Chapter 2 System Setup

2.1 Parameter Settings of EtherCAT Mode

- 1. Set parameter **P1-01** to **0x0C**_h for EtherCAT communication and CANopen as the application layer.
- 2. Restart the system of servo drive.

P1 - 01●	CTL	Control Mode and Output Direction	Address: 0102H, 0103H
	Operation Interface:	Keypad / Software Communication	Related Section: Section 8.1, Table A
	Default:	0	
	Control Mode:	ALL	
	Unit:	pulse (P mode), r/min (S mode), N-m (T mode)	
	Range:	• • •	
	Data Size:	16-bit	
	Display Format:	Hexadecimal	
	Settings:		
		Control mode settings Control wode settings Torque output direction settings Discrete I/O Setting not used	3

	een en meae een ge												
	PT	PR	S	Т	Sz	Tz		PT	PR	S	Т	Sz	Tz
Single Mode					Dua	al Mo	de						
00							06						
01							07						
02							08						
03							09						
04							0A						
05							0B			N	/A		
Multiple Mode				0C		CA	Nope	en Mo	ode				
0E							0D						
0F													

Control mode settings

- PT: Position control mode. The command is from the external pulse or analog voltage (External analog voltage will be available soon). Execution of the command selection is via DI.PTAS.)
- PR: Position control mode. The command is from the internal signal. Execution of 64 positions is via DI.POS0 ~ POS5. A variety of homing control is also provided.
- S: Speed control mode. The command is from the external signal or internal signal. Execution of the command selection is via DI.SPD0 and DI.SPD1.
- T: Torque control mode. The command is from the external signal or internal signal. Execution of the command selection is via DI.TCM0 and DI.TCM1.
- Sz: Zero speed / internal speed command
- Tz: Zero torque / internal torque command
- Dual Mode: The control mode selection is via DI signals. For example, either PT or S control mode can be selected via DI signal, S-P (see Table A).
- Multiple Mode: The control mode selection is via DI signals. For example, PT, PR or S control mode can be selected via DI signals, S-P and PT-PR (see Table A).

Torque output direction settings

Direction	0	1
Forward	CCW CCW	
Reverse		CCW CCW

Discrete I/O Setting

- 1: When switching to different mode, digital inputs/outputs (P2-10 ~ P2-22) will be set to the default value according to the mode you selected.
- 0: When switching to different mode, the setting value of digital inputs/outputs (P2-10 ~ P2-22) will remain the same and will not be changed.

2.2 TwinCAT Setup

A lot of software can be applied to configure EtherCAT system. The following procedures are the example of TwinCAT of Beckhoff. Please install the software properly before you start to configure the system.

- 1. Copy Delta XML description to the folder the TwinCAT installed (usually C:\TwinCAT\lo\EtherCAT).
- 2. Restart the TwinCAT.
- 3. The configuration procedure can be started by applying TwinCAT manager which shown as below.



Figure 4

- 4. Install the Network Interface Card (NIC) for EtherCAT communication.
 - Select Options → Show Real Time Ethernet Compatible Devices.

Edit Actions View	Options Help				
) 🛱 📽 🖬 💩 🕇	Language	• 🚼 🔧 🚱 🖹 Q, 🖓 661 🔦 🖉 🧶 🗵 🌹			
 SYSTEM - Configuration NC - Configuration PLC - Configuration I/Ο - Configuration I/Ο - Configuration I/Ο Devices Mappings 	Add <u>V</u> ariable Type Delete Variable Type Save User Types Load <u>User</u> Types	f System Manager nild 2214)			
	 Check PLC Project Changes Open Logger Automatically Open Last Used File Select Last Tree Element Generate BAK-File Auto Save to Target Show full document path Compatibility Mode (not recommended for new projects) 	AT NC I [Build 2220] ed to: 2012/8/3 # BECKHOFF © 1996-2011 w beckhoff.com			
	Show Real Time Ethemet Compatible Devices Change POMCIA Bese Address Update EthenCAT Dewre Descriptions Edit Terminal Types	r: Delta r: 87FE-4A13-37CE-1EFC			

Figure 5

Select the correct Adapter from the devices (NICs) installed in the computer for EtherCAT communication and click "Install".

Installation of TwinCAT RT-Ethernet Adapters				
Ethernet Adapters	Update List			
Installed and ready to use devices Bookhoff, NIC - TwinCAT-Intel PCI Ethernet Adapter	Install			
──■學 L画域連線 - Broadcom NetLink (TM) Gigabit Ethernet	Bind			
Incompatible devices Disabled devices	Unbind			
	Enable			
	Disable			
	🔲 Show Bindings			

Figure 6

- 5. Open a new project from the drop down menu File \rightarrow new.
- Right click I/O Devices and select Scan Devices or Press <F5> to scan the devices. Click OK in the pop-up dialog window to confirm the information.



Figure 8

取消

確定

7. Find Device [n] (EtherCAT), select this device and click **OK**.

new I/O devices foun	đ	Note
Device 1 (EtherCAT) Uevice 2 (H1-Etherne	[Beckhoff_NIC (TwinCAT-Intel PCI Ethernet Adapter - Packet S] [他现象进行 (Broadcom NetLink (TM) Gigabit Ethernet - Pack	OK Cancel
		Select All Unselect All

Figure 9

8. Click **Yes** to scan for boxes.



Figure 10

9. Click Yes to Add drives to NC-Configuration.



Figure 11

10. Click **No** and TwinCAT will be switched to **Config mode**.



Figure 12

11. TwincAT is in Config Mode. In the left panel, it shows **Device (EtherCAT)** and you can find ASDA A2-E CoE Drive.

<mark>雾</mark> 未命名 - TwinCAT System Manager			
File Edit Actions View Options Help			
□ ☞ ☞ 🖬 등 🗟 🐇 🖻 🕾 🔗 🗒	· → #	🧟 🧟 🚼 🔍 🚳 🖶 🔍 🖓 66'	🎗 🕵 🎯 😰 😵
SYSTEM - Configuration NC - Configuration	General Ether	CAT DC Process Data Startup CoE - On	line Online
C-Tesk 1 SAF NC-Tesk 1 SVB	<u>N</u> ame:	Drive 1 (ASDA-A2-E CoE Drive)	Id: 1
WC-Task 1-Image Tables	Туре:	Delta ASDA-A2-E EtherCAT(CoE) Drive	
Ave: Ave: Ave: Ave: PLC - Configuration PLC - Simage PLC - Simage	<u>Comment</u> :	Disabled	Crease symbols
Ready		Local	(172.16.190.220.1.1) Config Mode

Figure 13

12. Select the Drive (ASDA A2-E) and in **Online** tab you can check if the device's EtherCAT state machine (ESM) is in PREOP state.

le Edit Actions View Options Help		
		2 🔊 🗶 🖻 🔋
SYSTEM - Configuration W C - Configuration W C - Task 1 SAF W NC-Task 1 SVB W NC-Task 1 SVB W C-Task 1 SVB W Devices W Dovices 3-Image Device 3-Image Device 3-Image W Dutputs W Dirive (ASDA-A2-E CoE Drive) Wespings	General EtherCAT DC Process Data Startup CoE - Onl State Machine Init Bootstrap Current State: Pre-Op Safe-Op Requested State: Op Clear Error DLL Status Port A: Carrier / Open Port B: No Carrier / Closed Fort D: No Carrier / Closed File Access over EtherCAT File Access over EtherCAT	Ine Online PREOP PREOP
- 🕋 NC-Task 1 SAF - Device 3 (EtherCAT) - Info	Download Upload	

Figure 14

13. Double click on Drive (ASDA A2-E CoE Drive) and it will show:

CoE Tx PDO mapping CoE Rx PDO mapping

2nd TxPDO – 3rd RxPDO – WcState InfoData

🐨 🚮 SYSTEM - Configuration
🛓 🋍 NC - Configuration
📄 📴 NC-Task 1 SAF
🖻 NC-Task 1 SVB
🕂 🕂 NC-Task 1-Image
Tables
🚍 🚉 Axes
🔜 🕀 Axis 1
📲 PLC - Configuration
🖃 🛒 I/O - Configuration
📄 🎒 I/O Devices
🚍 🗮 Device 3 (EtherCAT)
Device 3-Image
Device 3-Image-Info
🛨 😽 Iniopata
The st 2nd TyPDO Monthing
🖬 👒 Zini TXFDO Mapping
infoData
NC-Task 1 SAF - Device 3 (EtherCAT)
A NC-Task 1 SAF - Device 3 (EtherCAT) - Info

Figure 15

- 14. Set the communication cycle* and the default value is 2ms.
 - Select NC-Task 1 SAF in the left window, and set Cycle ticks as communication cycle (The minimum value is 1ms) in the right window.



Figure 16

*The communication cycle time, SYNC0 cycle time, and PDO cycle time should be set to the same value.

15. Set Following Error Calculation to Extern.

■ Select Axis 1_Drive in the left window → In parameter column of the right window, select Extern in Following Error Calculation → click Download and then click OK in pop-up dialog.



Figure 17

- 16. Switch TwinCAT to Run Mode.
 - Press to generate Mappings → press ✓ to check confiugration → and press to activate configuration. TwinCAT will be switched to Run Mode and then click OK in pop-up dialog.

🗾 未命名 - TwinCAT System Manager		
<u>File Edit Actions View Options H</u> elp	1 2 3	
: D 🖆 📽 🖬 🧔 🔥 X 🖪 🖬 🖀 8 🚊	u 🙃 🗸 🏄 🏡 🏡 🎨 🌂 🚳 🖹 🔍 🖓 🚳 🗶 🔊	



- 17. Enable the axis (Servo On).
 - Under NC-Configuration of the left window, select Axis 1 → select Online tab in the right window \rightarrow click Set.

🥦 未命名 - TwinCAT System Manager		
File Edit Actions Yiew Options Help		
D 📽 📽 🖬 🤞 🕹 🐂 🖬 🔒 🔒	u == 🗸 🏽 👧 🔩 🔍 🗉 🍫 🖹 Q, 🖓 66 🍡 🐒 🧶 🕲 🎖	
SYSTEM - Configuration	General Settings Parameter Dynamics Online Functions Coupling Compensation	2
IVC-Task 1 SAF IVC-Task 1 SVB IVC-Task 1-Image Tables Loss Loss Im Axis 1_Inc Axis 1_Inc Im Axis 1_Drive Inputs Loss Inputs Loss Inputs Inputs Inputs Inputs Inputs Inputs	O.0000 Setpoint Position: mm] Lag Distance (min/max): mm] Actual Velocity: [mm/s] 0.0000 (0.000) 0.0022 0.0000 (0.000) 0.0022 Override: [%] Total / Control Output [%] Error: 0.0000 % 0.000 % Status (log.) Status (h)vs.) Cabrated Moving Fw In Targer Pose. In Pos. Range	
PLC - Configuration I/O - Configuration I/O - Configuration Device 3 (EtherCAT) Device 3 - Image Device 1 - Device 1 - De	Controller Ky-Factor: [mm/s/mm] Reference Velocity: [mm/s] 1 ↓ 2200 ↓ Iarget Fosition: [mm] Target Velocity: [mm/s] 0 ↓ F3 F9 F1 F2 F3 F4 F5 F6 F8 F9	*
Server (Port) Timestamp Message	T	~
Ready	Local (172.16.190.220.1.1)	me 0%

Figure 19

■ In pop-up dialog, click **All** to enable the motor.



Figure 20

 In Online tab, there are two different speed levels of jogging buttons for forward and backward movement which can test the system. During the operation, please Be Ensured that the movement would not damage your system and endanger the personnel safety.



Figure 21

2.3 Synchronization Modes Setting

2.3.1 Two Synchronization Modes of Delta Servo

ASDA A2-E supports two synchronization modes, Free Run mode and DC-Synchronous mode. Please note that the asynchronous Free Run mode is still under the definition of "Synchronization Modes" within EtherCAT specification guide.

■ Free Run Mode (Asynchronous)

The master and slaves are running in an asynchronous manner. The master and the slave both have their own clock to calculate the time. In other words, there is no synchronous clock between the master and the slave. A command sent by the master and a reply from the slave only consists with a sequential order instead of strict clock timing. For example, a master sends a PDO at tick t1 and the slave will receive it at tick t1 or tick t2 and vice versa.



Figure 22. Free Run Mode synchronization

DC-Synchronous Mode (SYNC0 synchronization)

There exists a clock tick for the master and all slaves operation. A data sent by the master will be received by slave(s) at the same clock interval. The master will inform all slaves about its clock and ask slaves to align according to the time. A strict clock tick is always running within this system.





2.3.2 Select the Synchronization Mode

- 1. Select Drive (ASDA A2-E CoE Drive) in the left window.
- 2. The DC tab in the right window, users can select DC-Synchronous or Free Run as the Operation Mode. This is for selecting synchronous or asynchronous mode.



Figure 24

2.3.3 Synchronous Clock Time Setting

- 1. Select NC-Task 1 SAF in the left window.
- 2. Click Task in the right window.
- 3. Cycle ticks are the data exchanging period under the Task tab.



Figure 25

The unit of cycle for SYNC0 cycle time is 1ms.

SYNC0 cycle time supported	1ms (PDO cycle time = 1ms) 2ms (PDO cycle time = 2ms) 3ms (PDO cycle time = 3ms) 	
* SYNC0 cycle time is used to define PDO cycle time.		

2.4 PDO Mapping

The PDO mapping Objects are allocated from index 0x1600 to 0x1604 for RxPDOs and $0x1A00 \sim 0x1A04$ for TxPDOs in Object Dictionary.

2.4.1 Default PDO Mappings

The following tables are the default PDO mappings of ASDA A2-E CoE Drive for cyclic data exchange and are also defined in EtherCAT Slave Information file (XML file).

■ 1st PDO Mapping

RxPDO	Control Word	Target Position	Target Velocity	Target Torque	Mode of Operation
(0x1600)	(0x6040)	(0x607A)	(0x60FF)	(0x6071)	(0x6060)
TxPDO	Status Word	Actual Position	Actual Velocity	Actual Torque	Mode of Operation Display
(0x1A00)	(0x6041)	(0x6064)	(0x606C)	(0x6077)	(0x6061)

■ 2nd PDO Mapping (default PDO assignment)

RxPDO	Control Word	Target Position
(0x1601)	(0x6040)	(0x607A)
TxPDO	Status Word	Actual Position
(0x1A01)	(0x6041)	(0x6064)

■ 3rd PDO Mapping

RxPDO	Control Word	Target Velocity	
(0x1602)	(0x6040)	(0x60FF)	
TxPDO	Status Word	Actual Position	Actual Velocity
(0x1A02)	(0x6041)	(0x6064)	(0x606C)

■ 4th PDO Mapping

RxPDO	Control Word	Target Torque	
(0x1603)	(0x6040)	(0x6071)	
TxPDO	Status Word	Actual Position	Actual Torque
(0x1A03)	(0x6041)	(0x6064)	(0x6077)

■ 5th PDO Mapping

Reserved.

2.4.2 Re-define a PDO Mapping

Setup procedure

- 1. Set [RxPDO Assignment:0x1C12:0/ TxPDO Assignment: 0x1C13:0] to 0x0 for disabling the PDO assignment.
- Set [RxPDO mapping entry: ex. 0x1601:0/ TxPDO mapping entry: ex. 0x1A01:0] to 0x0 for disabling the PDO mapping entry setting.
- Set [RxPDO mapping entry: ex. 0x1601:0 0x1601:7/ TxPDO mapping entry: ex. 0x1A01:0 0x1A01:7].
- 4. Set 【RxPDO mapping entry: ex. 0x1601:0/ TxPDO mapping entry: ex. 0x1A01:0】 to the number of mapping entries in PDO mapping.
- 5. Set [RxPDO Assignment:0x1C12:1/TxPDO Assignment: 0x1C13:1] to PDO assignment.
- 6. Set [RxPDO Assignment:0x1C12:0/ TxPDO Assignment: 0x1C13:0] to 0x1 for enabling the PDO assignment.

2.4.3 Using TwinCAT

- 1. Press 🙆 or **Shift** and **F4** to set/reset TwinCAT to Config Mode (Click OK in pop-up dialog).
- 2. Select Drive (ASDA A2-E CoE Drive) in the left window. In Process Data field, you can change PDO Assignment for another PDO mapping.
- Right click the PDO Content Window, and find the PDO mapping that you desire to set, and then you can configure (Insert/Delete/Edit/Move Up/Move Down) the PDO mapping content.

(8 PDOs is the maximum number of PDO which can be assigned in every PDO mappings.)

eneral EtherCAT DC Proces	s Data Startup CoE -	Online Online		
Sync Manager:	PDO List			
SM Size Type Flags	Index Size	Name	Flags SM	SU
0 128 Mbx 1 128 MbxIn 2 6 Outputs 3 6 Japuts	0x1A00 13.0 0x1A01 6.0 0x1A02 10.0 0x1A03 8.0	1st TxPDO Mapping 2nd TxPDO Mapping 3rd TxPDO Mapping 4th TxPDO Mapping	3	0
	0x1600 13.0 0x1601 6.0 0x1602 6.0 0x1603 4.0	1st RxPDO Mapping 2nd RxPDO Mapping 3rd RxPDO Mapping 4th RxPDO Mapping	2	0
PDO Assignment (0x1C12):	PDO Content (0x1A00 Index Size	l): Offs Name	Туре	Default (he 📤
Ux1600 (excluded by 0x1601) 0x1601 0x1602 (excluded by 0x1601) 0 1602 (excluded by 0x1601)	Index Size 0x6041:00 2.0 0x6064:00 4.0 0x6066C: 4.0	Offs Name 0.0 Status Word 2.0 ActualPosition 6.0 Velocity actual value	Type UINT DINT DINT	Default (he 📥
Doxioo2 (exerniner of oxioo1)	0x6077:00 2.0 0x6061:00 1.0	10.0 12.0 1 Insert 1a 13.0 Delete	, SINT	~
Download	Bredefined FDO measure	Edit		
PDO Assignment	Load PDO info from	device Move Up		
	and the second se	the second se		

Figure 27

Edit Pdo Entr	у		X
Name:			ОК
Index (hex):	0	0	Cancel
Sub Index:	0		
Data Type:	(none)	~	
Bit Lentgh:	1		
From Dictionary	y:		
0x2000 - DRV 0x2001 - DRV 0x2002 - DRV 0x2003 - DRV 0x2005 - DRV 0x2005 - DRV 0x2005 - DRV 0x2006 - DRV 0x2008 - DRV 0x2004 - DRV 0x2008 - DRV 0x2000 - DRV 0x2000 - DRV 0x2000 - DRV 0x2000 - DRV	"s Parameter P0-00 "s Parameter P0-01 "s Parameter P0-02 "s Parameter P0-03 "s Parameter P0-04 "s Parameter P0-06 "s Parameter P0-08 "s Parameter P0-09 "s Parameter P0-10 "s Parameter P0-11 "s Parameter P0-12 "s Parameter P0-12 "s Parameter P0-14		

Figure 28. ASD-A2-E CoE drive Object List

4. After changing the PDO Assignment, press sor **F4** to reload I/O devices. (Click **No** in pop-up dialog and stay in Config Mode.)