Smarter. Greener. Together.

Industrial Automation Headquarters

Delta Electronics, Inc.
Taoyuan Technology Center
No.18, Xinglong Rd., Taoyuan District,
Taoyuan City 330477, Taiwan
TEL: 886-3-362-6301 / FAX: 886-3-371-6301

Asia

Delta Electronics (Shanghai) Co., Ltd.
No.182 Minyu Rd., Pudong Shanghai, P.R.C.
Post code : 201209
TEL: 86-21-6872-3988 / FAX: 86-21-6872-3996
Customer Service: 400-820-9595

Delta Electronics (Japan), Inc.
Tokyo Office
Industrial Automation Sales Department
2-1-14 Shibadaimon, Minato-ku
Tokyo, Japan 105-0012
TEL: 81-3-5733-1155 / FAX: 81-3-5733-1255

Delta Electronics (Korea), Inc.
Seoul Office
1511, 219, Gasan Digital 1-Ro., Geumcheon-gu,
Seoul, 08501 South Korea
TEL: 82-2-515-5305 / FAX: 82-2-515-5302

Delta Energy Systems (Singapore) Pte Ltd.
4 Kaki Bukit Avenue 1, #05-04, Singapore 417939
TEL: 65-6747-5155 / FAX: 65-6744-9228

Delta Electronics (India) Pvt. Ltd.
Plot No.43, Sector 35, HSIIDC Gurgaon,
PIN 122001, Haryana, India
TEL: 91-124-4874900 / FAX : 91-124-4874945

Delta Electronics (Thailand) PCL.
909 Soi 9, Moo 4, Bangpoo Industrial Estate (E.P.Z),
Pattana 1 Rd., T.Phraksa, A.Muang,
Samutprakarn 10280, Thailand
TEL: 66-2709-2800 / FAX : 662-709-2827

Delta Electronics (Australia) Pty Ltd.
Unit 2, Building A, 18-24 Ricketts Road,
Mount Waverley, Victoria 3149 Australia
Mail: IA.au@deltaww.com
TEL: +61-1300-335-823 / +61-3-9543-3720

Americas

Delta Electronics (Americas) Ltd.
Raleigh Office
5101 Davis Drive, Research Triangle Park, NC 27709, U.S.A.
TEL: 1-919-767-3813 / FAX: 1-919-767-3969

Delta Electronics Brasil Ltd.
São Paulo Office
Estrada Velha Rio-São Paulo, 5300 Eugênio de
Melo - São José dos Campos CEP: 12247-004 – SP - Brasil
TEL: 55-12-3932-2300 / FAX: +55-12-3932-237

Delta Electronics International Mexico S.A. de C.V.
Mexico Office
Gustavo Baz No. 309 Edificio E PB 103
Colonia La Loma, CP 54060
Tlalnepantla, Estado de México
TEL: 52-55-3603-9200

EMEA

Headquarters: Delta Electronics (Netherlands) B.V.
Sales: Sales.IA.EMEA@deltaww.com
Marketing: Marketing.IA.EMEA@deltaww.com
Technical Support: iatechnicalsupport@deltaww.com
Customer Support: Customer-Support@deltaww.com
Service: Service.IA.emea@deltaww.com
TEL: +31(0)40 800 3900

BENELUX: Delta Electronics (Netherlands) B.V.
Automotive Campus 260, 5708 JZ Helmond, The Netherlands
Mail: Sales.IA.Benelux@deltaww.com
TEL: +31(0)40 800 3900

DACH: Delta Electronics (Netherlands) B.V.
Coesterweg 45, D-59494 Soest, Germany
Mail: Sales.IA.DACH@deltaww.com
TEL: +49(0)2921 987 0

France: Delta Electronics (France) S.A.
ZI du bois Challand 2, 15 rue des Pyrénées,
Lisses, 91090 Evry Cedex, France
Mail: Sales.IA.FR@deltaww.com
TEL: +33(0)1 69 77 82 60

Iberia: Delta Electronics Solutions (Spain) S.L.U
Ctra. De Villaverde a Vallecas, 265 1º Dcha Ed.
Hormigueras – P.I. de Vallecas 28031 Madrid
TEL: +34(0)91 223 74 20

Carrer Llacuna 166, 08018 Barcelona, Spain
Mail: Sales.IA.Iberia@deltaww.com

Italy: Delta Electronics (Italy) S.r.l.
Via Meda 2–22060 Novedrate(CO)
Piazza Grazioli 18 00186 Roma Italy
Mail: Sales.IA.Italy@deltaww.com
TEL: +39 039 8900365

Russia: Delta Energy System LLC
Vereyskaya Plaza II, office 112 Vereyskaya str.
17 121357 Moscow Russia
Mail: Sales.IA.RU@deltaww.com
TEL: +7 495 644 3240

Turkey: Delta Greentech Elektronik San. Ltd. Sti. (Turkey)
Şerifali Mah. Hendem Cad. Kule Sok. No:16-A
34775 Ümraniye – İstanbul
Mail: Sales.IA.Turkey@deltaww.com
TEL: + 90 216 499 9910

MEA: Eltek Dubai (Eltek MEA DMCC)
OFFICE 2504, 25th Floor, Saba Tower 1,
Jumeirah Lakes Towers, Dubai, UAE
Mail: Sales.IA.MEA@deltaww.com
TEL: +971(0)4 2690148

DELTA_IA-ASD_ASDA-A2-E_UM_EN_20221229

ASDA A2-E EtherCAT Interface Servo Drive User Manual

ASDA A2-E EtherCAT Interface Servo Drive User Manual

www.deltaww.com

Smarter. Greener. Together.

Table of Contents

(This page is intentionally left blank.)

Chapter 1 CoE Drive Overview

1.1 Communication Specification

EtherCAT communication functions	Physical layer	100BASE-TX
	Communication connector	RJ45 × 2 (Connector CN6A = input, CN6B = output)
	Network topology	Line connection
	Baud rate	2 x 100 Mbps (full duplex)
	Data frame length	Maximum 1484 bytes
	SyncManager	SM0: mailbox output SM1: mailbox input SM2: process data output SM3: process data input
	FMMU (Fieldbus Memory Management Units)	FMMU0: process data output area FMMU1: process data input area FMMU2: mailbox status area
	Device profile	CoE: CANopen over EtherCAT
	Synchronization mode	DC synchronization (SYNC0) Non-synchronized (Free Run)
	Communication object	SDO: Service Data Object PDO: Process Data Object EMCY: Emergency Data Object
	LED indicator (On RJ45 connector)	EtherCAT ERR (ER) × 1 EtherCAT Link/Activity (L/A) × 2 EtherCAT RUN (RN) × 1
	Application layer specifications	IEC61800-7 CiA402 Drive Profile
Supported CiA402 operation modes		■ Profile Position Mode (PP) ■ Profile Velocity Mode (PV) ■ Profile Torque Mode (PT) ■ Homing Mode (HM) ■ Interpolated Position Mode (IP) ■ Cycle Synchronous Position Mode (CSP) ■ Cycle Synchronous Velocity Mode (CSV) ■ Cycle Synchronous Torque Mode (CST)

1.2 The Interface of Delta EtherCAT Servo Drive

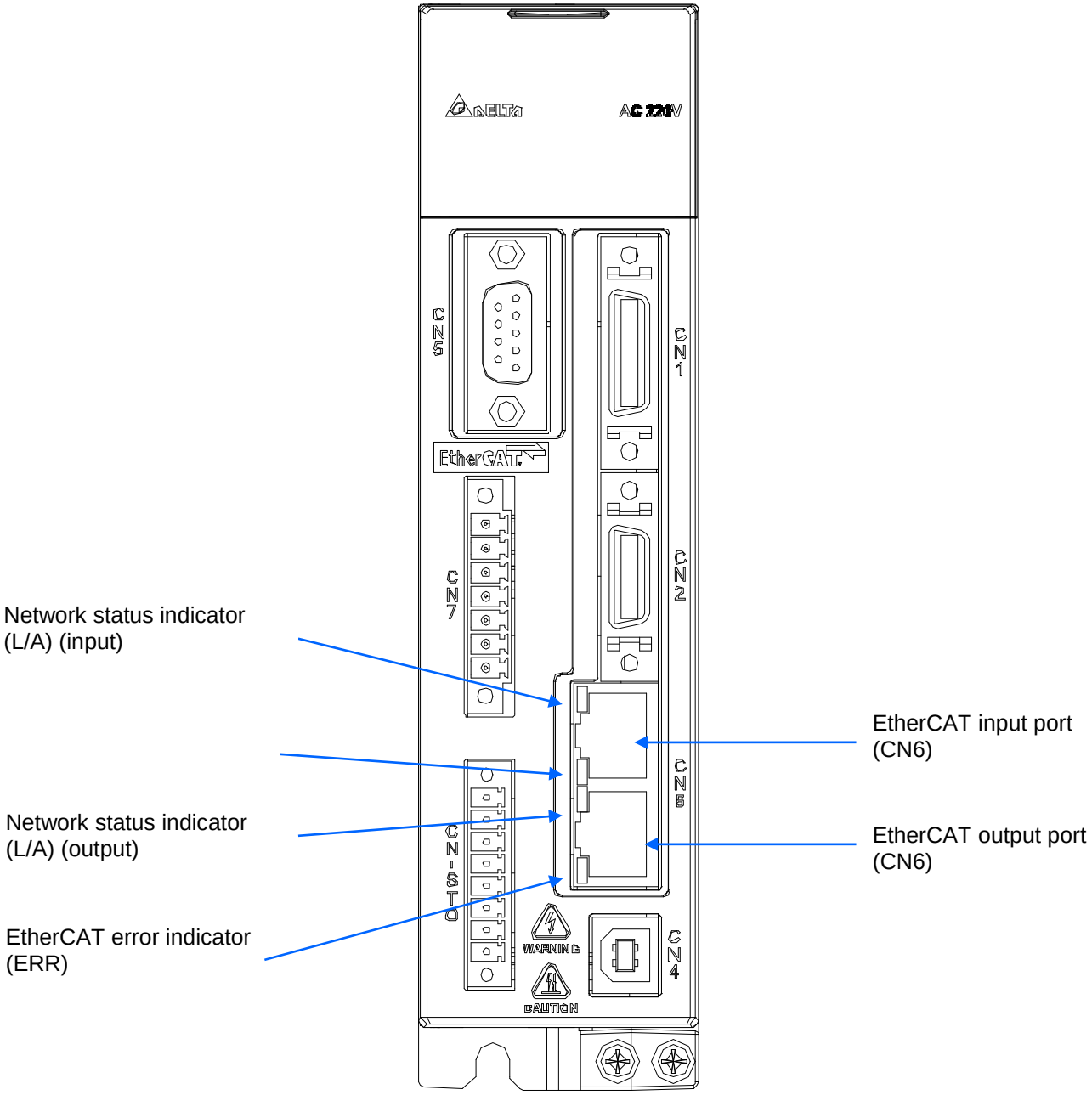


Figure 1.2.1 The Interface of Delta EtherCAT Servo Drive

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

1.3 LED Indicators

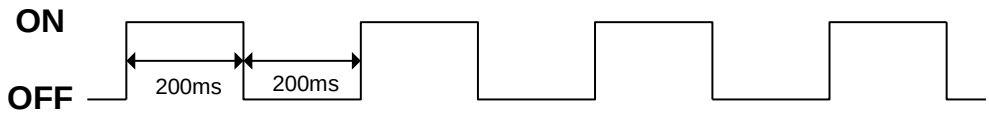
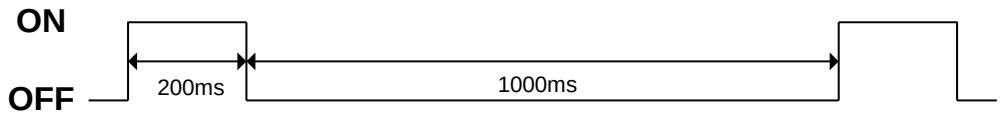
Indicator status	Description
ON	
Blinking	
Single Flash	
OFF	

Figure 1.3.1. RJ45 LED indicator status description

- Network status indicator (L/A)

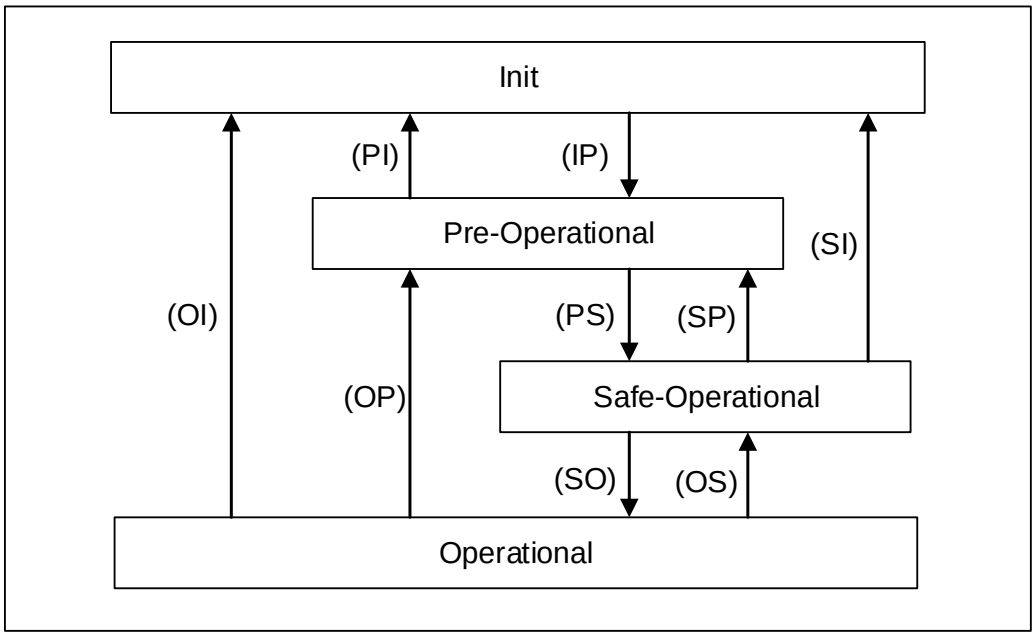
Indicator	Status	Description
On	Network is connected	Network connection is established but no data transmission.
Blinking	Network connection is established and data is in transmission	Data in transmission.
Off	No connection	Network connection is not established.

- EtherCAT connection status indicator (RUN)

Indicator	Status	Description
Off	Init (Initialization)	After power cycling and the initialization of the servo drive is complete, the communication has not yet started, but the controller can access the servo drive's register.
On	Operational	SDO, TxPDO, and RxPDO data packets can be transmitted.
Blinking	Pre-Operational	The servo drive can use the SDO data packets to communicate with the controller.
Single Flash	Safe-Operational	The servo drive can use the SDO and TxPDO data packets to exchange data with the controller.

- EtherCAT error indicator (ERR)

Indicator	Status	Description
Off	No error	No error has occurred.
On	PDI Watchdog timeout	Servo drive malfunction. Contact the distributor for assistance.
Blinking	State change error	Parameter setting error causes the system unable to switch the state. Refer to the following diagram.
Single Flash	Synchronization error	The synchronization between the controller and the servo drive failed.
	SyncManager error	The data was lost during data reception.



1.4 Connecting Multiple Servo Drives

The connecting method of multiple servo drives varies with the controller you use. Refer to the controller's application manual for details. There are only one input port and one output port for EtherCAT communication on the ASDA A2-E servo drive.

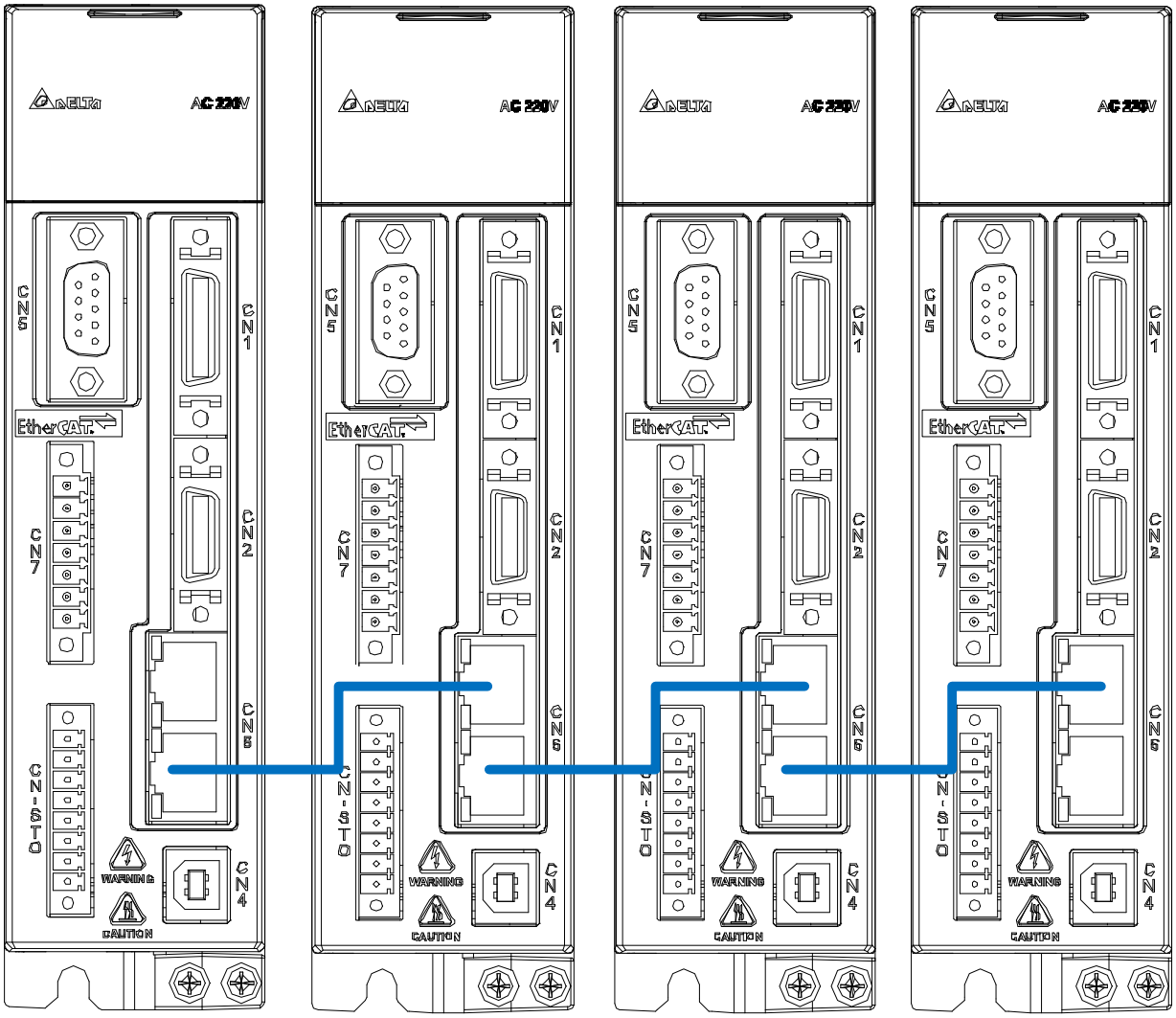


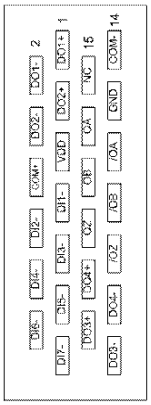
Figure 1.4.1 Example of EtherCAT connection for multiple servo drives

1.5 Wiring

1.5.1 Wiring for CN1 I/O Connector

For better communication with the controller, the CN1 IO connector includes 7 inputs (parameters P2-10 to P2-16) and 4 outputs (parameters P2-18 to P2-21) for you to define their functions. In addition, differential output signals (A+, A-, B+, B-, Z+, and Z-) for the encoder are also provided. The pin assignments are shown as follows:

CN1 Connector (female)



CN1 Connector (male)
rear view

2	DO1-	Digital output
4	DO2-	Digital output
6	COM+	Power input (12 - 24V)
8	DI2-	Digital input
10	DI4-	Digital input
12	DI6-	Digital input

1	DO1+	Digital output
3	DO2+	Digital output
5	VDD	+24V Power output
7	DI1-	Digital input
9	DI3-	Digital input
11	DI5-	Digital input
13	DI7-	Digital input

15	NC	N/A
17	OA	Encoder A pulse output
19	OB	Encoder B pulse output
21	OZ	Encoder Z pulse output
23	DO4+	Digital output
25	DO3+	Digital output

14	COM-	VDD power ground
16	GND	Analog input signal ground
18	/OA	Encoder /A pulse output
20	/OB	Encoder /B pulse output
22	/OZ	Encoder /Z pulse output
24	DO4-	Digital output
26	DO3-	Digital output

Note: NC represents “No connection”, which is for internal use only. Do not connect to NC, or it may damage the servo drive.

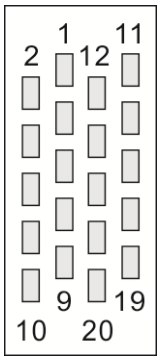
The following table details the signals listed in the previous section.

General signals:

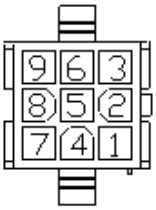
Signal		Pin No.	Description	Wiring Method (Refer to the A2 manual)
Position pulse (output)	OA /OA	17 18	Encoder signals A, B, and Z differential (line driver) output.	C13 / C14
	OB /OB	19 20		
	OZ /OZ	21 22		
Power	VDD	5	VDD is the +24V power provided by the servo drive for Digital Input (DI) and Digital Output (DO) signals. The maximum permissible current is 500 mA.	-
	COM+	6	COM+ is the common voltage input for Digital Input (DI) and Digital Output (DO). When using VDD, connect VDD to COM+. If not used, apply external power (+12V to +24V) to the drive. The positive end of the external power should connect to COM+ and the negative end should connect to COM-.	
	COM-	14		
	GND	16	VCC voltage is based on GND.	
Others	NC	15	No connection. This is for internal use only. Do not connect to NC, or it may damage the servo drive.	

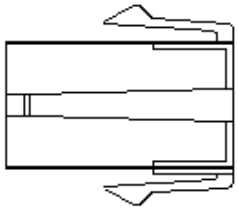
1.5.2 CN2 Connector

CN2 Connector (female)

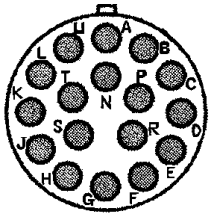


CN2 Connector (male)
Rear view





Quick Connector
Housing: AMP (1-172161-9)

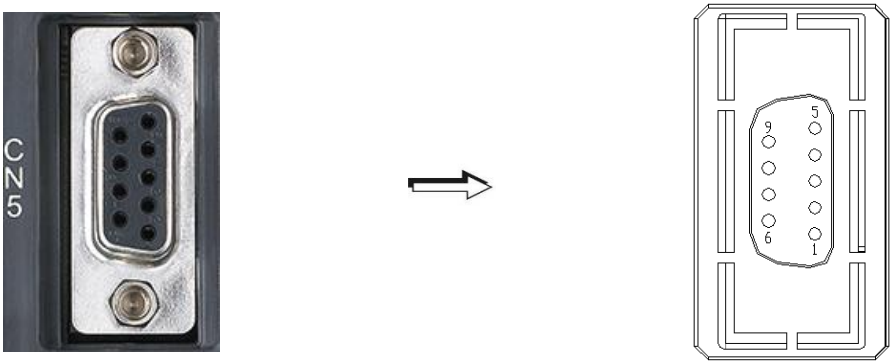


Military Connector
3106A-20-29S

CN2 of Servo Drive			Motor Connector		
Pin No.	Signal	Description	Military connector	Quick connector	Color
5	T+	Serial communication signal input / output (+)	A	1	Blue
4	T-	Serial communication signal input / output (-)	B	4	Blue & black
-	-	Reserved	-	-	-
-	-	Reserved	-	-	-
14,16	+5V	+5V power supply	S	7	Red / Red & white
13,15	GND	Power ground	R	8	Black / Black & white
-	-	Shielding	L	9	-

1.5.3 CN5 Connector (Applicable to Full-closed Loop)

The CN5 connector is for connecting to the external linear scale or the encoder (A, B, and Z), which forms a full-closed loop with the servo system. In Position mode, the pulse command issued by the controller is based on the control loop of the external linear scale; refer to Chapter 5 for details.



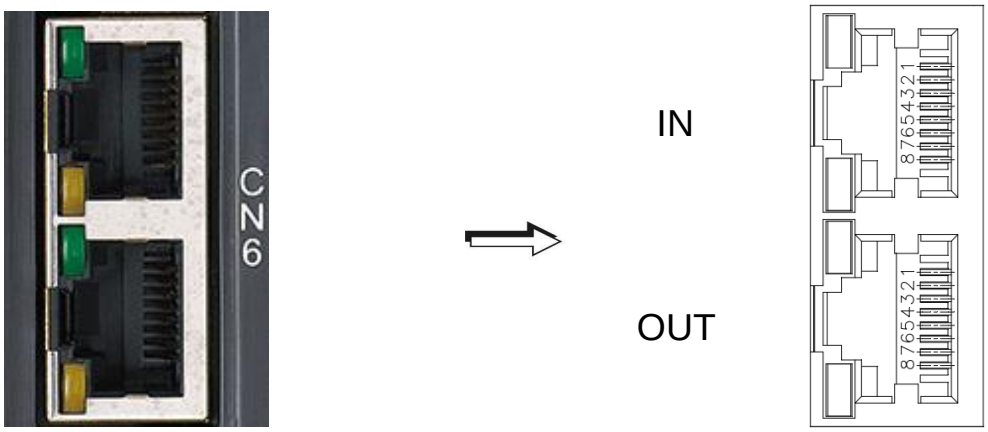
CN5 Connector (female)

Pin No.	Signal	Terminal	Description
1	/Z phase input	Opt_/Z	/Z phase
2	/B phase input	Opt_/B	/B phase
3	B phase input	Opt_B	B phase
4	A phase input	Opt_A	A phase
5	/A phase input	Opt_/A	/A phase
6	Ground for the encoder	GND	Ground
7	Ground for the encoder	GND	Ground
8	Encoder power	+5V	+5V power
9	Z phase input	Opt_Z	Z phase

Note:

1. CN5 only supports AB phase signals and the encoder of 5V.
2. Full-closed loop supports the encoder of highest resolution 1280000 pulse/rev, which is the pulse number per motor revolution in a full-closed loop that corresponds to an optical signal with AB (Quadrature) phase pulses (4x).

1.5.4 CN6 EtherCAT Communication Connector

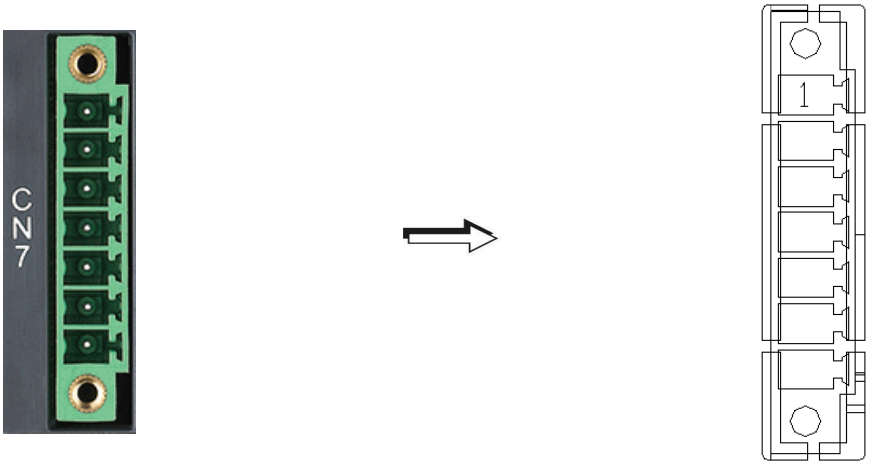


CN6 Connector (female)

Pin No.	Signal	Terminal	Description
1	TX +	TX +	Transmit +
2	TX -	TX -	Transmit -
3	RX +	RX +	Receive +
4	-	-	-
5	-	-	-
6	RX -	RX -	Receive -
7	-	-	-
8	-	-	-

Note:
1. When multiple servo drives are connected, the maximum distance between each servo drive is 50 meters (164.04 inches).
2. Use CAT5e STP shielded cable.
3. It is suggested that you use a Beckhoff EtherCAT cable (model number: ZB9020).

1.5.5 CN7 Extension DI Connector



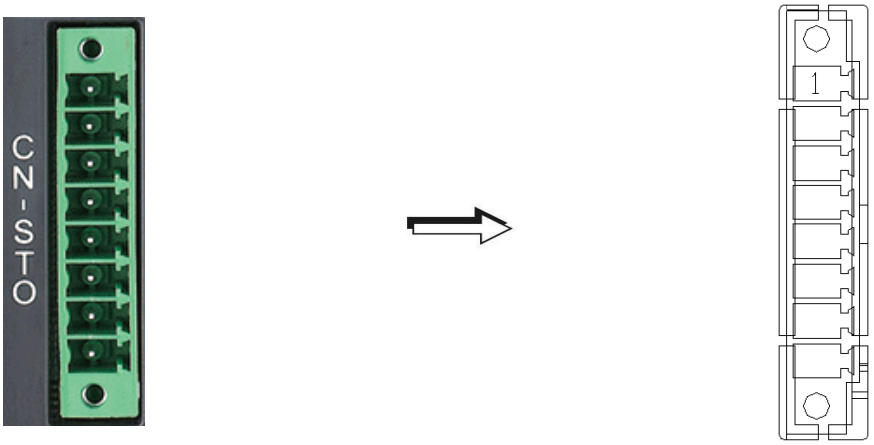
CN7 Connector (male)

Pin No.	Signal	Terminal	Description
1*	Power input (12 - 24V)	COM+	Power input
2	Extension DI9	EDI 9-	Digital input pin 9-
3	Extension DI10	EDI 10-	Digital input pin 10-
4	Extension DI11	EDI 11-	Digital input pin 11-
5	Extension DI12	EDI 12-	Digital input pin 12-
6	Extension DI13	EDI 13-	Digital input pin 13-
7	Extension DI14	EDI 14-	Digital input pin 14-

WARNING

➢ ***Caution: do not apply dual power to Pin 1 or it may damage the servo drive.***

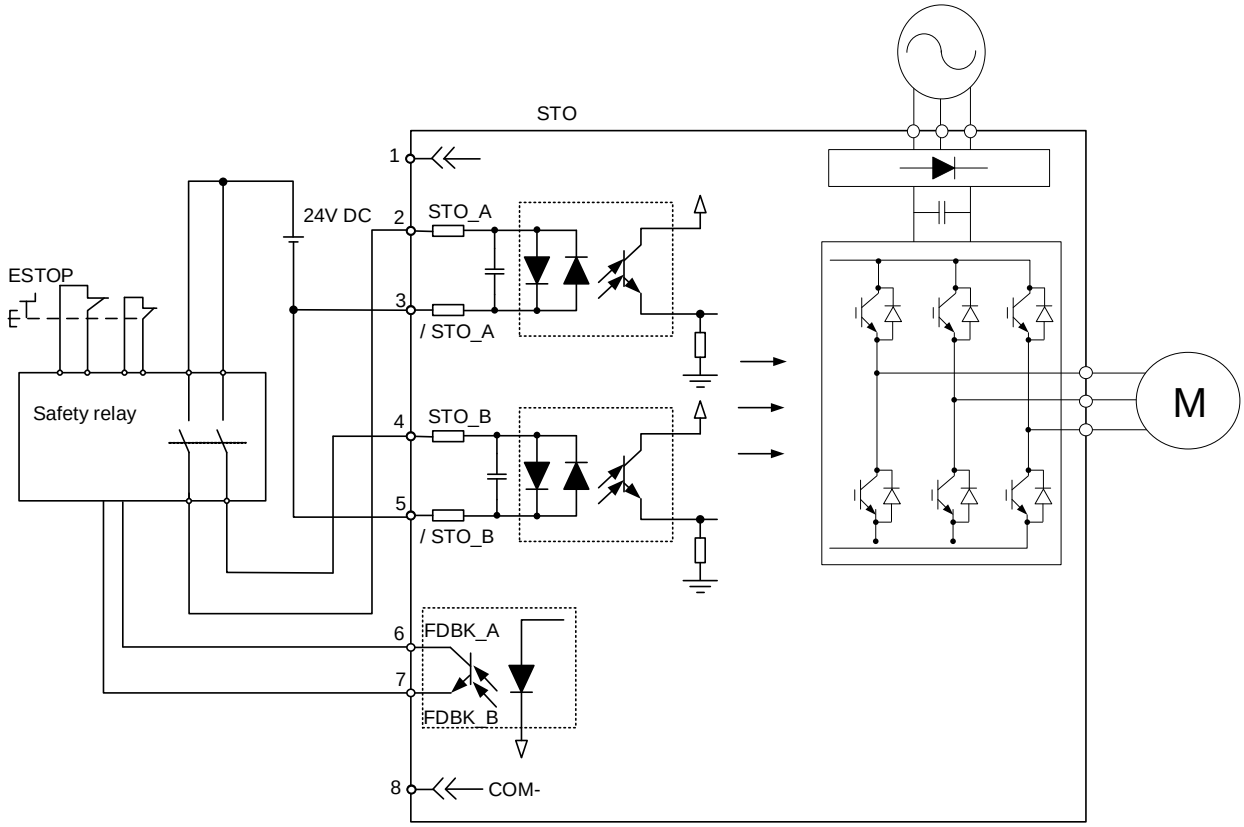
1.5.6 CN-STO Connector



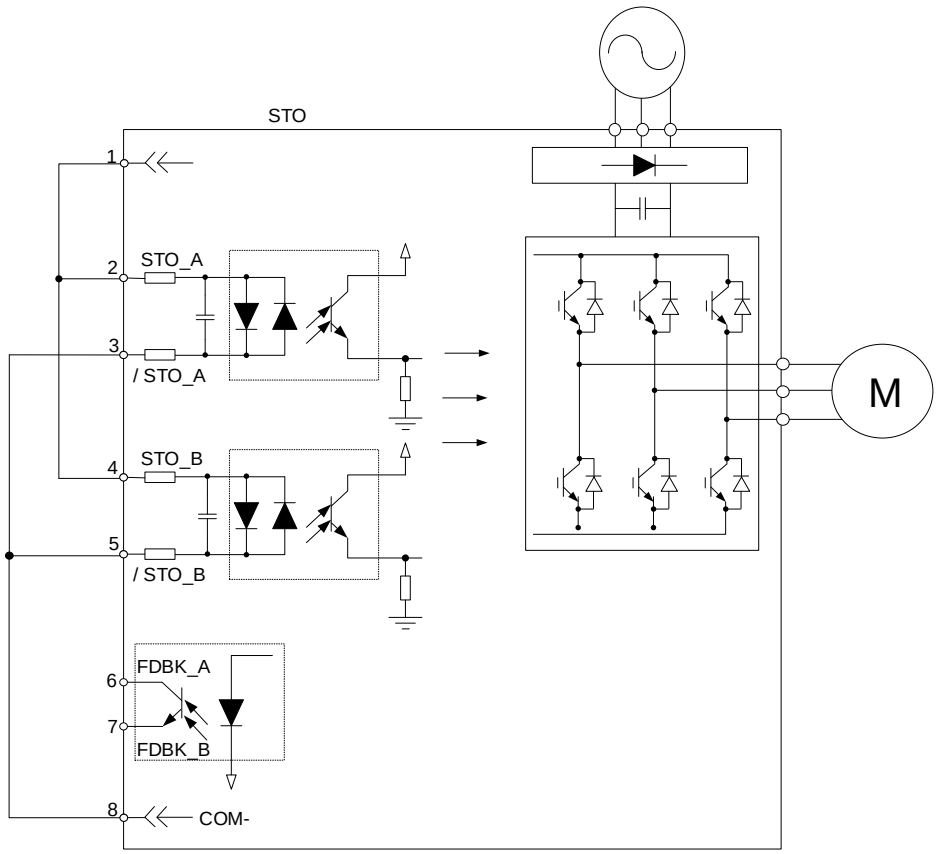
CN-STO Connector (male)

Pin No.	Signal	Terminal	Description
1	-	-	For short-circuiting the STO only. Do not connect the wiring for other purposes.
2	STO_A	STO_A	STO input pin A+
3	/STO_A	/STO_A	STO input pin A-
4	STO_B	STO_B	STO input pin B+
5	/STO_B	/STO_B	STO input pin B-
6	FDBK_A	FDBK_A	STO alarm output pin A Relay max. output current: 1 A
7	FDBK_B	FDBK_B	STO alarm output pin B Relay max. output current: 1 A
8	COM-	COM-	For short-circuiting the STO only. Do not connect the wiring for other purposes.

1.5.7 Trigger STO with Safety Relay



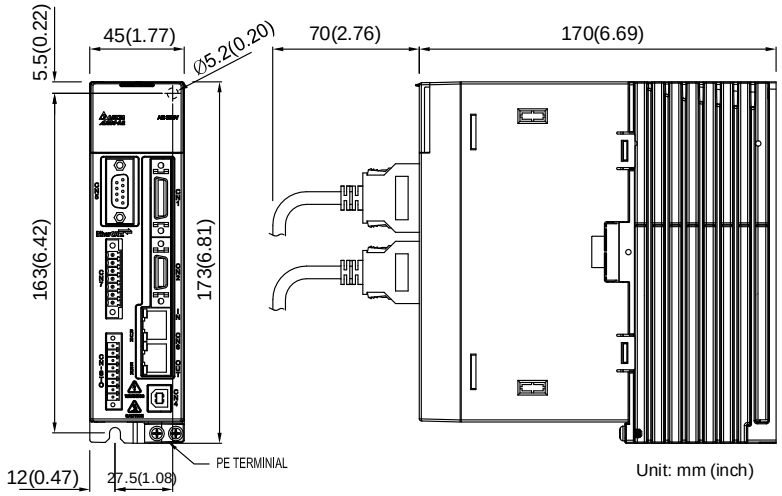
1.5.8 Disable STO

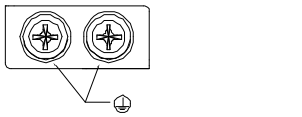


1.6 Dimensions

1.6.1 220V Series

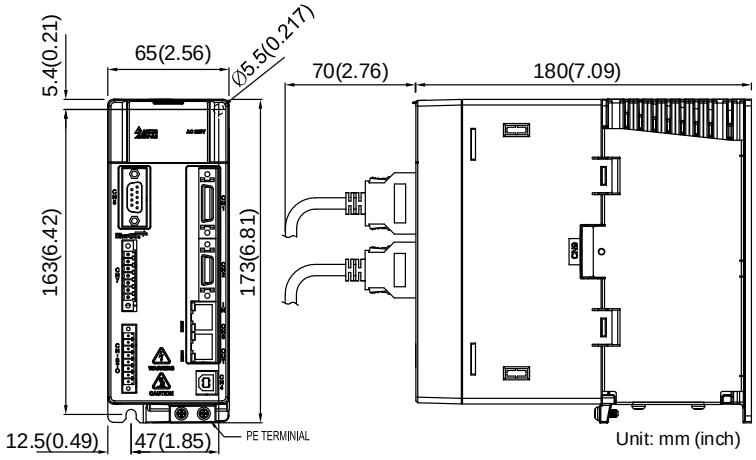
100 W / 200 W / 400 W

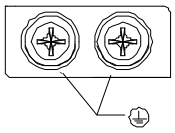




Weight	1.5 kg (3.3 lbs)

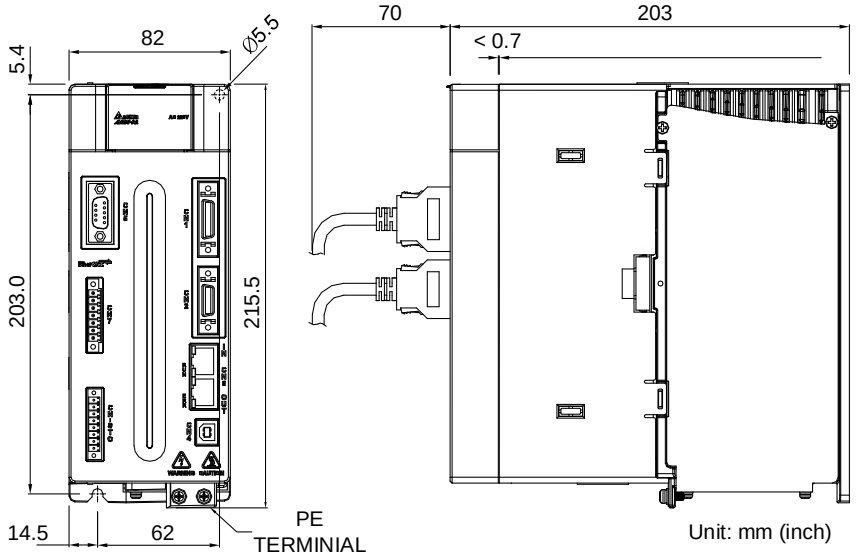
750 W / 1 kW / 1.5 kW

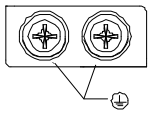




Weight	2.0 kg (4.4 lbs)

2 kW / 3 kW



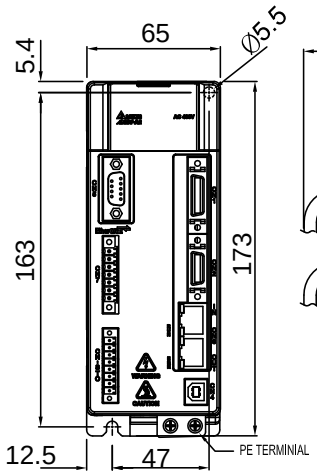


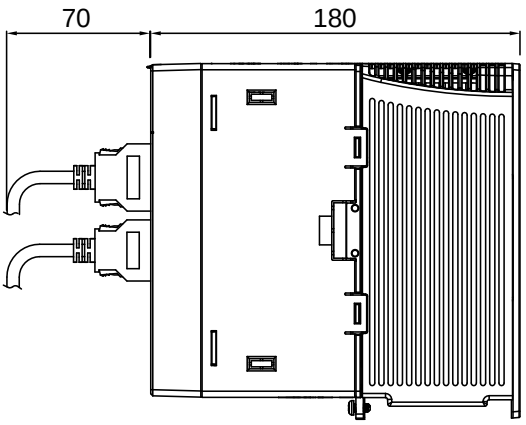
SCREW: M4×0.7
MOUNTING SCREW TORQUE:14(kgf-cm)

Weight	2.89 kg (6.36 lbs)

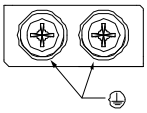
1.6.2 400V Series

400 W / 750 W / 1 kW / 1.5 kW





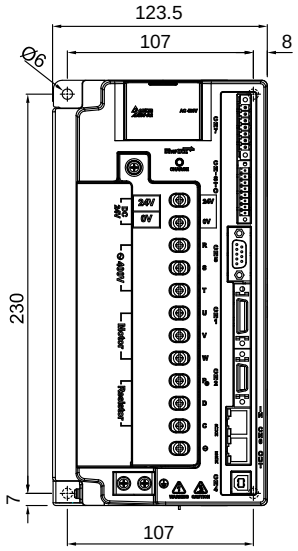
Unit: mm (inch)

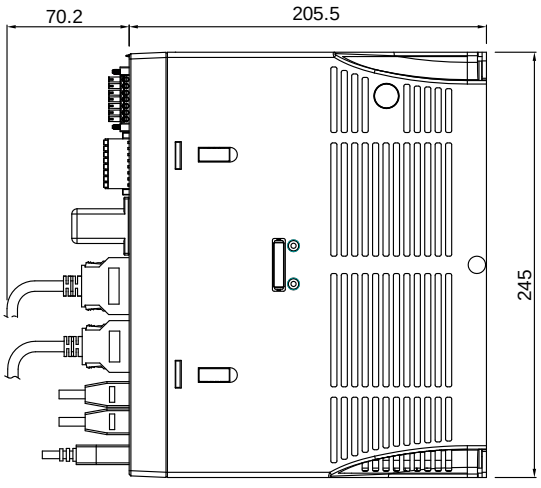


SCREW: M4×0.7
MOUNTING SCREW TORQUE:14(kgf-cm)

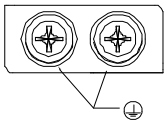
Weight	2.0 kg (4.4 lbs)

2 kW / 3 kW / 4.5 kW / 5.5 kW





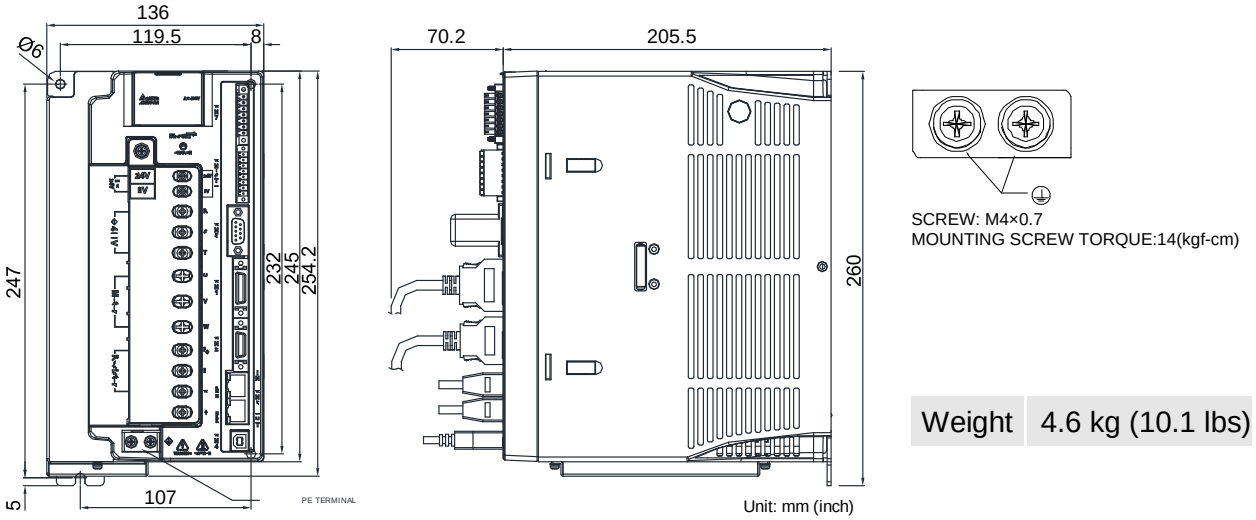
Unit: mm (inch)



SCREW: M4×0.7
MOUNTING SCREW TORQUE:14(kgf-cm)

Weight	4.6 kg (10.1 lbs)

7.5 kW



Weight	4.6 kg (10.1 lbs)

Note: dimensions and weights of the servo drive may be updated without prior notice.

1.7 Regenerative Resistor

Specifications of the built-in regenerative resistor in the ASDA-A2-E 220V series:

Servo drive (kW)	Specifications of the built-in regenerative resistor		Capacity of the built-in regenerative resistor (Watt)	Min. allowable resistance value (Ohm)
	Resistance (P1-52) (Ohm)	Capacity (P1-53) (Watt)		
0.1	-	-	-	30
0.2	-	-	-	30
0.4	40	40	20	30
0.75	40	60	30	20
1.0	40	60	30	20
1.5	40	60	30	20
2.0	20	100	50	10
3.0	20	100	50	10
4.5	20	100	50	10
5.5	-	-	-	8
7.5	-	-	-	5

Specifications of the built-in regenerative resistor in the ASDA-A2-E 400V series:

Servo drive (kW)	Specifications of the built-in regenerative resistor		Min. allowable resistance value (Ohm)
	Resistance (P1-52) (Ohm)	Capacity (P1-53) (Watt)	
0.4	80	40	60
0.75	80	40	60
1.0	80	40	60
1.5	80	40	40
2.0	-	-	40
3.0	-	-	30
4.5	-	-	20
5.5	-	-	20
7.5	-	-	15
11	-	-	15
15	-	-	12

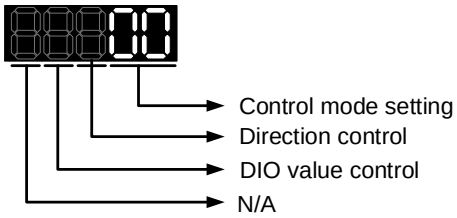
Chapter 2 System Setup

2.1 Parameter Settings for EtherCAT Modes

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

P1-01●	**CTL**	**Input for Control Mode and Control Command**		**Address: 0102H 0103H**
Interface:	Panel / Software	Communication	Reference:	-
Default:	0x0C$_h$		Control Mode:	ALL
Unit:	Pulse (Position mode); r/min (Speed mode); N-m (Torque mode)		Range:	0x0000 - 0x110F
Format:	Hex		Data Size:	16-bit

Settings:



■ Control mode setting

	PT	PR	S	T	Sz	Tz
Single Mode						
00	▲					
01		▲				
02			▲			
03				▲		
04					▲	
05						▲
Multi-mode						
0E	▲	▲	▲			
0F	▲	▲		▲		

	PT	PR	S	T	Sz	Tz
Dual Mode						
06	▲		▲			
07	▲			▲		
08		▲	▲			
09		▲		▲		
0A			▲	▲		
0B	N/A					
0C	CANopen Mode EtherCAT Mode					
0D	▲	▲				

PR: Position control mode; the command source is from the 64 sets of internal registers which you can select with DI.POS0 - POS5. Multiple homing methods are also available.

S: Speed control mode; the command source is from the external analog signal or the internal register, which you can select with DI.SPD0 and DI.SPD1.

T: Torque control mode; the command source is from the external analog signal or the internal register, which you can select with DI.TCM0 and DI.TCM1.

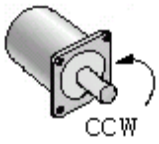
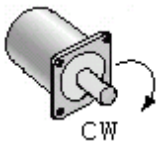
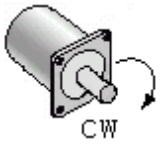
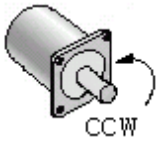
Sz: Speed control mode; the speed command is zero or the command source is from the internal speed registers, which you can select with DI.SPD0 and DI.SPD1.

Tz: Torque control mode; the torque command is zero or the command source is from the internal torque registers, which you can select with DI.TCM0 and DI.TCM1.

Dual Mode: you can switch between two modes with DI signals. For example, you can use DI.S-P to switch the dual mode of PT-S (refer to the A2 manual).

Multi-mode: you can switch between three modes with DI signals. For example, you can use DI.S-P and DI.PT-PR to switch the multi-mode of PT-PR-S (refer to the A2 manual).

■ Direction control

Direction	0	1
Positive		
Negative		

Note: when P1-01 = 0x0C, you need to set P3-12.Z to 1, or the direction setting in P1-01 will not be applied.

■ DIO value control

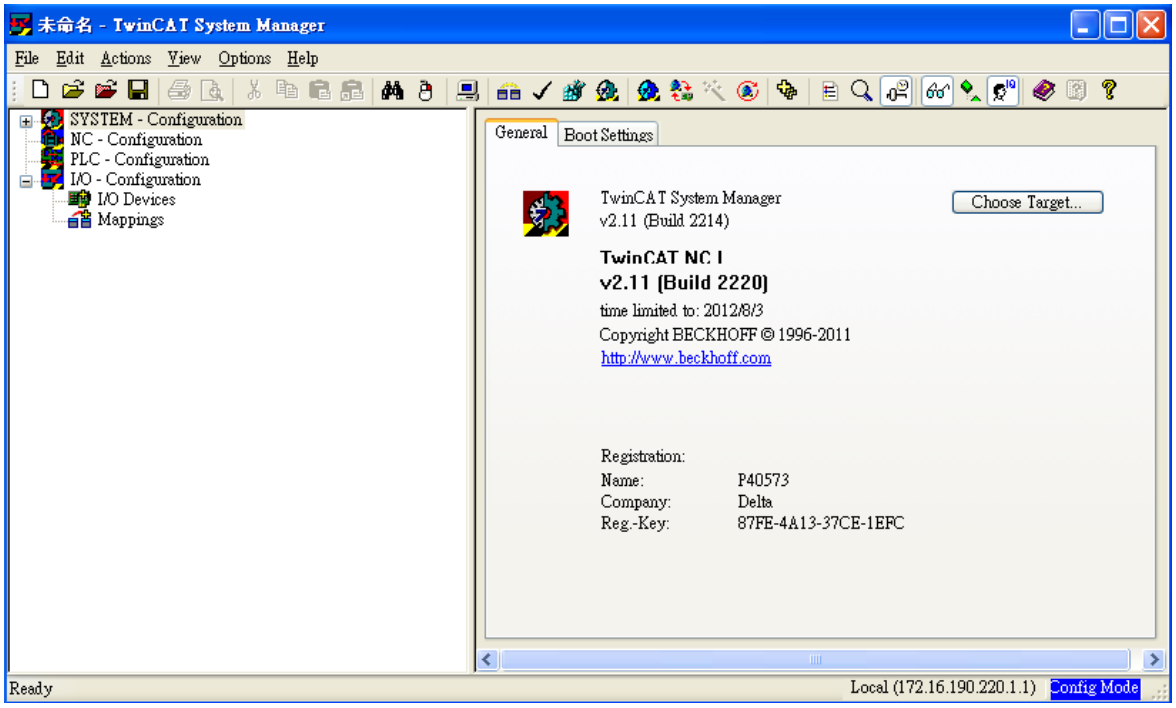
0: when modes are switched, DIO settings (P2-10 to P2-22) remain the same.

1: when modes are switched, DIO settings (P2-10 to P2-22) are reset to the default for each mode.

2.2 TwinCAT Setup

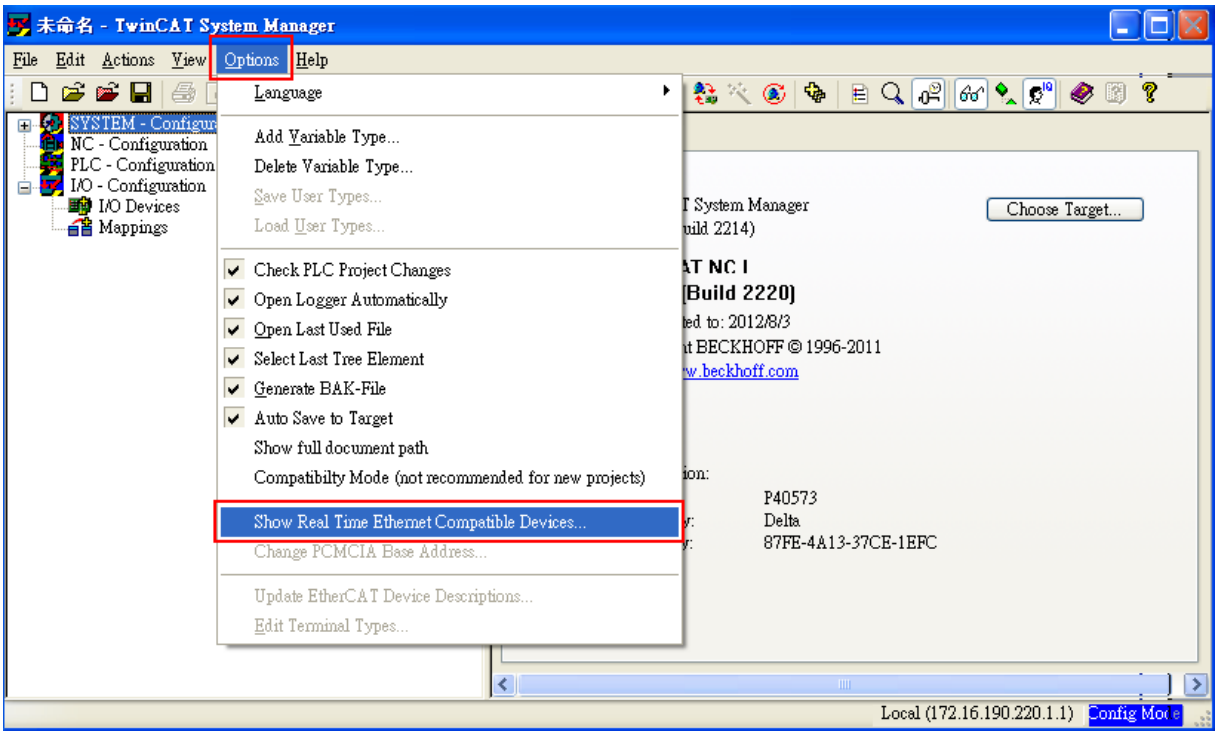
You can use different software to configure the EtherCAT system. The following steps use TwinCAT software of Beckhoff as an example. Please install the software before you start the TwinCAT setup.

1. Copy Delta XML description to the TwinCAT installation folder (usually in C:\TwinCAT\Io\EtherCAT).
2. Restart the TwinCAT.
3. Start the TwinCAT System Manager.

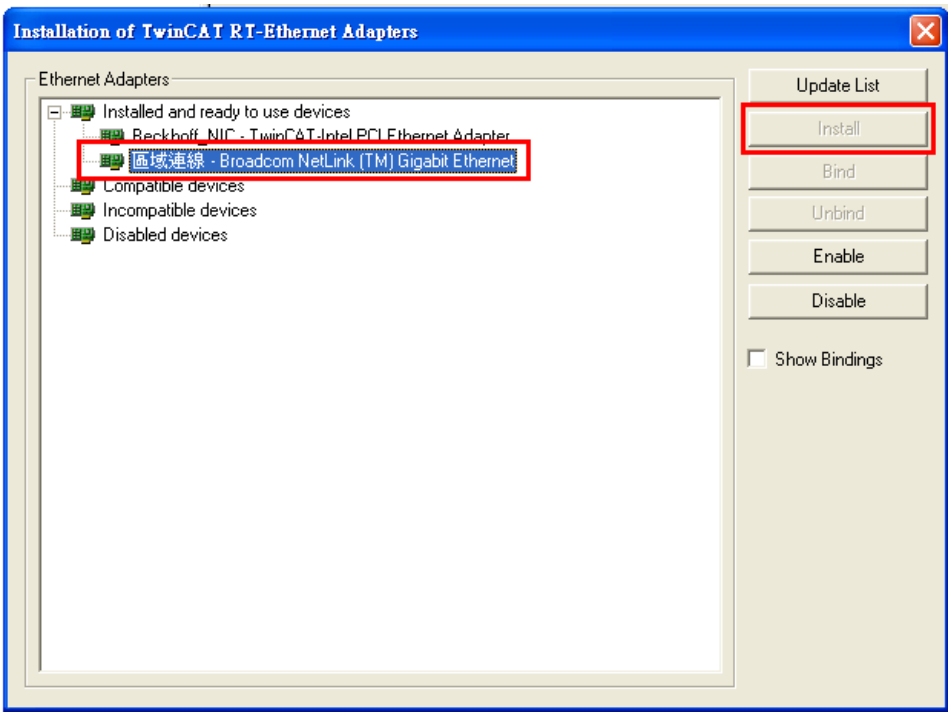


4. Install the Network Interface Card (NIC) for EtherCAT communication.

■ Select [**Options**] > [**Show Real Time Ethernet Compatible Devices...**].

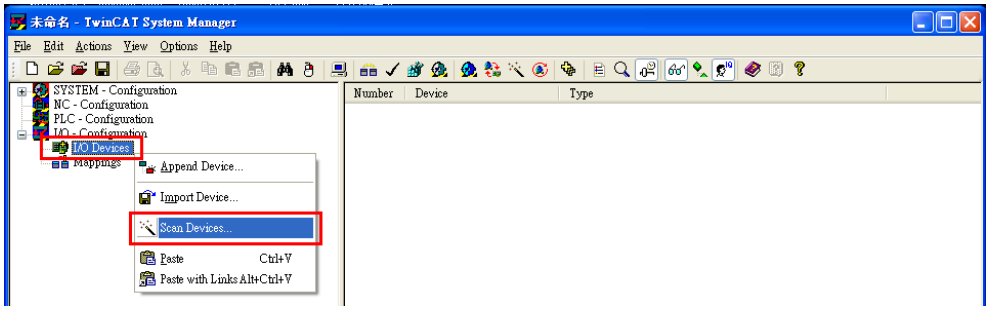


■ Select the correct Adapter from the devices (NICs) installed in the computer for EtherCAT communication and click **Install**.

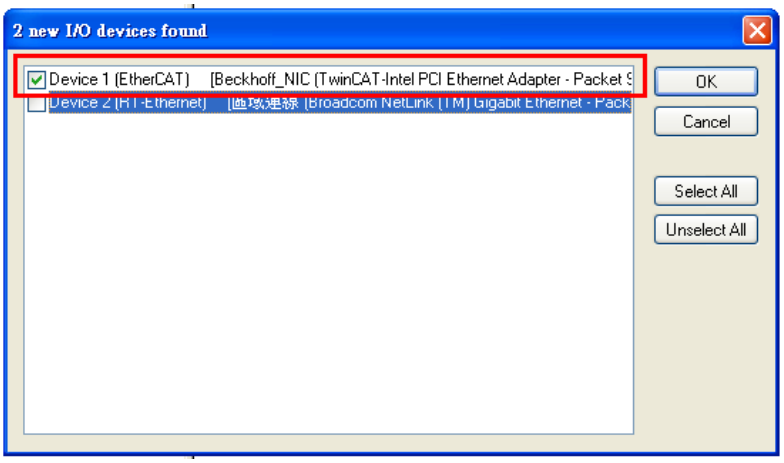


5. Select [**File**] > [**New**] from the drop-down list to create a new project.

6. Right-click **[I/O Devices**], and select [**Scan Devices…**] or press **F5** to scan the devices. Click **OK (確定)** in the pop-up window to proceed to the next step.

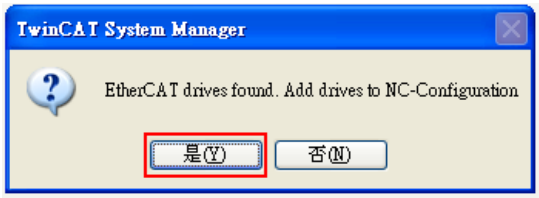


7. Select **Device [n] (EtherCAT)** and click **OK**.



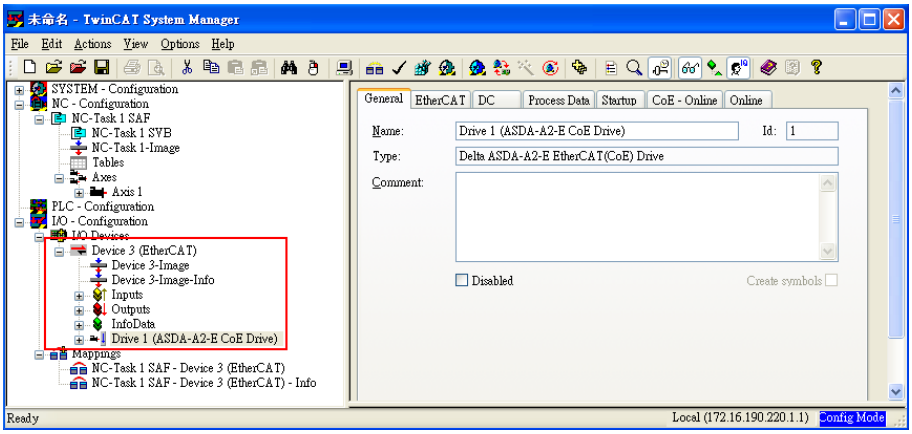
8. Click **Yes (是)** to scan for the control boxes.

9. Click **Yes (是)** to add drives to NC-Configuration.

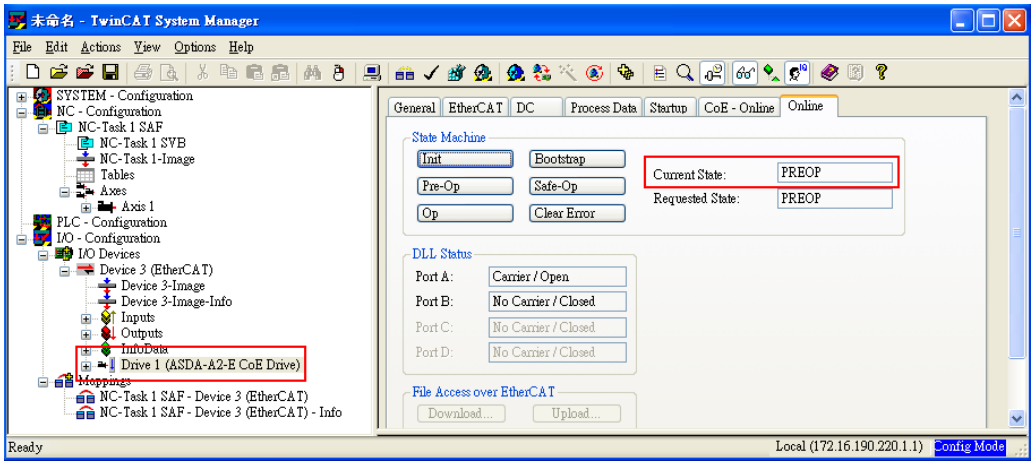


10. Click **No (否)** and TwinCAT will be switched to Config mode.

11. TwinCAT is in Config Mode. The window on the left shows Device 3 (EtherCAT) and Drive 1 (ASDA A2-E CoE Drive).

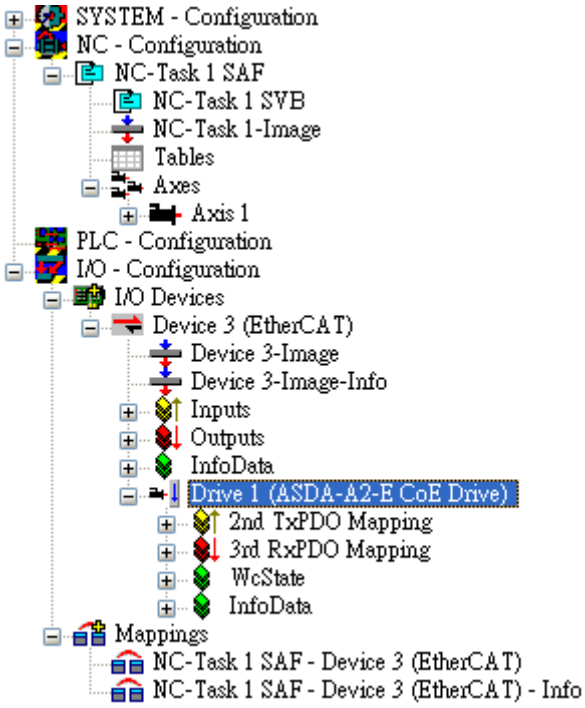


12. Select [**Drive 1 (ASDA A2-E CoE Drive)**] and in the **Online** tab you can check if the EtherCAT state machine (ESM) of the device is in PREOP state.



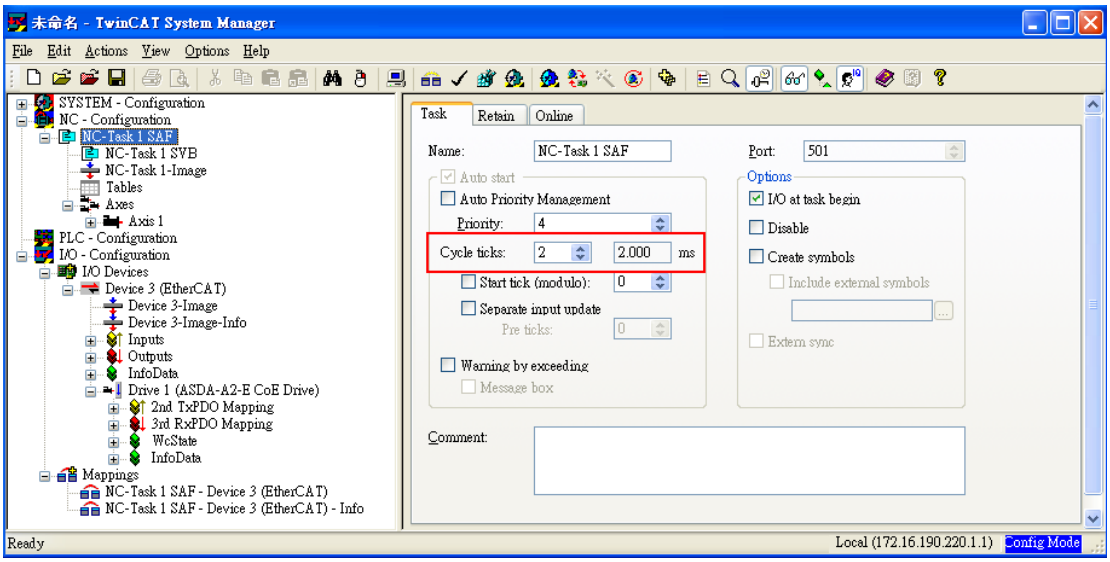
13. Double-click on [**Drive 1 (ASDA A2-E CoE Drive)**] and it will show:

    2nd TxPDO Mapping
    3rd RxPDO Mapping
    WcState
    InfoData



14. Set the communication cycle time* and the default value is 2 ms.

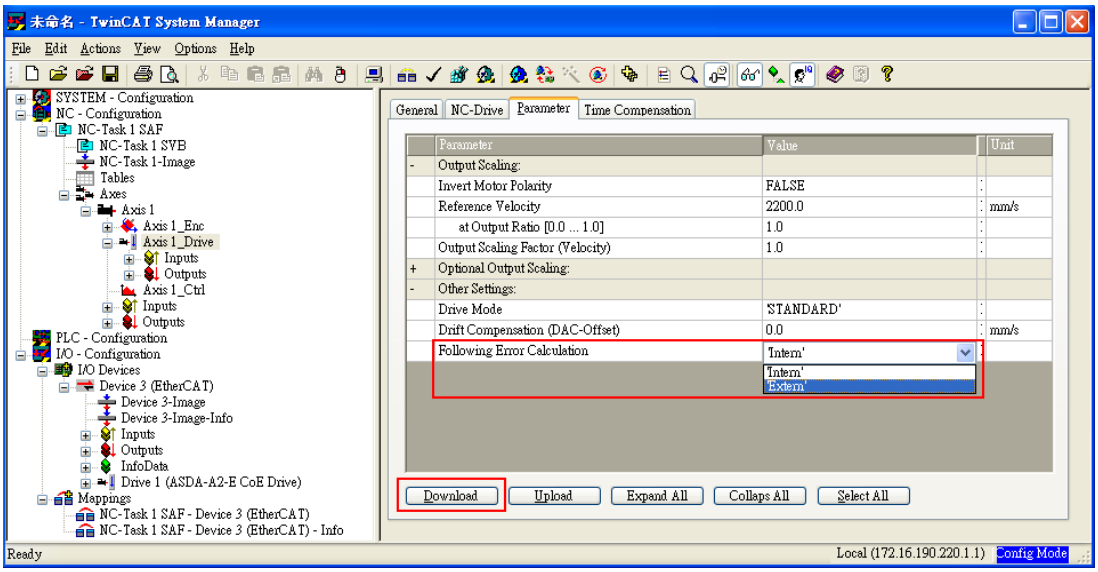
    ■ Select [**NC-Task 1 SAF**] in the left window, and set the communication cycle time (the minimum value is 1 ms) for Cycle ticks in the right window.



*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 the **Parameter** tab of the right window, select **Extern** for **Following Error Calculation** > click **Download** and then click **OK** in the pop-up window.

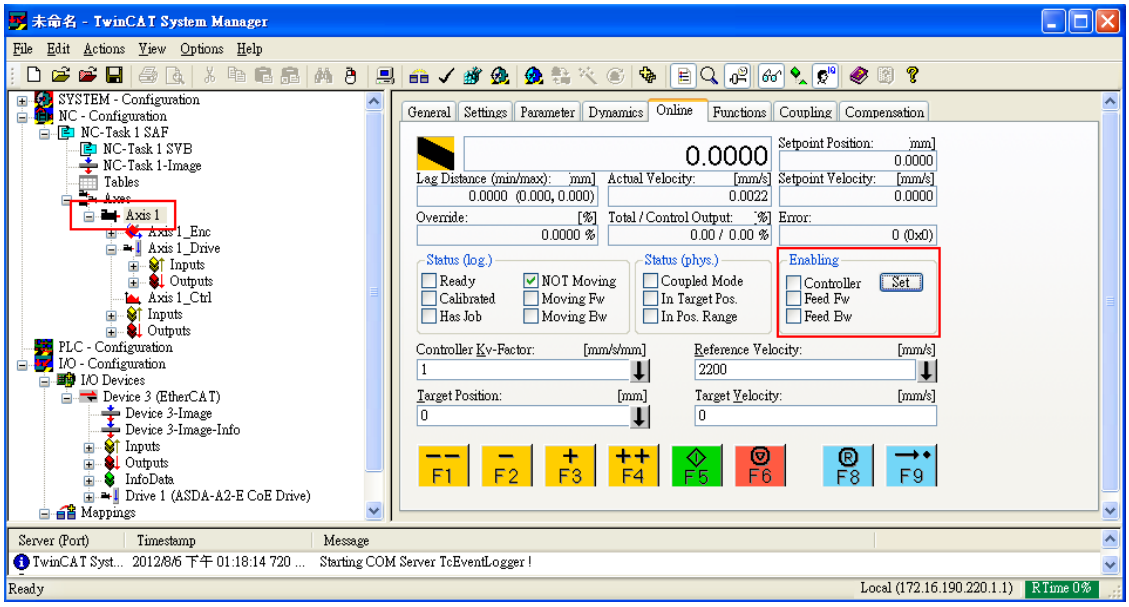


16. Switch TwinCAT to Run Mode.

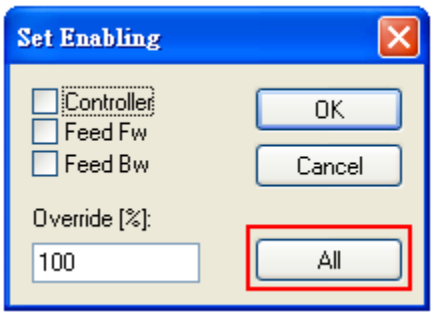
■ Press  to generate Mappings, press  to confirm the configuration, press  to activate the configuration, and then TwinCAT will be switched to Run Mode. Click **OK** in the pop-up window.

17. Enable the axis (Servo On).

■ Under [**NC-Configuration**] in the left window, select [**Axis 1**] > select the **Online** tab in the right window > click **Set**.



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



18. In the **Online** tab, there are jogging buttons with two different speed levels for forward and backward movement which can be used to test the system. During the operation, please ensure that the movement would not damage your system and endanger the personnel safety.

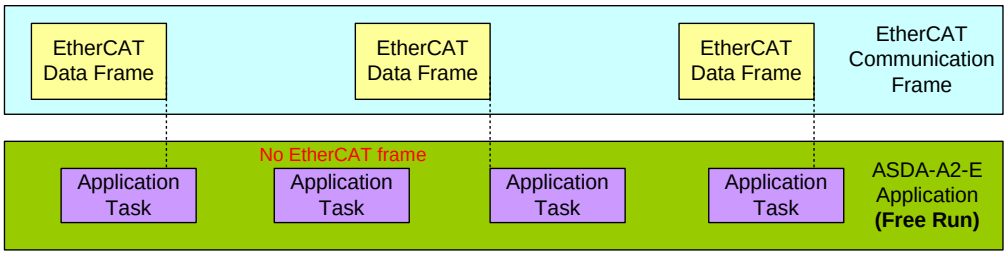
2.3 Synchronization Mode Setting

2.3.1 Synchronization Modes of the Servo Drive

ASDA A2-E supports two synchronization modes: Free Run mode and DC-Synchronous mode. Note that the Free Run mode is defined as a synchronous mode in the EtherCAT specification established by the EtherCAT Technology Group (ETG).

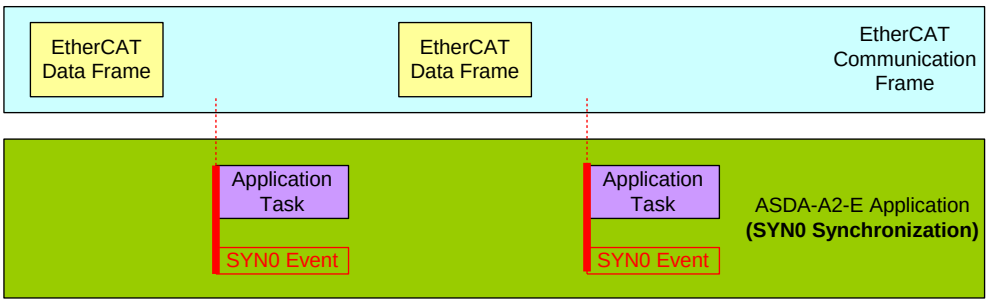
■ Free Run Mode (Asynchronous)

The master and slave stations run asynchronously in the Free Run mode. The clock of the slave runs independently of the clock of the master. In other words, the clocks are not synchronized. The command and feedback transmissions between the master and slave are based on a sequential order instead of a precise time synchronization. For example, the master sends a PDO at the time T1, and the slave receives the PDO at the time T1 or T2.



■ DC-Synchronous Mode (SYNC0 synchronization)

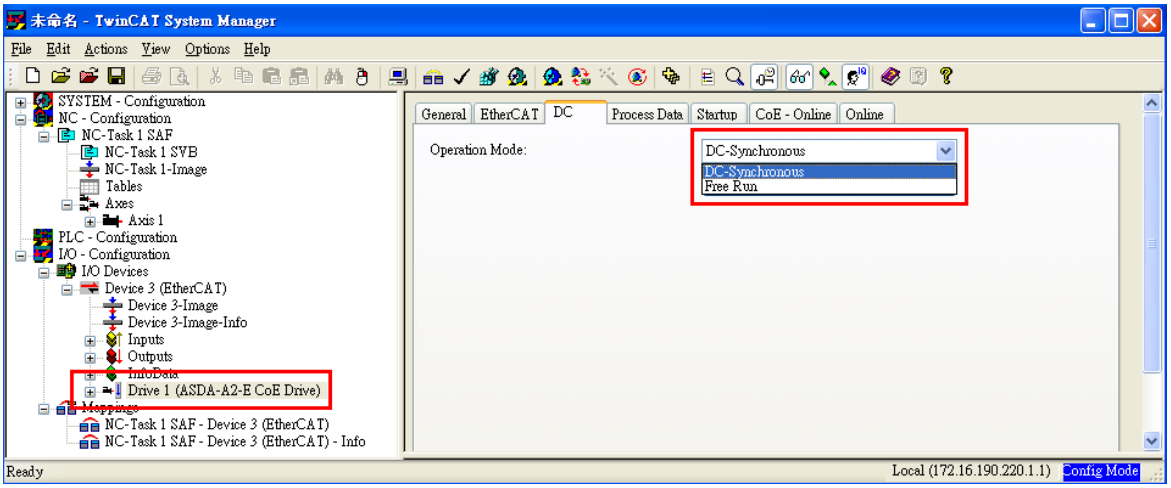
There is a clock tick for the master and all slaves operation. A data sent by the master will be received by the slave(s) at the same time interval. The master will inform all slaves about its clock and ask the slaves to align according to the time. A strict clock tick is always running within this system.



2.3.2 Select Synchronization Modes

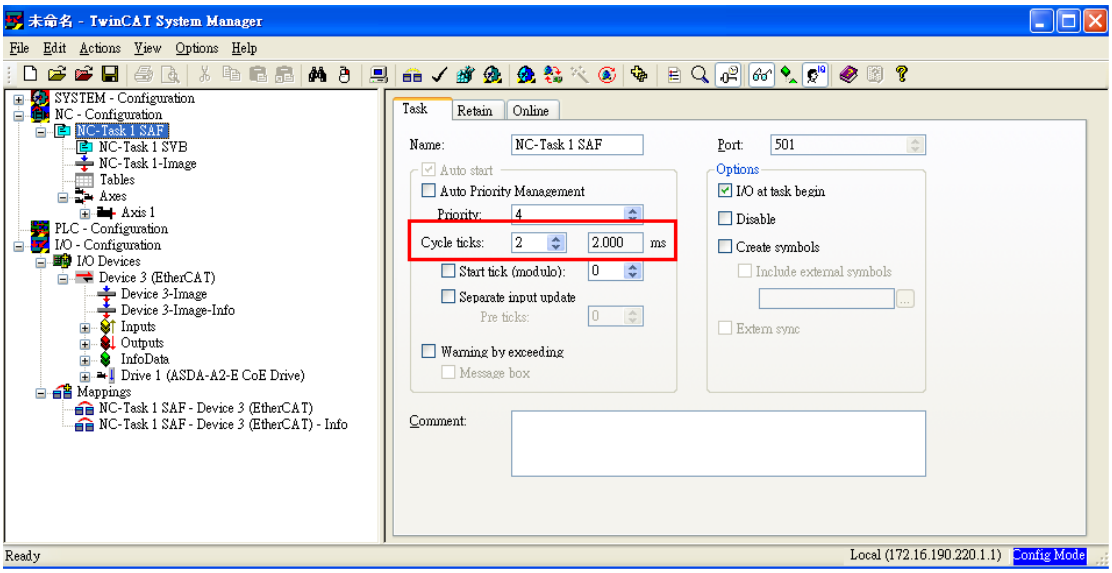
1. Select **Drive 1 (ASDA-A2-E CoE Drive)** in the left column of the TwinCAT System Manager software.

2. Under the **DC** tab in the right column, select **DC-Synchronous** or **Free Run** as the Operation Mode.



2.3.3 Distributed Clocks Setting

1. Select **NC-Task 1 SAF** in the left column of the TwinCAT System Manager software.
2. Set the data exchange cycle in the **Cycle ticks** field under the **Task** tab in the right column.



The SYNC0 cycle (unit: 1 ms) is used to define the PDO cycle time.

Supported SYNC0 cycle time	1 ms (PDO cycle time = 1 ms) 2 ms (PDO cycle time = 2 ms) 3 ms (PDO cycle time = 3 ms) …

2.4 PDO Mapping

The PDO mapping objects are allocated from OD 0x1600 to 0x1603 for RxPDOs and OD 0x1A00 to 0x1A03 for TxPDOs in the object dictionary.

2.4.1 Default PDO Mapping Configuration

The following tables show the default PDO mapping configuration of ASDA A2-E servo drive for data exchange. This is also defined in the XML file of the EtherCAT Slave.

- 1st group of PDO Mapping

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

- 2nd group of PDO Mapping (default)

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

- 3rd group of PDO Mapping

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

- 4th group of PDO Mapping

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

2.4.2 Set PDO Mapping

Setup procedure

1. Set 【RxPDO Assignment:0x1C12:0/ TxPDO Assignment: 0x1C13:0】to 0x0 for disabling the PDO assignment.
2. Set 【RxPDO mapping entry: ex. 0x1600:0/ TxPDO mapping entry: ex. 0x1A01:0】 to 0x0 for disabling the PDO mapping entry setting.
3. Set 【RxPDO mapping entry: ex. 0x1601:1 - 0x1601:7/ TxPDO mapping entry: ex. 0x1A01:1 - 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 the specified PDO assignment.
6. Set 【RxPDO Assignment:0x1C12:0/ TxPDO Assignment: 0x1C13:0】to 0x1 for enabling the PDO assignment.

2.4.3 Set PDO Mapping with TwinCAT

1. Press or **Shift** and **F4** to set / reset TwinCAT to Config Mode (Click **OK** in the pop-up window).
2. Select [Drive 1 (ASDA A2-E CoE Drive)] in the left window. In Process Data field, you can change PDO Assignment for another PDO mapping.
3. 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. (Each set of PDO mapping allows up to 8 PDO assignments.)

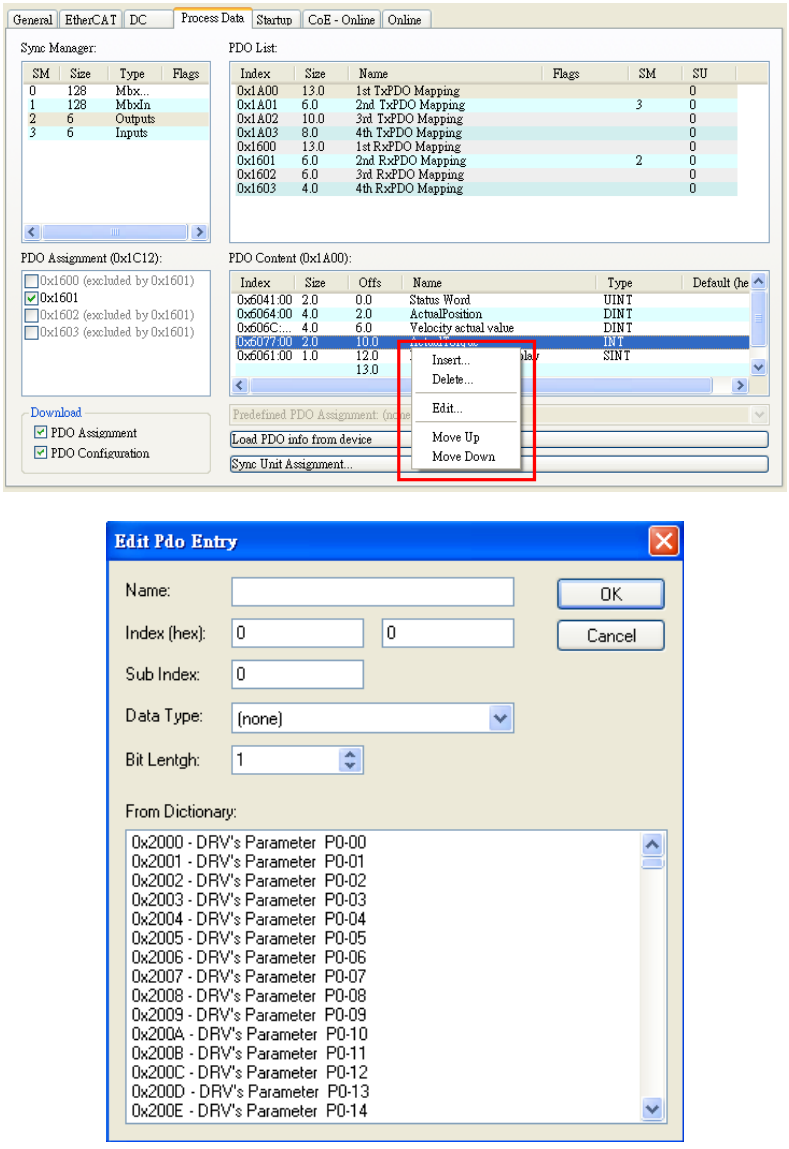


Figure 2.4.3.1 ASD-A2-E CoE drive Object List

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

(This page is intentionally left blank.)

Chapter 3 EtherCAT Communication Function

ASDA A2-E supports four EtherCAT communication states:

- Init (Initialization)
- Pre-Operational
- Safe-Operational
- Operational

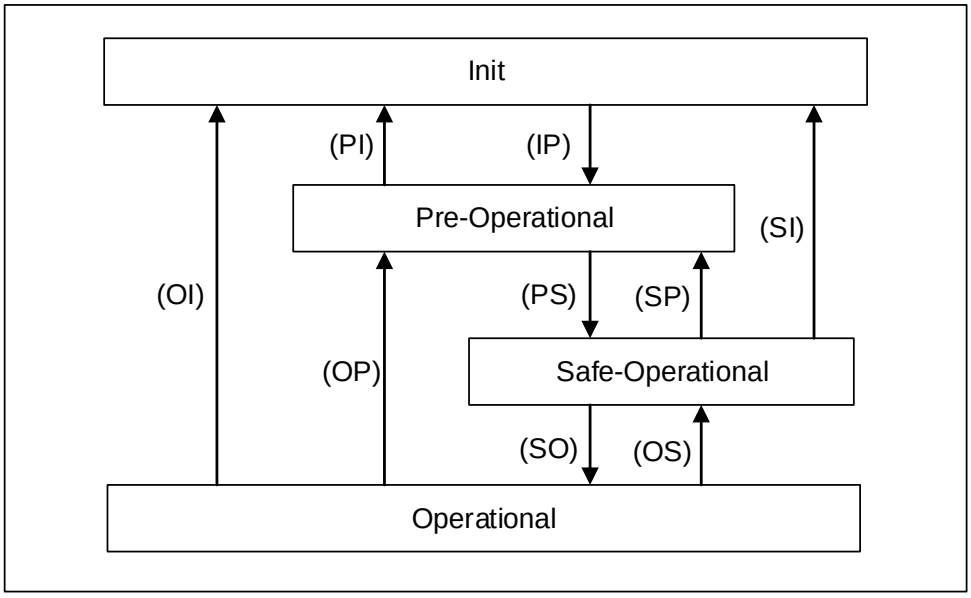


Figure 3.1 EtherCAT State machine

The EtherCAT controller (master) can have the servo drive (slave) switched between the four states. Different actions are allowed in each state.

State	Description
Init	The servo drive successfully completes the initialization after being powered on without errors occurring. The packets cannot yet be transmitted in this stage.
Pre-Operational	Data can be exchanged with SDOs. If an alarm occurs in the servo drive, an emergency message is sent to notify the controller.
Safe-Operational	The servo drive can use SDO and TxPDO data packets to exchange data with the controller.
Operational	All data exchanges including SDOs and PDOs (TxPDO and RxPDO) are allowed.

3.1 State Transition

The EtherCAT controller (master) issues corresponding commands to the servo (slave) according to the state transition.

State Transition	Description
IP	● The master defines the slave address as well as the SyncManager 0 and 1 (SM0 and SM1) registers and establishes the mailbox communication. ● The master issues the command to have the slave switched to Pre-Operational state.
PS	● The master uses the SDOs to set the PDO mapping related parameters. ● The master defines the FMMU as well as the SyncManager 2 and 3 (SM2 and SM3) registers, and the slaves continues to transmit the PDO (TxPDO) packets to the master. ● The master issues the command to have the slave switched to Safe-Operational state.
SO	● The master starts transmitting PDOs (RxPDOs). ● The distributed clock synchronization process between the master and slave is started.
PI, SI, OI	● The slave disables all communication functions, including transmission of the SDOs and PDOs. ● The slave switches to the Init state.
SP, OP	● The slave disables the PDO function. ● The slave switches to the Pre-Operational state.
OS	● The master stops transmitting PDOs (RxPDOs). ● The slave switches to the Safe-Operational state.

Chapter 4 EtherCAT FAQ

Q1: Why my TwinCAT cannot find EtherCAT Device from the installed NIC (Network Interface Card) and only shows RT-Ethernet devices?

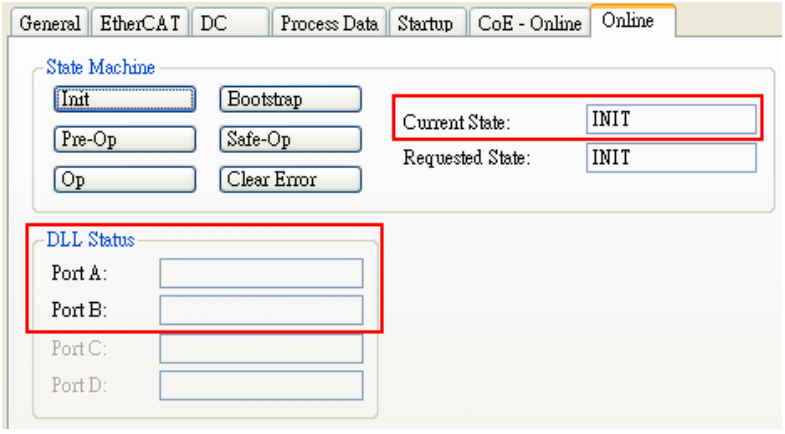
A: 1. Refer to Section 2.2 TwinCAT Setup and make sure the NIC is installed properly.

2. Check if the cable is correctly connected and if the L/A LED is on.

Q2: The window shows "Unknown device type found" while using TwinCAT Scan boxes.

A: Copy XML description of the ASDA-A2-E to TwinCAT device description folder (usually in C:\TwinCAT\Io\EtherCAT) and restart TwinCAT System.

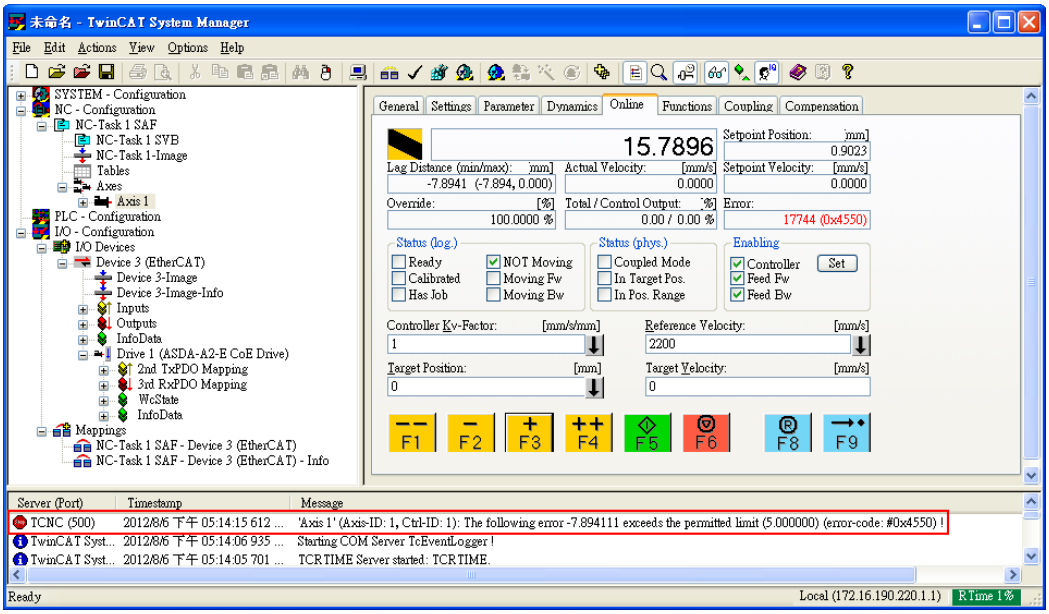
Q3: Why does EtherCAT State Machine shows INIT in the Current State field and blank in the DLL Status fields when TwinCAT is in Config Mode?



A: 1. Set P1-01 to 0x0C (EtherCAT communication mode).

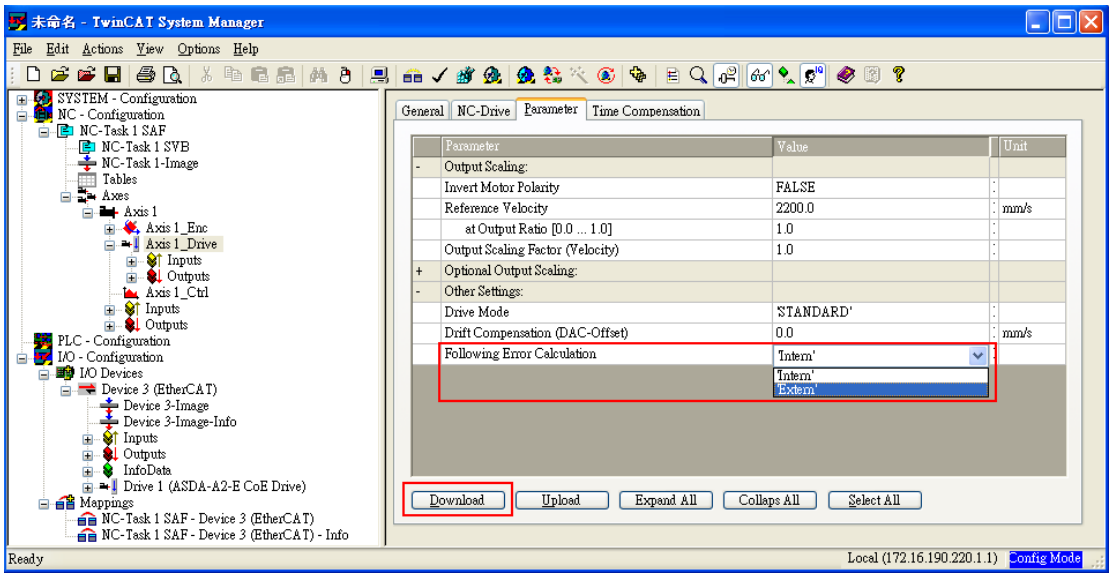
2. Check the wiring from the host to EtherCAT communication port (CN6A for input and CN6B for output) on the servo drive. If the Link LED lights up, it indicates that the physical connection is correct and the drive is connecting.

Q4: TwinCAT shows "following error".



A: Set Following Error Calculation to Extern:

1. Select [Axis 1_Drive] in the left column.
2. Under the Parameter tab, select Extern for Following Error Calculation.
3. Click **Download** and click **OK** in the pop-up window.



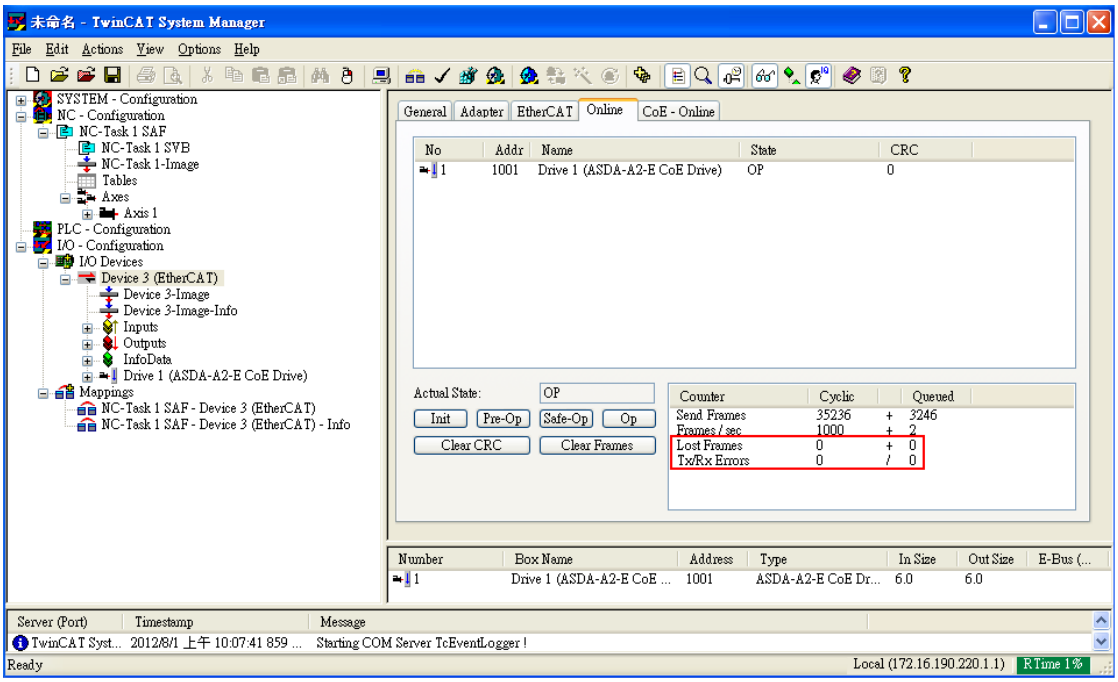
Q5: ASDA A2-E servo drive shows AL185.

A: This alarm is triggered when the EtherCAT communication between the host and the slave is disconnected. Check the wiring and then switch the servo drive to on again or set OD 0x6040 to 0x86 for fault reset.

Q6: ASDA A2-E servo drive shows AL180.

A: Working under Operational state without receiving any PDOs will trigger this alarm.

1. Set P0-02 to 121 to monitor errors when receiving PDOs. If the value keeps increasing, it indicates server interference on the communication cable.
2. Select the servo drive and click the Online tab. If the values in the columns of Lost Frames and Rx Errors keep increasing, it means the system is severely interfered.



3. You can adjust the value of P3-22 to set the allowable communication cycle times before triggering AL180 when PDOs are not received.

Q7: ASDA A2-E servo drive shows AL3E1.

A: When DC synchronization is enabled, if the reference clock jitters violently, it may trigger this alarm.

1. Check the reference clock for violent time jitter.
2. Set the control word OD 0x6040.7 = 1 for fault reset.

Q8: ASDA A2-E servo drive shows AL3E3.

A: Working under Operational state in CANopen CSP/CSV/CST mode without receiving any PDOs for consecutive times triggers this alarm.

1. Make sure the host controller periodically and stably sends PDOs.
2. Make sure the drive is properly grounded and wired.
3. You can adjust the value of P3-22 to set the allowable communication cycle times before triggering AL3E3 when PDOs are not received.

Chapter 5 CANopen Operation Mode

5.1 Profile Position Mode

5.1.1 Description

Servo drive (hereinafter “Drive”) receives position command from the host (external) controller (hereinafter “Host”) and then controls the servo motor to reach the target position.

Pulse of User-defined Unit Definition:

Pulse of User Unit (PUU): No. of $\frac{\text{PUU}}{\text{Rev}}$ = 1280000 × $\frac{\text{Ox6093 Sub2}}{\text{OD}-\text{6093h Sub1}}$

5.1.2 Operation Procedures

1. Set 【Modes of operation: 6060_h】to profile position mode (0x01).
2. Set 【Target position: $607A_h$】to the target position (unit: PUU).
3. Set 【Profile velocity: 6081_h】to the profile velocity (unit: PUU per second).
4. Set 【Profile acceleration: 6083_h】to plan acceleration slope (millisecond from 0 rpm to 3000 rpm).
5. Set 【Profile deceleration: 6084_h】to plan deceleration slope (millisecond from 0 rpm to 3000 rpm).
6. Set 【Controlword: 6040_h】to (0x06 > 0x07 > 0x0F) in sequence, switch the drive to Servo On state and enable the motor.
7. Read 【Position actual value: 6064_h】to obtain feedback position of the motor.
8. Read 【Statusword: 6041_h】to obtain the drive status, including the following error, set-point acknowledge, and target reached.

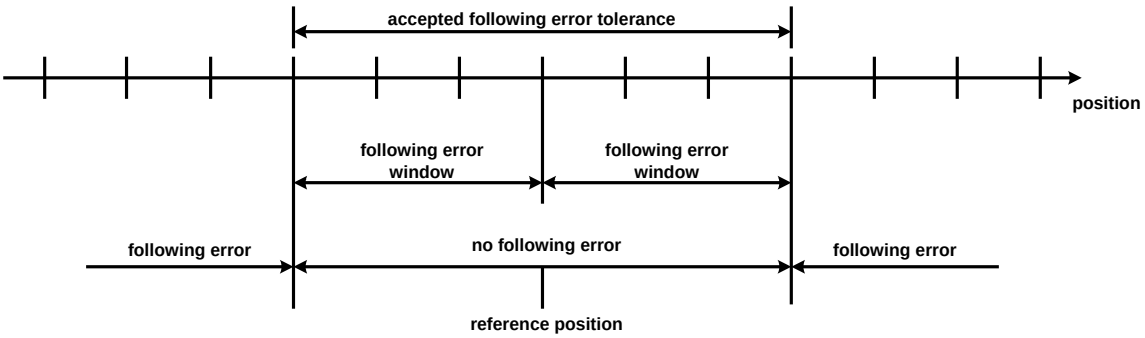
5.1.3 Advanced Setting Procedures

1. The Host could obtain more information about profile position mode.

- Read 【Position demand value: 6062h】to obtain the internal position command. (unit: PUU)
- Read 【Position actual value: 6063h】to obtain the actual position value. (unit: increments)

2. Following error

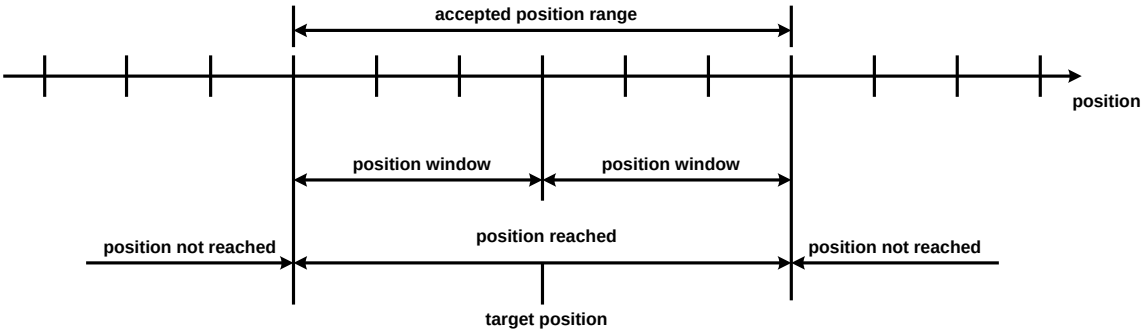
- Set 【Following error window: 6065h】 to define a symmetrical range of the tolerated position value which is relative to the position demand value. (unit: PUU)
- Read 【Following error actual value: 60F4h】to obtain the actual value of the following error. (unit: PUU)



Reference position

3. Position window

- Set 【Position window: 6067h】to define a symmetrical range of the accepted positions which is relative to the target position. (unit: PUU)
- Set 【Position window time: 6068h】to plan the activation time of target reached. (unit: millisecond)



Position reached

5.1.4 Associated Object List

Index	Name	Data Type	Access
6040_h	Controlword	UNSIGNED16	RW
6041_h	Statusword	UNSIGNED16	RO
6060_h	Modes of operation	INTEGER8	RW
6061_h	Modes of operation display	INTEGER8	RO
6062_h	Position demand value [PUU]	INTEGER32	RO
6063_h	Position actual value [increment]	INTEGER32	RO
6064_h	Position actual value	INTEGER32	RO
6065_h	Following error window	UNSIGNED32	RW
6067_h	Position window	UNSIGNED32	RW
6068_h	Position window time	UNSIGNED16	RW
$607A_h$	Target position	INTEGER32	RW
6081_h	Profile velocity	UNSIGNED32	RW
6083_h	Profile acceleration	UNSIGNED32	RW
6084_h	Profile deceleration	UNSIGNED32	RW
6093_h	Position factor	UNSIGNED32	RW
$60F4_h$	Following error actual value	INTEGER32	RO
$60FC_h$	Position demand value	INTEGER32	RO

(Refer to the Section 6.4 Details of Objects for more details)

5.2 Interpolation Position Mode

5.2.1 Description

The Host sends PDOs to the drive periodically with each PDO carrying the next reference Xi, difference $\triangle X_i$, and controlword. While receiving the next SYNC0, the drive interpolates from X_{i-1} to X_i.

■ Extrapolation, Jitter Compensation

- When PDO is delayed, the interpolator predicts the speed and position for the next time according to the last acceleration.
- If PDO is delayed, the Drive stops and sends out an error message. Set the maximum tolerable delay time with P3-22.

■ PDO Rx/Tx Mapping record

- The Drive receives PDOs from the Host
  - 32-bit reference position [position increment]
  - 16-bit symmetrical difference [increments]

    $\triangle X_i = (X_{i+1} – X_{i-1})/2$ (It is the same for velocity.)
  - 16-bit controlword

The Drive receives PDOs from the Host. (Every PDO contains 8 bytes field, which is shown as below.)

32-bit reference position	16-bit difference	16-bit controlword

5.2.2 Operation Procedures

1. Set 【Modes of operation: 6060_h】to interpolation position mode (0x07).

2. Set 【Interpolation sub mode select: $60C0_h$】to Interpolation mode.

   - If $60C0_h$ is [0], the Host does not need to send [$60C1_h$ Sub-2], which saves the calculating time for the host and the Drive is still operable.
   - If $60C0_h$ is [-1], the Host needs to send [$60C1_h$ Sub-2] to increase the Drive precision.

3. Set 【Interpolation time period: $60C2_h$】, and the value should be identical to that of the SYNC0 cycle time.

   - $60C2_h$ Sub-1 is used for Interpolation time units, with the range from 1 ms to 20 ms.
     - $60C2_h$ Sub-2 is used for Interpolation time index. The value is always -3, meaning the interpolation time unit is 10^{-3} second.

4. Drive PDO Rx:

   - Use $60C1_h$ Sub-1 to set Pos Cmd (32-bit).
   - Use 6040_h Sub-0 to set Controlword.

5.2.3 Associated Object List

Index	Name	Data Type	Access
6040_h	Controlword	UNSIGNED16	RW
6041_h	Statusword	UNSIGNED16	RO
6060_h	Modes of operation	INTEGER8	RW
6061_h	Modes of operation display	INTEGER8	RO
6093_h	Position factor	UNSIGNED32	RW
$60C0_h$	Interpolation sub mode select	INTEGER16	RW
$60C1_h$	Interpolation data record	ARRAY	RW

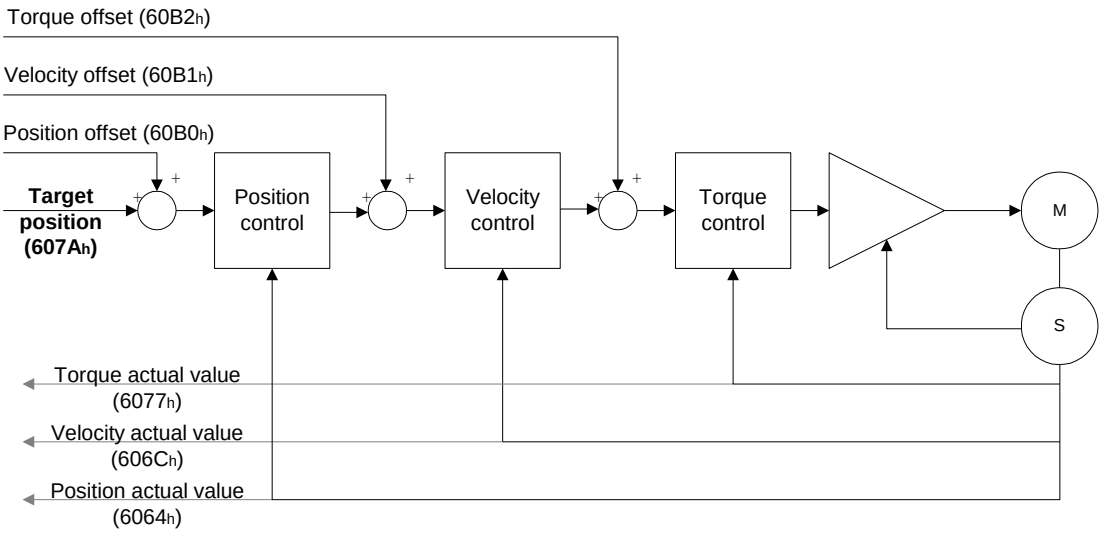
(Refer to the Section 6.4 Details of Objects for more details)

5.3 Cyclic Synchronous Position Mode

5.3.1 Description

The Host plans the path in Cyclic Synchronous Position mode and sends PDOs periodically to the drive with each PDO carrying the target position and controlword. The velocity offset and torque offset can be used as the velocity and torque feed forward.

5.3.2 The Function of CSP Mode



5.3.3 Operation Procedures

1. Set 【Modes of operation: 6060_h】to cyclic synchronous position mode (0x08).

2. Set 【Interpolation time period: $60C2_h$】, and the value should be identical to that of the SYNC0 cycle time.

   - $60C2_h$ Sub-1 is used for Interpolation time units with the range from 1 ms to 20 ms.

     - $60C2_h$ Sub-2 is used for Interpolation time index. The value is always -3, meaning the interpolation time unit is 10^{-3} second.

3. Drive PDO Rx:

   - Use $607A_h$ to set Target Pos Cmd (32-bit).
   - Use 6040_h Sub-0 to set Controlword.

5.3.4 Associated Object List

Index	Name	Data Type	Access
6040_h	Controlword	UNSIGNED16	RW
6041_h	Statusword	UNSIGNED16	RO
6060_h	Modes of operation	INTEGER8	RW
6061_h	Modes of operation display	INTEGER8	RO
$607A_h$	Target position	INTEGER32	RW
$60B0_h$	Position offset	INTEGER32	RW
6064_h	Position actual value	INTEGER32	RO
$60B1_h$	Velocity offset	INTEGER32	RW
$606C_h$	Velocity actual value	INTEGER32	RO
$60B2_h$	Torque offset	INTEGER16	RW
6077_h	Torque actual value	INTEGER16	RO

(Refer to Section 6.4 Details of Objects for more details.)

5.4 Homing Mode

5.4.1 Description

This mode helps the Drive to find the home position. Users can specify the speed, acceleration, and method of homing.

5.4.2 Operation Procedures

1. Set【Modes of operations: 6060_h】to the homing mode (0x06).
2. Set【Home offset: $607C_h$】.
3. Set【Homing method: 6098_h】. The setting range is from 1 to 35. (Refer to the OD-6098h definition shown below.)
4. Set【Homing speed: 6099_h Sub-1】to set speed during the search for Home Switch. (unit: rpm)
5. Set【Homing speed: 6099_h Sub-2】to set speed during the search for zero. (unit: rpm)
6. Set【Homing acceleration: $609A_h$】for homing acceleration. (unit: millisecond from 0 rpm to 3000 rpm)
7. Set【Controlword: 6040_h】to (0x06 > 0x07 > 0x0F) in sequence, switch the drive to Servo ON state and enable the motor.
8. Set【Controlword: 6040_h】to (0x0F > 0x1F) in sequence to search for Home Switch and perform homing.
9. Read【Statusword: 6041_h】to obtain the drive status.

5.4.3 Associated Object List

Index	Name	Data Type	Access
6040_h	Controlword	UNSIGNED16	RW
6041_h	Statusword	UNSIGNED16	RO
6060_h	Modes of operation	INTEGER8	RW
6061_h	Modes of operation display	INTEGER8	RO
$607C_h$	Home offset	INTEGER32	RW
6093_h	Position factor	UNSIGNED32	RW
6098_h	Homing method	INTEGER8	RW
6099_h	Homing speed	ARRAY	RW
$609A_h$	Homing acceleration	UNSIGNED32	RW

(Refer to Section 6.4 Details of Objects for more details.)

5.5 Profile Velocity Mode

5.5.1 Description

The Drive receives velocity command, and plans acceleration and deceleration.

5.5.2 Operation Procedures

1. Set【Modes of operation: 6060_h】to profile velocity mode (0x03).
2. Set【Controlword: 6040_h】to (0x06 > 0x07 > 0x0F) in sequence, switch the drive to Servo ON state and enable the motor. (After Servo On, the internal velocity command will be reset and OD-$60FF_h$ will be cleared.)
3. Set【Profile acceleration: 6083_h】to plan the acceleration slope. (millisecond from 0 rpm to 3000 rpm)
4. Set【Profile deceleration: 6084_h】to plan the deceleration slope. (millisecond from 0 rpm to 3000 rpm)
5. Set【Target velocity: $60FF_h$】. The unit of the target velocity is 0.1 rpm.

   (If the drive is already servo-on, it will work immediately after receiving the velocity command. OD-$60FF_h$ will be cleared to 0 if OD-6060_h [Mode] is changed, Servo is off, or Quick-Stop is activated.)
6. Read【Statusword: 6041_h】to obtain the drive status.

5.5.3 Advanced Setting Procedures

1. The Host could obtain more information about velocity mode.

- Read【Velocity demand value: $606B_h$】to inquire the internal velocity command. (unit: 0.1 rpm)
- Read【Velocity actual value: $606C_h$】to obtain the actual velocity value. (unit: 0.1 rpm)

2. The Host could set velocity monitor threshold.

- Set【Velocity window: $606D_h$】to allocate the velocity reached zone. (unit: 0.1 rpm)
- Set【Velocity window time: $606E_h$】in order to ensure the activation time is before the velocity reached. (unit: millisecond)
- Set【Velocity threshold: $606F_h$】to allocate the zero speed level. (unit: 0.1 rpm)

5.5.4 Associated Object List

Index	Name	Data Type	Access
6040_h	Controlword	UNSIGNED16	RW
6041_h	Statusword	UNSIGNED16	RO
6060_h	Modes of operation	INTEGER8	RW
6061_h	Modes of operation display	INTEGER8	RO
$606B_h$	Velocity demand value	INTEGER32	RO
$606C_h$	Velocity actual value	INTEGER32	RO
$606D_h$	Velocity window	UNSIGNED16	RW
$606E_h$	Velocity window time	UNSIGNED16	RW
$606F_h$	Velocity threshold	UNSIGNED16	RW
$60FF_h$	Target velocity	INTEGER32	RW

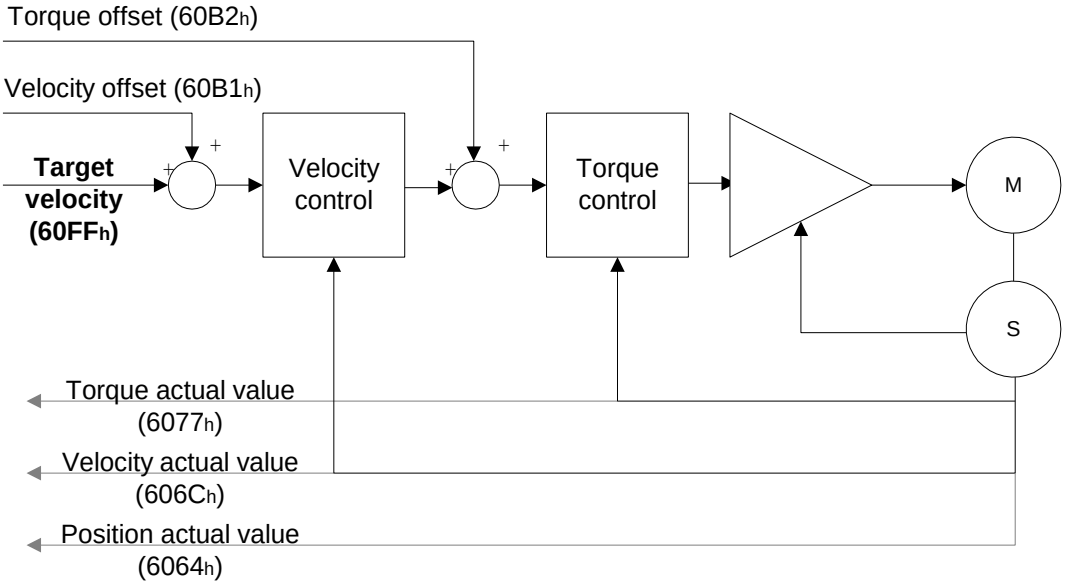
(Refer to Section 6.4 Details of Objects for more details.)

5.6 Cyclic Synchronous Velocity Mode

5.6.1 Description

The Host plans the path in Cyclic Synchronous Velocity mode and sends PDOs periodically to the drive with each PDO carrying the target position and controlword. In addition, the velocity offset and torque offset can be used as the velocity and torque feed forward.

5.6.2 The Function of CSV Mode



5.6.3 Operation Procedures

1. Set 【Modes of operation: 6060_h】to cyclic synchronous velocity mode (0x09).

2. Set 【Interpolation time period: $60C2_h$】, and the value should be identical to that of the SYNC0 cycle time.

   - $60C2_h$ Sub-1 is used for Interpolation time units with the range from 1 ms to 20 ms.

     - $60C2_h$ Sub-2 is used for Interpolation time index. The value is always -3, meaning the interpolation time unit is 10^{-3} second.

3. Drive PDO Rx:

   - Use $60FF_h$ to set Target Velocity Cmd (32-bit).
   - Use 6040_h Sub-0 to set Controlword.

5.6.4 Associated Object List

Index	Name	Data Type	Access
6040_h	Controlword	UNSIGNED16	RW
6041_h	Statusword	UNSIGNED16	RO
6060_h	Modes of operation	INTEGER8	RW
6061_h	Modes of operation display	INTEGER8	RO
$60FF_h$	Target velocity	INTEGER32	RW
$60B1_h$	Velocity offset	INTEGER32	RW
$606C_h$	Velocity actual value	INTEGER32	RO
6064_h	Position actual value	INTEGER32	RO
$60B2_h$	Torque offset	INTEGER16	RW
6077_h	Torque actual value	INTEGER16	RO

(Refer to the Section 6.4 Details of Objects for more details)

5.7 Profile Torque Mode

5.7.1 Description

The Drive receives torque command and plans profile torque slope.

5.7.2 Operation Procedures

1. Set 【Modes of operation: 6060_h】to profile torque mode (6060_h = 04h).
2. Set 【Controlword: 6040_h】to (0x6 > 0x7 > 0x0F) in sequence, switch the drive to Servo ON state and enable the motor.

   (After Servo On, the internal torque command will be reset and OD-6071h will be cleared. It means the drive is servo-on and starts to receive the torque command.)
3. Set 【Torque slope: 6087_h】to plan torque slope time. (unit: millisecond from 0 to 100% rated torque)
4. Set 【Target torque: 6071_h】to the target torque. The unit is given one rated torque in a thousand. (OD-6071_h will be cleared to 0 if OD-6060_h [Mode] is changed, Servo is off, or Quick-Stop is activated.)

5.7.3 Advanced Setting Procedures

The Host could obtain more information about torque mode.

- Read 【Torque demand value: 6074_h】to obtain the output value of the torque limit function. (unit: one rated torque in a thousand)
- Read 【Torque rated current: 6075_h】to obtain the rated current determined by the motor and drive type. (unit: multiples of milliamp)
- Read 【Torque actual value: 6077_h】to obtain the instantaneous torque in the servo motor. (unit: one rated torque in a thousand)
- Read 【Current actual value: 6078_h】to obtain the instantaneous current in the servo motor. (unit: one rated torque in a thousand)

5.7.4 Associated Object List

Index	Name	Data Type	Access
6040_h	Controlword	UNSIGNED16	RW
6041_h	Statusword	UNSIGNED16	RO
6060_h	Modes of operation	INTEGER8	RW
6061_h	Modes of operation display	INTEGER8	RO
6071_h	Target torque	INTEGER16	RW
6074_h	Torque demand value	INTEGER16	RO
6075_h	Motor rated current	UNSIGNED32	RO
6077_h	Torque actual value	INTEGER16	RO
6078_h	Current actual value	INTEGER16	RO
6087_h	Torque slope	UNSIGNED32	RW

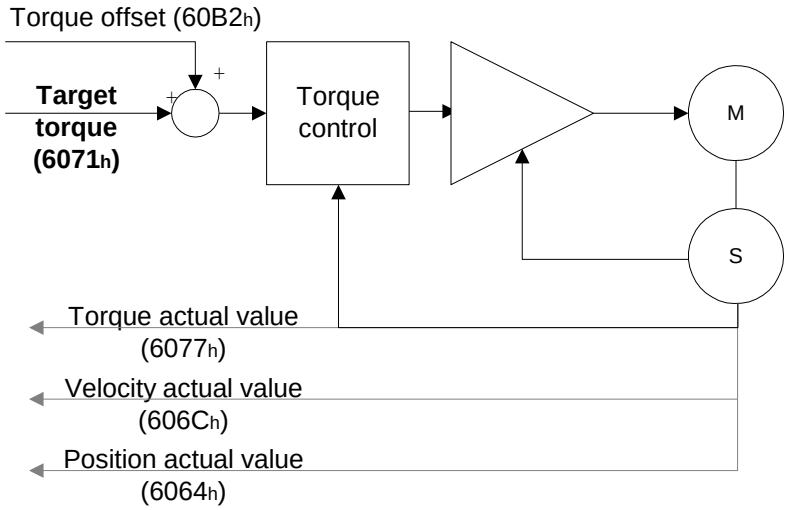
(Refer to Section 6.4 Details of Objects for more details.)

5.8 Cyclic Synchronous Torque Mode

5.8.1 Description

The Host plans the path in Cyclic Synchronous Torque mode and sends PDO periodically to the drive with each PDO carrying the target position and controlword. In addition, the velocity offset and torque offset can be used as the velocity and torque feed forward.

5.8.2 The Function of CST Mode



5.8.3 Operation Procedures

1. Set【Modes of operation: 6060h】to cyclic synchronous torque mode (0x0A).
2. Set【Interpolation time period: 60C2h】to predict the cycle that SYNC0 receives PDO.
   - 60C2h Sub-1 is used for Interpolation time units with the range from 1 ms to 20 ms.
     - 60C2h Sub-2 is used for Interpolation time index. The value is always -3, meaning the interpolation time unit is 10^{-3} second.
3. Drive PDO Rx:
   - Use 6071h to set Target Torque Cmd (16-bit)
   - Use 6040h Sub-0 to set Controlword.

5.8.4 Associated Object List

Index	Name	Data Type	Access
6040_h	Controlword	UNSIGNED16	RW
6041_h	Statusword	UNSIGNED16	RO
6060_h	Modes of operation	INTEGER8	RW
6061_h	Modes of operation display	INTEGER8	RO
6071_h	Target torque	INTEGER16	RW
$60B2_h$	Torque offset	INTEGER16	RW
6077_h	Torque actual value	INTEGER16	RO
$606C_h$	Velocity actual value	INTEGER32	RO
6064_h	Position actual value	INTEGER32	RO

(Refer to Section 6.4 Details of Objects for more details.)

5.9 Limit Position Handling Procedure

5.9.1 Description

The Drive switches to Quick-Stop status while the motor travels to the position of positive or negative limit sensors, and it can be handled by the following procedures.

5.9.2 Operation Procedures

1. The servo panel shows the alarm while the sensors are close to the positive or negative limit. The motor is stopped by a deceleration slope and the drive is at Quick-Stop status. The drive keeps in servo-on status but will not accept further motion commands.
2. Set 【Controlword: 6040_h】to 0x8F for fault reset and clear the alarm displayed on the panel.
3. Set 【Controlword: 6040_h】to 0x1F / 0x0F for Operation Enabled, and then the servo drive can receive the motion command again.
4. When the motor reaches the limit position, there must be a command which can drive the motor to the backward direction. Or the alarm will be triggered again while the motor starts moving.

5.9.3 Associated Object List

Index	Name	Data Type	Access
6040_h	Controlword	UNSIGNED16	RW

(Refer to Section 6.4 Details of Objects for more details.)

5.10 Touch Probe Function

5.10.1 Description

Touch Probe function can be enabled by the high-speed DI on CN7 (only DI13 is a high-speed DI, with the hardware response time as 5 μs) or by the zero signal from the encoder; among that, the feedback position can be latched as positive or negative edge with DI13 on CN7 with P2-40. This function is used for high-speed measurement or packaging applications.

5.10.2 Touch Probe Function

The current status of Touch Probe can be obtained by Object $60B8_h$.
Note the following:

1. When the capture source is set to the motor Z pulse, you can only use Touch Probe 1. Regardless of the settings of OD 60B8h [Bit 4] and [Bit 5], the command is rising-edge triggered and the data is stored in OD 60BAh.
2. When the capture source is set to the DI of CN1, the previously set function code for the DI is changed to 0x0100 so one DI does not have two functions.

The definition of each bit is as follows.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit	Function	Description
Bit 0	Touch Probe 1 switch	0: disable Touch Probe 1. 1: enable Touch Probe 1.
Bit 1	Touch Probe 1 number of capturing times	0: capture one time. 1: capture multiple times.
Bit 2	Touch Probe 1 capture source	0: DI13 of CN7. 1: motor Z-pulse.
Bit 3	Reserved	-
Bit 4	Rising-edge trigger action of Touch Probe 1	0: N/A 1: start capturing when the Touch Probe 1 signal is rising-edge triggered and store the data in OD $60BA_h$.
Bit 5	Falling-edge trigger action of Touch Probe 1	0: N/A 1: start capturing when the Touch Probe 1 signal is falling-edge triggered and store the data in Object $60BB_h$.
Bit 6 - 7	Reserved	-

Bit	Function	Description
Bit 8	Touch Probe 2 switch	0: disable Touch Probe 2. 1: enable Touch Probe 2.
Bit 9	Touch Probe 2 number of capturing times	0: capture one time. 1: capture multiple times.
Bit 10	Touch Probe 2 capture source	0: DI14 of CN7.
Bit 11	Reserved	-
Bit 12	Rising-edge trigger action of Touch Probe 2	0: N/A 1: start capturing when the Touch Probe 2 signal is rising-edge triggered and store the data in OD 60BCh.
Bit 13	Falling-edge trigger action of Touch Probe 2	0: N/A 1: start capturing when the Touch Probe 2 signal is falling-edge triggered and store the data in OD 60BDh.
Bit 14 - 15	Reserved	-

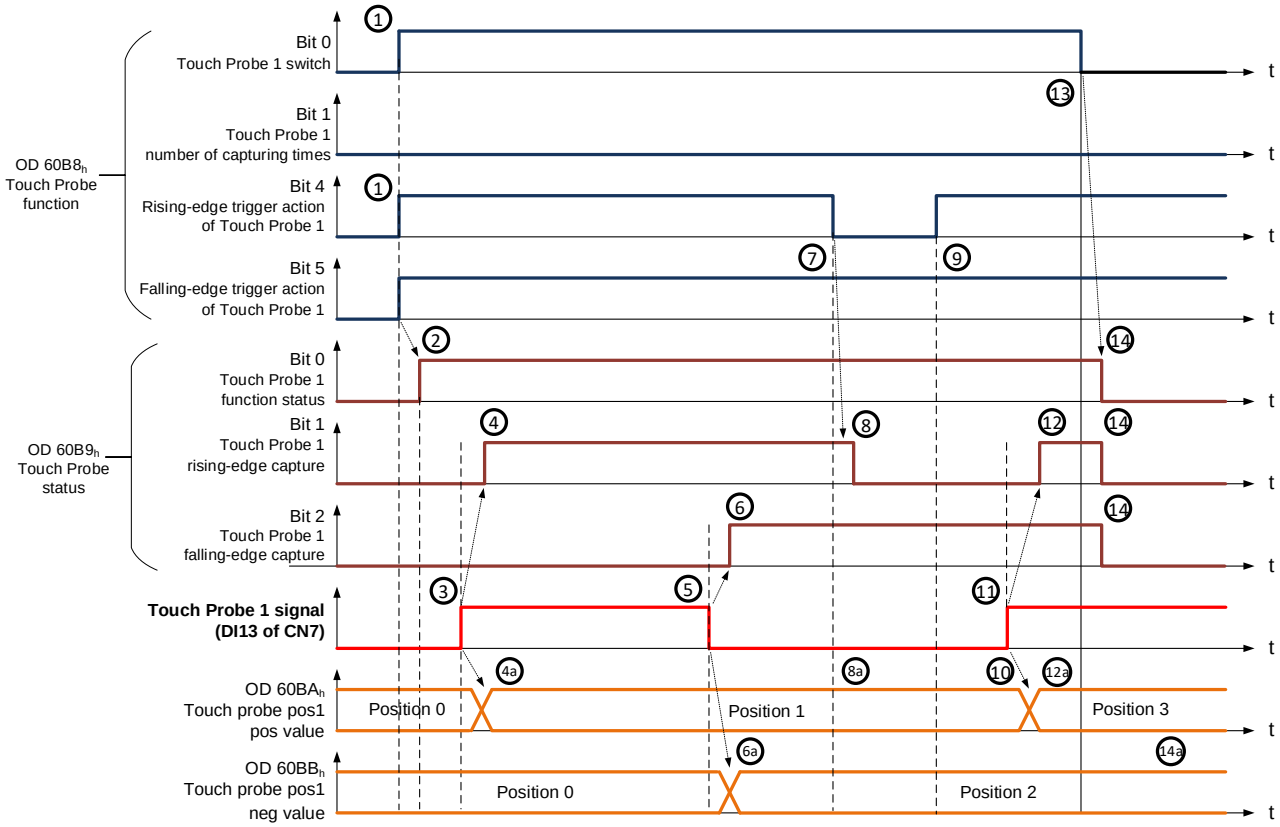
5.10.3 Touch Probe Status

The current status of Touch Probe can be obtained by Object 60B9$_h$. The definition of each bit is as follows.

Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit	Function	Description
Bit 0	Touch Probe 1 function status	0: Touch Probe 1 disabled. 1: Touch Probe 1 enabled.
Bit 1	Touch Probe 1 rising-edge capture	0: capturing is not triggered. 1: the Touch Probe 1 signal is rising-edge triggered and the data is successfully captured.
Bit 2	Touch Probe 1 falling-edge capture	0: capturing is not triggered. 1: the Touch Probe 1 signal is falling-edge triggered and the data is successfully captured.
Bit 3 - 5	Reserved	-
Bit 6	Touch Probe 1 capture source	0: DI13 of CN7. 1: motor Z pulse.
Bit 7	Touch Probe 1 signal for capturing multiple times (Available when OD 60B8$_h$ [Bit 1] is enabled)	The status is reversed once the capturing succeeds. Refer to the timing diagram in Example 3.
Bit 8	Touch Probe 2 function status	0: Touch Probe 2 disabled. 1: Touch Probe 2 enabled.
Bit 9	Touch Probe 2 rising-edge capture	0: capturing is not triggered. 1: the Touch Probe 2 signal is rising-edge triggered and the data is successfully captured.
Bit 10	Touch Probe 2 falling-edge capture	0: capturing is not triggered 1: the Touch Probe 2 signal is falling-edge triggered and the data is successfully captured.
Bit 11 - 13	Reserved	-
Bit 14	Touch Probe 2 capture source	0: DI14 of CN7.
Bit 15	Touch Probe 2 signal for capturing multiple times (Available when OD 60B8h [Bit 9] is enabled)	The status is reversed once the capturing succeeds.

Example 1: the following is the timing diagram for Touch Probe 1 function. In this example, the data capturing action is triggered through the external DI. When OD 60B8h [Bit 1] is set to 0 and OD 60B8h [Bit 4] & [Bit 5] are set to 1, the Touch Probe 1 signal is both rising-edge and falling-edge triggered, and the data is captured once for each triggering.

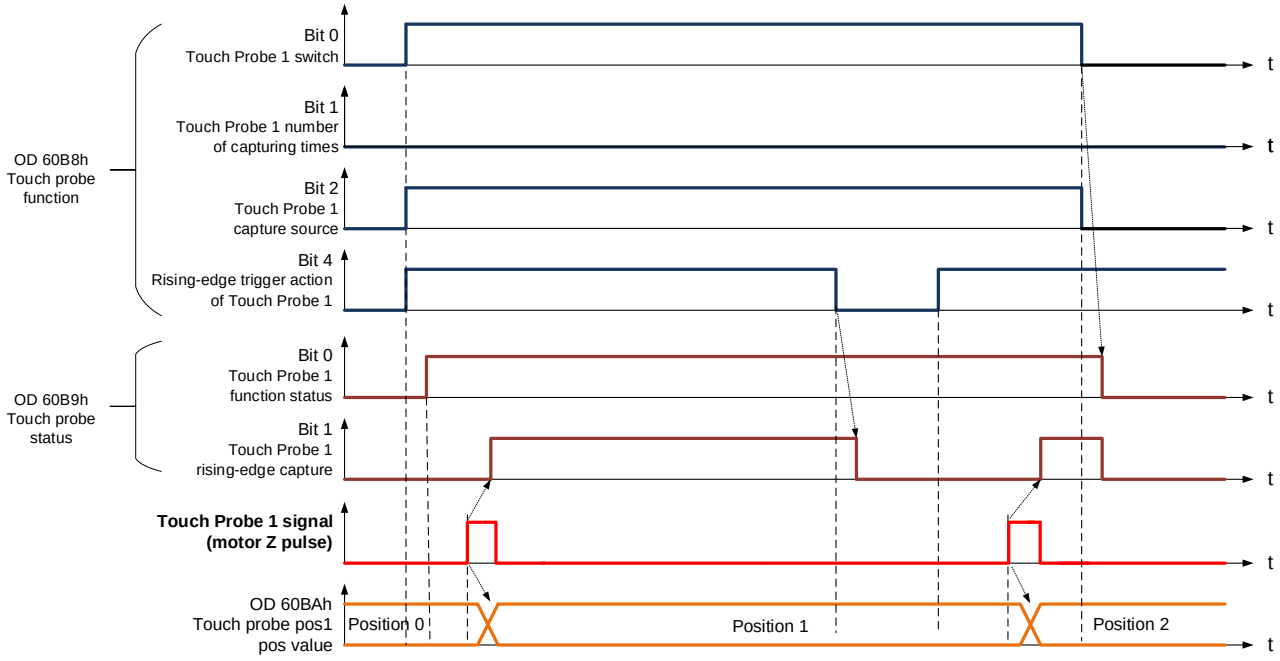


The timing status is described below:

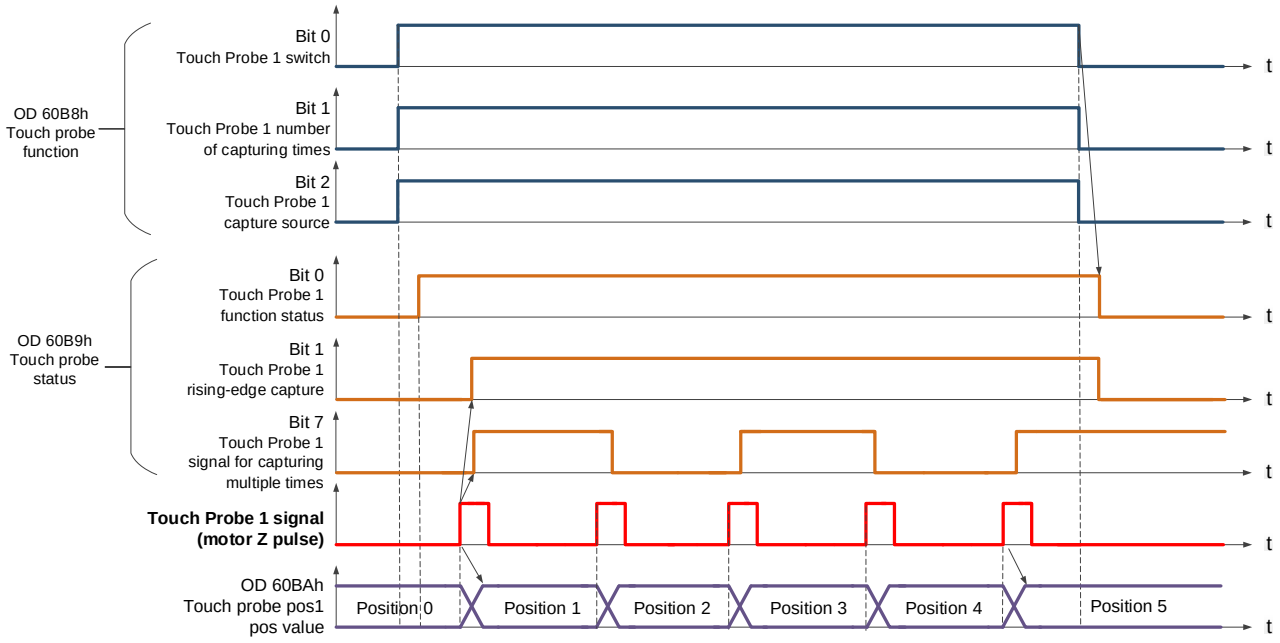
Status	Function	Description
(1)	OD 60B8h Bit 0 = 1 OD 60B8h Bit 1 = 0 OD 60B8h Bit 4 = 1 OD 60B8h Bit 5 = 1	1: enable Touch Probe 1. 0: capture the data once. 1: start capturing when the Touch Probe 1 signal is rising-edge triggered. 1: start capturing when the Touch Probe 1 signal is falling-edge triggered.
(2)	OD 60B9h Bit 0 = 1	Touch Probe status: Touch Probe 1 function enabled.
(3)	-	Touch Probe 1 is rising-edge triggered by external signal.
(4)	OD 60B9h Bit 1 = 1	Touch Probe status: Touch Probe 1 is rising-edge triggered and the data is successfully captured.
(4a)	OD 60BAh	Store the captured data in OD 60BAh when the Touch Probe 1 signal is rising-edge triggered.
(5)	-	Touch Probe 1 is falling-edge triggered by external signal.
(6)	OD 60B9h Bit 2 = 1	Touch Probe status: Touch Probe 1 signal is falling-edge triggered and the data is successfully captured.

Status	Function	Description
(6a)	OD $60BB_h$	Store the captured data in OD $60BB_h$ when the Touch Probe 1 signal is falling-edge triggered.
(7)	OD $60B8_h$ Bit 4 = 0	Disable the rising-edge trigger action of Touch Probe 1.
(8)	OD $60B9_h$ Bit 1 = 0	Touch Probe status: reset the rising-edge capture status to non-triggered.
(8a)	OD $60BA_h$	Data at the rising-edge remains the same.
(9)	OD $60B8_h$ Bit 4 = 1	Start capturing when the Touch Probe 1 signal is rising-edge triggered.
(10)	OD $60BA_h$	Data at the rising-edge remains the same.
(11)	-	Touch Probe 1 is rising-edge triggered by external signal.
(12)	OD $60B9_h$ Bit 1 = 1	Touch Probe status: Touch Probe 1 signal is rising-edge triggered and the data is successfully captured.
(12a)	OD $60BA_h$	Store the captured data in OD $60BA_h$ when the Touch Probe 1 signal is rising-edge triggered.
(13)	OD $60B8_h$ Bit 0 = 0	Disable Touch Probe 1.
(14)	OD $60B9_h$ Bit 0 = 0 OD $60B9_h$ Bit 1 = 0 OD $60B9_h$ Bit 2 = 0	Reset Touch Probe 1 status.
(14a)	OD $60BA_h$,OD $60BB_h$	The previously captured data remain the same.

Example 2: the following is the timing diagram for the Touch Probe 1 function. In this example, the Touch Probe function is triggered by the motor Z pulse. The data is captured only once when the Touch Probe 1 signal is rising-edge triggered.



Example 3: the following is the timing diagram for the Touch Probe 1 function. In this example, the Touch Probe function is triggered by the motor Z pulse. The data is captured multiple times when the Touch Probe 1 signal is rising-edge triggered.



5.10.4 Associated Object List

Index	Name	Data Type	Access
$60B8_h$	Touch probe function	UNSIGNED16	RW
$60B9_h$	Touch probe status	UNSIGNED16	RO
$60BA_h$	Touch probe pos1 pos value	INTEGER32	RO
$60BB_h$	Touch probe pos1 neg value	INTEGER32	RO
$60BC_h$	Touch probe pos2 pos value	INTEGER32	RO
$60BD_h$	Touch probe pos2 neg value	INTEGER32	RO

(Refer to Section 6.4 Details of Objects for more details.)

Chapter 6 Object Dictionary

6.1 Specifications for Objects

6.1.1 Object Type

Object Name	Comments
VAR	A single value such as an UNSIGNED8, Boolean, float, or INTEGER16, etc.
ARRAY	A multiple data field object where each data field is a sample variable of the SAME basic data type e.g. array of UNSIGNED16 etc. Sub-index 0 is UNSIGNED8 but is not part of the ARRAY data.
RECORD	A multiple data field object where the data fields may be any combination of simple variables. Sub-index 0 is UNSIGNED8 but is not part of the RECORD data.

6.1.2 Data Type

Refer to CANopen Standard 301.

6.2 Overview of Object Group 1000_h

Index	Object Type	Name	Data Type	Access
1000_h	VAR	Device type	UNSIGNED32	RO
1001_h	VAR	Error register	UNSIGNED8	RO
1600_h - 03_h	RECORD	Receive PDO mapping	UNSIGNED32	RW
$1A00_h$ - 03_h	RECORD	Transmit PDO mapping	UNSIGNED32	RW

※ Only 1001_h could be mapped to PDO.

6.3 Overview of Object Group 6000_h

Index	Object Type	Name	Data Type	Access	Mappable
$603F_h$	VAR	Error Code	UNSIGNED16	RO	Y
6040_h	VAR	Controlword	UNSIGNED16	RW	Y
6041_h	VAR	Statusword	UNSIGNED16	RO	Y
$605B_h$	VAR	Shutdown option code	INTEGER16	RW	N
$605E_h$	VAR	Fault reaction option code	INTEGER16	RW	N
6060_h	VAR	Modes of operation	INTEGER8	RW	Y
6061_h	VAR	Modes of operation display	INTEGER8	RO	Y
6062_h	VAR	Position demand value [PUU]	INTEGER32	RO	Y
6063_h	VAR	Position actual value [increment]	INTEGER32	RO	Y
6064_h	VAR	Position actual value	INTEGER32	RO	Y
6065_h	VAR	Following error window	UNSIGNED32	RW	Y
6067_h	VAR	Position windows	UNSIGNED32	RW	Y
6068_h	VAR	Position window time	UNSIGNED16	RW	Y
$606B_h$	VAR	Velocity demand value	INTEGER32	RO	Y
$606C_h$	VAR	Velocity actual value	INTEGER32	RO	Y
$606D_h$	VAR	Velocity window	UNSIGNED16	RW	Y
$606E_h$	VAR	Velocity window time	UNSIGNED16	RW	Y
$606F_h$	VAR	Velocity threshold	UNSIGNED16	RW	Y
6071_h	VAR	Target torque	INTEGER16	RW	Y
6072_h	VAR	Max torque	UNSIGNED16	RW	Y
6074_h	VAR	Torque demand value	INTEGER16	RO	Y
6075_h	VAR	Motor rated current	UNSIGNED32	RO	Y
6076_h	VAR	Motor rated torque	UNSIGNED32	RO	Y
6077_h	VAR	Torque actual value	UNSIGNED16	RO	Y
6078_h	VAR	Current actual value	INTEGER16	RO	Y
$607A_h$	VAR	Target position	INTEGER32	RW	Y
$607C_h$	VAR	Home Offset	INTEGER32	RW	Y
$607D_h$	ARRAY	Software position limit	INTEGER32	RW	Y
$607E_h$	VAR	Polarity	UNSIGNED8	RW	Y
$607F_h$	VAR	Max profile velocity	UNSIGNED32	RW	Y
6080_h	VAR	Max motor speed	UNSIGNED32	RW	Y
6081_h	VAR	Profile velocity	UNSIGNED32	RW	Y
6083_h	VAR	Profile acceleration	UNSIGNED32	RW	Y
6084_h	VAR	Profile deceleration	UNSIGNED32	RW	Y

Index	Object Type	Name	Data Type	Access	Mappable
6085_h	VAR	Quick stop deceleration	UNSIGNED32	RW	Y
6086_h	VAR	Motion profile type	INTEGER16	RW	Y
6087_h	VAR	Torque slope	UNSIGNED32	RW	Y
6093_h	ARRAY	Position factor	UNSIGNED32	RW	Y
6098_h	VAR	Homing method	INTEGER8	RW	Y
6099_h	ARRAY	Homing speeds	UNSIGNED32	RW	Y
$609A_h$	VAR	Homing acceleration	UNSIGNED32	RW	Y
$60B0_h$	VAR	Position offset	INTEGER32	RW	Y
$60B1_h$	VAR	Velocity offset	INTEGER32	RW	Y
$60B2_h$	VAR	Torque offset	INTEGER16	RW	Y
$60B8_h$	VAR	Touch probe function	UNSIGNED16	RW	Y
$60B9_h$	VAR	Touch probe status	UNSIGNED16	RO	Y
$60BA_h$	VAR	Touch probe pos1 pos value	INTEGER32	RO	Y
$60BB_h$	VAR	Touch probe pos1 neg value	INTEGER32	RO	Y
$60BC_h$	VAR	Touch probe pos2 pos value	INTEGER32	RO	Y
$60BD_h$	VAR	Touch probe pos2 neg value	INTEGER32	RO	Y
$60C0_h$	VAR	Interpolation sub mode select	INTEGER16	RW	Y
$60C1_h$	ARRAY	Interpolation data record	UNSIGNED16 / 32	RW	Y
$60C2_h$	RECORD	Interpolation time period	SIGNED8	RW	Y
$60C5_h$	VAR	Max acceleration	UNSIGNED32	RW	Y
$60C6_h$	VAR	Max deceleration	UNSIGNED32	RW	Y
$60F2_h$	VAR	Positioning option code	UNSIGNED16	RW	Y
$60F4_h$	VAR	Following error actual value	INTEGER32	RO	Y
$60FC_h$	VAR	Position demand value	INTEGER32	RO	Y
$60FD_h$	VAR	Digital inputs	UNSIGNED32	RO	Y
$60FF_h$	VAR	Target velocity	INTEGER32	RW	Y
6502_h	VAR	Supported drive modes	UNSIGNED32	RO	Y
Delta parameter definition					
2xxx	VAR	Parameter Mapping	INTEGER16 / 32	RW	Y

6.4 Details of Objects

Object 1000_h: Device Type

INDEX	1000_h
Name	device type
Object Code	VAR
Data Type	UNSIGNED32
Access	RO
PDO Mapping	No
Value Range	UNSIGNED32
Default Value	04020192_h: A2 Series

Object 1001_h: Error Register

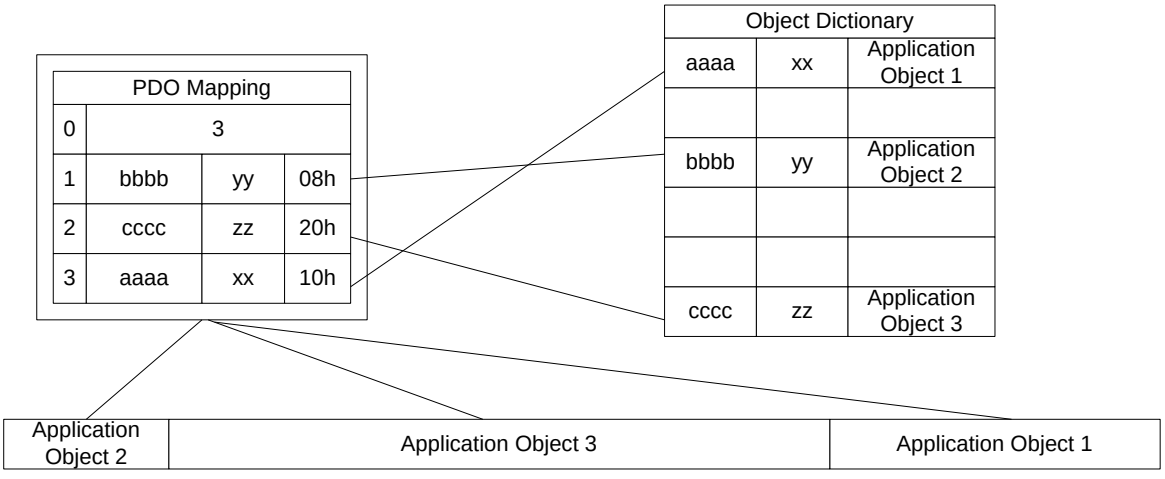
INDEX	1001_h
Name	error register
Object Code	VAR
Data Type	UNSIGNED8
Access	RO
PDO Mapping	Yes
Value Range	UNSIGNED8
Default Value	0

Object 1600_h - 1604_h: Receive PDO Mapping Parameter

INDEX	1600_h - 1603_h
Name	Receive PDO mapping
Object Code	RECORD
Data Type	PDO Mapping
Access	RW
PDO Mapping	No

Sub-Index	0
Description	Number of mapped application objects in PDO
Data Type	UNSIGNED8
Access	RW
PDO Mapping	No
Value Range	0: deactivated 1 - 8: activated
Default Value	0

Sub-Index	1 - 8
Description	PDO mapping for the nth application object to be mapped
Data Type	UNSIGNED32
Access	RW
PDO Mapping	No
Value Range	UNSIGNED32
Default Value	0



Object $1A00_h$ - $1A04_h$: Transmit PDO Mapping Parameter

INDEX	$1A00_h$ - $1A03_h$
Name	Transmit PDO mapping
Object Code	RECORD
Data Type	PDO Mapping
Access	RW
PDO Mapping	No

Sub-Index	0
Description	Number of mapped application objects in PDO
Data Type	UNSIGNED8
Access	RW
PDO Mapping	No
Value Range	0: deactivated 1 - 8: activated
Default Value	0

Sub-Index	1 - 8
Description	PDO mapping for the nth application object to be mapped
Data Type	UNSIGNED32
Access	RW
PDO Mapping	No
Value Range	UNSIGNED32
Default Value	0

Object $1C12_h$: RxPDO assign

INDEX	$1C12_h$
Name	RxPDO assign
Object Code	RECORD
Data Type	PDO Mapping assign
Access	RW
PDO Mapping	No

Sub-Index	0
Description	Number of assigned PDO mapping
Data Type	UNSIGNED8
Access	RW
PDO Mapping	No
Value Range	0: deactivated 1: one PDO mapping be assigned to SycManager2 for RxPDO
Default Value	1

Sub-Index	1
Description	Index of assigned PDO mapping
Data Type	UNSIGNED16
Access	RW
PDO Mapping	No
Value Range	1600_h to 1603_h
Default Value	1601_h

Object $1C13_h$: TxPDO assign

INDEX	$1C13_h$
Name	TxPDO assign
Object Code	RECORD
Data Type	PDO Mapping assign
Access	RW
PDO Mapping	No

Sub-Index	0
Description	Number of assigned PDO mapping
Data Type	UNSIGNED8
Access	RW
PDO Mapping	No
Value Range	0: deactivated 1: one PDO mapping be assigned to SycManager3 for TxPDO
Default Value	1

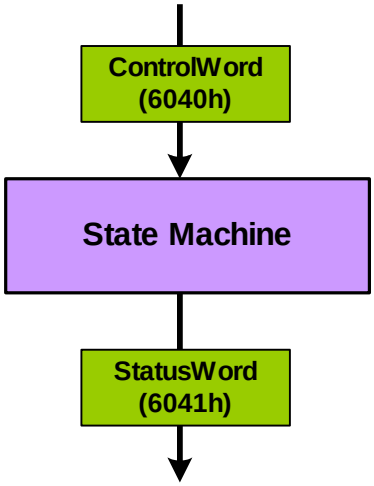
Sub-Index	1
Description	Index of assigned PDO mapping
Data Type	UNSIGNED16
Access	RW
PDO Mapping	No
Value Range	$1A00_h$ to $1A03_h$
Default Value	$1A01_h$

Object $603F_h$: Error code (error code of CANopen defined)

INDEX	$603F_h$
Name	Error code
Object Code	VAR
Data Type	UNSIGNED16
Access	RO
PDO Mapping	Yes
Value Range	UNSIGNED16
Default Value	0

Object 6040h: Controlword

INDEX	6040h
Name	Controlword
Object Code	VAR
Data Type	UNSIGNED16
Access	RW
PDO Mapping	Yes
Value Range	UNSIGNED16
Default Value	When P1-01 = 0x0C, default is 0x0004



State machine in system context

Bit definition

15 - 9	8	7	6 - 4	3	2	1	0
N/A	Halt	Fault reset	Operation mode specific	Enable operation	Quick Stop (B-contact)	Enable voltage	Switch on

Note:

You need to set 6040h to 0x0006 > 0x0007 > 0x000F for Servo On step by step.

Bit	Operation mode				
	PP	HM	IP	PV	PT
4	New set-point (positive trigger)	Homing operation start (positive trigger)	N/A	N/A	N/A
5	Change set immediately	N/A	N/A	N/A	N/A
6	Absolute(0) / relative(1)	N/A	N/A	N/A	N/A

Abbreviation:

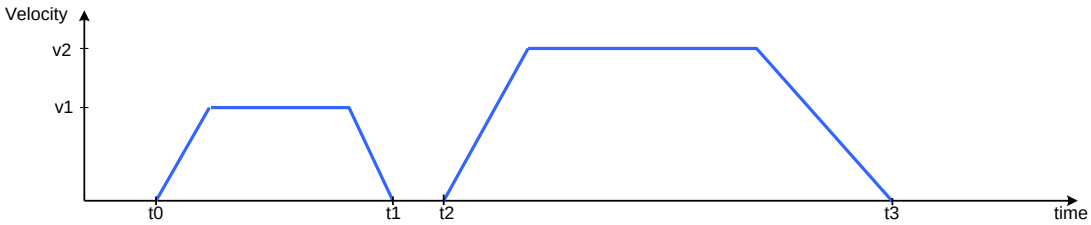
PP Profile Position Mode

HM Homing Mode

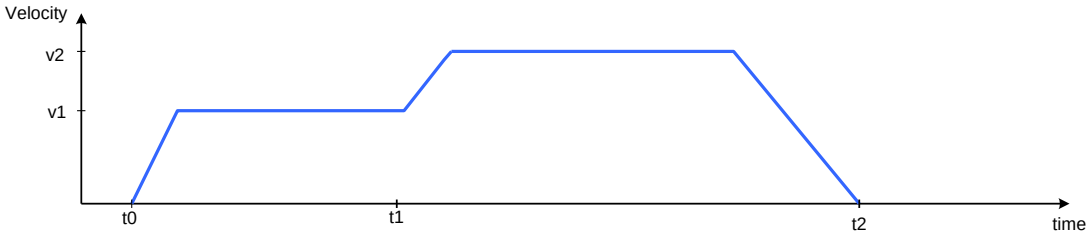
IP Interpolated Position Mode

PV Profile Velocity Mode

PT Profile Torque Mode



Single set-point



Change settings immediately

Object 6041_h: Statusword

INDEX	6041_h
Name	Statusword
Object Code	VAR
Data Type	UNSIGNED16
Access	RO
PDO Mapping	Yes
Value Range	UNSIGNED16
Default Value	0

Data description

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

MSB LSB

Bit definition

0	Ready to switch on				
1	Switch on				
2	Operation enabled (status of servo on)				
3	Fault (the drive will servo off)				
4	Voltage enabled				
5	Quick stop				
6	Switch on disabled				
7	Warning (the drive is still servo on)				
8	N/A				
9	Remote				
10	Target reached				
11	Internal limit active (Not supported)				
	PP	HM	IP	PV	PT
12	Set-point acknowledge	Homing attained	IP mode active	Zero Speed	N/A
13	Following error	Homing error	N/A	N/A	N/A
14	N/A	N/A	N/A	N/A	N/A
15	N/A	N/A	N/A	N/A	N/A

Note:

Set-point acknowledge: Trajectory generator has assumed the positioning values

Homing attained: Homing mode carried out successfully

IP mode active: interpolated position mode active – mode is running in IP mode

Object 605B$_h$: Shutdown option code

INDEX	605B$_h$
Name	Shutdown option code
Object Code	VAR
Data Type	INTEGER16
Access	RW
PDO Mapping	Yes
Value Range	INTEGER16
Default Value	0
Comment	0: disable drive function -1: dynamic break enable

Object 605E$_h$: Fault reaction option code

INDEX	605E$_h$
Name	Fault reaction option code
Object Code	VAR
Data Type	INTEGER16
Access	RW
PDO Mapping	Yes
Value Range	INTEGER16
Default Value	2
Comment	0: disable drive, motor is free to rotate 1: slow down on slow down ramp 2: slow down on quick stop ramp

Object 6060_h: Modes of operation

INDEX	6060_h
Name	Modes of operation
Object Code	VAR
Data Type	INTEGER8
Access	RW
PDO Mapping	Yes
Value Range	INTEGER8
Default Value	0
Comment	0: reserved 1: Profile position mode 3: Profile velocity mode 4: Profile torque mode 6: Homing mode 7: Interpolated position mode 8: Cyclic synchronous position mode 9: Cyclic synchronous velocity mode 10: Cyclic synchronous torque mode

Object 6061_h: Modes of operation display

INDEX	6061_h
Name	Modes of operation display
Object Code	VAR
Data Type	INTEGER8
Access	RW
PDO Mapping	Yes
Value Range	INTEGER8
Default Value	0

Object 6062_h: Position demand value

INDEX	6062_h
Name	Position demand value
Object Code	VAR
Data Type	INTEGER32
Access	RO
PDO Mapping	Yes
Value Range	INTEGER32
Default Value	0
Comment	Position command is calculated by Interpolation theory Unit: PUU

Object 6063_h: Position actual value

INDEX	6063_h
Name	Position actual value
Object Code	VAR
Data Type	INTEGER32
Access	RO
PDO Mapping	Yes
Value Range	INTEGER32
Default Value	0
Comment	Unit: increments

Object 6064_h: Position actual value

INDEX	6064_h
Name	Position actual value
Object Code	VAR
Data Type	INTEGER32
Access	RO
PDO Mapping	Yes
Value Range	INTEGER32
Default Value	0
Comment	Unit: PUU

Object 6065_h: Following error window

INDEX	6065_h
Name	Following error window
Object Code	VAR
Data Type	UNSIGNED32
Access	RW
PDO Mapping	Yes
Value Range	UNSIGNED32
Default Value	3840000
Comment	Unit: PUU

Object 6067_h: Position window

INDEX	6067_h
Name	Position window
Object Code	VAR
Data Type	UNSIGNED32
Access	RW
PDO Mapping	Yes
Value Range	UNSIGNED32
Default Value	100
Comment	Unit: PUU

Object 6068_h: Position window time

INDEX	6068_h
Name	Position window time
Object Code	VAR
Data Type	UNSIGNED16
Access	RW
PDO Mapping	Yes
Value Range	UNSIGNED16
Default Value	0
Comment	Unit: millisecond

Object $606B_h$: Velocity demand value

INDEX	$606B_h$
Name	Velocity demand value
Object Code	VAR
Data Type	INTEGER32
Access	RO
PDO Mapping	Yes
Value Range	INTEGER32
Comment	Unit: 0.1 rpm

Object $606C_h$: Velocity actual value

INDEX	$606C_h$
Name	Velocity actual value
Object Code	VAR
Data Type	INTEGER32
Access	RO
PDO Mapping	Yes
Value Range	INTEGER32
Comment	Unit: 0.1 rpm

Object $606D_h$: Velocity window

INDEX	$606D_h$
Name	Velocity window
Object Code	VAR
Data Type	INTEGER16
Access	RO
PDO Mapping	Yes
Value Range	0 - 3000
Default Value	100
Comment	Unit: 0.1 rpm

Object 606E$_h$: Velocity window time

INDEX	606E$_h$
Name	Velocity window time
Object Code	VAR
Data Type	UNSIGNED16
Access	RW
PDO Mapping	Yes
Value Range	UNSIGNED16
Default Value	0
Comment	Unit: millisecond

Object 606F$_h$: Velocity threshold

INDEX	606F$_h$
Name	Velocity threshold
Object Code	VAR
Data Type	UNSIGNED16
Access	RW
PDO Mapping	Yes
Value Range	0 - 2000
Default Value	100
Comment	Unit: 0.1 rpm

Object 6071$_h$: Target torque

INDEX	6071$_h$
Name	Target torque
Object Code	VAR
Data Type	INTEGER16
Access	RW
PDO Mapping	Yes
Value Range	-3000 to +3000
Default Value	0
Comment	Unit: one rated torque in a thousand

Object 6072_h: Max torque

INDEX	6072_h
Name	Max torque
Object Code	VAR
Data Type	UNSIGNED16
Access	RW
PDO Mapping	Yes
Value Range	0 - 3000
Default Value	3000
Comment	Unit: one rated torque in a thousand

Object 6074_h: Torque demand value

INDEX	6074_h
Name	Torque demand value
Object Code	VAR
Data Type	INTEGER16
Access	RO
PDO Mapping	Yes
Value Range	INTEGER16
Comment	Unit: one rated torque in a thousand

Object 6075_h: Motor rated current

INDEX	6075_h
Name	Motor rated current
Object Code	VAR
Data Type	UNSIGNED32
Access	RO
PDO Mapping	Yes
Value Range	UNSIGNED32
Comment	Unit: milliamp

Object 6076_h: Motor rated torque

INDEX	6076_h
Name	Motor rated torque
Object Code	VAR
Data Type	UNSIGNED32
Access	RO
PDO Mapping	Yes
Value Range	UNSIGNED32
Comment	Unit: one rated torque in a thousand

Object 6077_h: Torque actual value

INDEX	6077_h
Name	Torque actual value
Object Code	VAR
Data Type	INTEGER16
Access	RO
PDO Mapping	Yes
Value Range	INTEGER16
Comment	Unit: one rated torque in a thousand

Object 6078_h: Current actual value

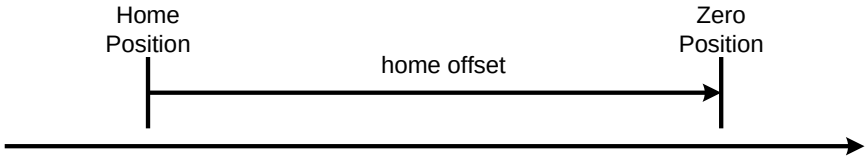
INDEX	6078_h
Name	Current actual value
Object Code	VAR
Data Type	INTEGER16
Access	RO
PDO Mapping	Yes
Value Range	INTEGER16
Comment	Unit: one rated current in a thousand

Object $607A_h$: Target position

INDEX	$607A_h$
Name	Target position
Object Code	VAR
Data Type	INTEGER32
Access	RW
PDO Mapping	Yes
Value Range	INTEGER32
Default Value	0
Comment	For Profile position mode 6060_h = 1 Unit: PUU

Object $607C_h$: Home offset

INDEX	$607C_h$
Name	Home offset
Object Code	VAR
Data Type	INTEGER32
Access	RW
PDO Mapping	Yes
Value Range	INTEGER32
Default Value	0
Comment	Unit : PUU



Home offset

Object 607D$_h$: Software position limit

INDEX	607D$_h$
Name	Software position limit
Object Code	ARRAY
Data Type	INTEGER32
Access	RW
PDO Mapping	Yes

Sub-Index	0
Description	Number of entries
Data Type	UNSIGNED8
Access	RO
PDO Mapping	Yes
Value Range	2
Default Value	2

Sub-Index	1
Description	Min position limit
Data Type	INTEGER32
Access	RW
PDO Mapping	Yes
Value Range	-2147483648 to +2147483647
Default Value	-2147483648
Comment	Unit: PUU

Sub-Index	2
Description	Max position limit
Data Type	INTEGER32
Access	RW
PDO Mapping	Yes
Value Range	-2147483648 to +2147483647
Default Value	+2147483647
Comment	Unit: PUU

Object 607F$_h$: Max profile velocity

INDEX	607F$_h$
Name	Max profile velocity
Object Code	VAR
Data Type	UNSIGNED32
Access	RW
PDO Mapping	Yes
Value Range	UNSIGNED32
Default Value	P1-55 (rpm) * 10
Comment	Unit: 0.1 rpm

Object 6080$_h$: Max motor speed

INDEX	6080$_h$
Name	Max motor speed
Object Code	VAR
Data Type	UNSIGNED32
Access	RW
PDO Mapping	Yes
Value Range	UNSIGNED32
Default Value	P1-55 (rpm)
Comment	Unit: rpm

Object 6081$_h$: Profile velocity

INDEX	6081$_h$
Name	Profile Velocity
Object Code	VAR
Data Type	UNSIGNED32
Access	RW
PDO Mapping	Yes
Value Range	UNSIGNED32
Default Value	10000
Comment	For Profile position mode 6060$_h$ = 1 Unit: PUU per second

Object 6083h: Profile acceleration

INDEX	6083h
Name	Profile acceleration
Object Code	VAR
Data Type	UNSIGNED32
Access	RW
PDO Mapping	Yes
Value Range	1 - UNSIGNED32
Default Value	200
Comment	For Profile position mode 6060_h = 1 & Profile velocity mode 6060_h = 3 Unit: millisecond (time from 0 rpm to 3000 rpm)

Object 6084h: Profile deceleration

INDEX	6084_h
Name	Profile deceleration
Object Code	VAR
Data Type	UNSIGNED32
Access	RW
PDO Mapping	Yes
Value Range	1 - UNSIGNED32
Default Value	200
Comment	For Profile position mode 6060_h = 1 & Profile velocity mode 6060_h = 3 Unit: millisecond (time from 0 rpm to 3000 rpm)

Object 6085h: Quick stop deceleration

INDEX	6085_h
Name	Quick stop acceleration
Object Code	VAR
Data Type	UNSIGNED32
Access	RW
PDO Mapping	Yes
Value Range	UNSIGNED32
Default Value	0
Comment	Unit: millisecond (time from 0 rpm to 3000 rpm)

Object 6086_h: Motion profile type

INDEX	6086_h
Name	Motion profile type
Object Code	VAR
Data Type	INTEGER16
Access	RW
PDO Mapping	Yes
Value Range	INTEGER16
Default Value	0

Object 6087_h: Torque slope

INDEX	6087_h
Name	Torque slope
Object Code	VAR
Data Type	UNSIGNED32
Access	RW
PDO Mapping	Yes
Value Range	UNSIGNED32
Default Value	0
Comment	Unit: millisecond (time from 0 to 100% rated torque)

Object 6093_h: Position factor

INDEX	6093_h
Name	Position factor
Object Code	ARRAY
Data Type	UNSIGNED32
Access	RW
PDO Mapping	Yes
Comment	Position factor = Numerator / Feed_constant

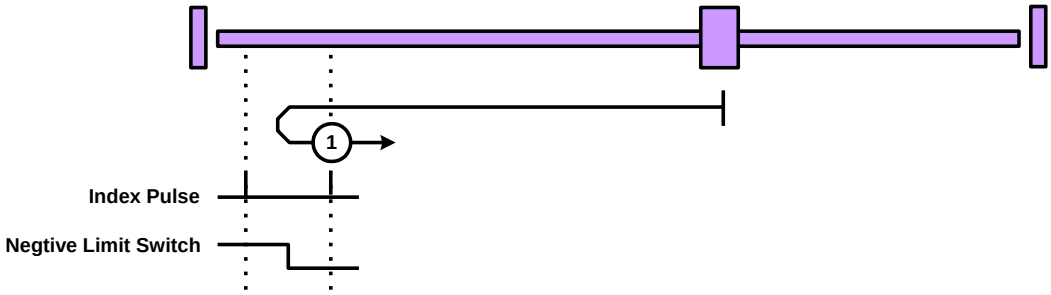
Sub-Index	0
Description	Number of entries
Data Type	UNSIGNED8
Access	RO
PDO Mapping	No
Value Range	2
Default Value	2

Sub-Index	1
Description	Numerator
Data Type	UNSIGNED32
Access	RW
PDO Mapping	Yes
Default Value	1
Comment	Same as P1-44

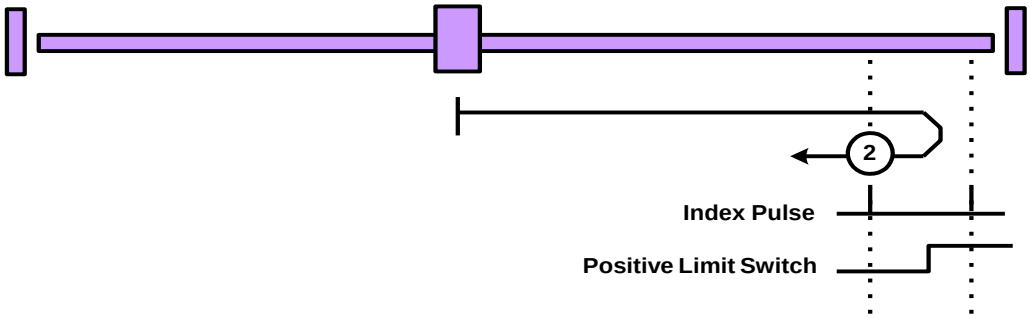
Sub-Index	2
Description	Feed_constant
Data Type	UNSIGNED32
Access	RW
PDO Mapping	Yes
Default Value	1
Comment	Same as P1-45

Object 6098_h: Homing method

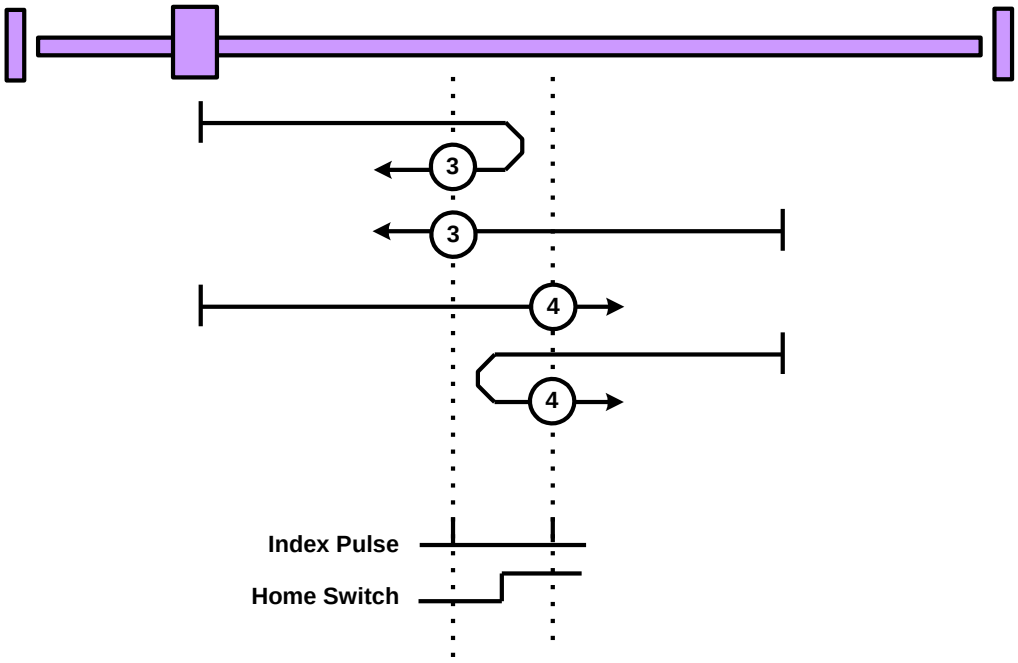
INDEX	6098_h
Name	Homing method
Object Code	VAR
Data Type	INTEGER8
Access	RW
PDO Mapping	Yes
Value Range	0 - 35
Default Value	0



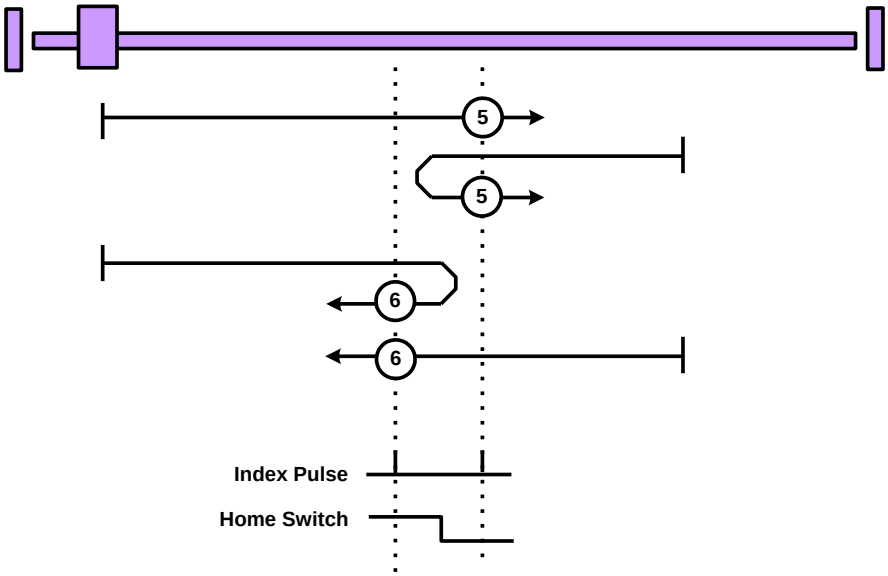
Method 1: homing on negative limit switch and index pulse



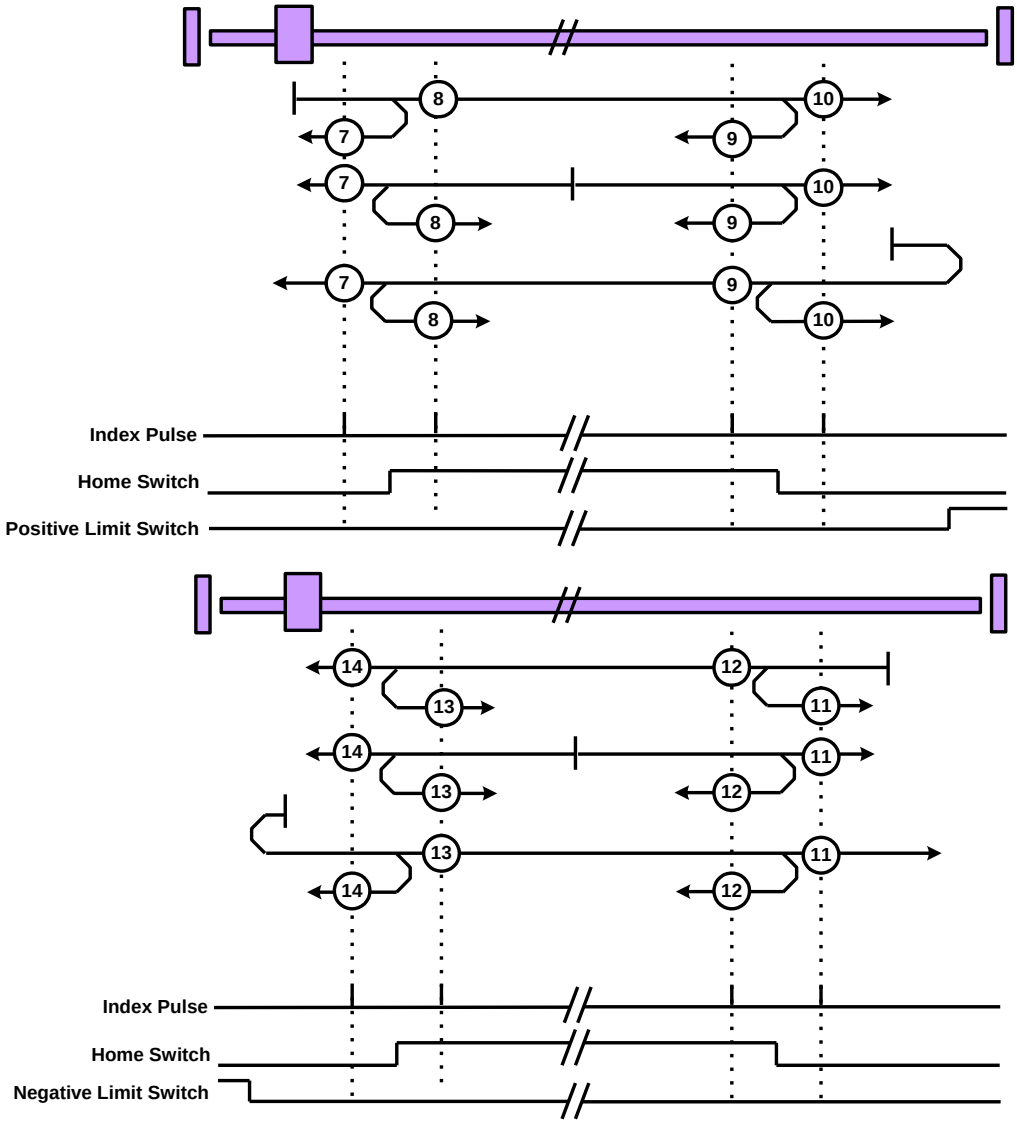
Method 2: homing on positive limit switch and index pulse



Methods 3 and 4: homing on positive home switch and index pulse

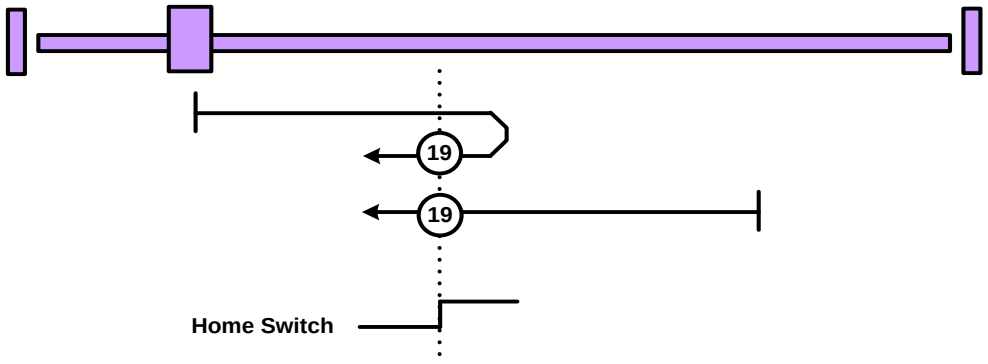


Methods 5 and 6: homing on negative home switch and index pulse



Methods 7 to 14: homing on home switch and index pulse

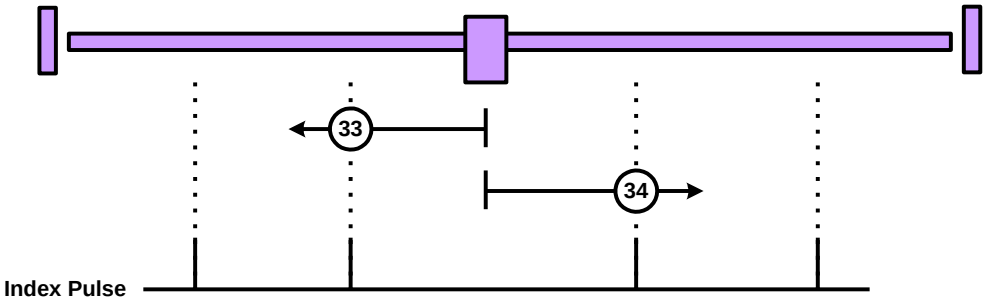
Methods 15 and 16: reserved (no picture)



Methods 17 to 30: Homing without an index pulse

Note: Methods 19 and 20 are the same. So are Methods 21 and 22, Methods 23 and 24, Methods 25 and 26, Methods 27 and 28, and Methods 29 and 30.

Methods 31 and 32: reserved (no picture)



Methods 33 to 34: homing on index pulse

Method 35: homing on current position (no picture)

Object 6099h: Homing speed

INDEX	6099h
Name	Homing speed
Object Code	ARRAY
Data Type	UNSIGNED32
Access	RW
PDO Mapping	Yes

Sub-Index	0
Description	Number of entries
Data Type	UNSIGNED8
Access	RO
PDO Mapping	Yes
Value Range	2
Default Value	2

Sub-Index	1
Description	Speed during search for switch
Data Type	UNSIGNED32
Access	RW
PDO Mapping	Yes
Value Range	1 - 2000 rpm
Default Value	100
Comment	Unit: 0.1 rpm

Sub-Index	2
Description	Speed during search for zero
Data Type	UNSIGNED32
Access	RW
PDO Mapping	Yes
Value Range	1 - 500 rpm
Default Value	20
Comment	Unit: 0.1 rpm

Object $609A_h$: Homing acceleration

INDEX	$609A_h$
Name	Homing acceleration
Object Code	VAR
Data Type	UNSIGNED32
Access	RW
PDO Mapping	Yes
Value Range	UNSIGNED32
Default Value	100
Comment	Unit: millisecond (time of acc from 0 rpm to 3000 rpm)

Object $60B0_h$: Position offset

INDEX	$60B0_h$
Name	Position offset
Object Code	VAR
Data Type	INTEGER32
Access	RW
PDO Mapping	Yes
Value Range	INTEGER32
Default Value	0
Comment	Unit: PUU

Object 60B1h: Velocity offset

INDEX	60B1h
Name	Velocity offset
Object Code	VAR
Data Type	INTEGER32
Access	RW
PDO Mapping	Yes
Value Range	INTEGER32
Default Value	0
Comment	Unit: 0.1 rpm

Object 60B2h: Torque offset

INDEX	60B2h
Name	Torque offset
Object Code	VAR
Data Type	INTEGER16
Access	RW
PDO Mapping	Yes
Value Range	-3000 to +3000
Default Value	0
Comment	Unit: one rated torque in a thousand

Object 60B8h: Touch probe function

INDEX	60B8h
Name	Touch probe function
Object Code	VAR
Data Type	UNSIGNED16
Access	RW
PDO Mapping	Yes
Value Range	UNSIGNED16
Default Value	0
Comment	0

Object 60B9h: Touch probe status

INDEX	60B9h
Name	Touch probe status
Object Code	VAR
Data Type	UNSIGNED16
Access	RO
PDO Mapping	Yes
Value Range	UNSIGNED16
Default Value	0
Comment	0

Object 60BAh: Touch probe pos1 pos value

INDEX	60BAh
Name	Touch probe pos1 pos value
Object Code	VAR
Data Type	INTEGER32
Access	RO
PDO Mapping	Yes
Value Range	INTEGER32
Default Value	0
Comment	Unit: PUU

Object 60BBh: Touch probe pos1 neg value

INDEX	60BBh
Name	Touch probe pos1 neg value
Object Code	VAR
Data Type	INTEGER32
Access	RO
PDO Mapping	Yes
Value Range	INTEGER32
Default Value	0
Comment	Unit: PUU

Object 60BC$_h$: Touch probe pos2 pos value

INDEX	60BC$_h$
Name	Touch probe pos2 pos value
Object Code	VAR
Data Type	INTEGER32
Access	RO
PDO Mapping	Yes
Value Range	INTEGER32
Default Value	0
Comment	Unit: PUU

Object 60BD$_h$: Touch probe pos2 neg value

INDEX	60BD$_h$
Name	Touch probe pos2 neg value
Object Code	VAR
Data Type	INTEGER32
Access	RO
PDO Mapping	Yes
Value Range	INTEGER32
Default Value	0
Comment	Unit: PUU

Object 60C0$_h$: Interpolation sub mode select

INDEX	60C0$_h$
Name	Interpolation sub mode select
Object Code	VAR
Data Type	INTEGER16
Access	RW
PDO Mapping	Yes
Value Range	INTEGER16
Default Value	0
Comment	0: manufacturer specific (Linear interpolation -- **no** need the Pos Difference [OD-60C1sub2]) -1: manufacturer specific (Delta definition -- need pos difference [OD-60C1sub2])

Object $60C1_h$: Interpolation data record

INDEX	$60C1_h$
Name	Interpolation data record
Object Code	ARRAY
Data Type	INTEGER32
Access	RW
PDO Mapping	Yes
Comment	Set this record by PDO every ***T*** msec before SYNC message where ***T*** is specified by $60C2_h$: 01_h

Sub-Index	0
Description	Number of entries
Data Type	UNSIGNED8
Access	RO
PDO Mapping	No
Value Range	2
Default Value	2

Sub-Index	1
Description	Pos_Cmd
Data Type	INTEGER32
Access	RW
PDO Mapping	Yes
Value Range	INTEGER32
Default Value	0
Comment	Unit: 32-bit CMD_PUU

Sub-Index	2
Description	Velocity – Pos_Cmd difference
Data Type	INTEGER16
Access	RW
PDO Mapping	Yes
Value Range	INTEGER16
Default Value	0
Comment	$\triangle X_i = (X_{i+1} - X_{i-1})/2$ (It is also the same as velocity.) Unit: PUU

Object $60C2_h$: Interpolation time period

INDEX	$60C2_h$
Name	Interpolation time period
Object Code	RECORD
Data Type	UNSIGNED8
Access	RW
PDO Mapping	Yes
Comment	The unit of ***interpolation time unit*** is given in $10^{interpolation\ time\ index}$ seconds

Sub-Index	0
Description	Number of entries
Data Type	UNSIGNED8
Access	RO
PDO Mapping	No
Value Range	2
Default Value	2

Sub-Index	1
Description	Interpolation time units
Data Type	UNSIGNED8
Access	RW
PDO Mapping	Yes
Value Range	UNSIGNED8
Default Value	1

Sub-Index	2
Description	Interpolation time index
Data Type	INTEGER8
Access	RW
PDO Mapping	Yes
Value Range	-128 to +63
Default Value	-3

Object 60C5h: Max acceleration

INDEX	60C5h
Name	Max acceleration
Object Code	VAR
Data Type	UNSIGNED32
Access	RW
PDO Mapping	Yes
Value Range	1 - 65500
Default Value	200
Comment	Unit: millisecond (min. time from 0 rpm to 3000 rpm)

Object 60C6h: Max deceleration

INDEX	60C6h
Name	Max deceleration
Object Code	VAR
Data Type	UNSIGNED32
Access	RW
PDO Mapping	Yes
Value Range	1 - 65500
Default Value	200
Comment	Unit: millisecond (min. time from 3000 rpm to 0 rpm)

Object 60F2h: Positioning option code

INDEX	60F2h
Name	Positioning option code
Object Code	VAR
Data Type	UNSIGNED16
Access	RW
PDO Mapping	Yes
Value Range	UNSIGNED16
Default Value	0

Object 60F4h: Following error actual value

INDEX	60F4h
Name	Following error actual value
Object Code	VAR
Data Type	INTEGER32
Access	RO
PDO Mapping	Yes
Value Range	INTEGER32
Comment	Unit: PUU

Object 60FCh: Position demand value

INDEX	60FCh
Name	Position demand value
Object Code	VAR
Data Type	INTEGER32
Access	RO
PDO Mapping	Yes
Value Range	INTEGER32
Comment	Unit: increment

Object 60FDh: Digital inputs

INDEX	60FDh
Name	Digital inputs
Object Code	VAR
Data Type	UNSIGNED32
Access	RO
PDO Mapping	Yes
Value Range	UNSIGNED32
Default Value	0

Object function:

Bit	31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
Bit	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

Bit	Function	Description
Bit 0	Negative limit switch	-

Bit	Function	Description
Bit 1	Positive limit switch	-
Bit 2	Home switch	-
Bit 3 - 15	-	-
Bit 16	Manufacturer-specific area	Set P3-18 U = 1 or 2 and this bit is mapped to DI 1.
Bit 17		Set P3-18 U = 1 or 2 and this bit is mapped to DI 2.
Bit 18		Set P3-18 U = 1 or 2 and this bit is mapped to DI 3.
Bit 19		Set P3-18 U = 1 or 2 and this bit is mapped to DI 4.
Bit 20		Set P3-18 U = 1 or 2 and this bit is mapped to DI 5.
Bit 21		Set P3-18 U = 1 or 2 and this bit is mapped to DI 6.
Bit 22		Set P3-18 U= 1 or 2 and this bit is mapped to DI 7.
Bit 23		Reserved.
Bit 24		Set P3-18 U = 1 or 2 and this bit is mapped to EDI 9.
Bit 25		Set P3-18 U = 1 or 2 and this bit is mapped to EDI 10.
Bit 26		Set P3-18 U = 1 or 2 and this bit is mapped to EDI 11.
Bit 27		Set P3-18 U = 1 or 2 and this bit is mapped to EDI 12.
Bit 28		Set P3-18 U = 1 or 2 and this bit is mapped to EDI 13.
Bit 29		Set P3-18 U = 1 or 2 and this bit is mapped to EDI 14.
Bit 30		Reserved.
Bit 31		Set P3-18 U = 2 and this bit is mapped to the Z pulse of encoder.

Object $60FF_h$: Target velocity

INDEX	$60FF_h$
Name	Target velocity
Object Code	VAR
Data Type	INTEGER32
Access	RW
PDO Mapping	Yes
Value Range	INTEGER32
Comment	Unit: 0.1 rpm

Object 6502h: Supported drive modes

INDEX	6502_h
Name	Supported drive modes
Object Code	VAR
Data Type	UNSIGNED32
Access	Ro
PDO Mapping	Yes
Value Range	UNSIGNED32
Default Value	$3ED_h$

31	16	15	7	6	5	4	3	2	1	0
Manufacturer specific		reserved		ip	hm	reserved	tq	pv	vl	pp
MSB										LSB

Object 2xxxh: Manufacturer parameter

INDEX	$2xxx_h$
Name	Manufacturer parameter
Object Code	VAR
Data Type	INTEGER16 / INTEGER32
Access	RW
PDO Mapping	Yes
Value Range	NTEGER16 / INTEGER32
Default Value	N/A

Object 2xxx is defined to parameter.

If you desire to use CANopen protocol for accessing parameter values, the conversion between parameter number and index is as follows:

Pa-bc <==> $2aBC_h$

'**BC**' is hexadecimal format of '**bc**'

You can read the Index first for knowing the Length of Parameter and then change the data by SDO or PDO.

Example 1: Object 2309_h: EtherCAT Synchronization Setting【P3-09】

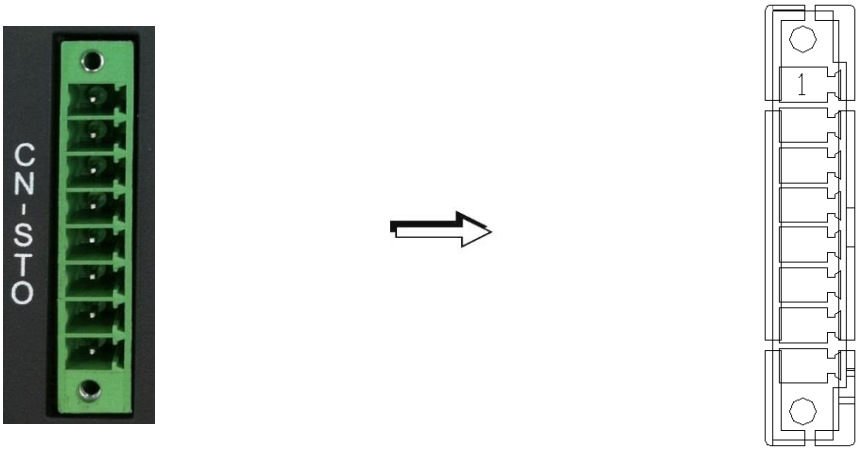
INDEX	2309_h
Name	EtherCAT Synchronization Setting
Object Code	VAR
Data Type	INTEGER16
Access	RW
PDO Mapping	Yes
Value Range	INTEGER16
Default Value	1512_h

Example 2: Object $212C_h$: Electronic Gear 【P1-44】

INDEX	$212C_h$
Name	Electronic Gear
Object Code	VAR
Data Type	INTEGER32
Access	RW
PDO Mapping	Yes
Value Range	INTEGER32

Chapter 7 STO (Safe Torque Off) Function

7.1 CN-STO Connector



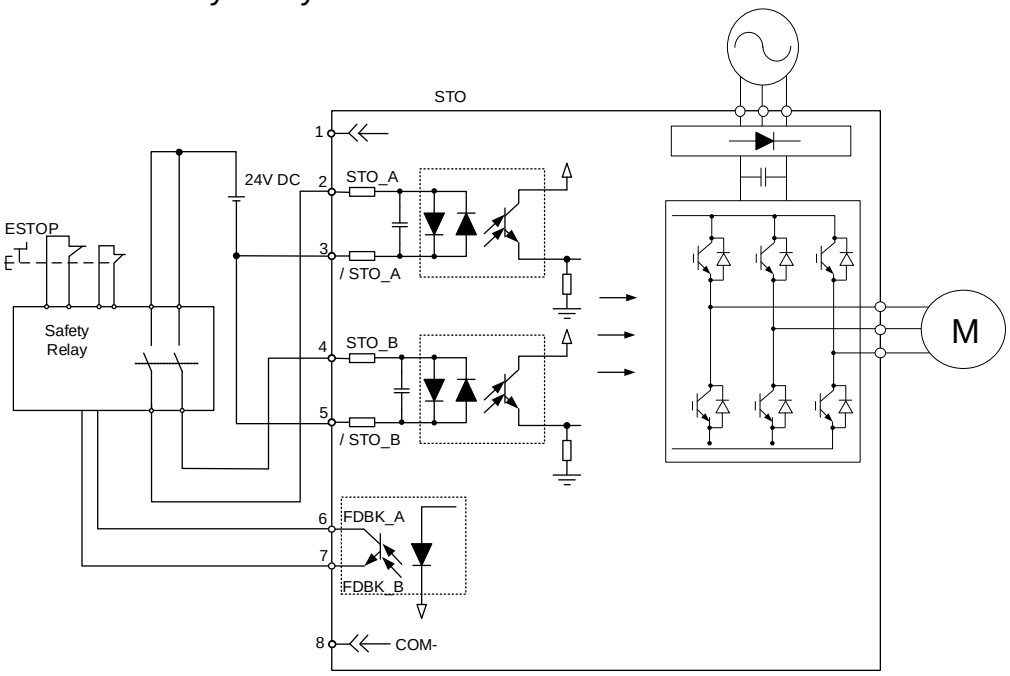
CN-STO Connector (male)

Pin No.	Terminal Symbol	Function and Description
1*	-	For short-circuiting the STO only. Do not connect the wiring for other purposes.
2	STO_A	STO input pin A+
3	/STO_A	STO input pin A-
4	STO_B	STO input pin B+
5	/STO_B	STO input pin B-
6	FDBK_A	STO alarm output pin A Relay max. output current: 1 A
7	FDBK_B	STO alarm output pin B Relay max. output current: 1 A
8	COM-	For short-circuiting the STO only. Do not connect the wiring for other purposes.

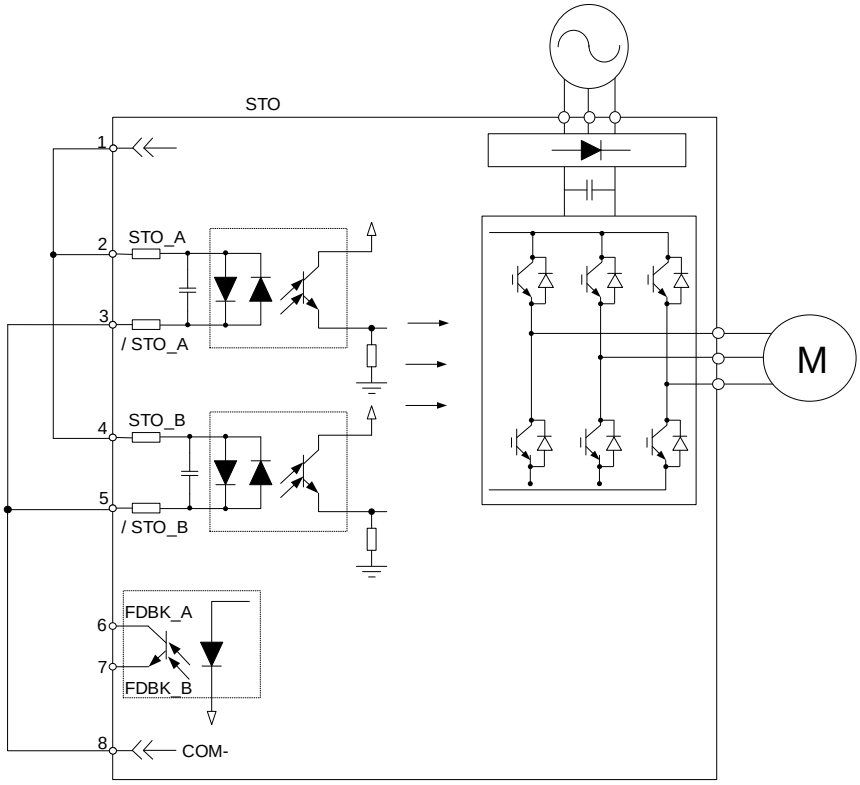
WARNING

- ***Caution: do not apply dual power to Pin 1 or it may damage the servo drive.***

Trigger STO with a Safety Relay:



Disable STO:



7.1.1 Functional Safety Standards and Certificates

Refer to Chapter 10.

7.2 Specifications of STO

Safety specifications

Item	Definition	Standard	Performance
SFF	Safe failure fraction	IEC61508	Channel 1: 80.08% Channel 2: 68.91%
HFT (Type A subsystem)	Hardware fault tolerance	IEC61508	1
SIL	Safety integrity level	IEC61508	SIL 2
		IEC62061	SILCL 2
PFH	Probability of dangerous failure per hour [h-1]	IEC61508	9.56×10^{-10}
PFD_{avg}	Average probability of failure on demand	IEC61508	4.18×10^{-6}
Category	Category	ISO13849-1	Category 3
PL	Performance level	ISO13849-1	d
$MTTF_d$	Mean time to dangerous failure	ISO13849-1	High
DC	Diagnostic coverage	ISO13849-1	Low

How does the STO Function work?

The STO function controls the motor current by two individual circuits. The two circuits cut off the power supply to the motor when needed, making the motor free from torque force. Refer to the following table.

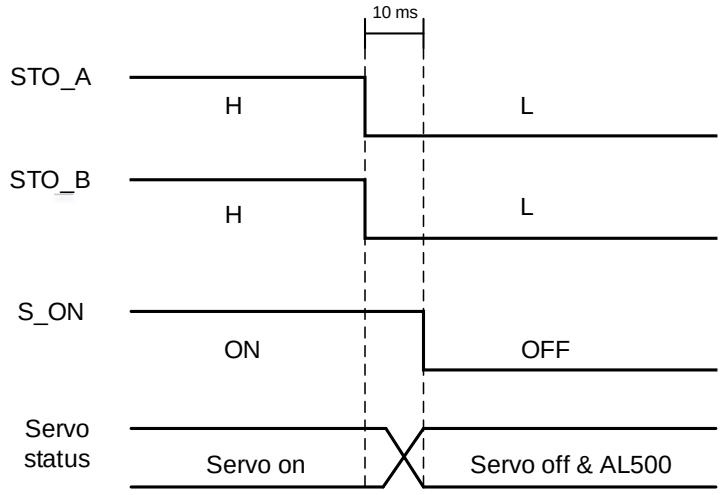
Description of STO ON/OFF

Signal		Status of opto-isolator			
STO	STO_A /STO_A	ON	ON	OFF	OFF
	STO_B /STO_B	ON	OFF	ON	OFF
Servo drive output status		Ready	STO_B lost (AL502) (Torque off)	STO_A lost (AL501) (Torque off)	STO Mode (AL501) (Torque off)

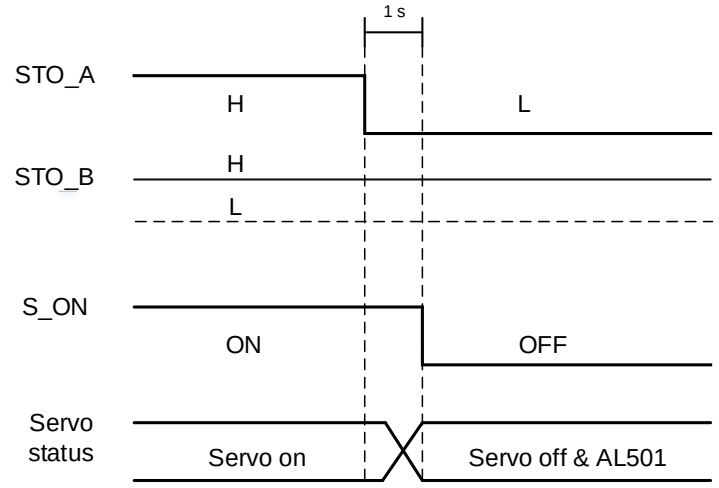
Note: ON = 24V; OFF = 0V.

(1) Status description of STO alarms:

See the following diagram. When the motor runs normally (Servo On), but both STO_A and STO_B signals (safety signal source) are low for 10 ms simultaneously, AL500 is triggered and the servo drive is Off.

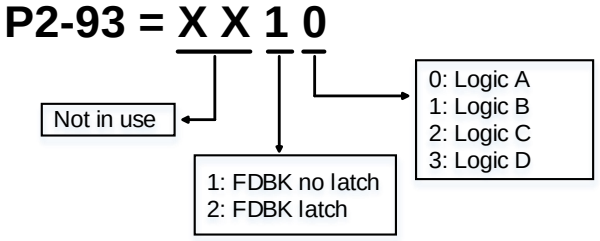


See the following diagram. When the motor runs normally (Servo On), but one of the safety signal source is low for 1 second, AL501 or AL502 is triggered and the servo drive is Off.



7.3 Related Parameter Descriptions of STO Function

Through the setting of P2-93, you can determine the FDBK status and whether FDBK will latch when an STO alarm occurs. Refer to the following figure for the setting of P2-93:



Description of STO Function:
See the following table. Four logics (Logic A, Logic B, Logic C, and Logic D) are provided to standardize FDBK status when different STO alarms occur. You can select the corresponding logic according to the demands.

In this table, Open means FDBK+ and FDBK- of CN8 are open circuit. Take Logic C as an example, when AL500 occurs, FDBK+ and FDBK- of CN8 are closed circuit.

Status of servo drive		FDBK_A & FDBK_B Status							
		Logic A		Logic B		Logic C		Logic D	
Parameter P2-93		XX10	XX20	XX11	XX21	XX12	XX22	XX13	XX23
FDBK status		No Latch	Latch	No Latch	Latch	No Latch	Latch	No Latch	Latch
No STO alarm occurs		Open		Close		Open		Close	
Alarm occurs	AL500	Close		Open		Close		Open	
	AL501	Close		Open		Open		Close	
	AL502	Close		Open		Open		Close	
	AL503	Close		Open		Open		Close	

Open = open circuit; Close = closed circuit

If FDBK is latched when an STO alarm occurs, the FDBK status will remain the same even when the alarm is cleared. Note that when more than one alarm occur at the same time, the drive panel will only display AL500.

- Example of Latch:

When Logic C P2-93 = XX22, the safety signal is lost and AL005 occurs, the FDBK status is Close.

1. Since FDBK is selected as Latch, even when the safety signal is back to normal, FDBK status remains Close. Use the following approaches to reset.
   i. Reconnect power supply. FDBK status returns to Open.
   ii. Do not reconnect power supply. Instead, set P2-93 = XX12 to make FDBK status return to Open. Then set P2-93 = XX22 again. This step is to set FDBK to Latch.
2. After the FDBK status restores, alarms can be cleared by normal corrective actions. In this case, AL500 can be cleared by DI.Alm Reset.

- Example of No Latch:

When Logic C P2-93 = XX12, the safety signal is lost and AL005 occurs, the FDBK status will be Close.

1. Since FDBK is selected as No Latch, the safety signals return to normal and the FDBK status automatically changes from Close to Open when AL500 occurs. You do not need to set P2-93 to XX12 again.
2. After the FDBK status restores, alarms can be cleared by normal corrective actions. In this case, AL500 can be cleared by DI.Alm Reset.

P2-93	**STO**	**STO FDBK Control**		**Address: 02BAH 02BCH**
Interface:	Panel / Software	Communication	Reference:	-
Default:	0		Control Mode:	ALL
Unit:	-		Range:	-
Format:	DEC		Data Size:	16-bit

Settings:

BIT 0: select the logic for FDBK status.

BIT 1: determine if FDBK is latched.

7.4 STO Type Alarms

Display	Alarm Name	Error Type	Servo State
AL500	STO function is enabled	ALM	Servo Off
AL501	STO_A loss (signal loss or signal error)	ALM	Servo Off
AL502	STO_B loss (signal loss or signal error)	ALM	Servo Off
AL503	STO_error	ALM	Servo Off

Causes and Corrective Actions:

AL500: STO Function is enabled

Cause	Checking Method	Corrective Action
Safe torque off function (STO) is enabled	Safe torque off function (STO) is enabled. Check why it is enabled.	Use DI.ARST, 0x6040.Fault Reset, or set P0-01 to 0.

AL502: STO_A loss (signal loss or signal error)

Cause	Checking Method	Corrective Action
Loss of STO_A signal, or STO_A and STO_B signals are not synchronized for more than 1 second.	Make sure the wiring of STO_A is correct.	Cycle power on the servo drive.

AL502: STO_B loss (signal loss or signal error)

Cause	Checking Method	Corrective Action
Loss of STO_B signal, or STO_A and STO_B signals are not synchronized for more than 1 second.	Make sure the wiring of STO_B is correct.	Cycle power on the servo drive.

AL503: STO_error

Cause	Checking Method	Corrective Action
STO self-diagnostic error	Make sure the STO wiring is correct.	STO circuit error. Contact the distributor.

(This page is intentionally left blank.)

Chapter 8 Parameters

The basic parameters for A2-E are the same as those for the general A2 models, so refer to ASDA-A2 User Manual for more details. The following introduces EtherCAT- and STO-related parameters only.

P3-18	ECATO	EtherCAT Special Function Switch		Address: 0324H 0325H
Interface:	Panel / Software	Communication	Reference:	-
Default:	0x00002000		Control Mode:	EtherCAT
Unit:	-		Range:	0x00000000 - 00112101
Format:	HEX		Data Size:	32-bit

Settings:

D C B A

U Z Y X

A	Source for EtherCAT Station Alias Register 0x0012	X	Select the unit for speed command and speed feedback
B	Calculating methods for OD $60F4_h$ position error	Y	Reserved
C	Select the unit for OD $607F_h$ / OD 6080_h	Z	Set the checking method for communication disconnection
D	Reserved	U	Set the manufacturer-specific area for OD $60FD_h$ mapping
h	High word	L	Low word

- A: set the source for the content of EtherCAT Station Alias Register 0x0012 after applying power to the drive.
  0: determined by the EtherCAT EEPROM address field (ADR 0x0004) setting, which needs to be set through the controller interface.
  1: determined by the address set in P3-00.
- B: calculating method for OD $60F4_h$ position deviation
  0: calculated by the motion controller.
  1: directly calculated by the motor (pos_err), and then converted with the E-gear ratio.
- X: in Profile Velocity mode or CSV mode, select the unit for speed command (OD $60FF_h$) and speed feedback (OD $606C_h$).
  0: 0.1 rpm
  1: pulse/sec
- Z: set the checking method for communication disconnection (AL185).
  0: check for the disconnection after the EtherCAT communication is in OP status.
  1: check for the disconnection after the EtherCAT communication is in INIT status.

- U: set the manufacturer-specific area for OD 60FD$_h$ mapping (see detailed information in Chapter 6)

  0: disabled. The manufacturer-specific area is not in use.

  1: map DI/EDI status to the manufacturer-specific area of OD 60FD$_h$.

  2: map the Z pulse of the encoder and DI/EDI status to the manufacturer-specific area of OD 60FD$_h$.

P3-19	CSTSA	Statusword Status Display Setting		Address: 0326H 0327H
Interface:	Panel / Software	Communication	Reference:	-
Default:	0x0021		Control mode:	CANopen/EtherCAT
Unit:	-		Range:	0x0000 - 0x1121
Format:	HEX		Data size:	16-bit

Settings:

D C B A

U Z Y X

A	Reserved	X	OD 6041$_h$ Bit 4 status
B	Reserved	Y	OD 6041$_h$ Bit 10 status
C	Reserved	Z	OD 6041$_h$ Bit 14 status
D	Reserved	U	OD 6041$_h$ Bit 15 status
h	High word	L	Low word

- X: OD 6041$_h$ Bit 4 status (applicable to EtherCAT only)

  0: the bit is On

  1: RST output status

- Y: OD 6041$_h$ Bit 10 status (applicable to EtherCAT only)

  0: in CSP mode, OD 6041$_h$ Bit 10 is invalid.

  2: in CSP mode, OD 6041$_h$ Bit 10 is in Target Reach status.

- Z: OD 6041$_h$ Bit 14 status (applicable to CANopen / EtherCAT)

  0: OD 6041$_h$ Bit 14 is in positive limit status.

  1: OD 6041$_h$ Bit 14 outputs the current status of the servo and controller synchronization. If it shows On, it means they have already been synchronized (SYN_OK).

- U: OD 6041$_h$ Bit 15 status (applicable to CANopen / EtherCAT)

  0: OD 6041$_h$ Bit 15 is in negative limit status.

  1: N/A

P3-22	EPTO	EtherCAT PDO Timeout Setting		Address: 032CH 032DH
Interface:	Panel / Software	Communication	Reference:	-
Default:	0xFF04		Control mode:	EtherCAT
Unit:	-		Range:	0x0002 - 0xFF14
Format:	HEX		Data size:	16-bit

Settings:

When exchanging Process Data with PDOs, you can set the following two sets of value to monitor the number of continuous packet loss and thus triggering the alarm if the number is exceeded.

YX	Allowable cycle times of packet loss for AL3E3
UZ	Allowable time for AL180

- YX: allowable cycle times of packet loss for AL3E3

  When in synchronous modes (IP/CSP/CSV/CST), use this parameter to set the allowable consecutive cycle times for packet loss within the range from 0x02 to 0x14. If the cycle time exceeds the range, AL3E3 occurs.

  Example: the communication cycle time is 4 ms, and if you set this parameter to 02, it means 2 cycle times are permissible. That is, if A2-E does not receive a PDO within 8 ms, it triggers AL3E3.

- UZ: allowable time for AL180 (applicable to all modes)

  Calculate the consecutive milliseconds for not receiving PDOs. The allowable range is from 0x00 (disabled) to 0xFF (default). If the time exceeds the range, AL180 occurs.

P4-27	AL503 diagnosis time		Address: 0436H 0437H
Default:	200	Control mode:	All
Unit:	ms	Range:	0 - 500
Format:	DEC	Data size:	16-bit

Settings:

Adjusts the diagnosis time duration for the STO internal circuit to avoid misdetection and triggering AL503.

(This page is intentionally left blank.)

Chapter 9 Alarms and Troubleshooting

9.1 EtherCAT Communication Alarm List

Emergency Object

Byte	0	1	2	3	4	5	6	7
Content	Emergency Error Code		Error register	Panel Alarm Code		N/A		

For the alarm codes not included here, refer to the ASDA-A2 User Manual.

Display	Alarm Name	Description	Alarm Clearing Method
AL185	Bus hardware error	EtherCAT communication is cut off.	6040h fault reset
AL180	Bus communication timeout (Servo Off)	The drive does not receive any PDO data within three communication cycle times.	6040h fault reset
AL122	Object's sub-index does not exist when PDO is accessed	The specified sub-index in the message does not exist.	6040h fault reset
AL123	Data length error occurs when PDO is accessed	The data length in the message does not match the length of the specified object.	6040h fault reset
AL124	Data range error occurs when PDO is accessed	The data value in the message is out of range for the specified object.	6040h fault reset
AL125	PDO object is read-only and write-protected	The specified object in the message is read-only and write-protected (cannot be changed).	6040h fault reset
AL126	Specified object does not support PDO mapping	The specified object does not support PDO mapping.	6040h fault reset

Display	Alarm Name	Description	Alarm Clearing Method
AL127	PDO object is write-protected when servo drive is on	PDO object is write-protected (unchangeable) when the servo drive is on.	6040h fault reset
AL128	Error occurs when PDO object is read from EEPROM	An error occurs when loading the default settings from EEPROM at start-up. All CANopen objects are restored to the default settings automatically.	6040h fault reset
AL129	Error occurs when PDO object is written to EEPROM	An error occurs when the PDO object is written to EEPROM.	6040h fault reset
AL130	Accessing address of EEPROM is out of range	The amount of data in the ROM is greater than the allowable space specified by the firmware. It is probably because the firmware has been updated, but the data in the ROM was stored by the previous firmware version.	6040h fault reset
AL131	EEPROM CRC calculation error	The data saved in EEPROM has been damaged and all CANopen objects return to the default settings automatically.	6040h fault reset
AL132	Parameter is write-protected	The parameter is password-protected when using CANopen communication to access the parameter. The users must enter the valid password to unlock the parameter.	6040h fault reset
AL201	Initialization error of object dictionary data	An error occurs while reading / writing data from / to EEPROM.	After firmware upgrade, set P2-08 = 10, or set P2-08 = 30 and then 28.
AL3E1	Communication fails to synchronize (Servo Off)	The synchronous communication with the external controller has failed.	6040h fault reset
AL3E2	Communication synchronization signal is sent too soon (Servo Off)	The CANopen SYNC signal is received too soon.	6040h fault reset

Display	Alarm Name	Description	Alarm Clearing Method
AL3E3	Communication synchronization signal timeout (Servo Off)	The CANopen SYNC signal is not received within four consecutive communication cycle times. If the interference is too great to be removed by the hardware, increase the communication cycle for P3-22 XY to loosen the condition for triggering AL3E3.	6040h fault reset
AL3E4	CANopen IP command failed (Servo Off)	Internal command of CANopen IP mode cannot be sent and received.	6040h fault reset
AL3E5	SYNC period error (Servo Off)	SYNC period 1006h value is invalid.	6040h fault reset
AL500	STO function is enabled (Servo Off)	The safety function (STO) is enabled. STO_A and STO_B change state simultaneously.	6040h fault reset
AL501	STO_A lost (Servo Off)	Loss of STO_A signal, or STO_A and STO_B signals are not synchronized for more than 1 second. Make sure the wiring of STO_A is correct.	6040h fault reset
AL502	STO_B lost (Servo Off)	Loss of STO_B signal, or STO_A and STO_B signals are not synchronized for more than 1 second. Make sure the wiring of STO_B is correct.	6040h fault reset
AL503	STO self-diagnostic error (Servo Off)	An error occurs during STO self-diagnosis, which may be caused by an abnormality in the STO circuit.	Sent your servo drive back to Delta.

9.2 Alarm List

Display	Alarm Name	32-bit Error Code (16-bit Error Code + 16-bit Additional Info)
AL001	Overcurrent	2310-0001$_h$
AL002	Overvoltage	3110-0002$_h$
AL003	Undervoltage	3120-0003$_h$
AL004	Motor error	7122-0004$_h$
AL005	Regeneration error	3210-0005$_h$
AL006	Overload	3230-0006$_h$
AL007	Overspeed	8400-0007$_h$
AL008	Abnormal pulse control command	8600-0008$_h$
AL009	Excessive deviation	8611-0009$_h$
AL010	Reserved	0000-0010$_h$
AL011	Encoder error	7305-0011$_h$
AL012	Adjustment error	6320-0012$_h$
AL013	Emergency stop activated	5441-0013$_h$
AL014	Reverse limit switch error	5443-0014$_h$
AL015	Forward limit switch error	5442-0015$_h$
AL016	IGBT temperature error	4210-0016$_h$
AL017	Memory error	5330-0017$_h$
AL018	Encoder output error	7306-0018$_h$
AL019	Serial communication error	7510-0019$_h$
AL020	Serial communication time out	7520-0020$_h$
AL021	Reserved	Reserved
AL022	Input power phase loss	3130-0022$_h$
AL023	Early warning for overload	3231-0023$_h$
AL024	Encoder initial magnetic field error	7305-0024$_h$
AL025	Encoder internal error	7305-0025$_h$
AL026	Unreliable internal data of the encoder	7305-0026$_h$
AL027	Encoder data error	7305-0027$_h$
AL030	Motor protection error	7121-0030h
AL031	U,V,W wiring error	3300-0031h
AL040	Full-closed loop excessive deviation	8610-0040h
AL099	DSP firmware upgrade	5500-0099h

Display	Alarm Name	32-bit Error Code (16-bit Error Code + 16-bit Additional Info)
-		
AL283	Software positive limit	5444-0283h
AL285	Software negative limit	5445-0285h
-		
AL185	Bus hardware error (Servo Off)	8120-0185h
AL180	Bus communication timeout (Servo Off)	8130-0180h
AL122	Object's sub-index does not exist when PDO is accessed	8200-0122h
AL123	Data length error occurs when PDO is accessed	8200-0123h
AL124	Data range error occurs when PDO is accessed	8200-0124h
AL125	PDO object is read-only and write-protected	8200-0125h
AL126	Specified object does not support PDO mapping	8200-0126h
AL127	PDO object is write-protected when servo drive is on	8200-0127h
AL128	Error occurs when PDO object is read from EEPROM	8200-0128h
AL129	Error occurs when PDO object is written to EEPROM	8200-0129h
AL130	Accessing address of EEPROM is out of range	8200-0130h
AL131	EEPROM CRC calculation error	8200-0131h
AL132	Parameter is write-protected	8200-0132h
AL201	Initialization error of object dictionary data	6310-0201h
AL3E1	Communication fails to synchronize (Servo Off)	6200-03E1h
AL3E2	Communication synchronization signal is sent too soon (Servo Off)	6200-03E2h
AL3E3	Communication synchronization signal timeout (Servo Off)	6200-03E3h
AL3E4	CANopen IP command failed (Servo Off)	6200-03E4h
AL3E5	SYNC period error (Servo Off)	6200-03E5h
AL500	STO function is enabled (Servo Off)	9000-0500h
AL501	STO_A lost (Servo Off)	9000-0501h
AL502	STO_B lost (Servo Off)	9000-0502h
AL503	STO self-diagnostic error (Servo Off)	9000-0503h

9.3 SDO Abort Codes

SDO Abort Code	Description
05040001_h	Client / server command specifier not valid or unknown
06010002_h	Attempt to write a read-only object
06020000_h	Object does not exist in the object dictionary
06040041_h	Object cannot be mapped to PDO
06040042_h	The number and the length of the objects to be mapped would exceed PDO length
06060000_h	Access failed due to a hardware error (store or restore error)
06070010_h	Data type does not match; length of the service parameter does not match
06090011_h	Sub-index does not exist
06090030_h	Value range of parameter exceeded (only for writing access)
08000000_h	General error
$080000a1_h$	Object error when reading from EEPROM
$080000a2_h$	Object error when writing to EEPROM
$080000a3_h$	Invalid range when accessing EEPROM
$080000a4_h$	Checksum error when accessing EEPROM
$080000a5_h$	Password error when writing encryption zone
08000020_h	Data cannot be transferred or stored in the application
08000021_h	Data cannot be transferred or stored in the application because of the local control (store or restore in wrong state)
08000022_h	Object is in use

Chapter 10 Reference Material

1. CANopen Application Layer and Communication Profile, CiA Draft Standard 301, Version 4.02, Date: 13 February 2002
2. CANopen Device Profile Drives and Motion Control, CiA Draft Standard Proposal 402, Version 2.0, Date: 26 July 2002

EC Type-Examination Certificate

Functional Safety Type Approved

TÜVRheinland® CERTIFIED

www.tuv.com
ID 0600000000

Reg.-No.: 01/205/5429.00/15

Product tested	Safety Function "Safe Torque Off" (STO)	**Certificate holder**	Delta Electronics, Inc. 18 Xinglong Road Taoyuan County Taoyuan City 33068 Taiwan, R.O.C.
Type designation	within the drive series VFD-C, VFD-CP, VFD-CT, VFD-CH, VFD-HH, DPD, VFD-ED-S and ASD-A2. Details see Annex (Version Release List)		
Codes and standards	IEC 61800-5-2:2007 IEC 61800-5-1:2007 (in extracts) IEC 61800-3:2012 IEC 62061:2012		EN ISO 13849-1:2008 + AC:2009 IEC 60204-1:2009 (in extracts) IEC 61508 Parts 1-7:2010
Intended application	The safety function complies with the requirements of the relevant standards (Cat. 3 / PL d acc. to EN ISO 13849-1, SIL CL 2 acc. to IEC 62061 / IEC 61508) and can be used in applications up to PL d acc. to EN ISO 13849-1 and SIL 2 acc. to IEC 62061 / IEC 61508.		
Specific requirements	The instructions of the associated Installation and Operating Manual shall be considered.		

It is confirmed, that the product under test complies with the requirements for machines defined in Annex I of the EC Directive 2006/42/EC.

Valid until 2020-01-08

The issue of this certificate is based upon an examination, whose results are documented in Report No. 968/FSP 1074.00/15 dated 2015-01-08.
This certificate is valid only for products which are identical with the product tested. It becomes invalid at any change of the codes and standards forming the basis of testing for the intended application.

TÜV Rheinland 0035 Notified Body

Berlin, 2015-01-08

Certification Body for Machinery, NB 0035

Dipl.-Ing. Eberhard Frejno

TÜV Rheinland Industrie Service GmbH, Alboinstr. 56, 12103 Berlin / Germany
Tel.: +49 30 7562-1557, Fax: +49 30 7562-1370, E-Mail: industrie-service@de.tuv.com

www.fs-products.com
www.tuv.com

TÜVRheinland®
Precisely Right.