (SM_Drive_GenericDSP402)	Status	Sync offset 30 🗁 %
SoftMotion General Axis Pool	Information	Sync window indicating

(2) Double-click "Kinco_FD_RX (FD Drive_RX) " \rightarrow "General" to enable "Expert settings".

Projecti	General	Address			- Addit	tional -		
Device (AX500)	Expert Process Data	AutoInc address	0	*		Expertse	ettings	Ether CAT.
Application Ibrary Manager DLC PRG (PRG)	Process Data	EtherCAT address	1001			Optional		
King Task Configuration King Task Configuration King Task Configuration	Startup Parameters	Select DC	DC-Sync	hronous			~	
🖻 👹 MainTask	Log	Enable	1000	Sync u	nit cycle (µs)		
LocalBus (LocalBus Adapter)	EtherCAT Parameters	Sync0						
EtherCAT A (EtherCAT A)	EtherCAT I/O Mapping	Sync unit cycle	x 1	~	1000	4	Cycle time (µs	s)
Kinco_FD_RX (FD Drive_RX)	EtherCAT IEC Objects	O User-defined			0		Shift time (µs)
SoftMotion General Axis Pool	Status	Sync1 Enable Sync 1						
	Information	Sync unit cycle	x 1	~	1000	-	Cycle time (µs	s)
		O User-defined			0	-	Shift time (µs)

(3) Configure PDO

```
(1) To add RxPDO and TxPDO, click "Process Data" to select RxPDO and TxPDO.
```

General	Select the Outputs			Select the Inputs		
	Name	Туре	Index	Name	Туре	Index
Expert Process Data	✓ 16#1600 RxPDO			✓ 16#1A00 TXPDO		
Des ses a Data	Target Position	DINT	16#607A:00	Actual position	DINT	16#6064:00
Process Data	Control Word	UINT	16#6040:00	Status word	UINT	16#6041:00
Startup Daramatere	Touch probe function	UINT	16#60B8:00	Error Code	UINT	16#603F:00
Startup Parameters	16#1601 RxPDO (excluded	by 16#1		mode of operation display	SINT	16#6061:00
Log	Target Position	DINT	16#607A:00	Touch probe status	UINT	16#60B9:00
	Control Word	UINT	16#6040:00	Touch probe Rising1	DINT	16#60BA:00
EtherCAT Parameters	Operation mode	SINT	16#6060:00	Digital Inputs	UDINT	16#60FD:00
	Profile_Acce	UDINT	16#6083:00	16#1A01 TXPDO (excluded	by 1	
EtherCAT I/O Mapping	Profile_Dece	UDINT	16#6084:00	Actual position	DINT	16#6064:00
	Touch probe function	UINT	16#60B8:00	Status word	UINT	16#6041:00
EtherCAT IEC Objects	16#1602 RxPDO (excluded	by 16#1		mode of operation display	SINT	16#6061:00
	Profile velocity	DINT	16#6081:00	Actual Velocity	DINT	16#606C:00
Status	Target velocity	DINT	16#60FF:00	Input status	UINT	16#2010:10
Information				Error status	UINT	16#2601:00
Information				Error status2	UINT	16#2602:00

(2) If the default PDO does not meet your needs, you can add or delete it in the "Expert Process Data" screen.

General	Sync Manager	🕂 Add 📝 Edit	X Del	ete			
Durant Durana Data	SM Size Type	PDO List					
Expert Process Data	0 128 Mailbox Out	Index	Size	Name		Flags	SM
Process Data	1 128 Mailbox In	16#1600	8.0	RxPD0			2
	2 8 Outputs	16#1601	17.0	RxPDO			
Startup Parameters	3 19 Inputs	16#1602	8.0	RxPD 0			
		16#1A00	19.0	TXPDO			3
Log		16#1A01	17.0	TXPDO			
Log EtherCAT Parameters		16#1A01	17.0	TXPDO			
Log EtherCAT Parameters EtherCAT I/O Mapping	PD0 Assignment (16#1C12)	16#1A01	17.0	TXPD 0	Move Up 😽 Move Down		
Log EtherCAT Parameters EtherCAT I/O Mapping	PDO Assignment (16#1C12) ✓ 16#1600	16#1A01	17.0 it × C 5#1600	TXPD 0 Delete 🕆 I	Move Up 🗣 Move Down		
Log EtherCAT Parameters EtherCAT I/O Mapping EtherCAT IEC Objects	PDO Assignment (16≠1C12) ☐ 16≠1600 ☐ 16≠1601 (excluded by 16≠1600)	16#1A01	17.0 lit × C	Delete 1	Move Up 🕴 Move Down		Тур
Log EtherCAT Parameters EtherCAT I/O Mapping EtherCAT IEC Objects	PDO Assignment (16≠1C12) ✓ 16≠1600 □ 16≠1601 (excluded by 16≠1600) □ 16≠1602 (excluded by 15≠1600)	16#1A01	17.0 it × C 5#1600	Delete 1 Size Of 4.0 0	Move Up 🗣 Move Down fs Name 1.0 Target Position		Тур
Log EtherCAT Parameters EtherCAT I/O Mapping EtherCAT IEC Objects Status	PD0 Assignment (16#1C12) ☑ 16#1600 □ 15#1601 (excluded by 16#1600) □ 16#1602 (excluded by 16#1600)	16#1A01	17.0 it X C	Delete De	Move Up & Move Down fs Name .0 Target Position .0 Control Word		Тур DIN1 UIN1

(4) Set startup parameters

① Drive parameters can be set automatically by SDO at power-on. Click "Add" in the "Startup Parameters" interface to select the parameter to be set at power-on and set the parameter value.

General	🕂 Add	Edit 🗙 D	elete	🕆 Move Up 🐥 Mo	ve Down						
Evenet Process Data	Line	Index:Subin	dex	Name		Value	Bit Length	Abort or	Error	Jump to L	Line on
Expert Process Data	<u> </u>	16#3011:16;	#01	Group_CAN.ECAN	Sync_Cyde	0	8	E			
Process Data	- 2	16#3011:16;	#02	Group_CAN.ECAN	Sync_Clock	1	8				
	- 3	16#6007:16;	#00	Abort_connection_	option_code	1	16	E]		
Startup Parameters	- 4	16#2340:16	#0D	Group_SpecialF.Ke	ba	1	8	E]		
	- 5	16#2010:16;	#03	Group_DIO.Din1_F	unction	0	16	E]		
og	- 6	16#2010:16;	#04	Group_DIO.Din2_F	unction	0	16	E	3		
	- 7	16#2010:16:	#05	Group_DIO.Din3_F	unction	0	16	E	3		
therCAT Parameters	8	16#6060:16	#00	Modes_of_operation	n	8	8	E]		
EtherCAT I/O Mapping	Select #	tem from Ob	oject	Directory							
	Inde	Subindex		Name				Flags	Type	D	e^
tatus		5#1006:16#0	0	ECAN Sync Period				RW	UDINT	16	54
	- 16	5#100B:16#0	0	ID Com				RW	USINT	16	5.4
nformation	- 10	5#100C:16#0	00	Guard time				RW	UINT	16	5#
	- 16	5#100D:16#0	00	Life time factor				RW	USINT	16	5#
) H- 10	5#1010:16#0	0	Store_parameters.Hi	hest_sub_ind	ex_suppor	ted				-
	· €- 16	5#1011:16#0	0	Restore_default_para	ameters.Highe	st_sub_ind	lex_supported				
	- 1e	5#1600:16#0	0	RPDO01_mapping.Hig	hest_sub_ind	ex_suppor	ted				-
	œ 10	5#1601:16#0	0	RPDO02_mapping.Hig	hest_sub_ind	ex_suppor	ted				
	œ. 16	5#1602:16#0	0	RPDO03_mapping.Hig	hest_sub_ind	ex_suppor	ted				
	· 10	5#1603:16#0	0	RPDO04_mapping.Hig	hest_sub_ind	ex_suppor	ted				-
		5#1604:16#0	0	RPDO05_mapping.Hig	hest_sub_ind	ex_suppor	ted				
		5#1605:16#0	0	RPDO06_mapping.Hig	hest_sub_ind	ex_suppor	ted				
	. ⊞- 16	5#1606:16#0	0	RPDO07_mapping.Hig	phest_sub_ind	ex_suppor	ted				
	÷ 16	5#1607:16#0	0	RPDO08_mapping.Hig	phest_sub_ind	ex_suppor	ted				
	€~ 10	5#1A00:16#0	00	TPDO01_mapping.Hig	hest_sub_inde	ex_suppor	ted				~
	<									>	•
	Nan	1e									
	Inde	ex: 16#	0	÷	Bit length	8		÷		ОК	
	Sub	Index: 16#	0	lei l	Value	0		4		Cancel	
										Cancel	

(2) Drive parameters need to be set for DIN, Keba mode (For details, see Table 3-1), synchronization cycle and synchronization mode, see the following figures. The synchronization cycle[301101] should be the same as the controller setting, 0 means 1ms, and the synchronization mode [301102] should be enabled. These parameters can be set in the "Startup Parameters" screen above.

	Enable			>> ×		•			•
IN2	Reset Errors			>> ×		•			•
IN3	Operate Mo	de Sel		>> ×		•		1	•
IN4	P Limit +			>> ×		•			•
IN5	P Limit -			>> ×		•		1	•
							-		
			((a)					
[Search			2340				Sear	ch
[Index	Sub.	Na	me	Da	ta Type		Attrib	ute
[2340	OD [Ke	ba	Un	signed8		RW	s
		Value				Unit			
		1	-			DEC			
	Help Informa	tion of:Keba	Enab	lo Kol	na m	ode			
	Help Informa 0: default	tion of:Keba	Enab	le Kel	oa m	node	9		
	Help Informa 0: default 1: support Ke	tion of:Keba ba PLC	Enab	le Kel	oa m	node	2		

Value 00681168 040F ????? 1000 3	Unit HEX HEX HEX DEC
00681168 040F ????? 1000 3	HEX HEX HEX DEC
040F ????? 1000 3	HEX HEX DEC
????? 1000 3	HEX DEC
1000	DEC
3	
	DEC
?????	HEX
??????	HEX
??????	DEC
?????	DEC
0	DEC
1	DEC
0	DEC
0	DEC
1	DEC
	77777 77777 0 1 0 0 1 0

Table 3-1 Keba parameters Function description

Keba	Description
0	When the servo is not enabled, the Operation_Mode_Buff [606100] remains 0, and the Operation_Mode [606000] is immediately updated to the Operation_Mode_Buff [606100] after the servo is enabled.
1	Whether the servo is enabled or not, the Operation_Mode [606000] is immediately updated to the Operation_Mode_Buff [606100]

6. Set the CiA402 axis parameter

(1) Set the scaling of the axis. Double-click the CiA402 axis and set it in "Scaling/Mapping".

▼ + X	EtherCAI_A Device	axis X					
Device (AX500)	General	Motor Type	Scaling	ection			
	Scaling/Mapping	Rotary	16#10000	incren	nents <=> mo	tor turns	60
Library Manager	Commissioning	O Linear	1	motor tur	ns <=> gear	output turns	1
PLC_PRG (PRG)	SM Drive ETC GenericDSP402:		1	gear output t	urns <=> uni	ts in application	1
	Parameters SM_Drive_ETC_GenericDSP402: I/O Mapping	Mapping	pping				
LocalBus (LocalBus Adapter)	SM_Drive_ETC_GenericDSP402: IEC Objects	Inputs:					
Modbus_TCP_Slave (Modbus TCP Slave)	Status	Cyclic object status word (in.v	vStatusWord)	Object number 16#6041:16#00	Address '%IW4'	Type 'UINT'	
E Kinco FD RX (FD Drive RX)	Information	actual position (diActPosition)	16#6064:16#00	'%ID1'	'DINT'	
axis (SM_Drive_GenericDSP402)	Information	actual velocity (diActVelocity)	16#606C:16#00	**		
SoftMotion General Axis Pool		actual torque (w	ActTorque)	16#6077:16#00	"		

(2) Set the axis name. Set in "SM_Drive_ETC_GenericDSP402:IEC Objects", the name of the object is

the axis name in the MC instruction.

→ ₽ X	EtherCAT_A Device	🖌 🗤 axis 🗙		
Project1 Device (AX500)	General	🕂 Add 📝 Edit 🕻	K Delete → Go to \	/ariable
	Scaling/Mapping Commissioning SM_Drive_ETC_GenericDSP402: Parameters SM_Drive_ETC_GenericDSP402: I/O Mapping SM_Drive_ETC_GenericDSP402: IEC Objects Status	Variable	Mapping **	Type AXIS_REF_ETC_DS402_CS
Kinco Kinco FD RX (FD Drive RX) Kinco Kinco FD RX (FD Drive RX) Kinco	Information			

7. Write a PLC program

(1) Create a new POU program as shown in the following figures, right-click "Application" \rightarrow "Add Object" \rightarrow "POU...", and enter the name of the POU.



- EtherCAT_A
 Device
 As axis
 ECAT_PRG x φ× Project1 Device (AX500) END VAR C Application ECAT_PRG (PRG) Task Configuration Cut X MainTask PLC_PRG Сору LocalBus (LocalBus Adapter) Modbus_TCP_Slave (Modbus TCP Slave) 8 Paste × Delete EtherCAT_A (EtherCAT_A) Browse 18 axis (SM_Drive_GenericDSP402) Refactoring Properties. Add Object Program Call... C² Edit Object Edit Object With.. (a) nput Assistan Text Search Categ A program call Descreame Application POU to call Structured view Insert with arguments Insert with namespace prefix Add Cancel PROGRAM ECAT_PRG Mdd Library.... OK Cancel
- (2) The program "ECAT PRG" is called in the task "EtherCAT Task A" as shown in the following figures.

- (b)
- (3) Open "ECAT PRG", the upper part is the declaration area, the lower part is the programming area.



(4) Write a program to control the drive using motion control instructions.



3.2 BECKHOFF TwinCAT 3 application

3.2.1 Direct servo control with TwinCAT

1. Create a new TwinCAT project

(1) Before starting TwinCAT, you need to copy the XML file of the drive to the installation directory of TwinCAT, the default path is C:\TwinCAT\3.1\Config\Io\EtherCAT.

(2) Start TwinCAT and create a new TwinCAT project as shown in the following figures.

Start Page - TcXaeShell File Edit View Project Debug O • O I • • • • • I I • • • • • • I I • • • • • • • • • • • • • • • • • • •	TwinCAT TwinSAFE PLC Team Scope Tools Window ゴロック・マート ログマンの「なっ」
Solution Explorer 🛛 🤻 🗙	Start Page * × TwinCAT® 3 Open Open Project/ Solution New project New TwinCAT Project New Measurement Project



(c)

2. Install Ethernet real time driver

(1) TwinCAT can do NC control of servo directly without PLC, you need to install Ethernet real time

driver before doing NC control.



(2) As shown in the figure above, open the menu "TwinCAT" \rightarrow "Show Realtime Ethernet Compatible Devices..." The following window is displayed. Select a local NIC (Network Interface Card) in the "Incompatible devices" column and click "Install". After successful installation, the NIC is displayed in "Installed and ready to use devices(for demo use only)" column:

ernet Adapters	Update List
Installed and ready to use devices(realtime capable) Installed and ready to use devices(for demo use only)	Install
→ 一	Update
Incompatible devices	Bind
	Unbind
	Enable
	Disable

(3) After the Ethernet driver is installed successfully, you can scan for slaves. According to the official instructions of BECKHOFF, the computer NIC should choose Intel 100 Mbit/s NIC, other NICs are not guaranteed to successfully install the driver.

3. Scan for the slave

(1) Right click on "I/O" \rightarrow "Devices" and click "Scan" to scan the slave.

TwinCAT Project2		
SYSTEM		
MOTION		
PLC		
SAFETY		
WISION		
ANALYTICS		
I/O		
1/ 201		
2 Devices	Add New Item	Ins
Devices Mappings	Add New Item	Ins Shife Alex A
Mappings	Add New Item Add Existing Item	Ins Shift+Alt+A
Mappings	Add New Item Add Existing Item Rename	Ins Shift+Alt+A
Mappings	Add New Item Add Existing Item Rename Add New Folder	Ins Shift+Alt+A
Mappings	Add New Item Add Existing Item Rename Add New Folder Export EAP Config File	Ins Shift+Alt+A
Mappings	Add New Item Add Existing Item Rename Add New Folder Export EAP Config File	Ins Shift+Alt+A
Mappings	Add New Item Add Existing Item Rename Add New Folder Export EAP Config File Scan	Ins Shift+Alt+A Ctrl+V

(2) As shown in the following figures, after scanning the slave, continue to click "Scan for boxes", and finally click "Append linked axis to NC - Configuration"

TcXaeShell	\times
HINT: Not all types of devices can be found automatically	
OK Cancel	
(a)	
1 new I/O devices found	×
Martin Controller)] [[以太序] (Realtek PCIe GbE Family Controller)]	OK Cancel
	Select All Unselect All
(b)	
TcXaeShell	
? Scan for boxes	
Yes No	

Append linked axis to:	ONC - Configuration	OK
	O CNC - Configuration	Coursel

(d)

(3) After scanning the slave, you can see the slave information of "Drive1 (KincoFD_RX)" under "Devices", and it is automatically connected to the NC axis, TwinCAT automatically turns to the config mode.



4. Set drive parameters via COE-Online

(1) In the COE-Online interface you can set the DIN of the drive. The default functions of DIN1-DIN7 that must be canceled are Enable (value 1), Reset Errors (value 2) and Operate Mode Select (value 4). Others such as Position Limit (value 0x10 and 0x20) can be set as needed. For details, see the IO definition chapter of the drive manual.

2	010:0	Group_DIO.Highest_sub_index		> 41 <	
	2010:02	Group_DIO.Din_Simulate	RW	0x0000 (0)	
and the	2010:03	Group_DIO.Din1_Function	RW	0x0000 (0)	
ŀ	2010:04	Group_DIO.Din2_Function	RW	0x0000 (0)	
ndm	2010:05	Group_DIO.Din3_Function	RW	0x0000 (0)	
1	2010:06	Group_DIO.Din4_Function	RW	0x0000 (0)	
inday	2010:07	Group_DIO.Din5_Function	RW	0x0000 (0)	
and the	2010:08	Group_DIO.Din6_Function	RW	0x0000 (0)	
	2010:09	Group DIO.Din7 Function	RW	0x0000 (0)	

(2) Configure the appropriate motor for the drive, and fill in the object [641001] with the hexadecimal motor code. For details of the relevant motor codes, please refer to the motor chapter of the drive manual.

(3) Set the synchronization cycle [301101] of the drive, and enable the synchronization clock mode ([301102] value is 1), as below, the default has enabled the synchronization mode, and the synchronization cycle is 2ms ([301101] value is 1).

<u>⊟</u> 3011:0	Group_CAN.ECAN		> 8 <
3011:01	Group_CAN.ECAN_Sync_Cycle	RW	0x01 (1)
3011:02	Group_CAN.ECAN_Sync_Clock	RW	0x01 (1)
3011:03	Group_CAN.ECAN_Sync_Shift	RW	0x00 (0)
3011:04	Group_CAN.Sync_TPDO_Diff	RW	0

(4) As above, the drive parameters have been set. If it is the first time to set, you need to store the control parameters ([2FF001] is set to 1) and motor parameters ([2FF003] is set to 1), and it will take effect after restarting the drive with power off.

Ė.	2F	F0:0	Group_Store	RO	> 3 <	
		2FF0:01	Group_Panel.Store_Data	RW	0x01 (1)	
		2FF0:02	Group_Panel.Store_Calibrate_D	RW	0x00 (0)	
		2FF0:03	Group_Panel.Store_Motor_Data	RW	0x01 (1)	

(5) After setting the drive parameters, let the drive work in 8 mode ([606000] is set to 8), NC control is possible.

6060 Modes of operation	RW P 8	
-------------------------	--------	--

(6) If you need to adjust the drive PI and other performance parameters, you can set the speed loop (0x60F9 group) and position loop (0x60FB group), etc., for details, see the performance adjustment chapter of the drive manual. Note that the object units here are drive internal units, need to be converted, see the unit conversion chapter of the drive manual.

± 60F9:0	Group_Speed_Loop.Highest_sub_inde	> 0 <
+ 60FB:0	Group Position Loop.Highest sub ind	> 1000 <

(7) If you can't find the object in COE-Online or want to monitor the drive more conveniently, please use the KincoServo software.

5. TwinCAT project setting

(1) Set the control cycle of the NC task, i.e. the cycle of the NC-Task SAF (the cycle in which the NC axis exchanges data with the drive), here set to 2 ms. In this task, TwinCAT NC completes the calculation of the set values for position, speed and acceleration.



(2) Enable the distributed clock, note that the "Cycle Time" here should be the same as the ECAN synchronization cycle [301101] of the drive.

Solution Explorer ▼ ♀ × ● ● ☆ ☆ ◇ ● ◆ ● ● ● Search Solution Explorer (Ctrl+;) ▶ •	TwinCAT Project2 + × General EtherCAT DC	Process Data Pic Startup CoE-Online Online
 Solution 'TwinCAT Project2' (1 project) TwinCAT Project2 System 		3 Advanced Settinga
MOTION MC-Task 1 SAF	Advanced Settings	Distributed Clock
PC SAFEY SAFEY SAFEY SAFEY ANALYTICS ANALYTICS SAFEY Social Mage Info Image Info Image Info Image Info Safe Office Image Info Image In		Cycle Mode Operation Mode: 4 DC-Synchronous 5 Enable Sync Lht Cycle (ja): 2000 SYNC 0 User Defined 2000 Enable SYNC 0 Sync Lht Cycle x 0 Sync Dycle Sync Lht Cycle Sync Lht Cycle
		7 OK Cancel

(3) The other NC cycle, the NC-Task SVB cycle, is the cycle in which the NC axis exchanges data with

the PLC, with a typical value of 10ms.

Solution Explorer 🔹 🕂 🗙	TwinCAT Project2 🕫 🗙	
○ ○ 🏠 🗄 - [*] ⊙ - 哥 🌶 💻	Task Online Add Symbols	
Search Solution Explorer (Ctrl+;)	Name: NC-Task 1 SVB	Port: 511 \$
WinCAT Project2 Offer System MOTION	Auto start Auto Priority Management Priority: 8	Object Id: 0x05000020 Options
INC-Task 1 SAF	Cycle ticks: 10 💠 10.000 ms	Create symbols
image T	Start tick (modulo): 0	Include external symbols
ables ☐ Objects ▲ 🚉 Axes	Pre ticks: 0 +	
Axis 1 PLC	Waming by exceeding Message box	
G++ SAFETY VISION	Watchdog Cycles: 0	

(4) In "Axis1" \rightarrow "Enc", you can set the "Scaling Factor", i.e. the distance for each encoder pulse.

○ ○ 🏠 🗄 - 💿 - 🗊 🖌 🗕	Gene	aral NC-Encoder2 Parameter Time Compensation Online					
Search Solution Explorer (Ctrl+;)			1		(11	1
Solution 'TwinCAT Project2' (1 project)		Parameter	Offline Value		Online Value	T	Unit
TwinCAT Project2	•	Encoder Evaluation:					
SYSTEM		Invert Encoder Counting Direction	FALSE	-		в	
		Scaling Factor Numerator	60.0			F	mm/INC
NC-Task 1 SAF		Scaling Factor Denominator (default: 1.0)	65536.0			F	
Image		Position Bias	0.0	-	1	F	mm
Tables		Modulo Factor (e.g. 360.0°)	360.0			F	mm
Objects		Tolerance Window for Modulo Start	0.0			F	mm
▲ 🚔 Axes		Encoder Mask (maximum encoder value)	0xFFFFFFFF			D	
		Encoder Sub Mask (absolute range maximum value)	0x000FFFFF			D	
D = Drive		Reference System	'INCREMENTAL'	-	1	E	
ta Ctrl	-	Limit Switches:					
Þ 😓 Inputs		Soft Position Limit Minimum Monitoring	FALSE	-	1	в	
Outputs		Minimum Position	0.0			F	mm
PLC		Soft Position Limit Maximum Monitoring	FALSE	•	1	в	
SALC++		Maximum Position	0.0			F	mm

(5) In "Axis1" \rightarrow "Drive", you can set the scaling factor of the set value.

×

THECAT

解决方案资源管理器	▼ # ×	TwinCAT	Project2 🕫 🗙			
© ◎ 🏠 🖆 - ⁵₀ - ☞ 🖋 💻 実素解決方案资源管理器(Ctrl+;)	. م	Gener	al NC-Drive Parameter Time Compensation			
 ○ 解表方套"TwinCAT Project2"(1 个项目) ▲ TwinCAT Project2 ▶ ▲ SVSTEM ▲ MOTION ▲ ▲ NC-Task 1 SVB ● Image □ Tables ■ Objects ▲ ▲ Axes ▲ ▲ Axis 1 ▶ ▲ ST 	项目)					
		-	Output Settings:			
			Invert Motor Polarity	FALSE .	В	
			Reference Velocity	2200.0	F	mm/s
			at Output Ratio [0.0 1.0]	1.0	F	
		10	Position and Velocity Scaling:			
			Output Scaling Factor (Position)	1.0	F	
		3	Output Scaling Factor (Velocity)	2048.0	F	
		Output Delay (Velocity)	0.0	F	s	
1 A = Drive			Minimum Drive Output Limitation [-1.0 1.0]	-1.0	F	
👂 🛁 Inputs			Maximum Drive Output Limitation [-1.0 1.0]	1.0	F	
Outputs		+	Torque and Acceleration Scaling:			
Inputs		+	Optional Position Command Output Smoothing Fil			
Outputs		+	Other Settings:			

(6) Set "Following Error Calculation" to "Extern" to prevent alarms of excessive following error.

Solution Explorer		Al Project2 - X				
◎ ◎ 🏠 🗄 • 🛛 🖉 🎾	Gen	eral NC-Drive2 Parameter Time Compensation				
Search Solution Explorer (Ctrl+;)	ρ.		000-161-2	0.5-1/1		There
Solution 'TwinCAT Project2' (1 p	project)	Parameter	Offline value	Online value		Unit
TwinCAT Project2		Output Settings:	-			
SYSTEM		Invert Motor Polarity	FALSE	1	В	
		Reference Velocity	2200.0		F	mm/s
NC-Task 1 SAF		at Output Ratio [0.0 1.0]	1.0		F	
Image	+	Position and Velocity Scaling:				
Tables	+	Torque and Acceleration Scaling:				
Cobjects	+	Optional Position Command Output Smoothin				
⊿ 🚔 Axes		Other Settings:				
Axis 1		Drive Mode	'STANDARD'		E	
1 ≥ ⇒1 Drive		Drift Compensation (DAC-Offset)	0.0		F	mm/s
The Ctrl		Following Error Calculation	'Extern'		E	
Inputs		Error Tolerance (NC error handling)	'STANDARD'		E	
Outputs						

(7) Or increase the dead time compensation. Set the dead time compensation to an integer multiple of the synchronization cycle. 4 times the synchronization cycle is recommended. As shown in the following figure, if the synchronization cycle is 2ms, the dead time compensation value is set to 0.008s.

Search Solution Explorer (Ctrl+1)	Gener	al Settings Parameter Dynamics O	nline Functions	C	oupling Compen	satio	n
Selection (Curry)		Parameter	Offline Value		Online Value		Unit
Solution IwinCAT Project2 (1 project)	+	Maximum Dynamics:					
SYSTEM	+	Default Dynamics:					
MOTION	+	Manual Motion and Homing:					
NC-Task 1 SAF	+	Fast Axis Stop:					
Image	+	Limit Switches:					
Tables	+	Monitoring:					
Objects	+	Setpoint Generator:					
⊿ ≟a Axes	+	NCI Parameter:					
1 Axis 1	-	Other Settings:					
b at Drive		Position Correction	FALSE	•		В	
te Ctrl		Filter Time Position Correction	0.0			F	s
Inputs		Backlash	0.0			F	mm
Outputs		Error Propagation Mode	'INSTANTAN	•		E	
SAFETY		Error Propagation Delay	0.0			F	s
Sec. C++		Couple slave to actual values if n	FALSE	•		В	
VISION		Velocity Window	1.0			F	mm/s
ANALYTICS		Filter Time for Velocity Window	0.01			F	s
▲ <u>₩</u> 1/0		Allow motion commands to slave	TRUE	•		В	
 Devices Device 2 (EtherCAT) 		Allow motion commands to exter	FALSE	•		В	
Image	3	Dead Time Compensation (Delay	0.008			F	s
📑 Image-Info		Data Persistence	FALSE	-		в	

The above completes the basic settings of the drive in NC mode.

6. NC control

(1) After the above settings are completed, NC control can be carried out. First, Activate Configuration, click OK to turn to run mode, as shown in the following figure.

?	Restart Twi	inCAT System	in Run Mode
-			

(2) Click on the "MOTION" \rightarrow "Axis 1" \rightarrow "Online" tab to commission the drive.

Solution Explorer 🔹 म 🗙	TwinCAT Project2 😐 🗙	
◎ ◎ @ # - `◎ - # ≯	General Settings Parameter Dynamics Online Functions Cou	upling Compensation
Search Solution Explorer (Ctrl+;) P -	3 0.0000 ^{Sett}	point Position: [mm] 0.0000
TwinCAT Project2 WinCAT Project2 SYSTEM	Lag Distance (min/max): [mm] Actual Velocity: [mm/s] Setp 0.0000 (0.000, 0.000) -0.0061	point Velocity: [mm/s] 0.0000
1 MOTION	Override: [%] Total / Control Output: [%] Error 0.0000 % 0.00 / 0.00 % <td>и: 0 (0x0)</td>	и: 0 (0x0)
MC-Task 1 SVB ■ Image Tables Objects ■ objects	Status (log.) Status (loftys.) Er Ready NOT Moving Coupled Mode	nabling) Controller Set) Feed Fw) Feed Bw
2 Axes 2 Axis 1 2 & the Axis 1	Controller Kv-Factor: [mm/s/mm] Reference Velocity 1 2200	r: [mm/s] ↓
 ▶ ** ∫ Drive La, Ctrl ▶ □ Inputs ▶ □ Outputs ▶ □ Outputs ■ PLC 	Target Postion: [mm] Target Velocity: 0 ↓ 0 - + +++ ♥ ♥ F1 F2 F3 F4 F5 ₱6	[mm/s] (mm/s) F8 F9

(3) Click "Set" in the current page, and then click "All" to enable the drive. The "Set Enabling" window allows you to set the axis enabling, forward and reverse rotation, and speed ratio.

			-0.0110	Setpoint Position:	mm] 0.0000		
Lag Distance (m 0.0000	in/max): mm] (0.000, 0.000)	Actual Veloc	ity: [mm/s] -0.1012	Setpoint Velocity:	[mm/s] 0.0000		
Override:	[%] 0.0000 %	Total / Cont	rol Output: [%] 0.00 / 0.00 %	Error:	0 (0x0)		
Status (log.) Ready Calibrated Has Job	NOT Movi Moving Fu	status ng Cou v In T v In F	(phys.) upled Mode Farget Pos. Pos. Range	Enabling Controller 1 Feed Fw Feed Bw	Set	Set Enabling Controllet Feed Fw Feed Bw	3 OK Cancel
Controller Kv-Fa	ctor: [mn	n/s/mm]	Reference Ve 2200	locity:	[mm/s]	Override (%): 0	2 AI
Target Position: 0		[mm]	Target Veloci	ty:	[mm/s]		

(4) After enabling, the "Ready" status will be ticked, press F1 to F4 to perform the jog operation, the jog speed is set in "Manual Velocity" in "MOTION" \rightarrow "Axis 1" \rightarrow "Parameter" tab, the default speed is 100 mm/s and 600 mm/s, which corresponds to slow and fast jog respectively.

	0.0000	Setpoint Position: [mm -0.0009
Lag Distance (min/max): [mm]	Actual Velocity: [mm/s	s] Setpoint Velocity: [mm/s
0.0000 (0.000, 0.000)	-0.0417	0.0000
Ovenide: [%]	Total / Control Output: [%	6] Emor:
100.0000 %	0.00 / 0.00 %	0 (0x0)
Status (log.)	Status (phys.)	Enabling
Ready NOT Movir	G Coupled Mode	Controller
Calibrated Moving Fw	In Target Pos.	Feed Fw
Has Job Moving Bw	In Pos. Range	Feed Bw
Controller Kv-Factor: [mn 1	n/s/mm] Reference V	elocity: [mm/s
Target Po <mark>si</mark> tion: 0	[mm] Target Veloc	ity: [mm/s

The above is an example of direct servo control with TwinCAT, more TwinCAT NC control methods see the official manual of BECKHOFF.

3.2.2 Servo control with PLC

When BECKHOFF PLC communicates with a single drive, use the network cable to connect the EtherCAT port of the PLC and the IN port of the drive; when the PLC connects with multiple drives, connect the OUT port of the previous drive to the IN port of the next drive as shown in the figure below (take BECKHOFF CX5020 as an example).



Figure 3-2 BECKHOFF CX5020 connecting drives

1. Create a new PLC project

				Add New Item - TwinCAT Project2						?)
				▲ Installed	Sort b	y: Default	• # 🗉		Search (Ctrl+E)	\$
				Plc Templates	01	Standard PLC Project		Plc Templates	Type: Plc Templates	
					01	Empty PLC Project		Plc Templates	 Creates a new TwinCAT PLC containing a task and a pro- 	project gram.
ution 'TwinCAT Project2' (1 proje	ect)									
winCAT Project2 SYSTEM										
MOTION										
NC-Task 1 SVB										
Tables										
Objects										
Þ ≝+ Axis 1										
SAFETY	°0	Add New Item	Ins							
C++	*0	Add Existing Item	Shift+Alt+A							
ANALYTICS		Rename								
1/0		Add Project from Source Control								
Device 1 (EtherCAT)		Paste	Ctrl+V	Name: Untitled1						
🟥 Image		Paste with Links		Location: C:\Lisers\Lenov	o\Docume	nts\TcYaeShell\TwinCAT	Project2\TwinCAT Project2\	-	Browse	
📑 Image-Info		Hide PLC Configuration		Tocarous Course	o (o o came		rojeca (rumerr rojeca (C 1
SyncUnits	_								Add	Cancel

2. Add the motion control library "Tc2_MC2"

Axis 1	Add Library	×
 PLC Untitled1 	mc2	
Imit Idd1 Project External Types References Tc2 Standard	Match →ᅋ Tc2_MC2 →ᅋ Tc2_MC2_ camming	Library
+□ Tc2_System +□ Tc3_Module	— I F_GetVersion_TcMC2_Camming → ∞ Tc2_MC2_Drive	Tc2_MC2_Camming
DUTs GVLs		Tc2_MC2_Drive
 POUs VISUs PlcTask (PlcTask1) Untitled1 Instance SAFFTY 	- ☐ F_GetVersion_TC <mark>HC2</mark> _FlyingSaw - ∞ Tc2_HC2_XFC - ∞ Tc3_HC2_AdvancedHoming - ∞ Tc3_HC2_AdvancedHoming_XFC	Tc2_MC2_FlyingSaw
C++		
 I/O Devices The Devices 		
a a botter (Enercari) a a Image a a Image Image Image Info		
 SyncUnits Inputs 	Advanced	OK Cancel

3. Call the function blocks and write a program

4.



5. Associate the NC axis with the PLC axis

Solution Explorer	→ ┦ 🗙 TwinCAT	Project2 😐 🗙 MAIN					
। । । । । । । । । । । । । । । । । । ।	Genera	al Settings Paramete	r Dynamics Online Functions Co	upling Compensation			
Solution 'TwinCAT Project2' (1 project)	Link	To I/O	Drive 3 (Kinco FD_RX)				
TwinCAT Project2 Variable SYSTEM	Link	To PLC	MAIN.Axis1 (Untitled1 Instance)			
 MOTION MC-Task 1 SAF NC-Task 1 SVB 	Axis ⁻	Type: CANopen DS	Nopen DS402/Profile MDP 742 (e.g. EtherCAT CoE Drive)				
2∎ Image ☐ Tables ☐ Objects	Unit:	mm	 ✓ Display (Only) Position: □ µm 				
Axes			Velocity:				

Save as library and install ... Copen Folder in File Explorer & Properties

Alt+En

6. Log in to the PLC after activating the configuration

in 🔝 🖉	きべ @	🔞 🐾 🄏 TwinCAT Project2 🔹 CX-186B26 🔹 🧋 Untitled1	• 1 • 🔁 = 🗄 :
- 4 ×	MAIN #	× TwinCAT Project2	登录到属性
<u>ه</u>	1	PROGRAM MAIN	▲ III V Filte
	8 2	VAR	日日日日日日日日日日日日日日日日日日日日日日日日日日日日日日日日日日日日日日日
p-4	3	Axisl : AXIS_REF;	四 / 唐正
"(1 个项目) 🔺	4	Power : MC_Power;	
(11-244)	5	Enable : BOOL;	
	6	MoveVelocity : MC_MoveVelocity;	
	7	ExecuteMove : BOOL;	
	8	TargetVel : LREAL;	
	9	END_VAR	100 🔍 🗸
B	C 1		
	· ·	Power (<u>^</u>

7. Run the program to control the servo motion

winCAT Project2	- CX-186B26	👻 🛫 🖗 UI	ntitled1 🔹	1 - 1	• • • • •	2 2 M	₫ 🖏	
winCAT Project2	MAIN [Online]	₽ X						
TwinCAT_Project2.Ur	titled1.MAIN							
Expression	Туре	Value	Prepared value	Address	Comment			
🗄 谢 Axis1	AXIS REF							
+ A Power	MC Power							
· · · ·	MC_Fower							
Enable	BOOL	TRUE						
🗄 < 🖗 MoveVelocity	MC_MoveVelocity							
ExecuteMove	BOOL	TRUE						
TargetVel	IREAL	200						
*		1 2002			Ks Basic Op	eration		
3 Enable 4 Enable 5 Enable 6 Overri 7 Buffer 8 Optior 9 Status 10 Busy= 11 Active 12 Error= 13 Error 13 Error 14 MoveVeloci 15 Axis;	<pre>TRUE := Enable Tf _Positive TRUE :=Negative TRUE := .de:= , Mode:= , is:= ,</pre>	RUE, = TRUE, = TRUE,			1 604100 2 606300 3 606C00 4 607800 5 268000 6 606000 7 604000 8 607A00 9 608100 10 608300 11 608400 12 60FF00 13 607100 14 607300	uint16 int32 int32 int16 uint16 int8 uint16 int32 uint32 uint32 int32 int32 int32 int16 uint16	Statusword Pos_Actual Speed_Real I_q Warning_Word Operation_Mode Controlword Target_Position Profile_Speed Profile_Acc Profile_Dec Target_Speed Target_Torque% CMD_q_Max Din Moden	5237 HBX 4533096 Inc 199.97 (pm 0.08 Ap 0000 HBX 8 DEC 001F HEX 4557354 Inc 0.00 (pm 100.00 (ps) 100.00 (pm) 0.00 (p

3.2.3 PDO configuration

1. The following figure shows the default RxPDO group (0x1600) and TxPDO group (0x1A00) of the drive.

The default parameters are sufficient for NC control.



2. If the default PDO group does not meet the requirements, then refer to the following figure to select another PDO group.

Solution Explorer	• 4 ×	TwinCAT Pro	ject2 ↔ ×								
○ ○ 습 🔠 - │ [™] ⊙ - @ │ 🔑 💻		General E	EtherCAT DC	Process D	lata Plc	Startup	CoE - Online	Online NC: Online	NC: Functions		
Search Solution Explorer (Ctrl+;)	ρ-	Sync Man	hager:		PDO List						
Solution 'TwinCAT Project2' (1 project) TwinCAT Project2 System MOTION DLC SAFETY SAFETY Solution 'Stole ANALYTICS SAVALYTICS	Se	SM S 0 1 2 3 3 1 1 2 3	Size Type 128 MbxOut 128 MbxIn 8 Outputs 19 Inputs OO or TxPD0	Flags O here	Index 0x1A00 0x1A01 0x1600 0x1601 0x1602 Th R0	Size 19.0 17.0 8.0 17.0 8.0 17.0 8.0 17.0 8.0 17.0 8.0	Name TXPDO TXPDO RxPDO RxPDO RxPDO Dws the PE s or TXPDO	DOs containec Ds	Rags	3 2 group c	SU 0 0 0 0 0
	Ti o	PDO Assi Contect Doctor Doctor TxPDO g	gnment (0x1C12): 00 11 (excluded by 0x 12 (excluded by 0x 12 (excluded by 0x 13 (an and a second by 0x 14 (an and a second by 0x) 15 (an and a second by 0x) 16 (an and a second by 0x) 17 (an and a second by 0x) 18 (an and a second by 0x) 19 (a	1600) 1600) 9 groups	PDO Content Index 0x607A:00 0x6040:00 0x6088:00 PPDC Predefined I Load PDO in	t (0x1600 Size 4.0 2.0 2.0 S are PDO Assi)): Offs Na 0.0 Ta 4.0 Co 6.0 To 8.0 displayed griment: (none) device	ame Irget Position Introl Word uch probe function here and can	די D U U U U	pe INT INT Or deli	Default (hex)
P 🛁 TXPDO ▶ 🌉 RxPDO		Name	(Online	Cime I hat A	/pe	Size	>Addr In/Out	User ID Lin	ked to	

3. If you do not have the desired object in the PDO group, you can add or delete it. Right-click in the "PDO

Content" window to remove the default PDO and add the required PDO.

eneral	EtherCAT	T DC	Process	Data Plc	Startup	CoE - Onlin	e Online	NC: Online	NC: Fun	ctions			
Sync M	lanager:			PDO List:									
SM	Size	Туре	Flags	Index	Size	Name			Flags		SM	SU	
0	128	MbxOut	· · · · ·	0x1A00	19.0	TXPDO					3	0	
1	128	Mbxin		0x1A01	17.0	TXPDO						0	
2	8	Outputs		0x1600	8.0	RxPDO					2	0	
3	19	Inputs		0x1601	17.0	RxPDO						0	
				0x1602	8.0	RxPDO						0	
_			_										
PDO A	ssignment	(0x1C12):	_	PDO Content	(0x1600)):							
	ssignment	(0x1C12):	1600)	PDO Content	(0x1600 Size): Offs	Name			Туре	(Default (hex)	
	ssignment 600 601 (exclu 602 (exclu	(0x1C12): ided by 0x ided by 0x	1600)	PDO Content Index 0x607A:00	(0x1600) Size 4.0): Offs 0.0	Name Target Pos	ition		Туре		Default (hex)	
	ssignment 600 601 (exclu 602 (exclu	(0x1C12): ided by 0x ided by 0x	.1600) 1600)	PDO Content Index 0x607A:00 0x6040:00	(0x1600) Size 4.0 2.0): Offs 0.0 4.0	Name Target Pos Control Wo	ition rd	10	Type Add Ne	ew Item	Default (hex) Ctrl+Si	hift+
PDO A	ssignment 600 601 (exclu 602 (exclu	(0x1C12): ided by 0x ided by 0x	.1600) 1600)	PDO Content Index 0x607A:00 0x6040:00 0x6083:00	(0x1600) Size 4.0 2.0 2.0): Offs 0.0 4.0 6.0	Name Target Pos Control Wo Touch prol	ition rd be function	ъ Х	Type Add Ne Delete	ew Item	Default (hex) Ctrl+Si Del	hift+
PDO A	ssignment 600 601 (exclu 602 (exclu	(0x1C12): ided by 0x ided by 0x	.1600) .1600)	PDO Content Index 0x607A:00 0x6040:00 0x60B8:00	(0x1600) Size 4.0 2.0 2.0): 0.0 4.0 6.0 8.0	Name Target Pos Control Wo Touch prol	ition rd be function	ъ Х	Type Add Ne Delete Edit	w Item	Default (hex) Ctrl+Si Del	hift+
PDO A 2 0x1 0x1 0x1 0x1	ssignment 600 601 (exclu 602 (exclu nload	(0x1C12): Ided by 0x Ided by 0x	:1600) :1600)	PDO Content Index 0x607A.00 0x6040:00 0x6088:00 Predefined F	(0x1600) Size 4.0 2.0 2.0 2.0): Offs 0.0 4.0 6.0 8.0 gnment: (non	Name Target Pos Control Wo Touch prot	ition rd be function	tu X ⊕	Type Add Ne Delete Edit Print	ew Item	Default (hex) Ctrl+Si Del Ctrl+P	hift+
PDO A 0x1 0x1 0x1	ssignment 600 601 (exclu 602 (exclu 602 (exclu	(0x1C12): ided by 0x ided by 0x	1600) 1600)	PDO Content Index 0x607A:00 0x6083:00 Predefined F Load PDO in	(0x1600) Size 4.0 2.0 2.0 2.0 PDO Assig): Offs 0,0 4.0 6.0 8.0 gnment: (non evice	Name Target Pos Control Wo Touch prol e)	ition rd be function	р Х С	Type Add Ne Delete Edit Print	w Item	Default (hex) Ctrl+Si Del Ctrl+P	hift+

3.2.4 Write slave E2PROM

 If TwinCAT has already scanned the slave, but the slave Drive1 (Kinco FD) has a question mark next to it or the PDO cannot be read or written due to a mismatch in the XML file, then you need to write the correct XML into the drive's E²PROM, as shown in the following figures.



(a)

istributed Clock	Config Data (evalua	ted from ESU)	_	Device Identity (hex)				
C Assess	E'PROM Size	2048	-	Vendor Id:	0x006811	68		
FIDROM 4	PDI Type:	SPI slave	•	Product Code:	0x04570862			
- Configured Stati	🔲 Device Emulati	on (state machine en	alle	Revison No. :	0x01F4008E 0x00000000			
- Enhanced ank D	SPI / 8 / 16 HC I	nterface		Serial No. :				
- Smart View Hex Editor	☑ BUSY Open Drai ☑ INT Open Drain	n 📝 BUSY High Act	ive ve	Product Revision:				
FPGA	32 Bit Interface			Mailbox				
Memory	V WD Open Drain	WD High Activ	•	CoE SoE	E eE	FoE		
	input Laten			Bootstrap Configuration				
	Sync Signal Confi	guration		Out Start/Length:	0	0		
	SINCO Upen Dra	SYNCO to PDI	IRQ	In Start/Length:	0	0		
	SYNC1 Open Dr	in 📃 SYNC1 High Ac	tiv	Standard Configurat	tion			
	SYNC1 Enabled	SYNC1 to PDI	IRQ	Out Start/Length:	4096	128		
	Impulse Length ()	0		In Start/Length:	5120	128		
	Write E'PROM	Read E' PROM.						

Note: Before writing E2PROM, you need to copy the drive XML file to the TwinCAT installation directory, default path C:\TwinCAT\3.1\Config\Io\EtherCAT.

 After clicking "Write E²PROM" the following window will pop up, in the window will appear in the list of XML has been added, select the correct XML, click OK to download.

Available EEPROM Descriptions:	Show Hidden Devices	ОК
Bill Beckholf Automation GmbH & Co. KG Kinco Electric (Sherrahen) Ltd. Kinco FD Kinco FD (72812642 / 32768142)		Cancel 7
		Browse

3. At the same time, there is a progress bar in the lower right corner of the TwinCAT window, please observe the status of the progress bar. After the operation is finished, please power off and restart the PLC and drive, and re-scan the slave to make the newly written XML take effect.

3.3 OMRON NJ series controller application

When Omron NJ series PLC controller communicates with a single drive, directly use the network cable to connect the EtherCAT port of the controller and the IN port of the drive; when the controller connects with multiple drives, connect the OUT port of the previous drive to the IN port of the next drive, as shown in Figure 3-3.



Figure 3-3 Omron NJ controller connecting drives

3.3.1 Drive parameters setting

Use KincoServo software to set the drive parameters, refer to the drive user manual for details, and only the parameters that must be set and the function description of commonly used parameters are listed below.

Cancel the default IO port function definition of the drive. Click Toolbar → Driver → Digital IO Functions, as shown below. Enable, Reset Errors and Operate Mode Set must be canceled, others such as Position Limit can be set as needed. See IO Definition section of drive user manual for details.

Num Function			×	Simulate	Real	Polarity	Internal
DIN1 Enable	Must car	23	×		•		•
DIN2 Reset Errors	IVIUSI Car	>>	×		•		•
DIN3 Operate Mode Sel		>>	×		•		•
DIN4 P Limit +	Sot as no	>>	×		•		•
DIN5 P Limit -	Set as he		×		•		
DING		>>	×		•		•
DIN7		>>	×				

Configure the corresponding motor, click Toolbar → Motor → Motor Settings, as shown below. Just fill in the hex code of the corresponding motor in the object of the Motor_Num in the diagram. The motor code can be obtained by querying the motor section of the drive user manual or by right-clicking the help.

Kŝ	Motor Se	ettings						Ks More Motors
N	Index	Туре	Name			Value	Unit	please visit www.kinco.cn to get more detail motor information
0	60F612	uint16	Motor_IIt_Real			0.00	%	Format definition:
1	641016	uint16	Motor_Using			B5	ASCII	e.g.
2	304106	uint8	Use Inner MTLib	л. У.		2	DEC	Motor Type AAK/LED
3	641001	uint16	Motor_Num	Add		B5	ASCII	SMH405-0010-30000-4LKH KY/594B
4	641002	uint8	Feedback_Type			04	HEX	xxx=AAK: Motor Num: KY, LED display: 594B
5	641003	uint32	Feedback_Resolution	Delete		65536.00	inc/r	
6	641004	uint32	Feedback_Period	Help	-	327702	DEC	Motor Type AAK/LED
7	641005	uint8	Motor_Pole_Pairs			5.00	2p/r	SMG130D-0100-10xxx-4LKG P3/3350
8	641006	uint8	Commu_Mode			1	DEC	SMG130D-0100-20yyy-4LKG_P4/3450
9	641007	int16	Commu_Curr			3.11	Ap	151101000 0100 20000 1010 1 1/5 150
10	641008	uint16	Commu_Delay			1000.00	ms	SMG130D-0150-20xxx-4LKG P5/3550
11	641009	uint16	Motor_IIt_I	8		4.20	Ap	
12	64100A	uint16	Motor_IIt_Filter	1		64.00	S	SMG130D-0150-20xxx-4HKG P6/3650
13	64100B	uint16	Imax_Motor			17.30	Ap	SMG130D-0200-20xxx-4LKG_P7/3750
14	64100C	uint16	L_Motor	3		11.80	mH	
15	64100D	uint8	R_Motor			3.40	Ohm	SMG130D-0200-20xxx-4HKG P8/3850
16	64100E	uint16	Ke_Motor			29.00	Vrms/krpr	
17	64100F	uint16	Kt_Motor			0.48	Nm/Arms	SMG180D-0440-15XXX-4HKG PA/4150
18	641010	uint16	Jr_Motor			0.26	kg*cm^2	SMG180D-0550-15xxx-4HKG_PB/4250
19	641011	uint16	Brake_Duty_Cycle	1		89.96	%	

3. Set the sync cycle and enable the sync mode. Click Toolbar → Driver → ECAN Configuration → Others, as shown below. The drive has enabled the sync clock with a sync cycle of 2 ms (value of 1), 1 ms (value of 0) and 2 ms (value of 1) are recommended, 4 ms and 8 ms lose the meaning of using EtherCAT. Please note that the drive only supports the four sync cycles of 1, 2, 4, and 8 ms, but the PLC generally supports more, and only one of the four supported by the drive can be selected at the PLC. The shift of the sync point can adjust the jitter when the sync signal of the PLC and the command signal are not synchronized. Generally, it is recommended to set it to 1, indicating that the drive receives the command signal after the sync signal is shifted by 62.5 us.

9	301101	uint8	ECAN_Sync_Cycle	0 DEC
10	301102	uint8	ECAN_Sync_Clock	1 DEC
11	301103	uint8	ECAN_Sync_Shift	0 DEC

- After setting the drive parameters, save the control parameters and motor parameters. Click Toolbar →
 Driver → Init Save Reboot.
- If you need to adjust the PI and other parameters, click Toolbar → Driver → Control Loops to set the velocity loop and position loop parameters. See the performance adjustment section of the drive user manual for details.

3.3.2 Controller parameters setting

- The drive XML file can be downloaded from the official website of Kinco: https://www.kinco.cn/download/sfqdqdj36.html
- 2. Copy the drive XML file to the NJ series programming software Sysmac Studio installation directory, such as:

C:\Program Files\OMRON\Sysmac Studio\IODeviceProfiles\EsiFiles\SystemEsiFiles

When the right toolbar can not find the drive slave, you can add the XML file to:

C:\Program Files\OMRON\Sysmac Studio\IODeviceProfiles\EsiFiles\UserEsiFiles

If you need to add or change XML files, please exit Sysmac Studio first. The XML files will not take effect until Sysmac Studio is restarted.

3. Connect the EtherNet port of the computer and the controller with a network cable, open Sysmac Studio, click New Project, and select the device and version information of the connected controller (found in the Controller product TAB).

Sysmac Studio (32bit)		
Offline Copen Project Copen Project Copen Project Copen to the test of test o	Project Prope Project name in Author in Comment	erties ico-Test ico
Online ∮ Connect to Device Version Control № Version Control Explorer	Type Sta	andard Project 💌
License	Category Device Version	Controller NJ501 I 1500 I 111
		Create

4. After creating the project, double-click "EtherCAT" in "Configurations and Setup" on the left, and then bring up the master view. Then set the parameters of the right master station (generally, the parameters can be set by default).



5. Find the kinco slave at the bottom of the right toolbox, right click Insert, add the connected slave (insert a few of the actual connections), after adding the slave, the main view area and the left configuration area will display the slave and assign the node address, as shown in the following figure (the test takes the single axis as an example).



6. Click the slave to set the slave parameters. Generally, the default parameters in the box as shown below can meet the basic motion control requirements. If the parameters of multiple slave stations are set, you can right-click to copy → paste after setting one slave parameter.



If there are other control requirements (for example, if there is no motion control, most of the PDOs need to be configured only as an ordinary EtherCAT slave), you need to add more PDOs. Click Edit PDO Map Settings, select output RPDO channel or input TPDO channel, click Add PDO Entry, and select the PDO to be added in the PDO menu bar that pops up. Then click Apply and OK.

										•
figuration Master Master			I				ltern name		1	Value
Kinco EOC Ki)1 nco FD_RX F	lev:0x000001F9				Device name Model name			E001 Kinco FD_RX	
		dit PDO Map Set Map Proc ctionIInput/Outp Cutput Output Output Input Input	tings ess Data Size :: No option RxPDO RxPDO RxPDO TXPDO TXPDO	Input 152 Output 6 I Flag Editable Editable Editable Editable Editable	Edit PDC 0x0000:00 0x2601:00 0x2602:00 0x6060:00 0x6066:00 0x6066:00 0x6066:00 0x6066:00 0x6066:00 0x6075:00 0x6075:00 0x6077:00 0x6077:00	Map Settings Map Settings Gron State / Error State / Error State / Error State / Error State / Varning Word / War Yos Abs / Pos Abs Pos Abs / Pos Abs Position actual interne Yelocity actual interne Yelocity actual value / Target torque / Target Welocity actual value / Target torque / Target Max current / Max cu Torque actual value / DC_link_circuit_voltage Home_offset / Home Max months walkedby /	A constraint of the second secon	YO er sition hbe_F	FD Drive RX 0x000001	ications Cycle 1 (2000 us) O/Target_position O/Controlword O/Torch Probe Function O/Osition_actual value O/Statusword O/Statusword O/Torch, Probe_Status O/Torch, Probe_Status O/Torch, Probe_Topsitive_Position O/Digital_inputs Tedit PDO Map Settings arronous
							5 OK Cance	2		
					Edit PDO E	Move Up Move ntry 3 Add PDO Entr				
						The data is input/outp	7 OK	Ca ss data (P	ncel Apply DO) communicatio	ns.

7. Associate the drive PDO to the controller local IO. In the left menu bar Configuration and Setup, double-click the I/O Map, then select the slave (note that only one slave can be set at a time, all slaves need to be set), right-click and select Create Device Variable, and the system will allocate the local IO variables.

File Edit View Insert Project	Controller Simulation	Tools	Window H	lelp	_	_	_	_	_	
	ポット	R. M. F	• 🔍	× 🖌	63 🔉	<u>k</u> a 🖡	* = () 🖫 🛱	[] €	Q
Multiview Explorer 🛛 🚽 👔	EtherCAT 🚽 I/O Ma	p x								
new Controller 0 🔻	Position	Port	c c		Descr	iption	R/W	Data Type	Variable	
Configurations and Setup	Node1	AI Network	Configuration	n						
▼ TherCAT	7 RxPI	00_Target					W	DINT	E001_RxPDO_T	larg∉
⊢⊐ Node1 : Kinco FD RX (Et	RxPE	DO_Contro	Сору				w	UINT	E001_RxPDO_C	Cont
► © CPU/Expansion Backs	RxPI	DO_Touch					W	UINT	E001_RxPDO_T	louc
	TXPI	DO_Positic	Undo				R	DINT	E001_TXPDO_F	osit
Controller Setup	TXPI	DO_Status					R	UINT	E001_TXPDO_S	Statu
Mation Control Setup	TXPI	DO_Error_	c			_	R	UINT	E001_TXPDO_E	rroi
Would Control Setup		DO_Mode	Search				R	SINT	E001_TXPDO_N	Vlod
e Cam Data Settings		DO_Touch	Expand/Coll	apse All			R	UINT	E001_TXPDO_T	ouc
► Event Settings		DO_louch	Create Devi	ce Variable			R		E001_TXPDO_T	louc
Task Settings		DO_Digita	Create Devi	ce Variable v	with Prefix		к	UDINI	EUUT_TXPDO_L	Jigit
☑ Data Trace Settings	Puilt in I/(► Duilt									
Programming										
▼ II POUs		Ion Board								
Programs		bus Maste	Display Noc	le Location	Port					
▼ 🖻 Program0			- Dispidy 1400	ie coeution						
L de Section0 C	output									
Lℋ Functions										

8. Sets the period in the task settings. In the Configurations and Setup area, double-click Task Settings to set the period of the main fixed-cycle task. Note that this task cannot be deleted and the period must correspond to the sync cycle set by the drive. Otherwise, it will cause the loss of sync messages and cause the motor operation oscillation!

File Edit View Insert Proje	ct Controller Simulatio	n Tools Win	dow Help									
	2 5 < 2 5	5. # #	🖲 🛛 🤻 🖌 👍	X 6	5a 🚱 🏠	4	0		2	ଇ୍େ	. ¹⁰ 0,	
Multiview Explorer 🗸 🗸	讲 EtherCAT 🛛 🖨 I/O M	ip 😽 Task Se	ettings 🗙									-
new_Controller_0	I	sk Setting:										
Configurations and Setup		Task Type	Task	Name	Period/Execu	tion C	Detaile	d Execut	ion Task Pe	riod Exce	ed Task Ti	imeou
V ar EtherCAT	Priority-	Primary Periodic	: Task Primary	/Task	2ms	-			Detect		6ms(l	Perioc
► S CPU/Expansion Backs					2ms	-						
* I/O Map					2.250ms							
► I Controller Setup					2.75ms							
♦ Motion Control Setup					3ms							
& Cam Data Settings					3.25ms							
► Event Settings					3.75ms							
Task Settings	WAD				4ms							
Data Trace Settings	VAN				4.25ms							
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	Ruild				5.75ms							
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- S Function Placks		gs	I Program		6.25ms							
L M TUNCION DIOCKS	I I Des	npuon	r riogram		6.50ms		1					

- 9. Select Project \rightarrow Check All Programs for errors.
- 10. The basic communication parameters are set, and the program can be downloaded and debugged:
 - (1) Select Controller \rightarrow Communication Setup, select the programming port used (such as network port).
 - (2) Select Controller → Online. After online, the controller status will be displayed in the bottom right corner.



(3) Select Controller → Synchronize. After synchronization, the comparison between the controller and the current local engineering program and parameters will be displayed. Select transfer to the controller, select "Yes" in the prompt box to enter the programming mode, and click "Yes" after the transfer is completed to enter the running mode.



11. If more than one drive is used, you can go back to the EtherCAT settings page, select the master, right-click to reallocate the slave node address, and assign the slave node address in the settings window that appears. Generally, the slave address is assigned in order from 1 to 32, etc. Set it and click Write Slave Node Address.



12. Power off and reboot the controller and drive, power on and online again. The monitor shows the slave station has been connected normally.



If the connection is wrong, the box below shows a cross instead of a triangular arrow. Click the Master, right click to display diagnosis/statistics information, can monitor the network status. If there is an error, you can select the Toolbar \rightarrow Tools \rightarrow Troubleshooting to see the specific error information.



13. The corresponding slave data can be viewed and read in the IO map, indicating successful communication.

Position	Port	Description	R/W	Data Type	Value	Variable
	▼ 💺 EtherCAT Network Configuration					
Node1	▼ Kinco FD					
	RxPDO_Target_position_607A_00		W	DINT	0	E001_RxPDO_Targe
	RxPDO_Controlword_6040_00		W	UINT	0	E001_RxPDO_Cont
	RxPDO_Touch_Probe_Function_60B8_(W	UINT	0	E001_RxPDO_Touc
	TXPDO_Position_actual_value_6064_00		R	DINT	3	E001_TXPDO_Posit
	TXPDO_Statusword_6041_00		R	UINT	21104	E001_TXPDO_Statu
	TXPDO_Error_code_603F_00		R	UINT	0	E001_TXPDO_Erroi
	TXPDO_Modes_of_operation_display_(R	SINT	8	E001_TXPDO_Mod
	TXPDO_Touch_Probe_Status_60B9_00		R	UINT	0	E001_TXPDO_Touc
	TXPDO_Touch_Probe1_Positive_Posit_(R	DINT	0	E001_TXPDO_Touc
	TXPDO_Digital_inputs_60FD_00		R	UDINT	1572864	E001_TXPDO_Digit

Can also view the three indicators of the EtherCAT port in the lower right corner of the controller body. The meaning of the status of each indicator is as follows:

Indicator	Color	St	atus	Meaning							
NET RUN	Green		Lit.	EtherCAT communications are in progress.							
		<u> </u>		 Inputs and outputs for I/O data are in operation. 							
			Flashing	EtherCAT communications are established.							
				This indicator shows either of the following conditions.							
				 Only message communications are in operation. 							
				 Only message communications and I/O data inputs are in op- 							
				eration.							
			Not lit.	EtherCAT communications are stopped.							
				 The power supply is OFF or the CPU Unit was reset. 							
				A MAC address error, communications Controller error, or oth-							
				er error occurred.							
NET ERR	Red		Lit.	A hardware error or unrecoverable error occurred, such as for							
		/		exception processing.							
			Flashing	A recoverable error occurred.							
			Not lit.	There are no errors.							
LINK/ACT	Yellow		Lit.	A link is established.							
			Flashing	Data communications are in progress after establishing link.							
				Flashes every time data is sent or received.							
			Not lit.	The link was not established.							

At this time, in the KincoServo software, click Driver \rightarrow ECAN Configuration, you can see the PDO information of successful configuration, as shown below. You can also see whether there is sync data in the "Others" (the ECAN_Sync is not 0, which means there is sync data and has been synchronized).

File Co	ommunicatio	on Driv	er Motor Tools He	р										
n le			Basic Operation											
			Control Loops	>										
Kŝ	TPDOSet		Digital IO Functions					23	Kš I	ECAN Se	ttings			, .
1	PDO1 TPC	002	Control Modes	> 5	TPD07	TPDO8			N	Index	Туре	Name	Value	Unit
IN	Index	TV	Object Dictionary	1		Value	Unit		0*	101801	uint32	Vendor_ID	00681168	HEX
0	1A0000	uin	Driver Configuration	İ		7	DEC	1 11	1	301107	uint16	ECAN_Sync	1E1F	HEX
1	1A0001	uir	come congulation		TODO	640020	IEX	1 11	2	100500	uint32	Sync_ID	?????	HEX
2	1A0002	uin	ECAN Configuration	-	TPDO	410010	IEX	1	3	100C00	uint16	Guard_Time	1000	DEC
3	1A0003	uin	485 Configuration		RPDO	3F0010	IEX	1	4	100D00	uint8	Life_Time_Factor	3	DEC
4	1A0004	uin	Scope		Others	610008	IEX	1 11	5	100E00	uint32	Node_Guarding_ID	77777	HEX
5	1A0005	uin	Advanced Tuner	1		00B90010	IEX	1	6	101400	uint32	Emergency_Mess_ID	?????	HEX
6	1A0006	uin	Advanced runer	1		60BA0020	IEX	1	7	101700	uint16	Producer_Heartbeat_T	?????	DEC
7	1A0007	uin	Error Display	1		60FD0020	IEX	1	8	2F8100	uint8	CAN_Baudrate	?????	DEC
8	1A0008	uin	Error History	1		00000000	HEX	1	9	301101	uint8	ECAN_Sync_Cycle	1	DEC
9	180001	uin	Panel Menu	, [?????	HEX	1	10	301102	uint8	ECAN_Sync_Clock	1	DEC
1	0 180002	uin		· · · ·		?????	DEC	1	11	301103	uint8	ECAN_Sync_Shift	0	DEC
1	1 180003	uin	Init Save Reboot	1		?????	DEC	1	12	301104	int16	Sync_TPDO_Diff	0	DEC
1	2 180005	uin	Driver Properties	1		?????	DEC	1	13	600700	int16	Abort_Connection_Mo	1	DEC
-		_	Load Firmware	1		0.0000	A	<u> </u>	14	23400D	uint8	Keba	0	DEC
Kš	RPDOSet	_						83		-				-
R	PDO1 RPD			PDO6		RPDO8			-					
					1.04.640.1				20	1		110		
IN	Index	Type	Name	-		Value	Unit	- 11	× .			let a		
0	160000	uint8	Group_RX1_PDO	-		3	DEC	- 11						-
1	160001	unt32	RX1_PDO1	_		60/A0020	HEX	- 11				211		
2	160002	unt32	KX1_PDO2	_		60400010	HEX	- 11			1	111		
3	160003	unt32	RX1_PDO3	-		60B80010	HEX			1	-			
4	160004	unt32	KX1_PDO4			0000000	HEX	- 11		fer a		and the second second		

According to the above information, it means that the controller has successfully communicated with the EtherCAT of the drive.

3.3.3 Programming control axis motion

1. Point-to-point control

After the communication is established, the variables mapped to the controller by IO in the program can be assigned to each object of the drive, to control the drive motion. For example, a value can be assigned to the target velocity, the control word is assigned to 0xF, and the operation mode is set to 3 to run the velocity mode. See the drive user manual and controller programming information for details.

2. Motion control axis configuration

(1) Add axis. In Configurations and Setup, double-click Motion Control Setup, select Axis Settings, click
 Add → Motion Control Axis, the project needs to control a few axes to add a few axes (must actually connect these axes, otherwise an error will be reported).

kinco-Test - new_Controller_0 - Sysmac Studio (32bit) - 🗆 🗙								
File Edit View Insert Project Controller Simulation Tools Window Help								
X 40 66 音 つ さ 62 日 く 26 度 思 品 品 19 1 ス 🔺 😣 🖗 🦫 🕯	• O ₽: ₽ ₽ € €,							
Multiview Explorer 🗸 🕴 📊 EtherCAT 🗙	- Toolbox - 7							
new_Controller_0	All vendors							
Comingurations and setup ■ Ether CAT L <> Node1 : Kinco FD (E001) L <> Node1 : Kinco FD (E001) L <> Node1 : Kinco FD (E001)	Terminal Coupler Servo Drives Fraguency Investor							
▼ S CPU/Expansion Racks Number 1 L == CPU Rack PDO Co 2000 us PDO Co variable PDO Co	Digital IO							
* I/O Map Referen Exist Total ca 1 m Total ca 1	Show all versions							
Avis Settings Add Motion Control Axis name for the	NX-ECC201 EtherCAT coupler NX-ECC202 Rev:1.2 NX-ECC202 EtherCAT coupler							
	NX-ECC203 Rev:1.6 NX-ECC203 EtherCAT coupler							
Task Settings Axis Setting Table Axis Mathematical Axis Setting Table	R88D-1SAN02H-ECT Rev:1.0 R88D-1SAN02H-ECT 200V/20							
Data Trace Settings Programming Information Build failed: Program0.Section0	R88D-1SAN04H-ECT Rev:1.0							

(2) Associate PDO to axis control variables. Double-click the axis you added to configure the axis. With the motion control axis, the point-to-point normal control can no longer be used, and the IO mapping will be automatically removed when the axis is configured.

📓 kinco-Test - new_Controller_0 - Sy	smac Studio (32bit)	- 🗆 ×
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X 🖲 🖻 🖄 つ さ 🖻		🗇 ବ୍ ବ୍ ଅ
Multiview Explorer 🗸 🗸	WC_Axis000 (0,MC1) ×	→ T → #
new_Controller_0 Configurations and Setup	🕵 🕯 🎊 Axis Basic Settings	<search></search>
	Axis number 0 Motion control MC1: Primary periodic task Axis use Used axis Axis use Used axis Axis use Used axis Control function All Feedback control No control loop Input device 1 <not assigned=""> Input device 2 <not assigned=""> Output device 3 <not assigned=""> Output device 1 Nota assigned> Output device 2 Nota assigned> V Channel Output device 2 Nota assigned></not></not></not>	
	Output device 3 KNot assigned> Channel Image: Channel in the second	Process Da

To use the instructions of the MC function module for the axis, the following objects must be set (if the corresponding PDO map is not selected, please refer to "<u>Edit PDO Settings</u>" on page 50 to add it).

Function Name	Device	Process Data
 Output (Controller to Device) 		
★ 1. Controlword	Node : 1 Kinco FD(E001)	6040h-00.0(RxPDO_Co 🔻
★ 3. Target position	Node : 1 Kinco FD(E001)	607Ah-00.0(RxPDO_Tar 🔻
5. Target velocity	<not assigned=""></not>	<not assigned=""></not>
7. Target torque	<not assigned=""></not>	<not assigned=""></not>
9. Max profile Velocity	<not assigned=""></not>	<not assigned=""></not>
11. Modes of operation	Node : 1 Kinco FD(E001)	6060h-00.0(RxPDO_Mc 🔻
15. Positive torque limit value	<not assigned=""></not>	<not assigned=""></not>
16. Negative torque limit value	<not assigned=""></not>	<pre><not assigned=""></not></pre>
21. Touch probe function	<not assigned=""></not>	<not assigned=""></not>
44. Software Switch of Encoder's Input	<not assigned=""></not>	<pre><not assigned=""></not></pre>
- Input (Device to Controller)		
★ 22. Statusword	Node : 1 Kinco FD(E001)	6041h-00.0(TXPDO_Sta 🔻
★ 23. Position actual value	Node : 1 Kinco FD(E001)	6064h-00.0(TXPDO_Po
24. Velocity actual value	<not assigned=""></not>	<not assigned=""></not>
25. Torque actual value	<not assigned=""></not>	<not assigned=""></not>
27. Modes of operation display	Node : 1 Kinco FD(E001)	6061h-00.0(TXPDO_Mc 🔻
40. Touch probe status	<not assigned=""> ▼</not>	<not assigned=""></not>
41. Touch probe pos1 pos value	<not assigned=""></not>	<not assigned=""></not>
42. Touch probe pos2 pos value	<not assigned=""></not>	<not assigned=""></not>

For configuration of other input and output PDOs, refer to the controller manual. If PDO is not necessary, it is not recommended to configure. Too much configuration will occupy the EtherCAT bus resources and affect the transmission efficiency.

(3) Set axis parameters such as encoder resolution, maximum velocity, home definition, position limit, etc. Please refer to the controller manual for details.

kinco-Test - new_Controller_0 - Sysmac Studio	(32bit) — 🗆 🗙
File Edit View Insert Project Controller	Simulation Tools Window Help
X 単 宿 前 ち さ 包 占 人	🎬 🗔 🖫 🏯 🛄 🕂 🔺 🔌 & 🆗 🦫 🗂 이 및 문 🗍 이 역 역 역
Multiview Explorer Image: Controller I make and Setup The Ether CAT Landold I: Kinco FD (E001) The CPU/Expansion Racks Landold I: Kinco FD (E001) The Controller Setup The Axis Settings The Control Setup The Axis Settings The Com Data Settings The Settings The Settings The Settings The Settings The Data Trace Settings	Source Travel Distance Command pulse count per motor rotation 65536 pulse/rev (1) Do not use gearbox Work travel distance per motor rotation Number of pulses [pulse] = (1) Command pulse count per motor rotation [UDINI] * Travel distance per motor rotation 65536 pulse/rev (2) Reference: Unit conversion formula 65536 pulse/rev (2) Number of pulses [pulse] = (1) Command pulse count per motor rotation [UDINI] * Travel distance per motor rotation 65536 pulse/rev (2) Reference: Unit conversion formula 65536 pulse/rev (2) Number of pulses [pulse] = (1) Command pulse count per motor rotation [UDINI] * Travel distance per motor rotation [UDINI] * Travel distance [U • Use gearbox Fill in the feedback resolution of Kinco motor encoder Work travel (incorrect value risk was the position formula f
Programming Filter	

NJ series motion control instructions conform to PLCopen standard. Kinco drive is the standard EtherCAT slave. The following is a brief description of CSP mode, CSV mode, and the MC_Home homing instruction. See the controller manual for more MC instructions.

3. Cyclic Synchronous Position mode (CSP) instruction

This mode can meet the requirements of most working conditions. For specific application instructions, please refer to the controller manual. The following PDOs need to be configured for this mode.

Reset to Default						
Function Name	Device	Process Data				
 Output (Controller to Device) 						
★ 1. Controlword	Node : 1 Kinco FD(E001)	6040h-00.0(RxPDO_Co 🔻				
★ 3. Target position	Node : 1 Kinco FD(E001)	607Ah-00.0(RxPDO_Tai 🔻				
5. Target velocity	<not assigned=""></not>	<not assigned=""></not>				
7. Target torque	<not assigned=""></not>	<not assigned=""></not>				
9. Max profile Velocity	<not assigned=""></not>	<not assigned=""></not>				
11. Modes of operation	Node : 1 Kinco FD(E001)	6060h-00.0(RxPDO_Mc 🔻				
15. Positive torque limit value	<not assigned=""></not>	<not assigned=""></not>				
16. Negative torque limit value	<not assigned=""></not>	<not assigned=""></not>				
21. Touch probe function	<not assigned=""></not>	<not assigned=""></not>				
44. Software Switch of Encoder's Input	<not assigned=""></not>	<not assigned=""></not>				
- Input (Device to Controller)						
★ 22. Statusword	Node : 1 Kinco FD(E001)	6041h-00.0(TXPDO_Sta 🔻				
★ 23. Position actual value	Node : 1 Kinco FD(E001)	6064h-00.0(TXPDO_Po				
24. Velocity actual value	<not assigned=""></not>	<not assigned=""></not>				
25. Torque actual value	<not assigned=""></not>	<not assigned=""></not>				

MC MoveVelocity instruction:



MC MoveRelative instruction:

		MC	MC_rel	ľ.
b rel	MC_Axis000-	Axis —	— Axis	— MC_Axis000
		Execute	Done	
	(20000) des—	Distance	Busy	Enter Variable
	(100000) vel_rel—	Velocity	Active	-Enter Variable
	100000—	Acceleration	CommandAborted	-Enter Variable
	100000—	Deceleration	Error	- Enter Variable
	500—	Jerk	ErrorID	—Enter Variable
	Enter Variable—	BufferMode		

Note

Calculate the actual velocity (RPM) of the motor according to the feedback resolution of the motor encoder. Because the instruction is CSP mode instruction, the actual velocity of the motor is about 100000/65536 * 60 = 92 RPM. (65536 is the feedback resolution of the kinco motor encoder)

4. Cyclic Synchronous Velocity mode (CSV) instruction

To use this instruction, the target velocity (0x60FF) must be mapped in the controller's axis settings. Here are the PDOs that need to be configured for this mode.

 Output (Controller to Device) 		
★ 1. Controlword	Node : 1 Kinco FD(E001)	6040h-00.0(RxPDO_Co 🔻
★ 3. Target position	Node : 1 Kinco FD(E001)	607Ah-00.0(RxPDO_Tai 🔻
5. Target velocity	Node : 1 Kinco FD(E001)	60FFh-00.0(RxPDO_Tar 🔻
7. Target torque	<not assigned=""></not>	<not assigned=""></not>
9. Max profile Velocity	<not assigned=""></not>	<not assigned=""></not>
11. Modes of operation	Node : 1 Kinco FD(E001)	6060h-00.0(RxPDO_Mc 🔻
15. Positive torque limit value	<not assigned=""></not>	<not assigned=""></not>
16. Negative torque limit value	<not assigned=""></not>	<not assigned=""></not>
21. Touch probe function	<not assigned=""></not>	<not assigned=""></not>
44. Software Switch of Encoder's Input	<not assigned=""></not>	<not assigned=""></not>
- Input (Device to Controller)		
★ 22. Statusword	Node : 1 Kinco FD(E001)	6041h-00.0(TXPDO_Sta 🔻
★ 23. Position actual value	Node : 1 Kinco FD(E001)	6064h-00.0(TXPDO_Po 🔻
24. Velocity actual value	<not assigned=""></not>	<not assigned=""></not>
25. Torque actual value	<not assigned=""></not>	<pre><not assigned=""></not></pre>
27. Modes of operation display	Node : 1 Kinco FD(E001)	6061h-00.0(TXPDO_M(🔻
40. Touch probe status	<not assigned=""></not>	<not assigned=""></not>
41. Touch probe pos1 pos value	<not assigned=""></not>	<not assigned=""></not>
42. Touch probe pos2 pos value	<not assigned=""></not>	<not assigned=""></not>

The MC SyncMoveVelocity instruction block is called in the program to run.



\rightarrow

Note

Calculate the actual velocity (RPM) of the motor according to the feedback resolution of the motor encoder. Since the instruction is in CSV mode, the actual velocity of the motor is about 2000000/65536/16.384 * 60 = 111 RPM. (65536 is the feedback resolution of the kinco motor encoder, 16.384 is the basic unit coefficient of the drive)

5. Use the probe for homing

(1) The drive DIN port defines the fast capture function, as shown in the following figure, DIN2 must be defined as Fast Capture 1, DIN3 as Fast Capture 2, so that the input state 0x60FD00 bit17 and bit18 exactly correspond to Fast Capture 1 and Fast Capture 2.

Num Eunction		٧I	Simulate	Real	Polarity	Internal
DIN1		×		•		•
DIN2 Fast Capture 1	>>	×		•		•
DIN3 Fast Capture2	>>	×		•		•
DIN4	>>	×		•		•
DIN5	>>	×		•		•
DIN6	>>	×		•		•
DIN7	>>	×		•		•
DIN8	>>	×		•		•

When using the Z phase signal as the trigger signal, because the Z signal is small, the drive starts the Z signal capture function after the fast capture 1 rising edge is triggered. That is, the drive will capture the position where the first Z signal is encountered after the fast capture 1 signal is set, so attention should be paid to reset the fast capture 1 signal when capturing continuously. The reset of the fast capture signal in DIN does not necessarily require the digital input port connection level for signal trigger, but can also be triggered by DIN simulation (0x201002).

(2) Add output and input mapping objects to the axis basic settings. When using the Omron MC_Home home reset instruction, three objects 0x60B8, 0x60B9 and 0x60BA must be mapped. If these settings are not made, the controller will alarm the set process data object insufficient error 0x3461.



N	Index	Туре	Name	Value	Unit
0	60B800	uint16	Touch_Probe_Function	0000	HEX
1	60B900	uint16	Touch_Probe_Status	0000	HEX
2	60BA00	int32	Touch_Probe_Rising1	0	DEC
3	60BB00	int32	Touch_Probe_Falling1	0	DEC
4	60BC00	int32	Touch_Probe_Rising2	0	DEC
5	60BD00	int32	Touch_Probe_Falling2	0	DEC
6	60FD00	uint32	Digital_Inputs	00000000	HEX
7*	23400D	uint8	Keba	1	DEC

Set the capture function (0x60B800) according to the application requirements, observe the capture state (0x60B900) and capture location. The capture function and the capture state are described as follows:

Bit	Value	Description					
0	0	Negative position limit signal input is valid					
0	1	Negative position limit signal input is invalid					
1	0	Positive position limit signal input is valid					
1	1	Positive position limit signal input is invalid					
2	0	Home signal input is valid					
2	1	Home signal input is invalid					
16	0	Fast capture 1 signal input is valid					
10	1	Fast capture 1 signal input is invalid					
17	0	Fast capture 2 signal input is valid					
1/	1	Fast capture 2 signal input is invalid					

Capture function 0x60FD00 description:

Capture function 0x60B800 description:

Bit	Value	Description							
0	0	Fast capture 1 is invalid							
0	1	Fast capture 1 is valid							
1	0	Single capture, only a single capture of the position. If you need to trigger fast capture 1 again to capture the position, you need to reset \rightarrow set bit 0.							
	1	Continuous capture, the position is continuously captured, and the position is captured every time the fast capture signal 1 is triggered, without the reset \rightarrow set bit0.							
2	0	Fast capture 1 triggered by an external signal							
Z	1	Fast capture 1 triggered by Z signal							
3	-	None							
4	0	Fast capture 1 rising edge is invalid							
4	1	Fast capture 1 rising edge is valid							
5	0	Fast capture 1 falling edge is invalid							
5	1	Fast capture 1 falling edge is valid							
6,7	-	None							
0	0	Fast capture 2 is invalid							
0	1	Fast capture 2 is valid							
9	0	Single capture, only a single capture of the position. If you need to trigger fast capture 2 again to capture the position, you need to reset \rightarrow set bit 0.							
	1	Continuous capture, the position is continuously captured, and the position is captured every time the fast capture signal 2 is triggered, without the reset \rightarrow set bit0.							
10	0	Fast capture 2 triggered by an external signal							
10	1	Fast capture 2 triggered by Z signal							
11	-	None							
12	0	Fast capture 2 rising edge is invalid							
12	1	Fast capture 2 rising edge is valid							
12	0	Fast capture 2 falling edge is invalid							
15	1	Fast capture 2 falling edge is valid							
14,15	-	None							

Bit	Value	Description
0	0	Fast capture 1 is invalid
0	1	Fast capture 1 is valid
1	0	Fast capture 1 or Z signal rising edge capture is not completed
1	1	Fast capture 1 or Z signal rising edge capture is completed
2	0	Fast capture 1 or Z signal falling edge capture is not completed
Z	1	Fast capture 1 or Z signal falling edge capture is completed
3,4,5,6,7	-	None
0	0	Fast capture 2 is invalid
0	1	Fast capture 2 is valid
0	0	Fast capture 2 or Z signal rising edge capture is not completed
9	1	Fast capture 2 or Z signal rising edge capture is completed
10	0	Fast capture 2 or Z signal falling edge capture is not completed
10	1	Fast capture 2 or Z signal falling edge capture is completed
11,12,13,14,15	-	None

Capture function 0x60B900 description:

(3) In addition to the above three objects, we also need to add a mapping of the digital input to transmit the relevant signal through 0x60FD. See the figure below to set the digital input.



In the above figure, the **Home switch** is the home proximity input signal of the Omron controller, which corresponds to the home signal of the drive.

External Latch Input 1 is the home proximity input signal, which corresponds to the fast capture 1 of the servo.

Positive limit switch is a positive position limit signal, corresponding to the positive limit of the drive.

Negative limit switch is the negative position limit signal, corresponding to the negative limit of the drive.

(4) There are 10 homing methods for selection according to the actual application. Through the homing setting interface, set the homing method. Please refer to the controller manual for detailed parameter information.



Please refer to the controller manual for the specific setting of the velocity/acceleration/deceleration of the drive to return the home. Since the homing instruction is CSP mode instruction, the return velocity of the motor is about 334000/65536 * 60 = 306 RPM

(5) After enabling the drive via MC_Power, the execution is triggered by giving a rising edge signal to the MC_Home instruction block. The following figure is the status of the instruction to complete homing.



(6) The homing method in this example is to use the home proximity input OFF, that is, the motor runs at the home return velocity after triggering the home instruction, switches to the home return velocity after touching the rising edge of the home signal, and triggers the fast capture 1 after meeting the falling edge of the home signal to return the home. The overall definition of DIN input of the drive is as follows:

igreal I	nput						
Num	Function		×	Simulate	Real	Polarity	Interna
DIN1	Home Signal	>>	×		•		•
DIN2	Fast Capture 1	>>	×		•		•
DIN3	Fast Capture 2	>>	×		•		•
DIN4	P Limit +	>>	×		•		•
DIN5	P Limit -	>>	×		•		
DIN6		>>	×		•		•
DIN7		>>	×		•		•
DIN8			×				

(7) Through the Controller → MC Monitor Table in the Sysmac Studio software toolbar, the running status, current operation mode, actual position, and actual velocity of the drive can be monitored. The final homing status of the axis can be monitored in the MC monitor table. If the homing cannot be successfully achieved, please refer to step (3) to check whether the digital input setting is correct.

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