



Fast, Accurate, Smooth Motion

Closed Loop Stepping System EtherCAT Network

User Manual

- **Ezi-SERVOII EtherCAT**
- **Ezi-SERVOII EtherCAT 86**
- **S-SERVO EtherCAT**
- **Ezi-SERVOII EtherCAT 4X**

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Introduction

Before Operation

- Thank you for your purchasing Ezi-SERVOII EtherCAT.
- 32 Bit high-performance of ARM Processor on-board Ezi-SERVOII EtherCAT is motion controller supports Field-network EtherCAT.
- This manual describes handling, safety instruction, diagnosis and troubleshooting of Ezi-SERVOII EtherCAT.
- Before operating Ezi-SERVOII EtherCAT, thoroughly read this manual.
- After reading the manual, keep the manual near the product so that any user can read the manual whenever needed.

Safety Precautions

General Precautions

- Contents of this manual are subject to change without prior notice for functional improvement, change of specifications or user's better understanding.
- When the manual is damaged or lost, please contact with Fastech's agents or our company to get a manual again.
- It is not responsible for Fastech to guarantee product randomly reconstructed because this kind of improper action is out of range of guarantee.

Safety Precautions

Before installation, operation and repairing, thoroughly read the manual and fully understand the contents. Also before operation, please understand the mechanical characteristics of the product and related safety information and precautions.

User manual describes level of precaution for safety as Warning and Danger.

Warning

If user does not properly handle the product, the user may seriously or slightly injured and damages may occur in the machine.



Danger

If user does not properly handle the product, a dangerous situation (such as an electric shock) may occur resulting in deaths or serious injuries.



Information

Necessary Information and extra attentions for operation.



Although precaution is only a Attention, a serious result could be caused depending on the situation.

Check the product

Warning

Check the product is damaged or parts are missing. Otherwise, the machine may get damaged or the user may get injured.



Installation

Warning

Carefully operate the product. Otherwise the product may get damaged or user's foot may get injured by dropping the product.

Use non-flammable materials such as metal in the place where the product is to be installed. Otherwise, a fire may occur.

When installing several units of FASTECH Co., Ltd.'s products in a sealed place, install a cooling fan to keep the ambient temperature as 50°C or lower. Otherwise a fire or other kinds of accidents may occur due to overheating.



Danger

The process of installation, Connection, Operation, Checking and Repairing should be done with qualified person.



Connect Cables

Warning

Keep the rated range of input voltage of the drive. Otherwise, a fire or other kinds of accidents may occur.

Please follow the wiring diagram for cable connection. Otherwise, a fire or other kinds of accidents may occur.



Danger

Before connecting cables, please check if input power is OFF. Otherwise, a fire or other kinds of accidents may occur.

The case of Ezi-SERVOII EtherCAT is insulated from the ground of the internal circuit by the condenser so please ground the product. Otherwise, an electric shock or a fire may occur.



Operation and Setting

Warning

If a protection function (alarm) occurs, firstly remove its cause and then release (alarm reset) the protection function. If you operate continuously without removal of root cause, the machine may get damaged or the user may get injured.

Make all input signals to OFF before supply input voltage to drive. Motor will run then the machine may get damaged or the user may get injured.

All parameter values of Ezi-SERVOII EtherCAT are set by default factory setting value. Change this value after reading this manual thoroughly. Otherwise, the machine may get damaged or other kinds of accidents may occur.



Check and Repair

Danger

Stop to supply power to main circuit and wait for a while before checking or repairing the Ezi-SERVOII EtherCAT. Electricity remains in the capacitor may cause danger as like electric shock.

Do not change cabling while power is being supplied. Otherwise, the user may get injured or the product may get damaged.

Do not reconstruct the product. Otherwise, an electric shock may occur or the reconstructed product can not get After Sales Service.



Chapter 1

Product Specification

1.1 Part Numbering

Ezi-SERVOII EtherCAT / Ezi-SERVOII EtherCAT 86

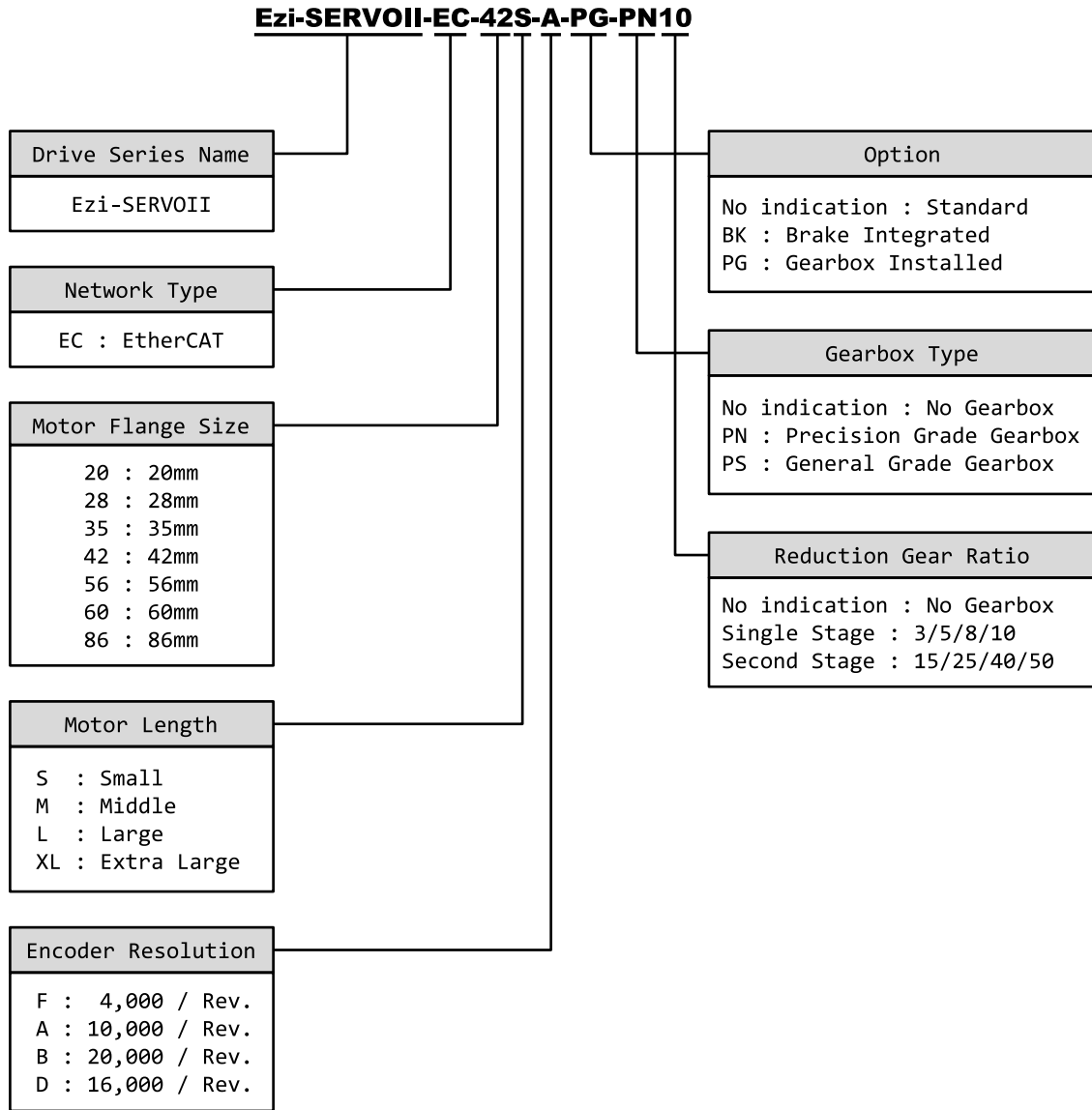


Figure 1.1: Model Naming

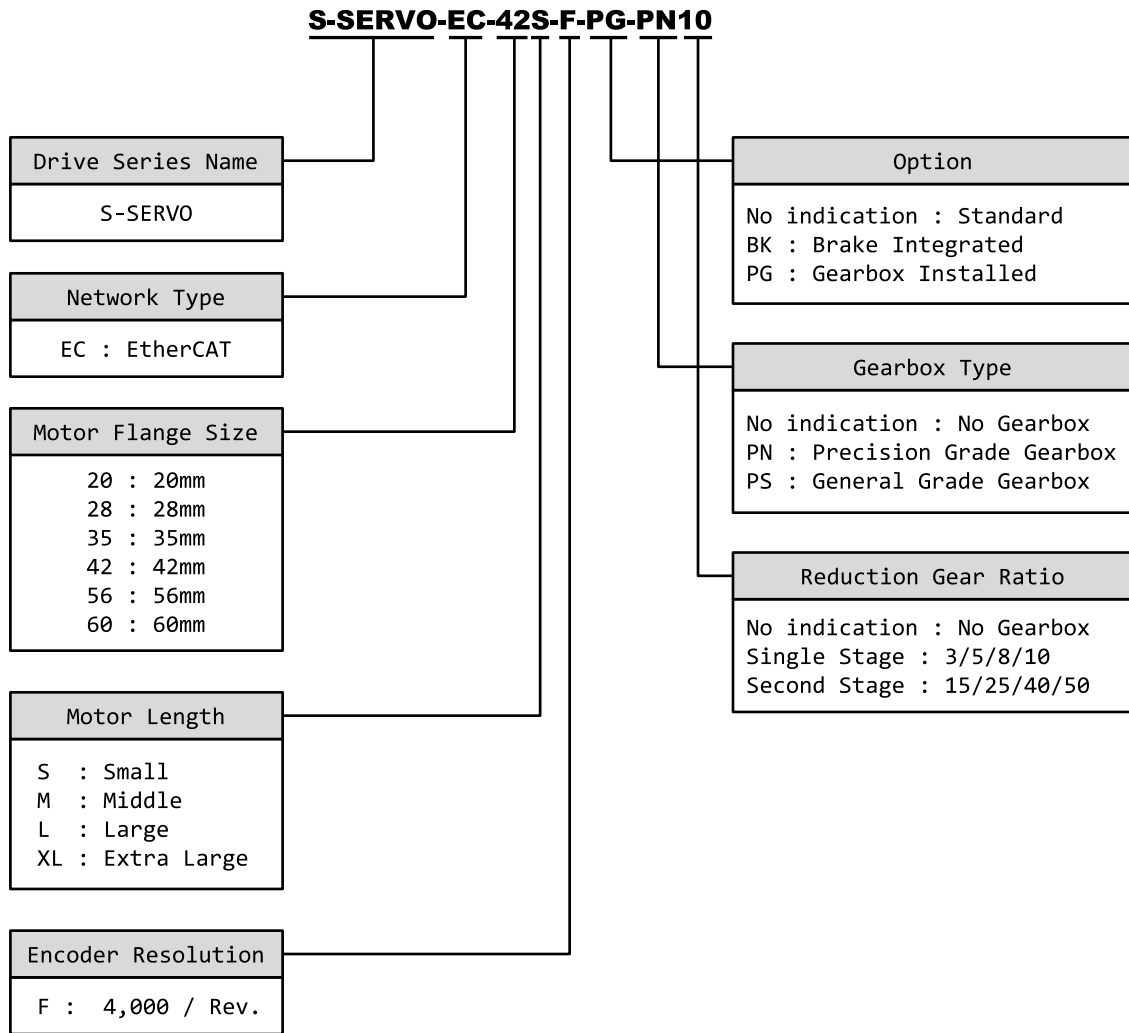
S-SERVO EtherCAT

Figure 1.2: Model Naming

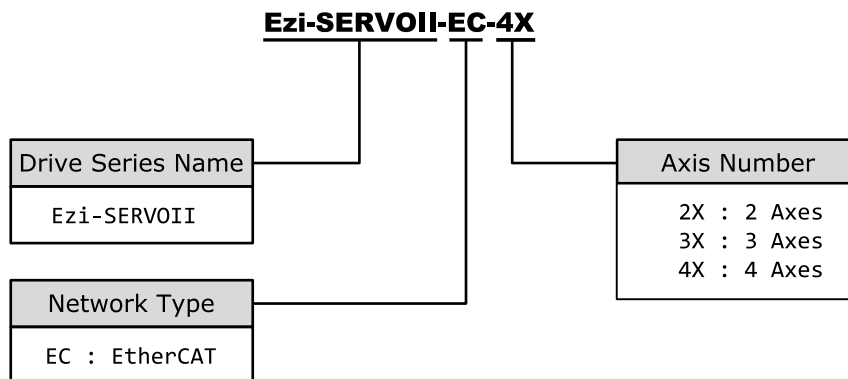
Ezi-SERVOII EtherCAT 4X

Figure 1.3: Model Naming

1.2 Product Dimension

Ezi-SERVOII EtherCAT / S-SERVO EtherCAT

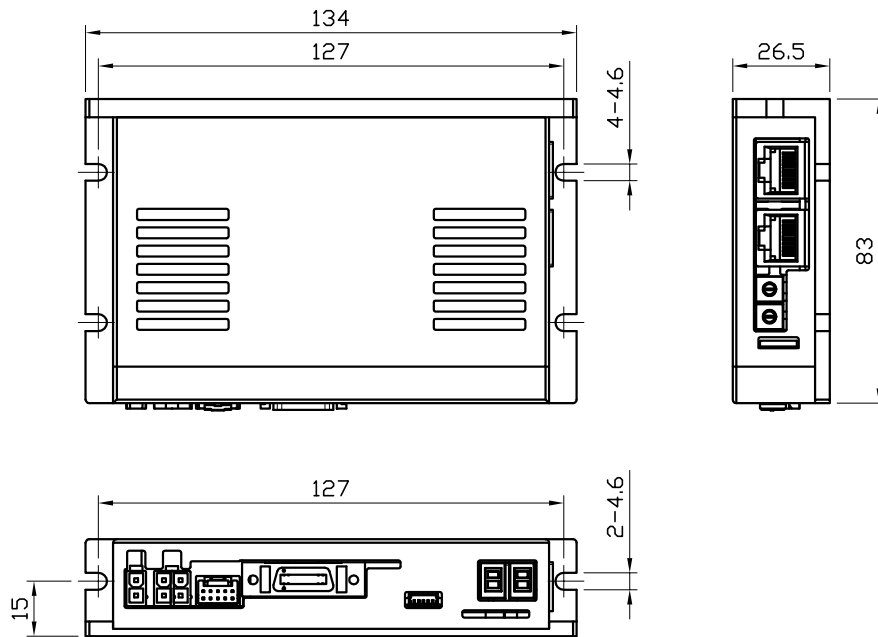


Figure 1.4: Dimensions

Ezi-SERVOII EtherCAT 86

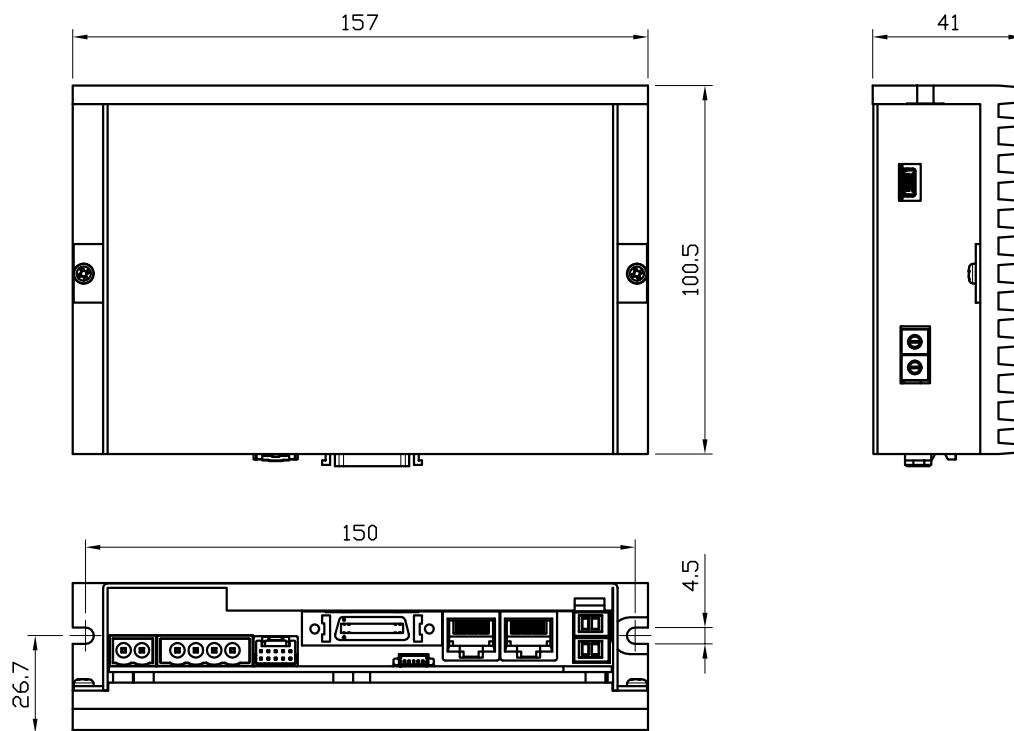


Figure 1.5: Dimensions

Ezi-SERVOII EtherCAT 4X

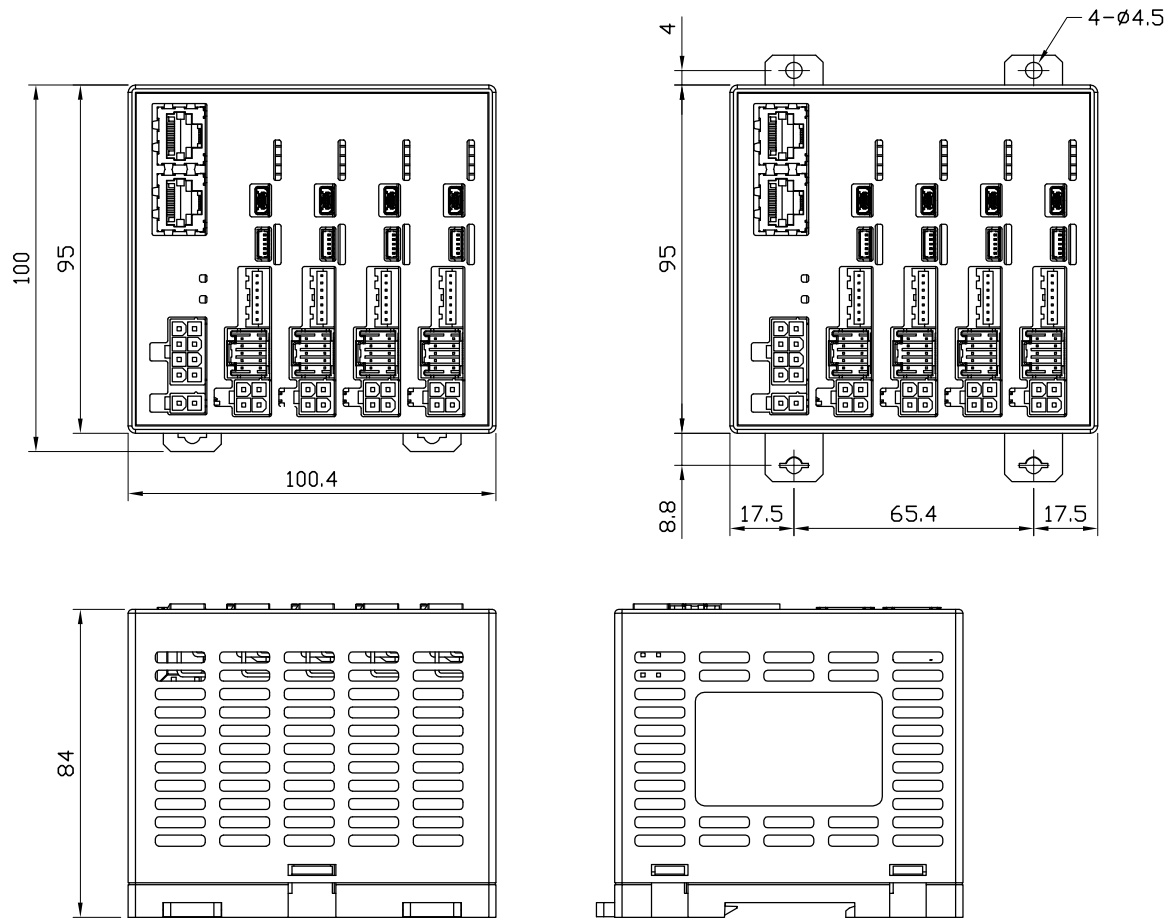


Figure 1.6: Dimensions

1.3 EtherCAT Specifications

Type of Communication	EtherCAT
Physical Layer	Ethernet - 100BASE-TX
Connector	RJ45 (shielded) ECAT IN : EtherCAT Input ECAT OUT : EtherCAT Output
ECAT Device ID	Set Configured Station Alias by ECAT ID Switch : 1 ~ 99 Set Physical Address at Master : 1 ~ 65535
Topology	Line (Structured by Ezi-SERVOII EtherCAT only) Tree, Star (When use Switch hub)
Support Protocol	CoE (CANopen application protocol over EtherCAT) FoE (File Access over EtherCAT)
Control Profile	CiA 402 drive profile (IEC61800-7)
Supported Operation Mode	Cyclic Synchronous Position Mode Profile Position Mode Homing Mode
Distributed Clock	Free Run, SM event mode, DC mode (minimum cycle time: 250us)
Processing Data	Fixed PDO Mapping (1600h, 1A00h) Configurable PDO Mapping (1601h, 1A01h)

Table 1.1: Communication Specification

1.4 Drive Specification

Ezi-SERVOII EtherCAT

Input Voltage		24VDC \pm 10%
Control Method		32bit ARM based Closed-loop Control
Current Consumption		500 mA (Except Motor Current)
Operating Condition	Ambient Temperature	In Use : 0 ~ 55°C In Storage : -27 ~ 70°C
	Humidity	In Use : 35 ~ 85%RH In Storage : 10 ~ 90%RH
	Vib. Resist.	0.5G
Function	Rotation Speed	0 ~ 3,000 rpm
	Resolution	200 ~ 20,000 pulse (Resolution setting by Object)
	Protection Function	Over current, Over Speed, Step out, Position Tracking Error, Over load, Over Temperature, Over regenerated voltage, Motor connect error, Encoder connect error, Motor voltage error, In-Position error, System error, ROM error, Position overflow error
	LED Display	Power status, In-Position status, Servo On status, Alarm status
I/O Signal	Input Signal	3 dedicated input (Limit+, Limit-, Origin) 7 user input
	Output Signal	1 dedicated output (Brake) 6 user output

Table 1.2: Drive Specification

S-SERVO EtherCAT

Input Voltage		24VDC \pm 10%
Control Method		32bit ARM based Closed-loop Control
Current Consumption		500 mA (Except Motor Current)
Operating Condition	Ambient Temperature	In Use : 0 ~ 55°C In Storage : -27 ~ 70°C
	Humidity	In Use : 35 ~ 85%RH In Storage : 10 ~ 90%RH
	Vib. Resist.	0.5G
Function	Rotation Speed	0 ~ 3,000 rpm
	Resolution	200 ~ 20,000 pulse (Resolution setting by Object)
	Protection Function	Over current, Over Speed, Step out, Position Tracking Error, Over load, Over Temperature, Over regenerated voltage, Motor connect error, Encoder connect error, Motor voltage error, In-Position error, System error, ROM error, Position overflow error
	LED Display	Power status, In-Position status, Servo On status, Alarm status
I/O Signal	Input Signal	3 dedicated input (Limit+, Limit-, Origin) 7 user input
	Output Signal	1 dedicated output (Brake) 6 user output

Table 1.3: Drive Specification

Ezi-SERVOII EtherCAT 86

Input Voltage		40~70VDC $\pm 10\%$
Control Method		32bit ARM based Closed-loop Control
Current Consumption		500 mA (Except Motor Current)
Operating Condition	Ambient Temperature	In Use : 0 ~ 55°C In Storage : -27 ~ 70°C
	Humidity	In Use : 35 ~ 85%RH In Storage : 10 ~ 90%RH
	Vib. Resist.	0.5G
Function	Rotation Speed	0 ~ 3,000 rpm
	Resolution	200 ~ 20,000 pulse (Resolution setting by Object)
	Protection Function	Over current, Over Speed, Step out, Position Tracking Error, Over load, Over Temperature, Over regenerated voltage, Motor connect error, Encoder connect error, Motor voltage error, In-Position error, System error, ROM error, Position overflow error
	LED Display	Power status, In-Position status, Servo On status, Alarm status
I/O Signal	Input Signal	3 dedicated input (Limit+, Limit-, Origin) 7 user input
	Output Signal	1 dedicated output (Brake) 6 user output

Table 1.4: Drive Specification

Ezi-SERVOII EtherCAT 4X

Input Voltage		24VDC $\pm 10\%$
Control Method		32bit ARM based Closed-loop Control
Current Consumption		500 mA (Except Motor Current)
Operating Condition	Ambient Temperature	In Use : 0 ~ 55°C In Storage : -27 ~ 70°C
	Humidity	In Use : 35 ~ 85%RH In Storage : 10 ~ 90%RH
	Vib. Resist.	0.5G
Function	Rotation Speed	0 ~ 3,000 rpm
	Resolution	200 ~ 20,000 pulse (Resolution setting by Object)
	Protection Function	Over current, Over Speed, Step out, Position Tracking Error, Over load, Over Temperature, Over regenerated voltage, Motor connect error, Encoder connect error, Motor voltage error, In-Position error, System error, ROM error, Position overflow error
	LED Display	Power status, In-Position status, Servo On status, Alarm status
I/O Signal	Input Signal	3 dedicated input (Limit+, Limit-, Origin) 7 user input
	Output Signal	1 dedicated output (Brake) 6 user output

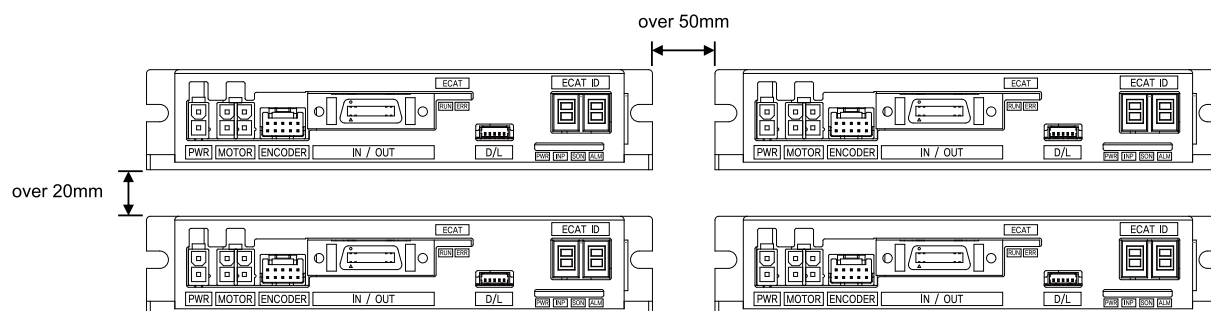
Table 1.5: Drive Specification

Chapter 2

Installation

2.1 Precautions of Installation

1. This product designed for indoor usage and the ambient temperature of the room should be 0 ~ 55°C.
2. If temperature of the case is 50°C, radiate the outside to cool down.
3. Do not install this product under direct rays or near magnetic or radioactive objects.
4. If more than 2 drives are installed in a line, keep the interval of 20mm or more vertically and 50mm or more horizontally at least.



2.2 System Configuration

Ezi-SERVOII EtherCAT / S-SERVO EtherCAT

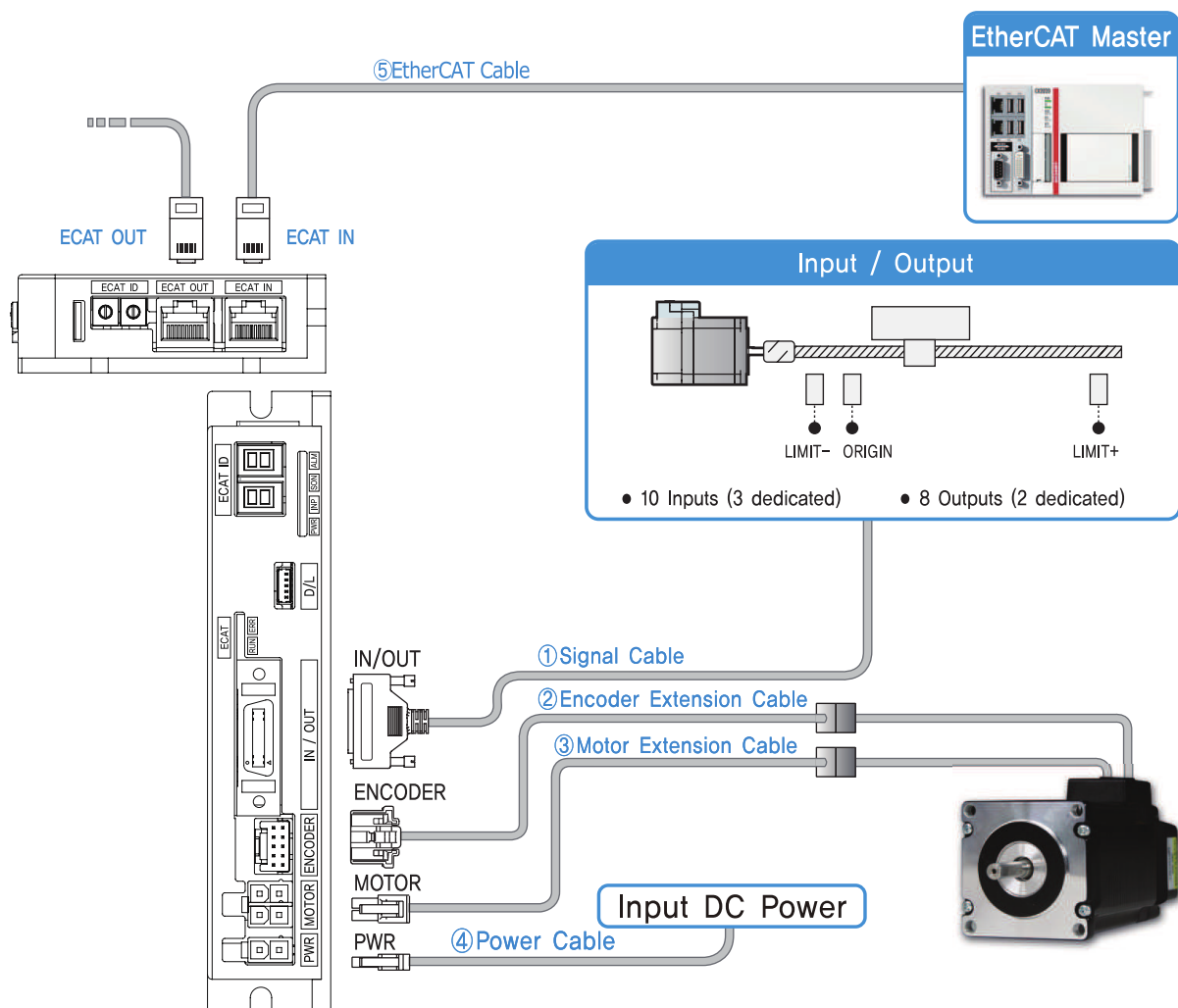


Figure 2.1: System Configuration Diagram

Ezi-SERVOII EtherCAT 86

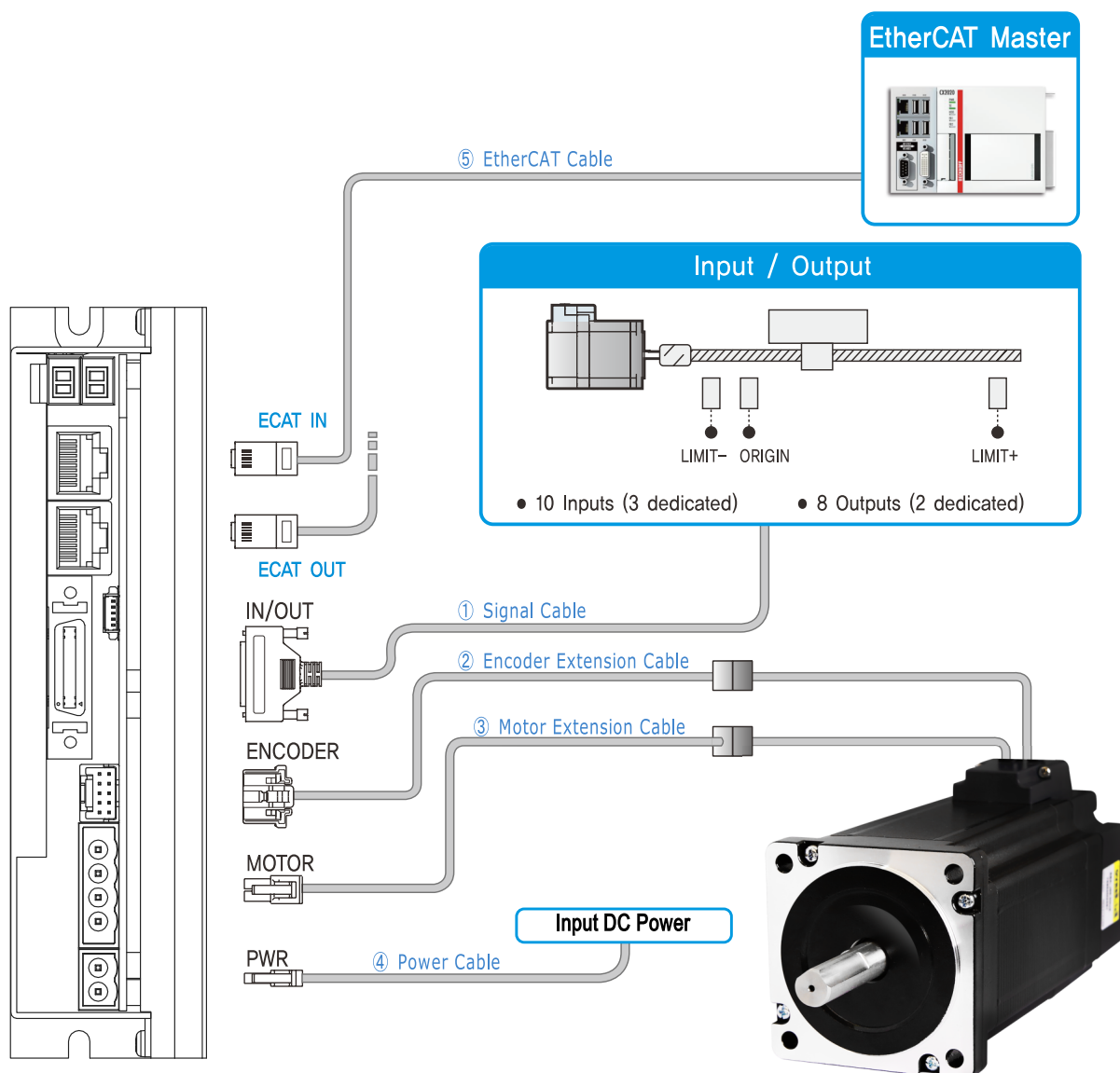


Figure 2.2: System Configuration Diagram

Ezi-SERVOII EtherCAT 4X

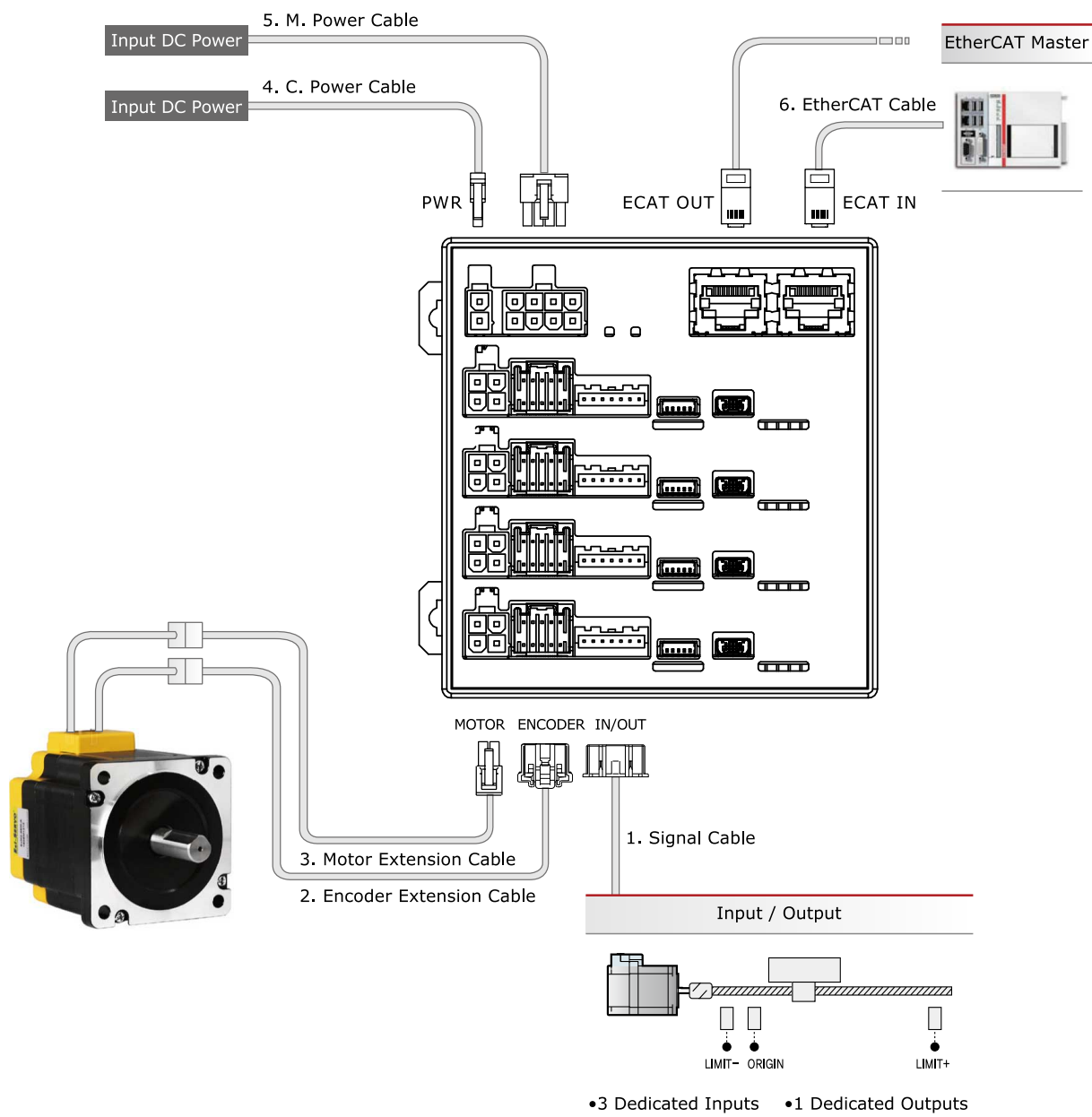


Figure 2.3: System Configuration Diagram

2.3 External Wiring Diagram

Ezi-SERVO II EtherCAT

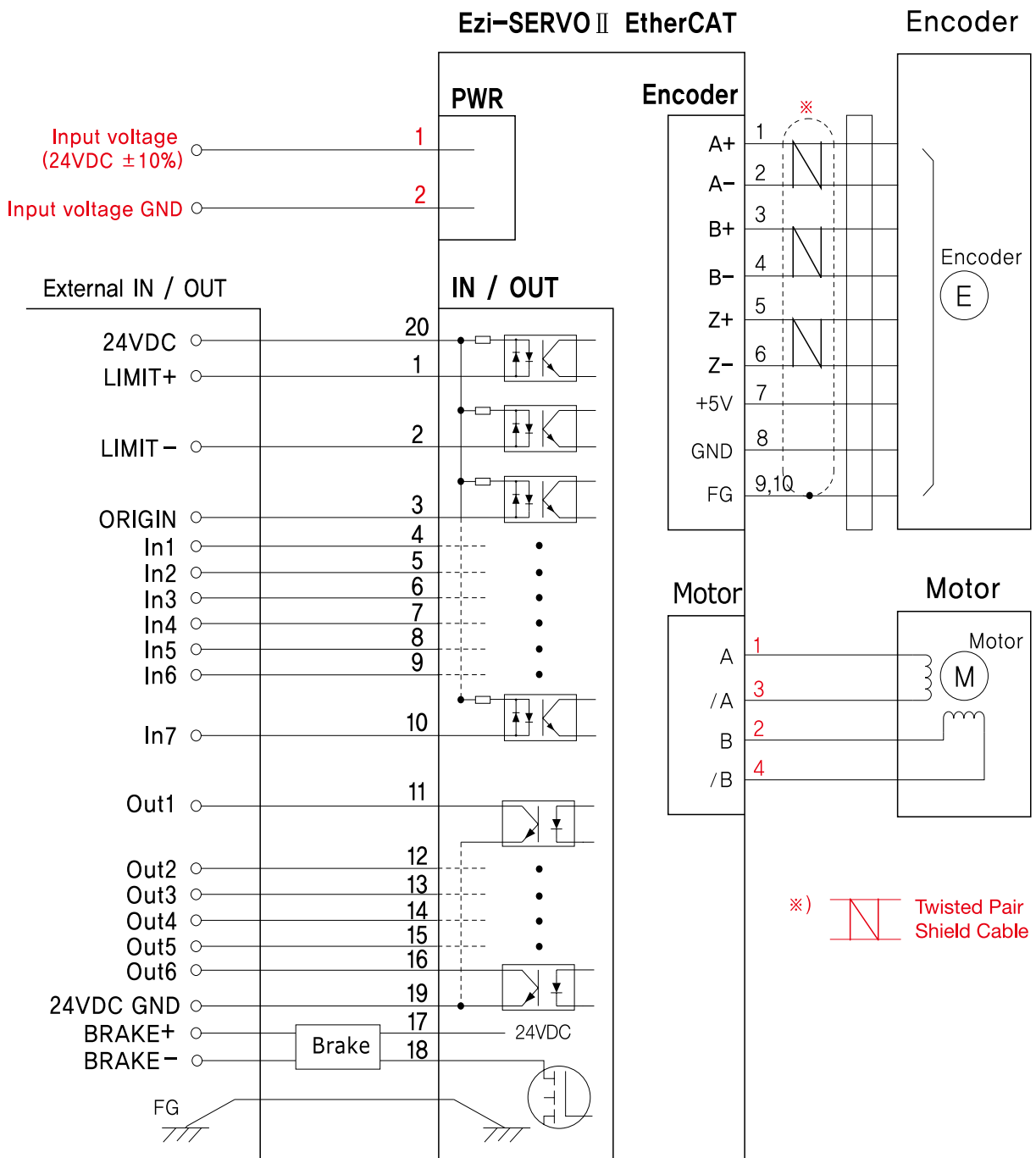


Figure 2.4: External Wiring Diagram

S-SERVO EtherCAT

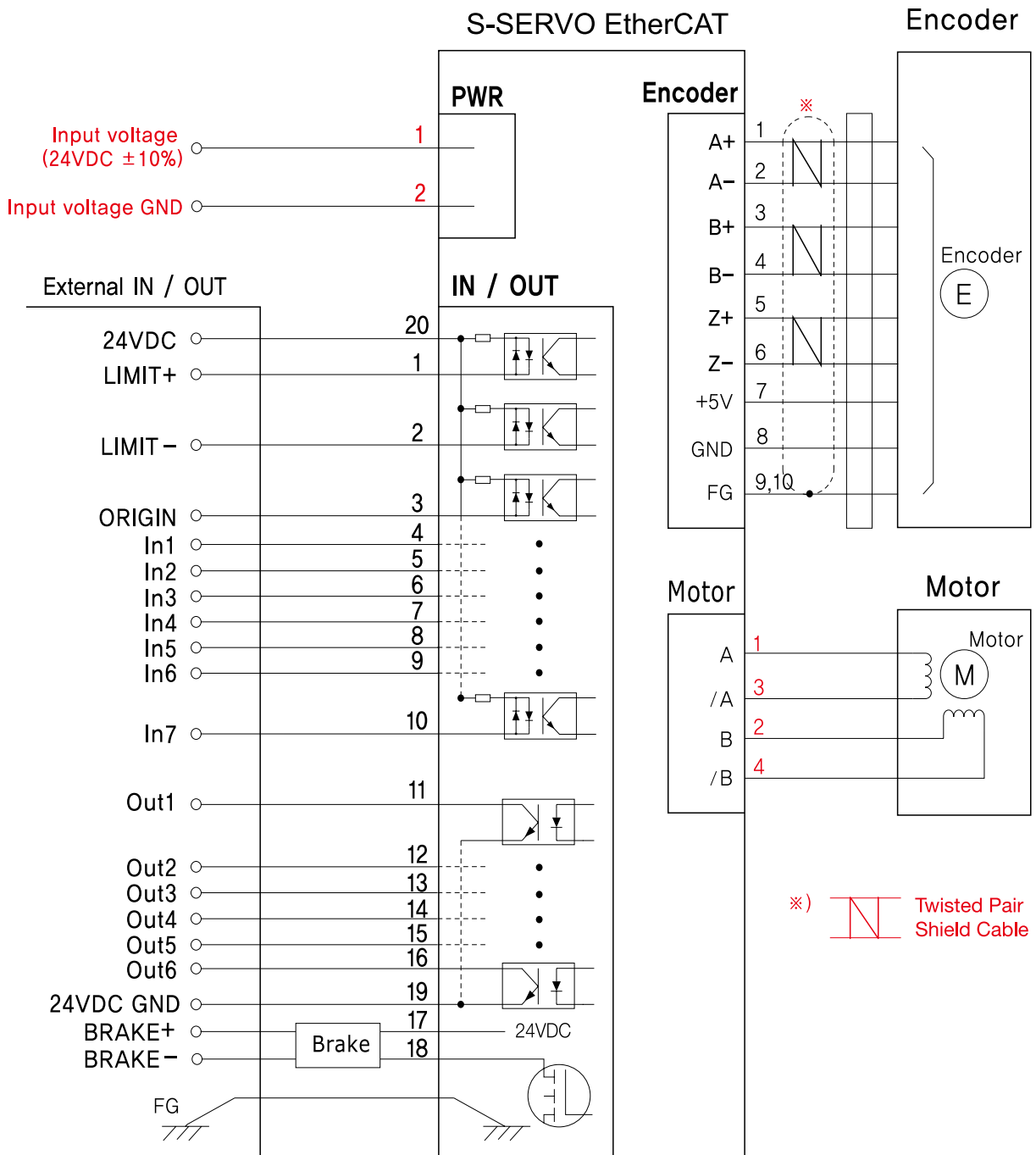


Figure 2.5: External Wiring Diagram

Ezi-SERVO II EtherCAT 86

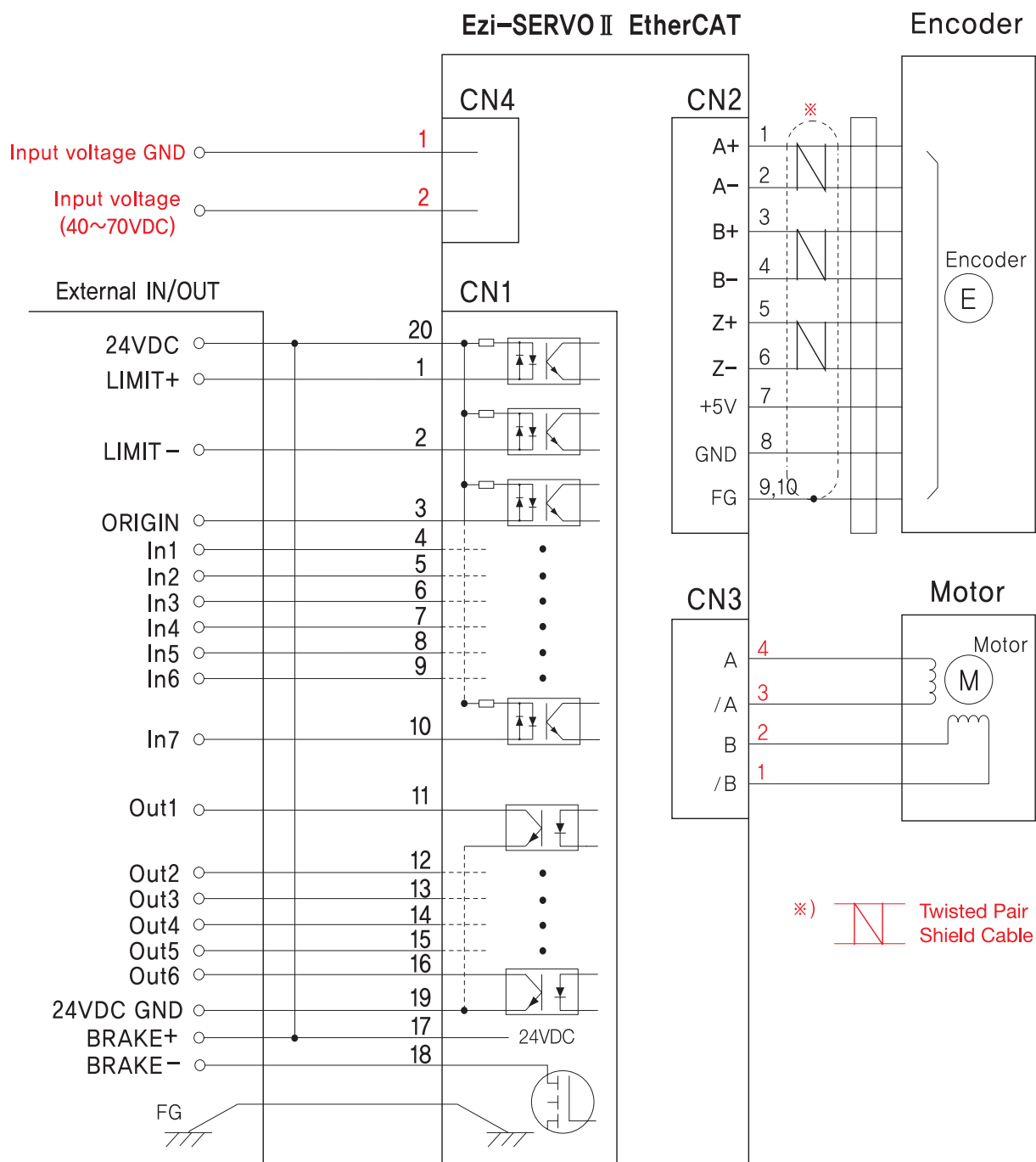


Figure 2.6: External Wiring Diagram

Ezi-SERVO II EtherCAT 4X

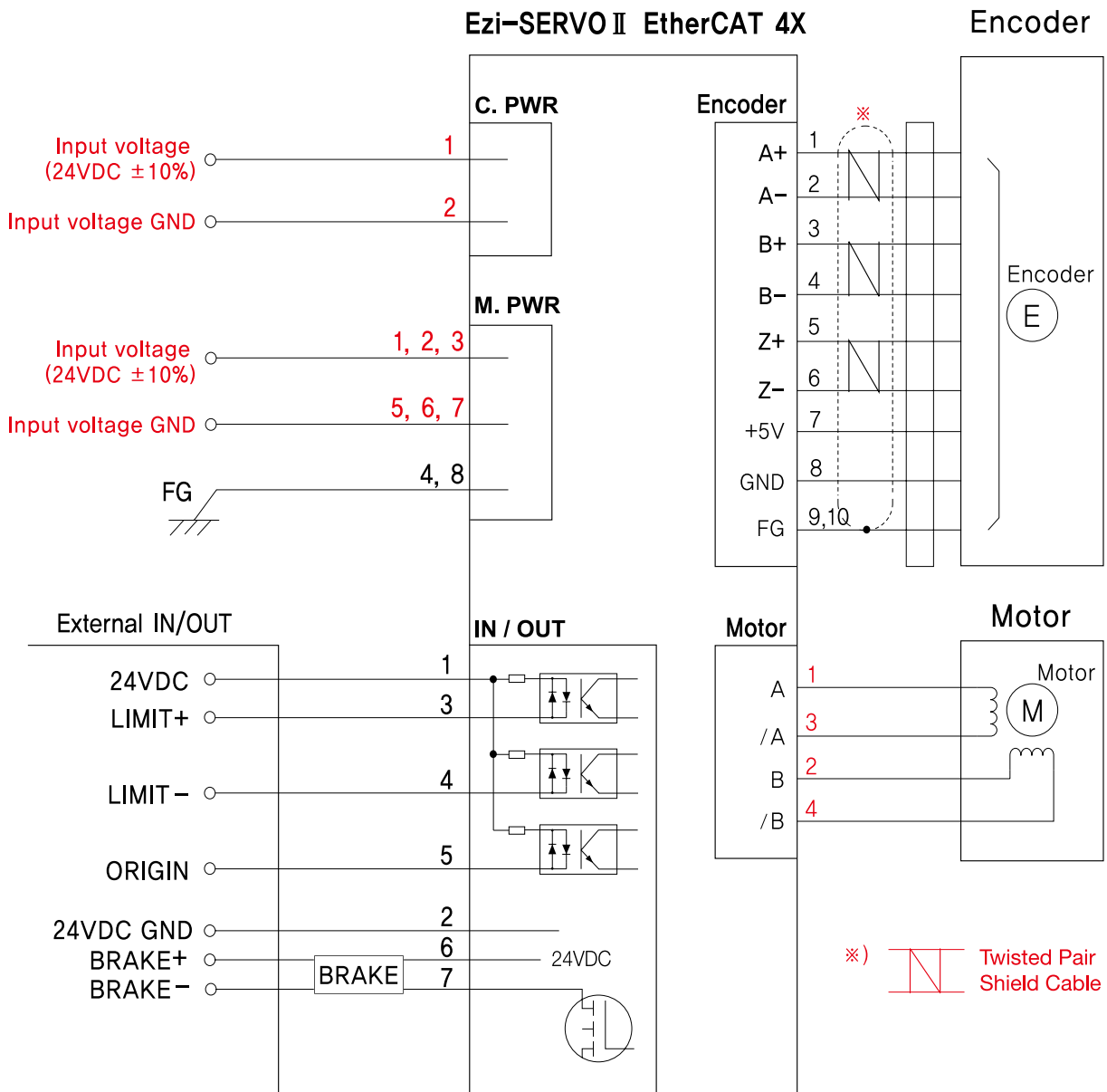


Figure 2.7: External Wiring Diagram

2.4 Appearance and Part Name

Ezi-SERVOII EtherCAT / S-SERVO EtherCAT

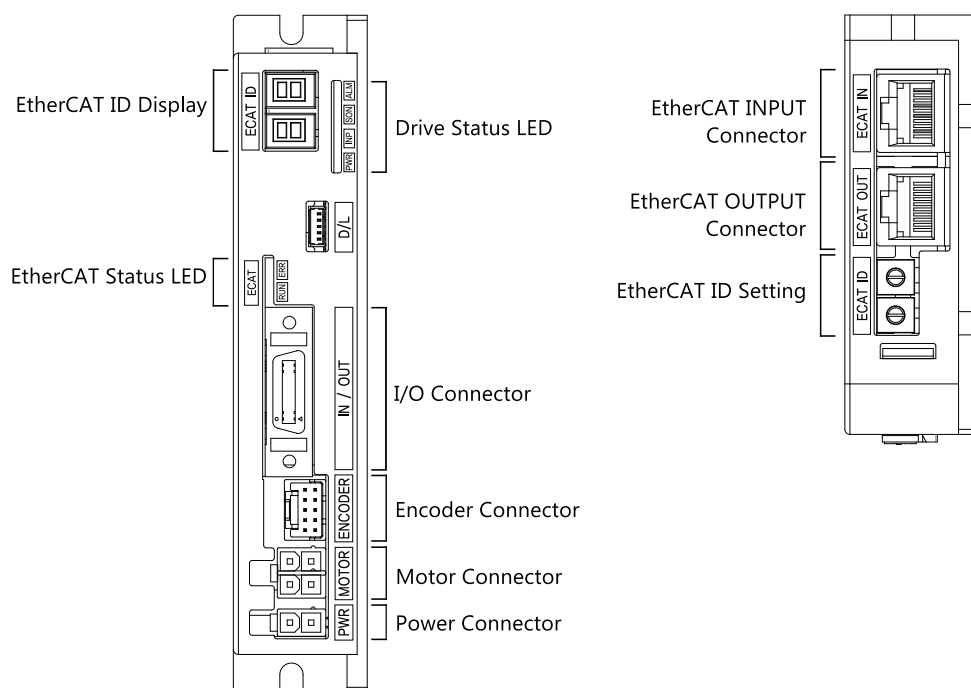


Figure 2.8: Appearance

Ezi-SERVOII EtherCAT 86

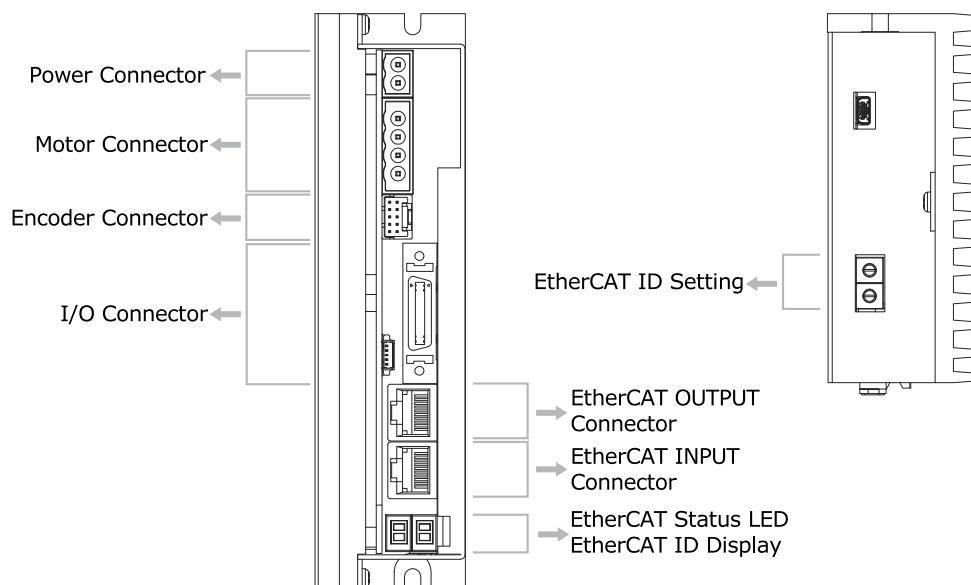


Figure 2.9: Appearance

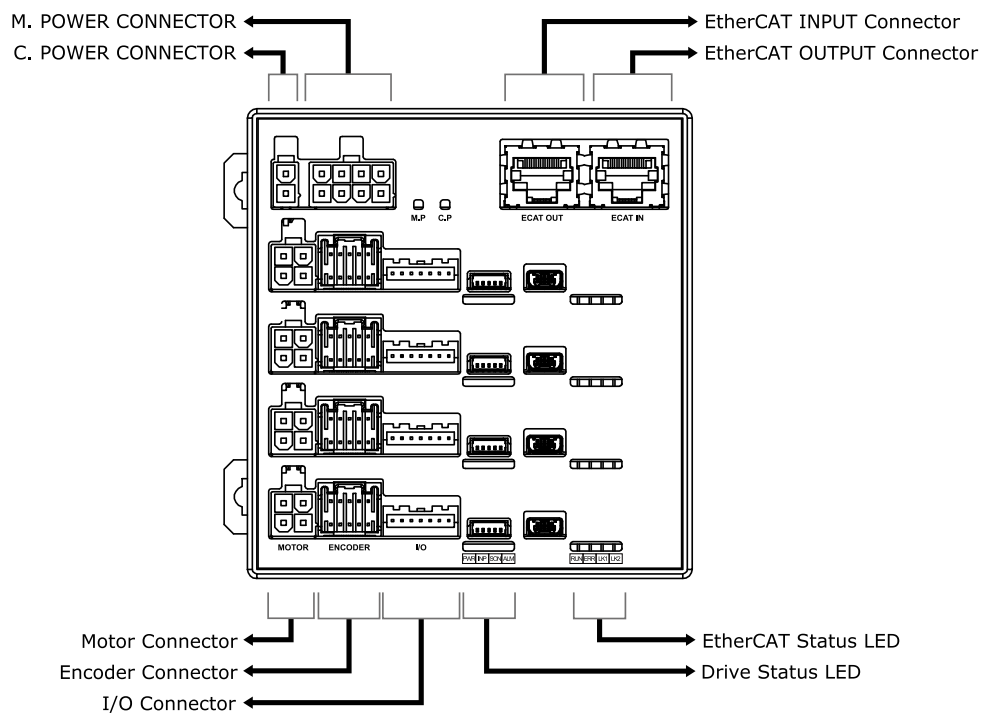
Ezi-SERVOII EtherCAT 4X

Figure 2.10: Appearance

2.4.1 EtherCAT ID

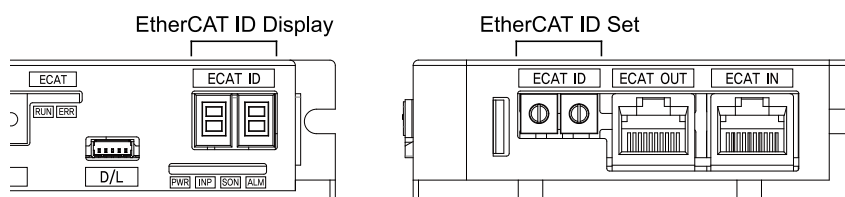


Figure 2.11: EtherCAT ID

2.4.1.1 ID Setting

Change EtherCAT ID (Configured Alias ID) value by Rotary switch setting. Right switch indicates tens and left switch indicates units.

Setting range is 0 ~ 99.

Information

ID value (Configured Alias ID) set by Rotary switch applies when power of controller turns on.



2.4.1.2 ID Indication

7-Segment indicates Physical Address or EtherCAT ID (EtherCAT configured Alias) value. Conditions for value indication as below.

- When Rotary Switch set all '0', 7-Segment indicates EtherCAT Physical Address Value. Before Physical Address assigned due to no connection between controller and master, It indicates 0. Once Master assigns each controllers physical address, it indicates relevant value.
- If Rotary switch set as not 0 but other value, 7-Segment indicates relevant set value (EtherCAT configured Alias).
- If 7-Segment of ID blinks, It indicates ID value as not applied yet. It can be applied once power turn on again.

2.4.1.3 Error value indication

If error generates from controller (Fault Status), 7-Segment indicates Error value instead of EtherCAT ID Value.

Error value is 'E-000' types then 2 digits will be indicated at 7-Segment.

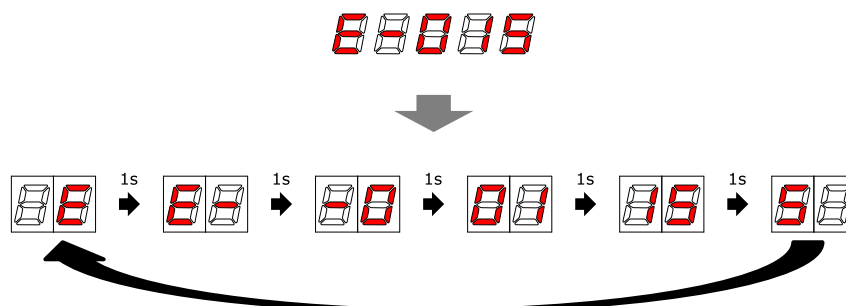


Figure 2.12: Error value indication (ex: E-015)

Please refer to [4.2 Error Code](#) regarding indication value

2.4.2 EtherCAT Status Indication LED

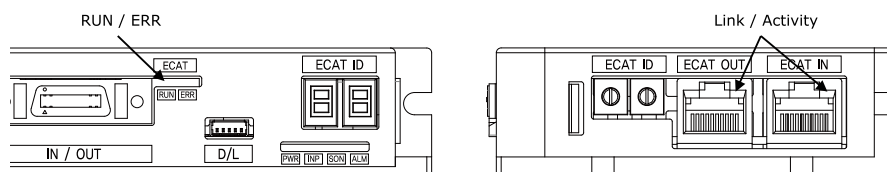


Figure 2.13: EtherCAT Status LED

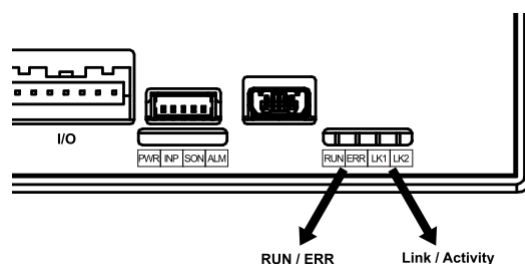


Figure 2.14: EtherCAT Status LED

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

Name	Color	Status	Description
RUN	Green	OFF	INIT Status or Power OFF
		Blinking	PRE-OPERATIONAL Status
		Single Flash	SAFE-OPERATIONAL Status
		ON	OPERATIONAL Status
		Flickering	BOOTSTRAP Status
ERROR	Red	OFF	Non-error status or Power OFF
		Blinking	Extra Error
		Single Flash	Sync Error
		Double Flash	Watch-dog Error
Link/Activity	Green	OFF	Link not established in physical layer
		ON	Link established in physical layer
		Flickering	In operation after establishing link

Table 2.1: EtherCAT Status LED

2.4.2.1 Type of Status Indication

EtherCAT LED Status Indication shown as picture as below to check visually.

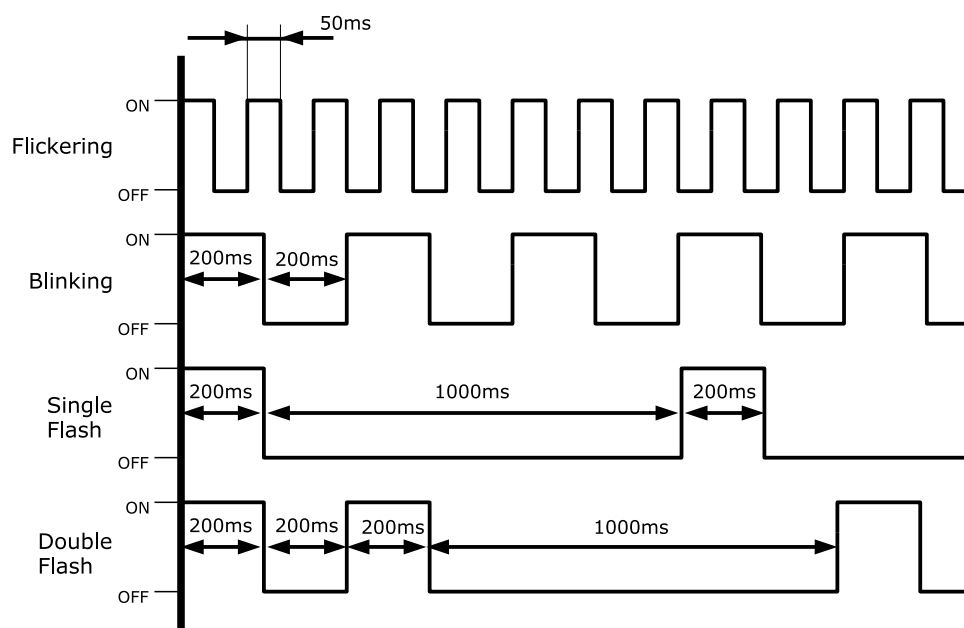


Figure 2.15: EtherCAT LED

2.4.3 EtherCAT Communication Connection

Connect communication cable from Master into communication connection ECAT IN. If there is next controller, connect communication cable from ECAT OUT to next controller of ECAT IN.

2.4.3.1 EtherCAT Communication Cable

Recommend to use communication cable Min. CAT5e level above.

- Above CAT5e
- Shield type : SF/FTP, S/FTP, SF/UTP
- Length : Max. 50m (Distance between Nodes)

2.4.4 I/O Connector

Ezi-SERVOII EtherCAT / S-SERVO EtherCAT / Ezi-SERVOII EtherCAT 86

No.	Function	I/O
1	LIMIT+	Input
2	LIMIT-	Input
3	ORIGIN	Input
4	User Input 1	Input
5	User Input 2	Input
6	User Input 3	Input
7	User Input 4	Input
8	User Input 5	Input
9	User Input 6	Input
10	User Input 7	Input
11	User Output 1	Output
12	User Output 2	Output
13	User Output 3	Output
14	User Output 4	Output
15	User Output 5	Output
16	User Output 6	Output
17	BRAKE +	Output
18	BRAKE -	Output
19	24VDC GND	Input
20	24VDC	Input

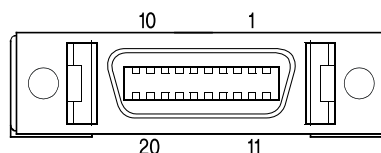


Table 2.2: I/O Connector

Input / Output signal connector (Type of connector: 3M 10226-52A2PL)

Ezi-SERVOII EtherCAT 4X

No.	Function	I/O
1	24VDC	Input
2	24VDC GND	Input
3	LIMIT+	Input
4	LIMIT-	Input
5	ORIGIN	Input
6	BRAKE +	Output
7	BRAKE -	Output

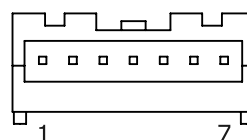


Table 2.3:

Input / Output signal connector (Type of connector: JST S07B-PASK-2)

Input and output signals of the drive are all photo-coupler protected, the signal status of internal photo-couplers [ON:conduction], [OFF:Non-conduction], not displaying the voltage levels of the signal.

2.4.4.1 Limit and Origin input signal

Connect Limit sensor and origin sensor to IN/OUT Connector of LIMIT+, LIMIT-, ORIGIN Pin. LIMIT+ and LIMIT- sensor works to limit each axis of rotation range to CW and CCW direction, using for protection of mechanical collision or others. ORIGIN Sensor uses to assign origin of mechanisms.

2.4.4.2 Brake Signal Output Signal

Brake function prevents motor rotation under Servo OFF Status by BRAKE+ / BRAKE- pin of I/O Connector (2.3). 'BRAKE+' is for +24V externally supplied to operate Brake circuit and 'BRAKE-' is output signal for actual motor control. Control signal automatically generates according to Servo ON/OFF status and Alarm generation. This output function can be only using under 200[mA]/DC24V of Brake current consumption.

2.4.4.3 Input Signal

Please individually prepare Power for Input circuit as DC 24V $\pm 10\%$ (Current consumption is around 5mA/Circuit)

2.4.4.4 Output Signal

Please individually prepare Power Supply for Output circuit. Possible to share with power supply for input circuit and in this case, please add capacity of power supply for output into capacity of power supply for input. Supply voltage and capacity of power for control output connection as below.

- Less than 30V of supply voltage
- Less than 15mA of current flow

2.4.5 Encoder Connection Connector

No.	Function
1	A+
2	A-
3	B+
4	B-
5	Z+
6	Z-
7	5VDC
8	5VDC GND
9	Frame GND
10	Frame GND

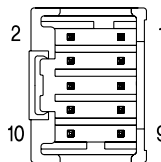


Table 2.4: Encoder Connection Connector

Encoder Connector (Type of Connector: Molex 55959-1030)

2.4.6 Motor Connection Connector

Ezi-SERVOII EtherCAT / S-SERVO EtherCAT

No.	Function
1	A Phase
2	B Phase
3	/A Phase
4	/B Phase

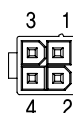


Table 2.5: Motor Connection Connector

Type of Connector: Molex 5569-04A2

Ezi-SERVOII EtherCAT 86

No.	Function
1	A Phase
2	B Phase
3	/A Phase
4	/B Phase

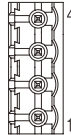


Table 2.6: Motor Connection Connector

Type of Connector: STL950/04

2.4.7 Power Connection Connector

Ezi-SERVOII EtherCAT / S-SERVO EtherCAT


No.	Function	
1	Input Voltage: 24VDC \pm 10%	
2	Input Voltage: GND	

Table 2.7: Power Connection Connector

Type of Connector: Molex 5569-02A2

Ezi-SERVOII EtherCAT 86


No.	Function	
1	Input Voltage: 40~70VDC \pm 10%	
2	Input Voltage: GND	

Table 2.8: Power Connection Connector

Type of Connector: STL950/02

Ezi-SERVOII EtherCAT 4X


No.	Function	
1	Input Voltage: 24VDC \pm 10%	
2	Input Voltage: GND	

Table 2.9: Control Power Connection Connector

Type of Connector: Molex 5569-02A2

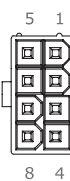
No.	Function	
1	Input Voltage: 24VDC \pm 10%	
2	Input Voltage: 24VDC \pm 10%	
3	Input Voltage: 24VDC \pm 10%	
4	Input Voltage: Frame GND	
5	Input Voltage: GND	
6	Input Voltage: GND	
7	Input Voltage: GND	
8	Input Voltage: Frame GND	

Table 2.10: Main Power Connection Connector

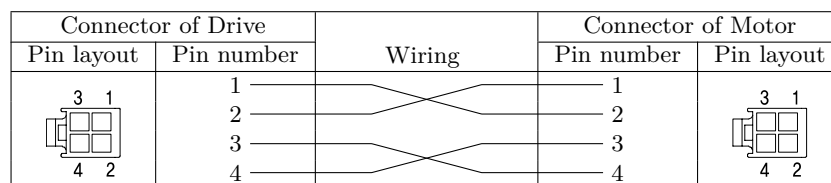
Type of Connector: Molex 5569-08A2

2.5 Appendix

2.5.1 Extension Cable for Motor

For cable extension between Motor and Drive.

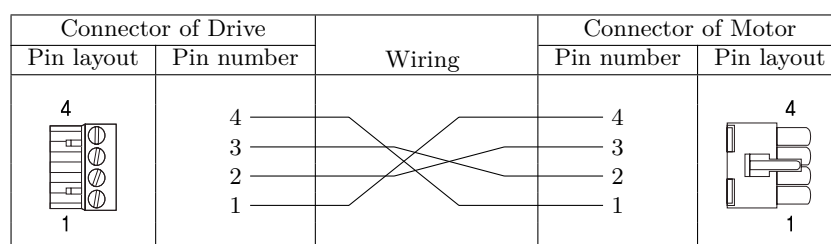
WIRING DIAGRAM



CONNECTOR

ITEM	Part Number	Maker
Housing	5557-04R	MOLEX
Terminal	5556T	MOLEX

WIRING DIAGRAM (86mm drive only)



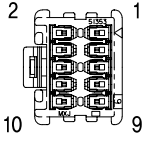
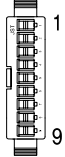
CONNECTOR (86mm drive only)

Usage	ITEM	Maker
Connector of Drive	Terminal Block	AK950-4
Connector of Motor	Housing Terminal	MOLEX MOLEX

2.5.2 Extension Cable for Encoder

For cable extension between Encoder and Drive.

Wiring Diagram

Connector of Drive		Wiring	Connector of Motor	
Pin layout	Pin number		Pin number	Pin layout
	1	—	1	
	2	—	2	
	3	—	3	
	4	—	4	
	5	—	5	
	6	—	6	
	7	—	7	
	8	—	8	
	9 ¹	—	9 ¹	
	10	—		

Connector Part Number

Usage	ITEM	Part Number	Maker
Connector of Drive	Housing	51353-1000	MOLEX
	Terminal	56134-9000	MOLEX
Connector of Motor	Housing	SMP-09V-NC	JST
	Terminal	SHF-001T-0.8BS	JST

2.5.3 Connector Specifications

The connector specifications used to connect the drive.

Usage		ITEM	Part Number	Maker	
Power		Housing Terminal	5557-02R 5556T	MOLEX MOLEX	
		Terminal Block	AK950-2	PTR	86mm motor drive only
Motor	Drive side	Housing Terminal	5557-04R 5556T	MOLEX MOLEX	
		Terminal Block	AK950-4	PTR	86mm motor drive only
	Motor side	Housing Terminal	5557-04R 5556T	MOLEX MOLEX	
		Housing Terminal	3191-4RI 1381T	MOLEX MOLEX	86mm motor drive only
Encoder	Drive side	Housing Terminal	51353-1000 56134-9000	MOLEX MOLEX	
	Motor side	Housing Terminal	SMP-09V-NC SHF-001T-0.8BS	JST JST	
Signal		Connector Backshell	10120-3000VE 10320-52AO-008	3M 3M	

- These connectors are serviced together with Ezi-SERVOII EtherCAT except when purchasing option cables.
- Above connector is the most suitable product for Ezi-SERVOII EtherCAT. Another equivalent connector can be used.

¹Connect to Shield

Chapter 3

EtherCAT Communication

3.1 CAN application protocol over EtherCAT

Ezi-SERVOII EtherCAT, S-SERVO EtherCAT is EtherCAT communication embedded type of controller to support CAN application protocol over EtherCAT (CoE). EtherCAT Slave structure is as below.

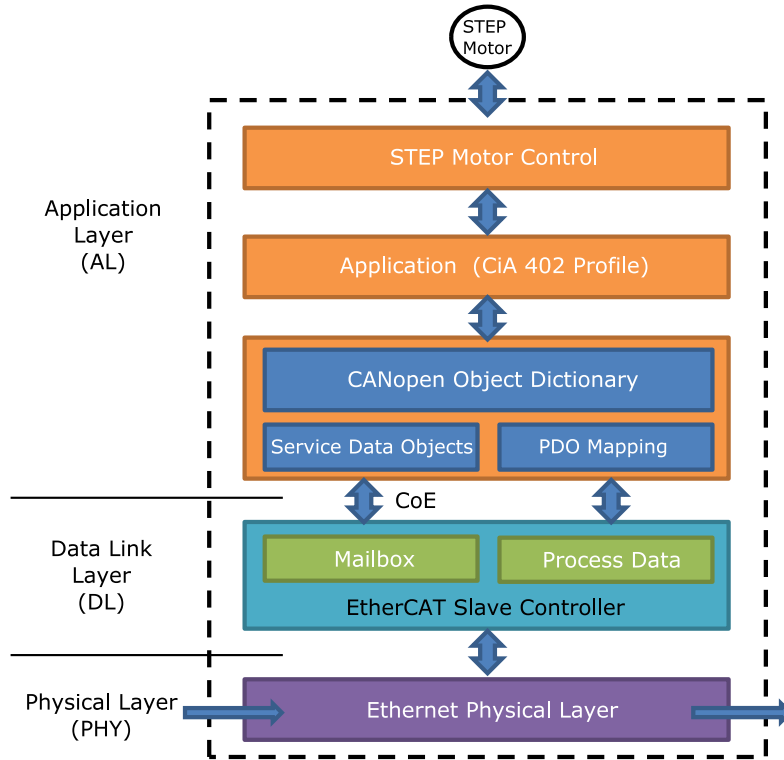


Figure 3.1: EtherCAT Structure

3.1.1 Object Dictionary

Object Dictionary is dictionary of Objects what product has.

3.1.2 Mailbox Communication

Master and Slave commands and receives Service Data Object (SDO) at Mailbox communication (SDO Communication). This communication method is the way of message transfer and master delivers command and slave responses.

SDO Communication used for setting or confirmation of objects at Object Dictionary. This communication can be used under Pre-Operation, Safe-Operation, Operation status of controller.

3.1.3 Process Data Communication

Process Data Communication (PDO Communication) commands and receives Process Data Objects (PDO) with Master periodically. Data that will be delivered and received is already defined at the initial stage of communication by PDO Mapping.

PDO communication is categorized as transmission PDO (following Tx PDO) delivers controller status information and Receipt PDO (following Rx PDO) delivers command from master.

This communication can be used under Operational status of controller and Tx PDO is only available for Safe-Operational.

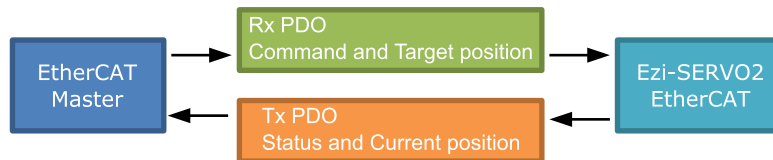


Figure 3.2: EtherCAT PDO Communication

3.2 PDO Mapping

PDO Mapping is to set Application Object will be delivered and received by PDO communication.

3.2.1 PDO Mapping

Tx PDO Mapping information to be delivered to Master is to set at 1600h ~ 1601h Object and Rx PDO Mapping information to be received command from master is to set at 1A00h ~ 1A01h Object.

Object ID value, Low level Index value, length of data (bit unit) of data that will be delivered and received are recorded at Mapping Table.

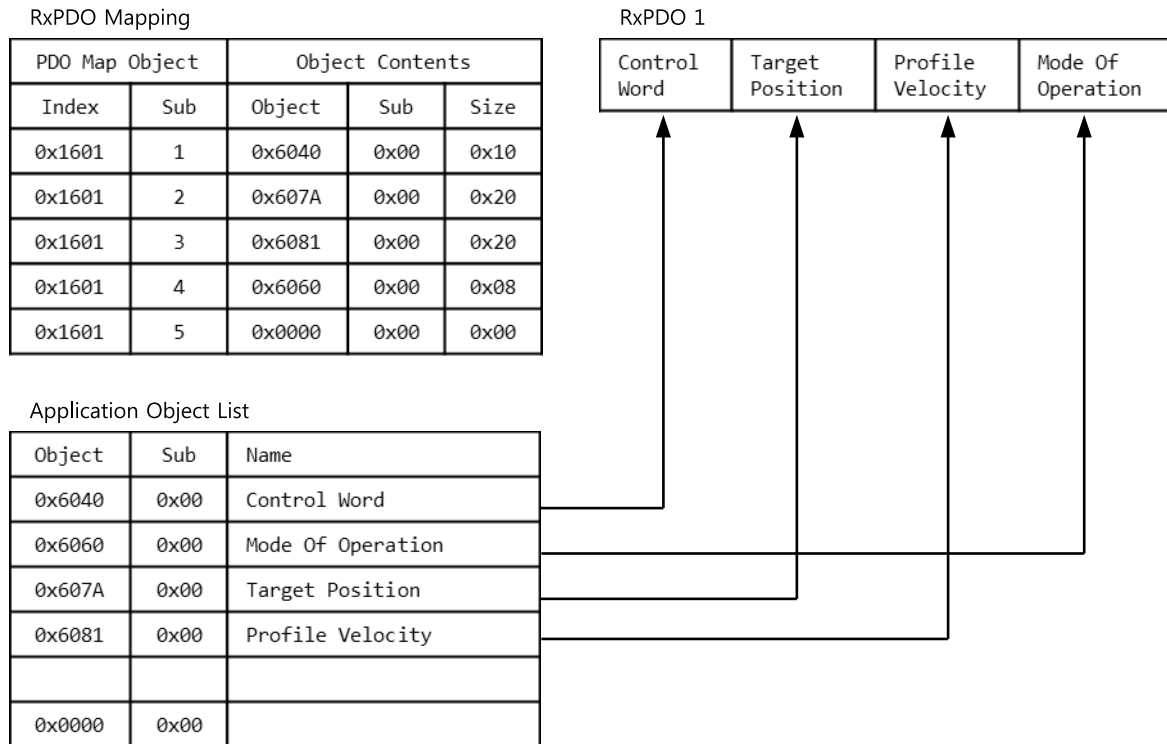


Figure 3.3: PDO Mapping

3.2.2 PDO Assign

PDO Assign is to set PDO Mapping Object will be assigned at SyncManager.

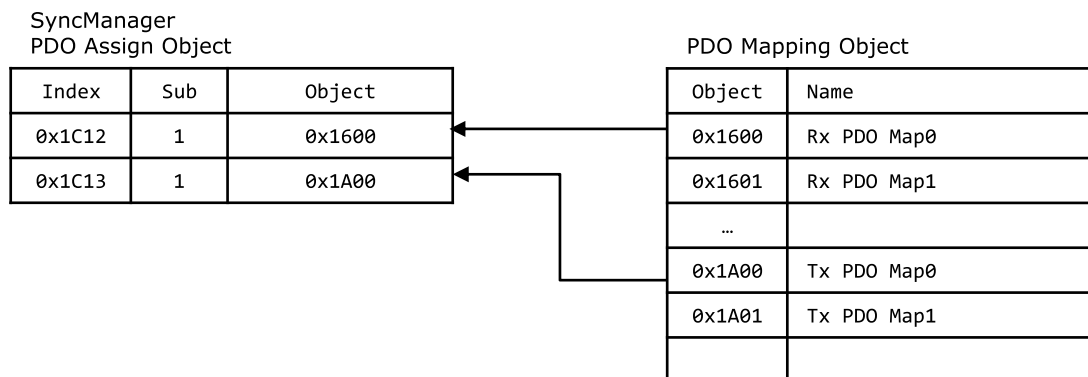


Figure 3.4: PDO Assign

1C12h is object to assign Rx PDO and can assign one object among Rx PDO Object 1600h or 1601h.
1C13h is object to assign Tx PDO and can assign one object among Tx PDO Object 1A00h or 1A01h.

3.3 EtherCAT State Machine

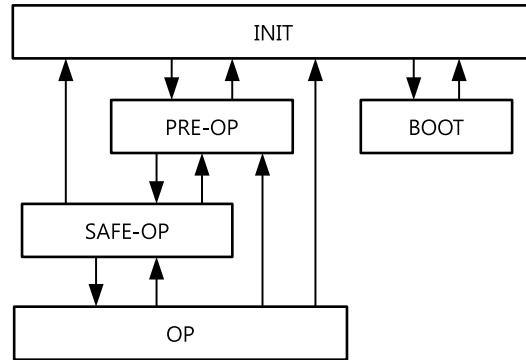


Figure 3.5: EtherCAT State Machine

EtherCAT controller of status motion is controlled by EtherCAT Master.

Status	SDO	Rx PDO	Tx PDO	Description
INIT	Non Available	Non Available	Non Available	EtherCAT communication is to reset. Status of communication is not available at this stage.
PRE-OP	Available	Non Available	Non Available	After initialization of communication, enters into this stage. Network setting is initialized. Only mailbox communication is available at this stage.
SAFE-OP	Available	Non Available	Available	Stage of Tx PDO communication is available.
OP	Available	Available	Available	All of communication is available.
BOOT	Available	Non Available	Non Available	Only mailbox communication is available. Possible to renew F/W of product with using FoE Protocol at this stage.

Table 3.1: EtherCAT Operational State

3.4 Synchronization

Synchronization modes provided from controller are as below.

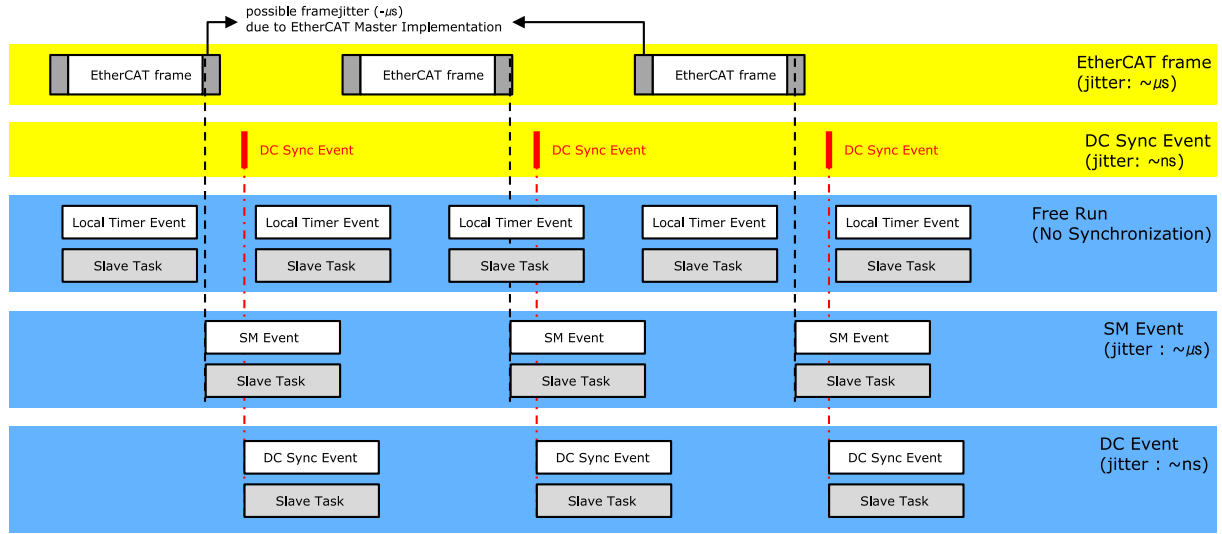


Figure 3.6: Type of EtherCAT Synchronization and Differences

3.4.1 Free Run

Controller runs under non-synchronization with Master. Under Free Run mode, Master and Controller has an individual independent Cycle.

3.4.2 SM Event

Controller runs under synchronization with SM Event of EtherCAT communication. SM Event is generated once controller receives EtherCAT Frame.

Once synchronization by SM Event, each one of controller has few us range of jitter.

3.4.3 DC Sync Event

Synchronized controller runs under Sync Interrupt is generated according to Distributed Clock (following DC).

DC is synchronized time shared between Master and Slave. With synchronized clock, interrupt is generated under accurate synchronization and controller executes commands under accurate timing.

In this case, each one of controller has few us range of jitter.

3.5 EtherCAT Slave Information

EtherCAT Slave Information file (XML File) is needed to connect controller with EtherCAT Master. This file is described slave device information as XML format based on EtherCAT specifications. With recording of XML file into EtherCAT Master Equipment through EtherCAT setting equipment, easily implement PDO and SDO setting of Slave device.

Information

XML file can be downloaded from product website of archives.



Chapter 4

CiA 402 Drive Profile

4.1 Drive Status Control

Status of product moves as follows. Status movement is executed by status of controller and Control word (6040h) and current status can be checked by Status word (6041h).

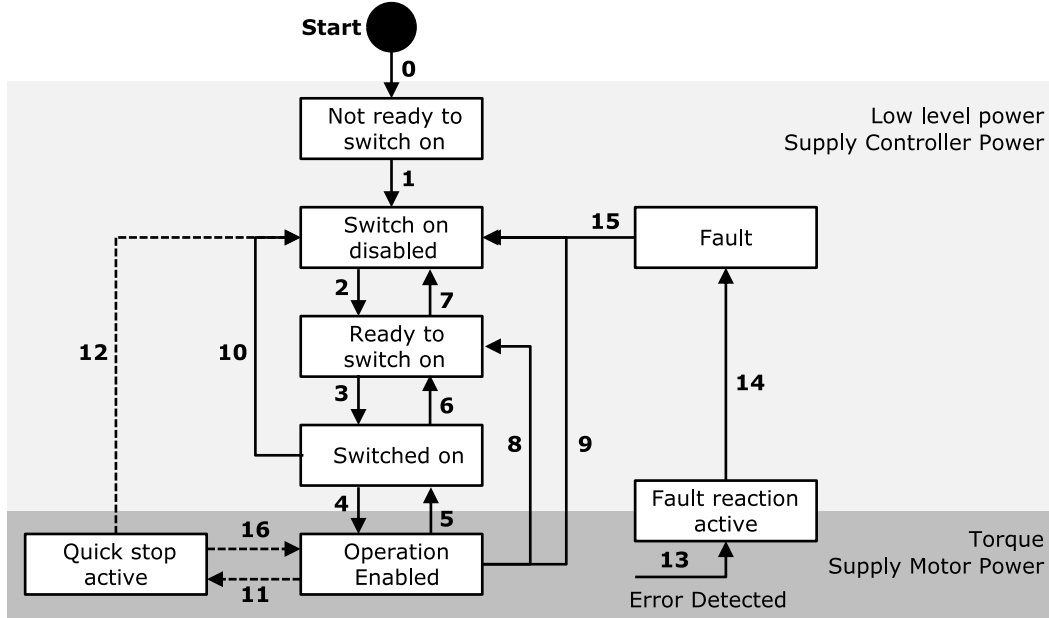


Figure 4.1: Power Drive System State Machine

Status movement and meaning of each status is as follows.

Transition	Event	Action
0	Automatic transition after power-on or reset application	Drive self-test and/or self initialization shall be performed.
1	Automatic transition	Communication shall be activated
2	Shutdown command from control device	
3	Switch On command from control device	
4	Enable Operation command from control device	The drive function shall be enabled.
5	Disable Operation command from control device	The drive function shall be disabled, Motor power shall be switched off.
6	Shutdown command from control device	
7	Quick Stop or Disable Voltage command from control device	
8	Shutdown command from control device	The drive function shall be disabled, Motor power shall be switched off.
9	Disable Voltage command from control device	The drive function shall be disabled, Motor power shall be switched off.
10	Quick Stop or Disable Voltage command from control device	
11	Quick Stop command from control device	The quick stop function shall be started.
12	Automatic transition (depends on the Quick stop option code)	The drive function shall be disabled, Motor power shall be switched off.
13	Fault signal	the configured fault reaction function shall be executed.
14	Automatic transition	The drive function shall be disabled, Motor power shall be switched off.
15	Fault Reset command from control device	A reset of the fault condition is carried out.
16	Enable Operation command from control device (depends on the Quick stop option code)	The drive function shall be enabled.

Table 4.1: State transition

Each status of functions supported by controller as follows.

Status	Brake Function	Motor Power	Control Command
Not ready to switch on	Yes	No	No
Switch on disabled	Yes	No	No
Ready to switch on	Yes	No	No
Switched on	Yes	No	No
Operation enabled	Yes	Yes	Yes
Quick stop active	Yes	Yes	Yes
Fault reaction active	Yes	Yes	Yes
Fault	Yes	No	No

Table 4.2: Function per Status

Able to control the status of controller by 0 ~ 3, 7 bits of Control word and bits per target status are as follows.

Command	Bit of Control word					Transition
	Bit 7	Bit 3	Bit 2	Bit 1	Bit 0	
Shutdown	0	x	1	1	0	2, 6, 8
Switch on	0	0	1	1	1	3
Switch on + Enable operation	0	1	1	1	1	3 + 4
Disable voltage	0	x	x	0	x	7, 9, 10, 12
Quick stop	0	x	0	1	x	7, 10, 11
Disable Operation	0	0	1	1	1	5
Enable Operation	0	1	1	1	1	4, 16
Fault reset	0 → 1	x	x	x	x	15

Table 4.3: Set Control word for status movement

If Quick stop option code (605Ah) of value is 5, 6, 7, 8 under Quick stop active status, waiting at correspondent status. Able to move to Operation Enabled status by 'Enable Operation' command of Control word.

Status word of values per each status are as follows.

Status word	Status
xxxx xxxx x0xx 0000b	Not ready to switch on
xxxx xxxx x1xx 0000b	Switch on disabled
xxxx xxxx x01x 0001b	Ready to switch on
xxxx xxxx x011 0011b	Switched on
xxxx xxxx x011 0111b	Operation enabled
xxxx xxxx x00x 0111b	Quick stop active
xxxx xxxx x0xx 1111b	Fault reaction active
xxxx xxxx x0xx 1000b	Fault

Table 4.4: Current status following by Status word

4.2 Error Code

Once Error generates at Controller (Sense Fault signal), changed to 'Fault reaction active' status. Under 'Fault' / 'Fault reaction active' status, types of error can be checked by Error code (603Fh). Indicated Error codes are as follows

Error code Hex / Dec	External Indication ¹	Status	Description
0x7500 / 29952	E-500	EtherCAT Communication Error	Error generated at EtherCAT Communication.
0xFF01 / 65281	E-001	Over Current Error	The current through power devices in inverter exceeds 4.8A. ²
0xFF02 / 65282	E-002	Over Speed Error	Motor speed exceed 3,000 [rpm].
0xFF03 / 65283	E-003	Position Tracking Error	Position error value is higher than set value (Following error window (6065h)). ³
0xFF04 / 65284	E-004	Over Load Error	The motor is continuously operated more than 5 second under a load exceeding the Max. torque of motor.
0xFF05 / 65285	E-005	Over Temperature Error	Inside temperature of drive exceeds 85°C.
0xFF06 / 65286	E-006	Over Regenerated Voltage Error	Motor Back-EMF is higher than limit value. ⁴
0xFF07 / 65287	E-007	Motor Connection Error	Abnormal connection between drive and motor.
0xFF08 / 65288	E-008	Encoder Connection Error	Abnormal connection between drive and encoder.
0xFF09 / 65289	E-009	Motor Voltage Error ⁵	Input voltage for motor is lower than limit value.
0xFF0A / 65290	E-010	In-position Error	After operation is finished, position error (over 1) generated more than 3 seconds.
0xFF0F / 65295	E-015	Position Overflow Error	Position error value is higher than given value after completion of position movement command. ⁶
0xFF31 / 65329	E-049	Drive Alarm	Generated Extra alarms generated from drive.
0xFF32 / 65330	E-050	Internal communication error of drive	Communication error from internal components of drive generated. (Time-out)
0xFF34 / 65332	E-052	Internal communication error of drive	Communication error from internal components of drive generated. (CRC Failed)
0xFF35 / 65333	E-053	Internal communication error of drive	Communication error from internal components of drive generated. (Command Failed)
0xFF3C / 65340	E-060	Torque enable Failure	Torque Enable command of drive failed.
0xFF3D / 65341	E-061	Push command Failure	Push command of drive failed.
0xFF46 / 65350	E-070	Encoder Count Error	Encoder input signal is abnormal and normal measurement is impossible.
0xFF64 / 65380	E-100	ROM Initialization Error	EEPROM is blank status.
0xFF65 / 65381	E-101	ROM Initialization Error	Check sum of EEPROM is not matched.
0xFF6E / 65390	E-110	ROM Reading Error	Error generated during EEPROM reading.
0xFF79 / 65401	E-121	ROM Writing Error	Error generated during EEPROM writing.
0xFF7A / 65402	E-122	ROM Writing Error	Error generated during EEPROM writing.
0xFF7B / 65403	E-123	ROM Writing Error	Error generated during EEPROM writing.
0xFF7C / 65404	E-124	ROM Writing Error	Error generated during EEPROM writing.

Table 4.5: Error code Lists

The voltage limit of Back-EMF according to the motor model of the product are as follows.

Motor Model	20M	20L	28S	28M	28L	35M	35L	42S	42M	42L	42XL
Ezi-SERVOII EtherCAT	48V	48V	48V	48V	48V	48V	48V	70V	70V	70V	70V
S-SERVO EtherCAT	48V	48V	48V	48V	48V	48V	48V	48V	48V	48V	48V
Ezi-SERVOII EtherCAT 4X	48V	48V	48V	48V	48V	48V	48V	48V	48V	48V	48V
Motor Model	56S	56M	56L	60S	60M	60L	86M	86L	86XL		
Ezi-SERVOII EtherCAT	70V	70V	70V	70V	70V	70V					
S-SERVO EtherCAT	48V	48V	48V	48V	48V	48V					
Ezi-SERVOII EtherCAT 4X	48V	48V	48V	48V	48V	48V					
Ezi-SERVOII EtherCAT 86							90V	90V	90V		

Table 4.6: Voltage Limit of Back-EMF

¹Products that have a 7-segment on the front of the product will display Error code information in the two 7-segments instead of EtherCAT ID when the alarm occurs.

²The given value can be changed. Please refer to Following error window (6065h).

³Voltage limit of Back-EMF depends on motor model. Please refer to [4.6 Voltage Limit of Back-EMF](#).

⁴The given value can be changed. Please refer to Following error window (6065h).

4.3 Mode of Operation

Currently activated Mode of operation display (6061h) decides the action of controller. Meaning for some bits of Control word (6040h) and Status word (6041h) Objects can be decided by Mode of operation display (6061h).

Able to set selected operation mode by Mode of operation (6060h). Currently activated operation mode can be checked by Mode of operation display (6061h).

Operation modes supported by current controller are as follows.

Mode of operation	Description
1	Profile Position Mode
6	Homing Mode
8	Cyclic Synchronous Position Mode

Table 4.7: Supported Operation Modes

4.4 Cyclic Synchronous Position Mode

4.4.1 Definition

Cyclic Synchronous Position mode(CSP Mode) assigns target position to controller by Master's operation profile creation function through cyclic communication. Controller internally executes position / velocity control with receipt of target position in each cycle.

To use CSP Mode, Mode of operation (6060h) Cyclic Synchronous Position Mode needs to be set. Mode of operation display (6061h) is shown as Cyclic Synchronous Position Mode, Target position transmitted from master : Object 607Ah: Target position is executed.

4.4.2 Related Objects

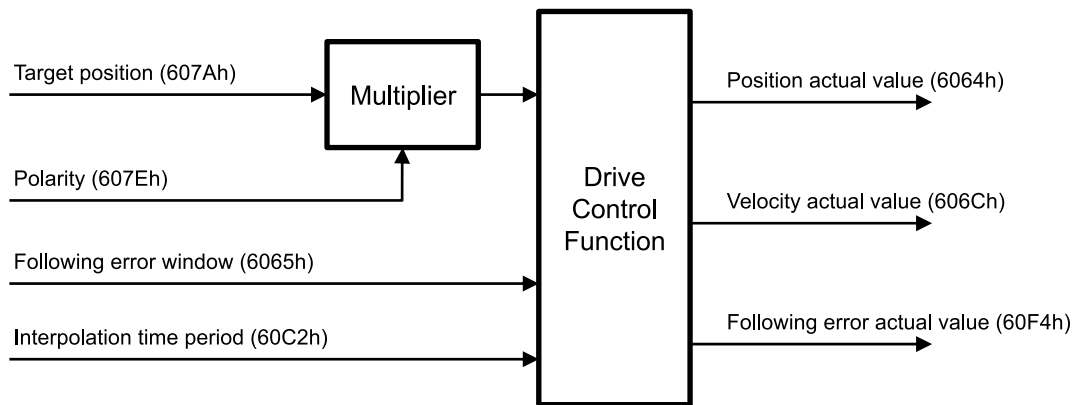


Figure 4.2: CSP Mode Objects

4.4.3 Control word and Status word

Control word under CSP Mode are as follows.

Bit	Name	Description
0	Switch On	
1	Enable Voltage	
2	Quick Stop	
3	Enable Operation	
4 ~ 15	Reserved	

Table 4.8: Control Word of CSP Mode

Please refer to [4.3 Set Control word for status movement](#) for the rest of bits. Status word (6041h) under position control mode are as follows.

Bit	Name	Description
0	Ready to switch on	
1	Switched on	
2	Operation enabled	
3	Fault	
4	Voltage enabled	
5	Quick stop	
6	Switch on disabled	
7	Warning	
8	Reserved	
9	Remote	
10	reserved	
11	Internal Limit Active	
12	Target position ignored	
13	Following Error	
14 ~ 15	Reserved	
		Whether target position moved Following Error

Table 4.9: Status word of CSP Mode

Please refer to drive status control for the rest of bits.

Bit	Value	Description
12	0	Target position value ignored.
	1	Target position value executed.

Table 4.10: Status word of Bit 12

Bit	Value	Description
13	1	Following Error generated.

Table 4.11: Status word of Bit 13

4.5 Profile Position Mode

4.5.1 Definition

Position control mode is to move to target position of Target position (607Ah) object with receipt of Control word (6040h) input.

It is general Point to point operation. To use position control mode, need to set Profile Position Mode at Mode of operation (6060h).

Mode of operation display (6061h) is shown as Profile Position Mode, ready to use position control command.

4.5.2 Related Objects

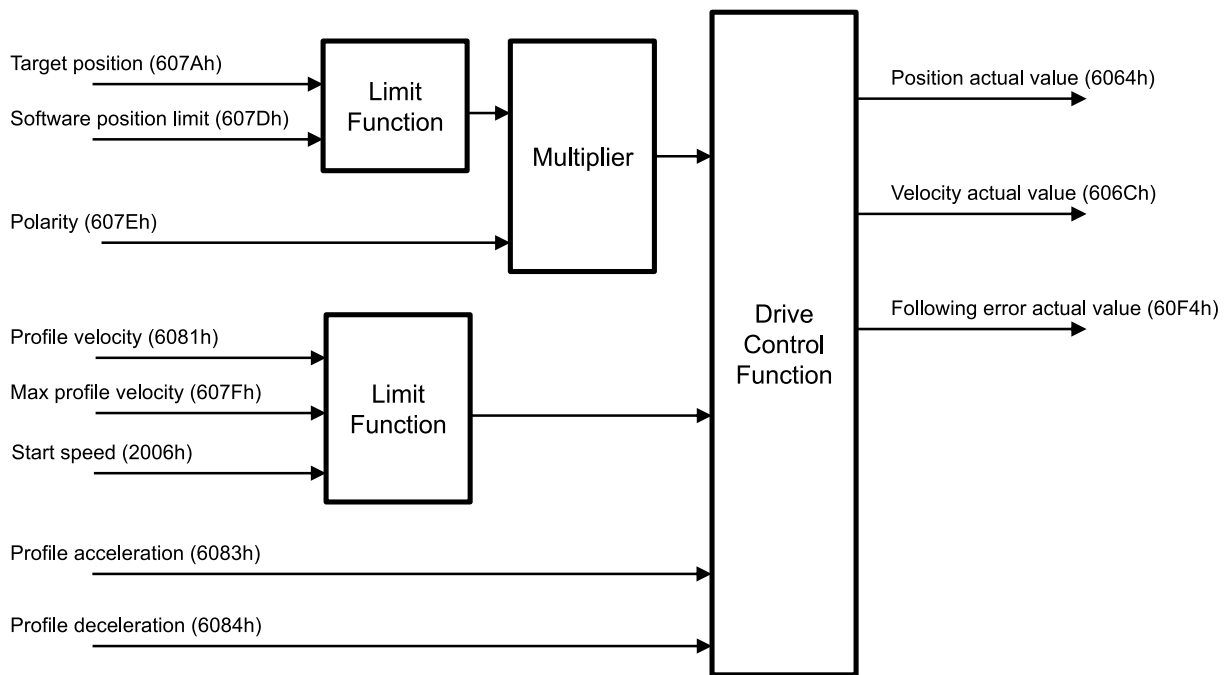


Figure 4.3: Profile Position Mode

4.5.3 Control word and Status word

Control word under position control mode are as follows.

Bit	Name	Description
0	Switch On	Position movement command position change set Absolute / Relative position
1	Enable Voltage	
2	Quick Stop	
3	Enable Operation	
4	New Set-Point	
5	Change Set Immediately	
6	Relative	Stop command
7	Fault Reset	
8	Halt	
9 ~ 15	Reserved	

Table 4.12: Profile Position Mode of Control Word

Please refer to [4.3 Set Control word for status movement](#) for the rest of bits.

Bit 5	Bit 4	Description
0	0 → 1	Execute position movement command after completion of previous command.
1	0 → 1	Execute position movement command with ignorance of previous position.

Table 4.13: Control Word of Bit 4, 5

Bit	Value	Description
6	0	Target position (607Ah) is absolute position.
	1	Target position (607Ah) is relative position.

Table 4.14: Control Word of Bit 6

Bit	Value	Description
8	1	Position movement command canceled and stops according to set action at Halt option code (605Dh).

Table 4.15: Control Word of Bit 8

Status word (6041h) under position control mode are as follows.

Bit	Name	Description
0	Ready to switch on	
1	Switched on	
2	Operation enabled	
3	Fault	
4	Voltage enabled	
5	Quick stop	
6	Switch on disabled	
7	Warning	
8	Reserved	
9	Remote	
10	Target Reached	Reached at target position
11	Internal Limit Active	
12	Set-point Acknowledge	‘New Set-Point’ Response
13	Following Error	Following Error
14 ~ 15	Reserved	

Table 4.16: Profile Position Mode of Status word

Please refer to drive status control for the rest of bits.

Bit	Value	Description
10	0	Control Word of Halt(Bit 8) = 0: Not reached at the target position. Control Word of Halt(Bit 8) = 1: Stop status of controller.
	1	Control Word of Halt(Bit 8) = 0: Reached at the target position. Control Word of Halt(Bit 8) = 1: Controller stops.

Table 4.17: Status word of Bit 10

Bit	Value	Description
12	0	Control Word of New Set-Point(Bit 4) has reset and previous position movement command processed. Able to input new position.
	1	Control word of New Set-Point(Bit 4) is already set or previous position movement command is under processing.

Table 4.18: Status word of Bit 12

Bit	Value	Description
13	1	Following Error generated.

Table 4.19: Status word of Bit 13

4.5.4 Position movement method

4.5.4.1 General Movement

Movement command to new target position can be requested by changing Control word (6040h) of New Set-Point (Bit 4) from RESET to SET. Once controller receives this request, Set-Point Acknowledge of Status word (Bit 12) is going to be SET and position movement command executed. Target position refers to Target position (607Ah) and Position value can be absolute coordinates or relative coordinates by Control word of Relative (Bit 6).

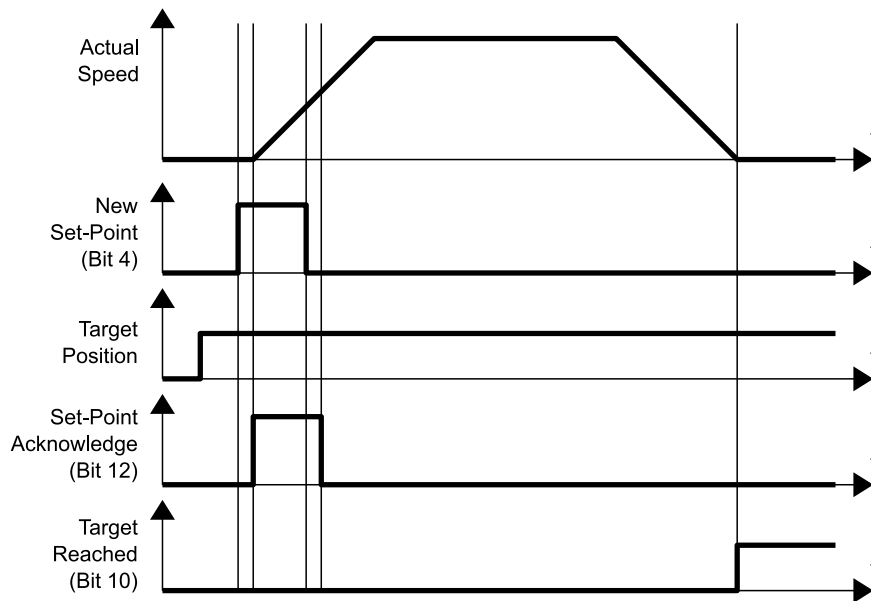


Figure 4.4: New Set-Point

Once reaches at target position, Status word of Target Reached (Bit 10) goes to SET. If it does not reach at target position due to error or status as below, Target Reached (Bit 10) can not be changed as SET.

- Fault status due to Error generation.
- Out of Operation Enabled Status.
- Stops during movement due to Limit Switch of operation direction goes to ON.
- Current position during movement goes out of Software Position Limit (607Dh).

4.5.4.2 Input next target position

Once commands to move to new target position during previous position movement still operates, executes new target position movement command after completion of previous position movement. So if already inputs next target position at buffer, position movement command can be executed immediately without time delay.

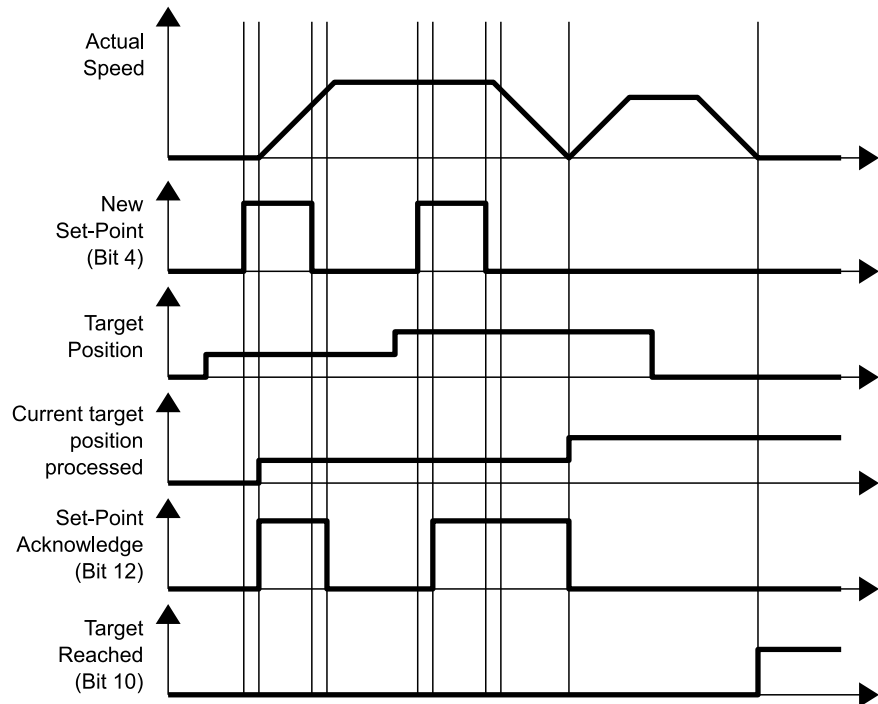


Figure 4.5: Next Set-Point

At this time, Status word of Set-Point Acknowledge (Bit 12) is going to be RESET of Control word of New Set-Point (Bit 4) and it goes to RESET after completion of previous position movement command. Target Reached (Bit 10) goes to SET once all of position movements completed.

4.5.4.3 Target position override

In case of using Control word of Change Set Immediately (Bit 5) under SET status during position movement command, able to cancel currently operating position movement command and immediately move to new target position.

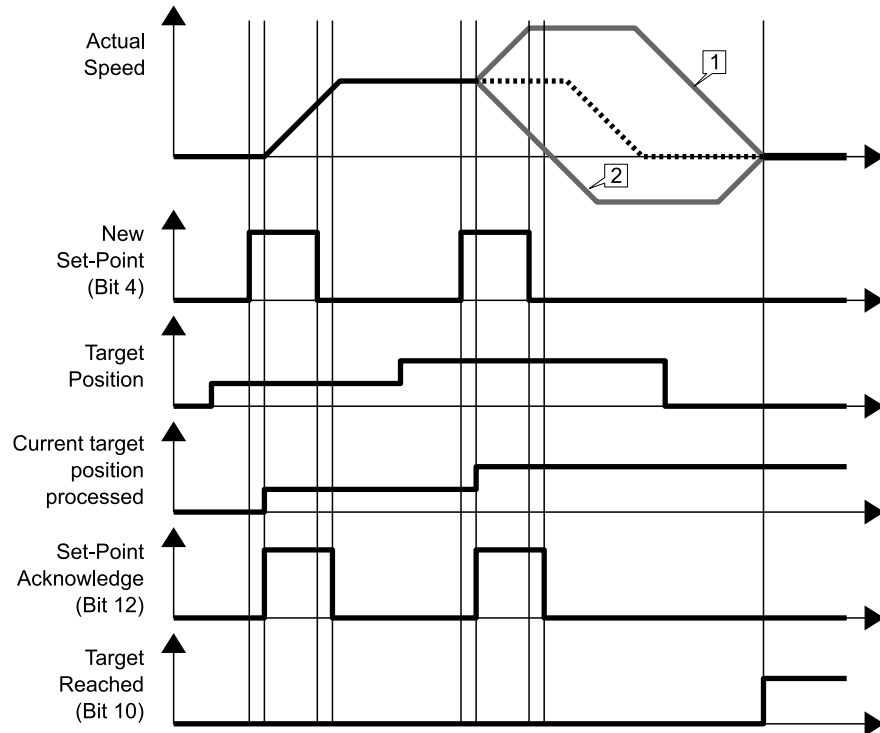


Figure 4.6: Change Set Immediately

1. If new target position is sufficiently ahead of previous target position, it will move to new target position passing by previous target position.
2. If new target position is behind of previous target position, it will be decelerated according to correspondent position and if need, it can stop and move to opposite direction.

If there is no previous position movement command or already completed, command under Change Set Immediately (Bit 5) under SET status is same as general position movement command.

4.6 Homing Mode

4.6.1 Definition

Origin search mode is the way of heading to origin with command of Control word (6040h). To use origin search mode, need to set Homing Mode at Mode of operation (6060h). Able to use origin search command once Mode of operation display (6061h) indicates Homing Mode.

4.6.2 Relative Objects

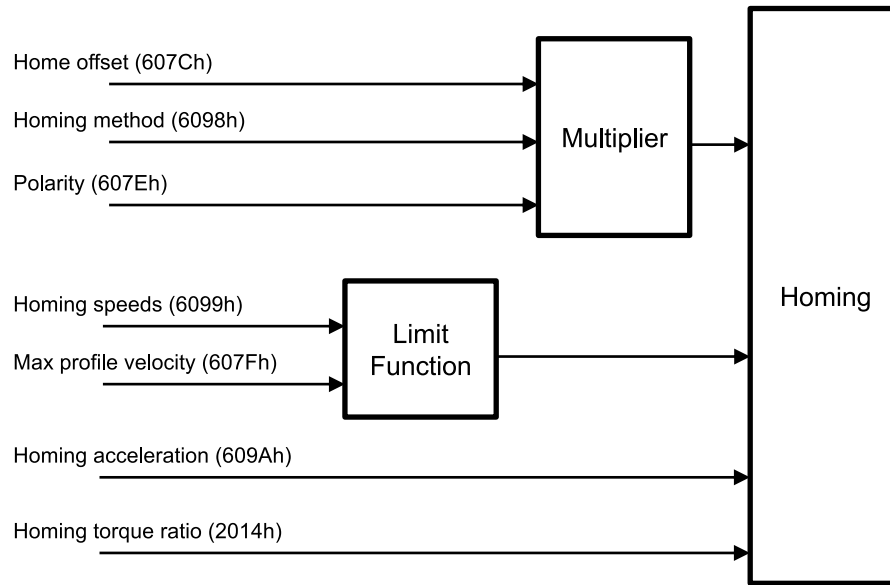


Figure 4.7: Homing Mode Objects

There are 4 kinds (Origin Switch, Positive Limit Switch, Negative Limit Switch, Index pulse of Encoder) switches to find out origin. And it can be differentiated by Homing Method (6098h).

If it is not Homing method by Limit Switch, once Limit Switch goes ON during origin searching, it will move to opposite direction against movement direction. During motion towards opposite direction, if opposite side of Limit Switch goes ON, origin search goes failure.

If Sensor origin and mechanical origin is different, able to set with using Home Offset (607Ch). Once position of mechanical origin is set to Home Offset, Status word - bit 12: Home Attained is going to be ON and position objects will be initialized.

4.6.3 Control word and Status word

Control words at Homing Mode (Mode of operation display (6061h) = 6) are as follows.

Bit	Name	Description
0	Switch On	Origin Search Command
1	Enable Voltage	
2	Quick Stop	
3	Enable Operation	
4	Homing Operation Start	
5 ~ 6	Reserved	Stop Command
7	Fault Reset	
8	Halt	
9 ~ 15	Reserved	

Table 4.20: Homing Mode of Control Word

Please refer to drive status control for the rest of bits.

Bit	Value	Description
4	0 → 1	Initiate origin search command.
8	1	Origin search command canceled and stops according to set action at Halt option code (605Dh).

Table 4.21: Control Word of Bit 4, 8

Status word at Homing Mode are as follows.

Bit	Value	Description
0	Ready to switch on	
1	Switched on	
2	Operation enabled	
3	Fault	
4	Voltage enabled	
5	Quick stop	
6	Switch on disabled	
7	Warning	
8	Reserved	
9	Remote	
10	Target Reached	Origin search status
11	Internal Limit Active	Origin search completed Origin search failed
12	Homing attained	
13	Homing Error	
14 ~ 15	Reserved	

Table 4.22: Homing Mode of Status word

Please refer to drive status control for the rest of bits.

Bit 13	Bit 12	Bit 10	Description
0	0	0	Origin search operation is on-going.
0	0	1	Origin search operation canceled or not started yet.
0	1	0	Origin has searched but controller is still under operation.
0	1	1	Origin search has successfully completed.
1	0	x	Origin search has failed. Controller stops.
1	1	x	Reserved

Table 4.23: Status word of bit 13, 12, 10

4.6.4 Origin Search Method

Origin search methods supported by this product are as follows.

Homing method	Name
1	Homing on Negative Limit Switch and Index Pulse
2	Homing on Positive Limit Switch and Index Pulse
7	Homing on Origin Switch (Positive Direction, Negative Edge) and Index Pulse
11	Homing on Origin Switch (Negative Direction, Positive Edge) and Index Pulse
17	Homing on Negative Limit Switch
18	Homing on Positive Limit Switch
24	Homing on Origin Switch (Positive Direction, Negative Edge)
28	Homing on Origin Switch (Negative Direction, Positive Edge)
33	Homing Index Pulse (Negative Direction)
34	Homing Index Pulse (Positive Direction)
35	Set the current position origin
36	reserved
37	Set the current position origin and reset current position
-3	Homing on Negative Limit touch
-4	Homing on Positive Limit touch
-5	Homing on Negative Limit touch and Index Pulse
-6	Homing on Positive Limit touch and Index Pulse

Table 4.24: Homing Method List

Supported origin searching method lists can be also checked from Supported homing methods (60E3h).

4.6.4.1 Method 1: Homing on Negative Limit Switch and Index Pulse

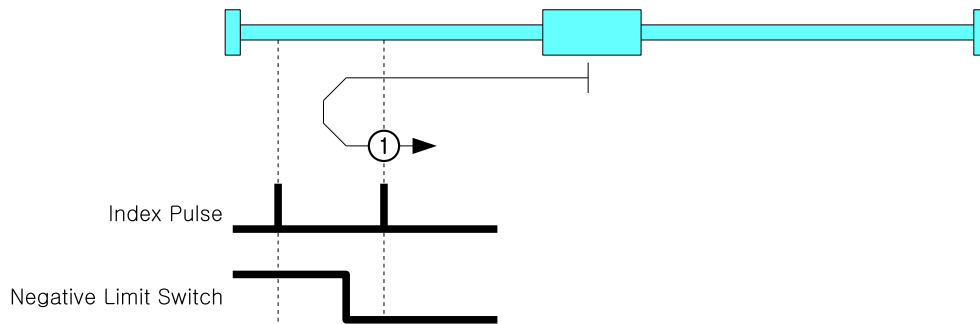


Figure 4.8: Homing Method 1

This origin methods is to start toward Negative Direction and movement velocity is the value of Speed during search for switch (6099h, index 01h). If Negative Limit Switch goes ON, it goes to opposite direction and moves by velocity of Speed during search for zero (6099h, index 02h). Index Pulse goes ON then stops and set correspondent position as sensor origin position.

4.6.4.2 Method 2: Homing on Positive Limit Switch and Index Pulse

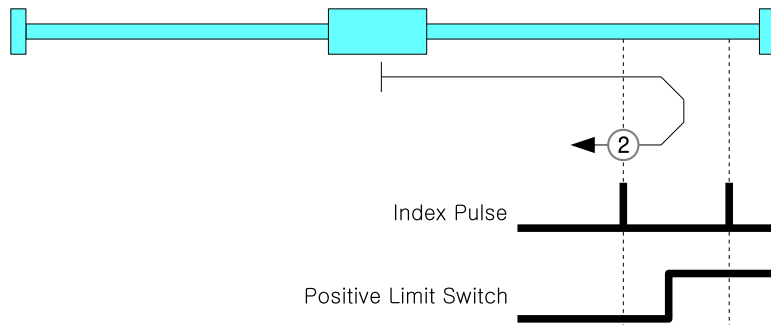


Figure 4.9: Homing Method 2

This origin method is to start toward Positive Direction and movement velocity is the value of Speed during search for switch (6099h, index 01h). Positive Limit Switch goes ON, it goes to opposite direction and moves to opposite direction by velocity of Speed during search for zero (6099h, index 02h). Index Pulse goes ON then stops and set correspondent position as sensor origin position.

4.6.4.3 Method 7: Homing on Origin Switch (Positive Direction, Negative Edge) and Index Pulse

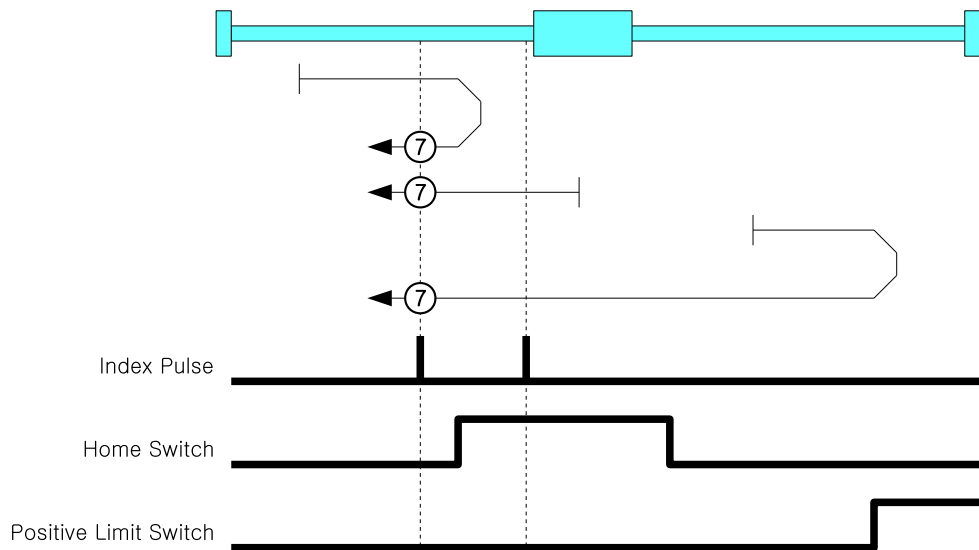


Figure 4.10: Homing Method 7

This origin method is to start toward Positive Direction and movement velocity is the value of Speed during search for switch (6099h, index 01h). Positive Limit Switch goes ON, it goes to opposite direction and moves to opposite direction. Switch goes ON and moves by velocity of Speed during search for zero (6099h, index 02h). Index Pulse goes ON then stops and set correspondent position as sensor origin position.

4.6.4.4 Method 11: Homing on Origin Switch (Negative Direction, Positive Edge) and Index Pulse

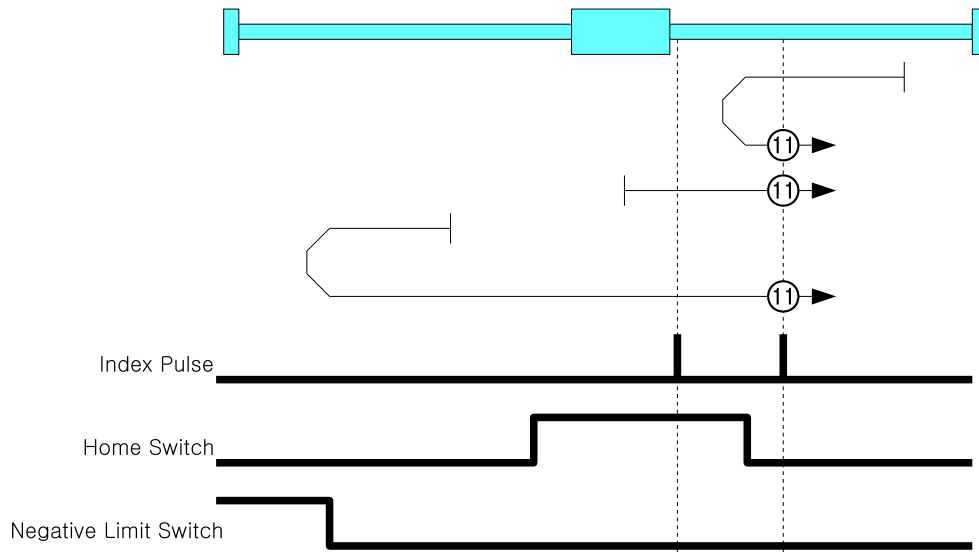


Figure 4.11: Homing Method 11

Initial movement direction of this origin search method is Negative Direction and movement velocity is the value of Speed during search for switch (6099h, index 01h). Negative Limit Switch goes ON, it goes to opposite direction. If Origin Switch goes ON, it goes to opposite direction and moves by velocity of Speed during search for zero (6099h, index 02h). Index Pulse goes ON then stops and set correspondent position as sensor origin position.

4.6.4.5 Method 17: Homing on Negative Limit Switch

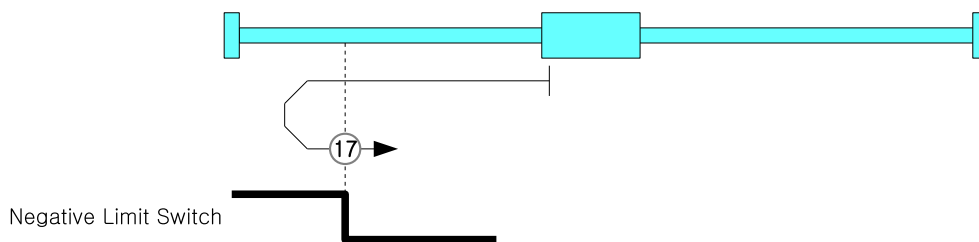


Figure 4.12: Homing Method 17

This origin search method goes for Negative Direction and movement velocity is the value of Speed during search for switch (6099h, index 01h). Negative Limit Switch goes ON, it goes to opposite direction by velocity of Speed during search for zero (6099h, index 02h). Limit Switch goes OFF then stops and set correspondent position as sensor origin position.

4.6.4.6 Method 18: Homing on Positive Limit Switch

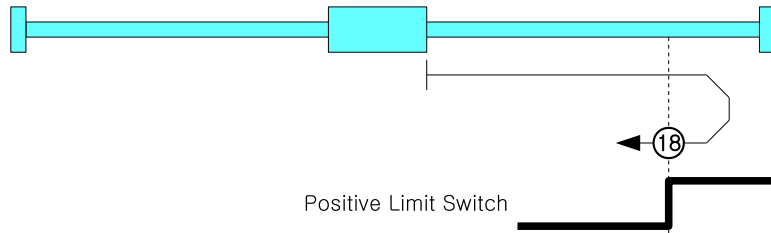


Figure 4.13: Homing Method 18

This origin method goes for Positive Direction and movement velocity of the value of Speed during search for switch (6099h, index 01h). Positive Limit Switch goes ON, it goes to opposite direction by velocity of Speed during search for zero (6099h, index 02h) Limit Switch goes OFF then stops and set correspondent position as sensor origin position.

4.6.4.7 Method 24: Homing on Origin Switch (Positive Direction, Negative Edge)

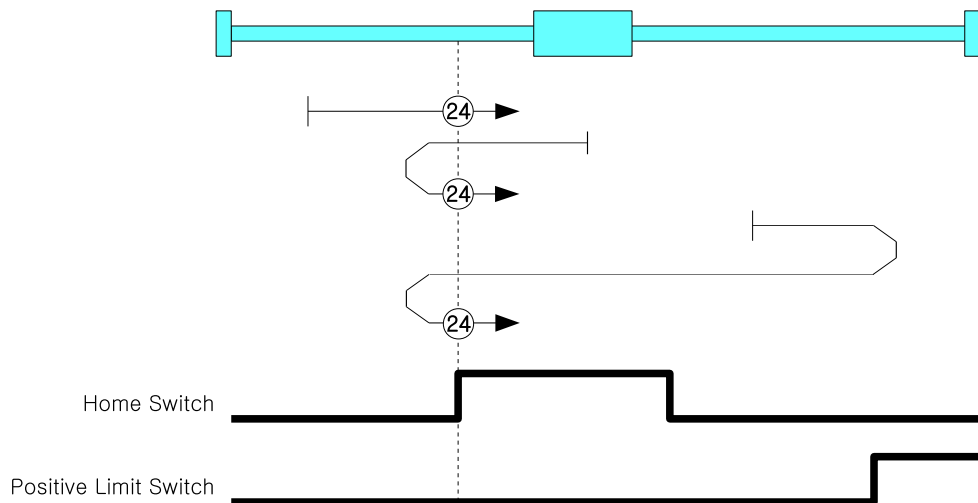


Figure 4.14: Homing Method 24

Initial movement direction of this origin search method is Positive Direction and movement velocity is the value of Speed during search for switch (6099h, index 01h). Positive Limit Switch goes ON, it goes to opposite direction by velocity of Speed during search for zero (6099h, index 02h) and get out of Origin Switch. If it gets out of Origin Switch, start to search origin by velocity of Speed during search for zero (6099h, index 02h) and stops when ON then set correspondent position as sensor origin position.

4.6.4.8 Method 28: Homing on Origin Switch (Negative Direction, Positive Edge)

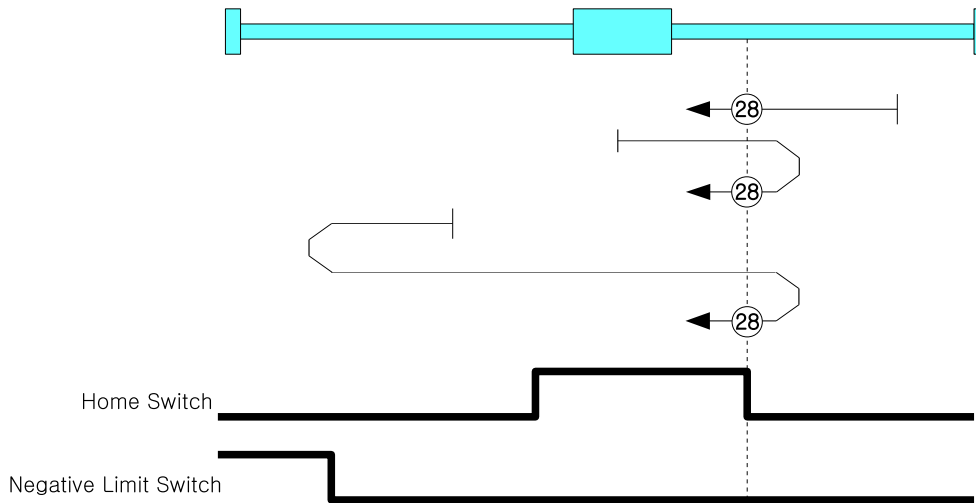


Figure 4.15: Homing Method 28

Initial movement direction of this origin search method is Negative Direction and movement velocity is the value of Speed during search for switch (6099h, index 01h). Negative Limit Switch goes ON, it goes to opposite direction. If Origin Switch goes ON, it goes out of Origin Switch toward opposite direction by velocity of Speed during search for zero (6099h, index 02h). If it gets out of Origin Switch, it searches Origin Switch again by velocity of Speed during search for zero (6099h, index 02h), then stops when it goes ON then set correspondent position as sensor origin position.

4.6.4.9 Method 33, 34: Homing Index Pulse

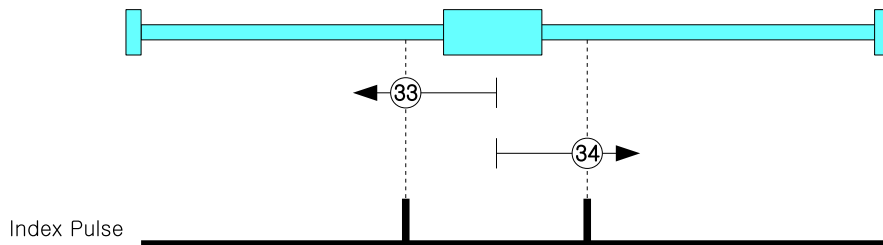


Figure 4.16: Homing Method 33

Origin search method 33 is to move from current position to Negative direction, 34 is moving to Positive Direction and movement velocity is Speed during search for zero (6099h, index 02h). Index Pulse goes ON then stops then set correspondent position as sensor origin position.

4.6.4.10 Method 35: Set the current position origin

This origin search method is to set current position as sensor origin position. If set value of Home offset (607Ch) is not 0, it moves to correspondent position.

4.6.4.11 Method 37: Set the current position origin and reset current position

This origin search method is to set current position as sensor origin position. If set value of Home offset (607Ch) is not 0, initialize current position as Home offset value.

4.6.4.12 Method -3: Homing on Negative Limit touch

This origin search method is to start toward Negative Direction and movement velocity is the value of Speed during search for zero (6099h, index 02h). If it sense certain Load then stops and set correspondent position as sensor origin position.

The level of load to be sensed is to set through Object 2014h: Homing Torque Ratio.

4.6.4.13 Method -4: Homing on Positive Limit touch

This origin search method is to start toward Positive Direction and movement velocity is the value of Speed during search for zero (6099h, index 02h). If it sense certain Load then stops and set correspondent position as sensor origin position.

The level of load to be sensed is to set through Object 2014h: Homing Torque Ratio.

4.6.4.14 Method -5: Homing on Negative Limit touch and Index Pulse

This origin search method is to start toward Positive Direction and movement velocity is the value of Speed during search for zero (6099h, index 02h). If it sense certain Load then stops and moves to opposite direction and movement velocity is Speed during search for zero (6099h, index 02h). Index Pulse goes ON then stops and set correspondent position as sensor origin position.

The level of load to be sensed is to set through Object 2014h: Homing Torque Ratio.

4.6.4.15 Method -6: Homing on Positive Limit touch and Index Pulse

This origin search method is to start toward Positive Direction and movement velocity is the value of Speed during search for zero (6099h, index 02h). If it sense certain Load then stops and moves to opposite direction and movement velocity is Speed during search for zero (6099h, index 02h). Index Pulse goes ON then stops and set correspondent position as sensor origin position.

The level of load to be sensed is to set through Object 2014h: Homing Torque Ratio.

4.7 Touch Probe

4.7.1 Definition

Touch probe function is to record current position with sensing inputs from external signal.

4.7.2 Related Objects

Object	Access	Description
Touch probe function	RW	Control Touch Probe 1/2.
Touch probe status	RO	Indicate status of Touch Probe 1/2.
Touch probe 1 positive value	RO	Indicate detected position of Rising edge of Touch Probe 1.
Touch probe 2 positive value	RO	Indicate detected position of Falling edge of Touch Probe 1.
Touch probe 1 negative value	RO	Indicate detected position of Rising edge of Touch Probe 2.
Touch probe 2 negative value	RO	Indicate detected position of Falling edge of Touch Probe 2.
Touch probe 1 positive edge counter	RO	Indicate detected frequency of Rising edge of Touch Probe 1.
Touch probe 2 positive edge counter	RO	Indicate detected frequency of Falling edge of Touch Probe 1.
Touch probe 1 negative edge counter	RO	Indicate detected frequency of Rising edge of Touch Probe 2.
Touch probe 2 negative edge counter	RO	Indicate detected frequency of Falling edge of Touch Probe 2.
Touch probe source	RO	Select input signal of Touch Probe 1/2.

Table 4.25: Touch Probe related Objects

4.7.3 Touch Probe Status and Control

4.7.3.1 Touch Probe Operation : Acknowledge initial signal

If Touch probe function of bit number 1, 9 has set as O, Touch probe only uses initially acknowledged signal after Enable.

Please refer to Timing chart as follow.

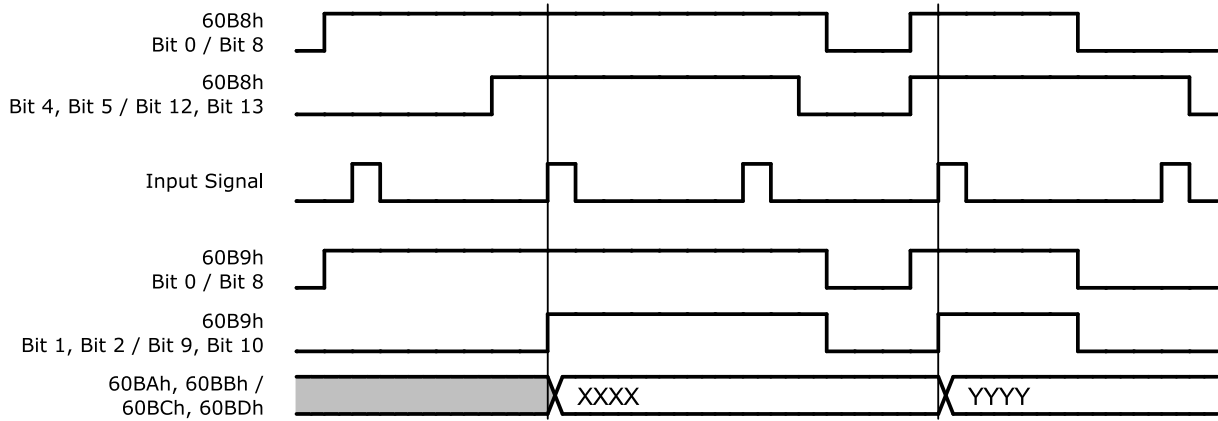


Figure 4.17: Touch Probe Operation (Bit 1 / Bit 9 = 0)

Able to check whether input signal acknowledged through Touch probe status of bit number 1 ~ 2, 9 ~ 10 (Detected).

Acknowledged position value, please check Touch probe 1 positive value, Touch probe 2 positive value, Touch probe 1 negative value, Touch probe 2 negative value.

4.7.3.2 Touch Probe Operation : Continuous signal acknowledgement

If Touch probe function of bit number 1, 9 has set as 1, Touch probe uses all acknowledged signals after Enable.

Please refer to Timing chart as follows.

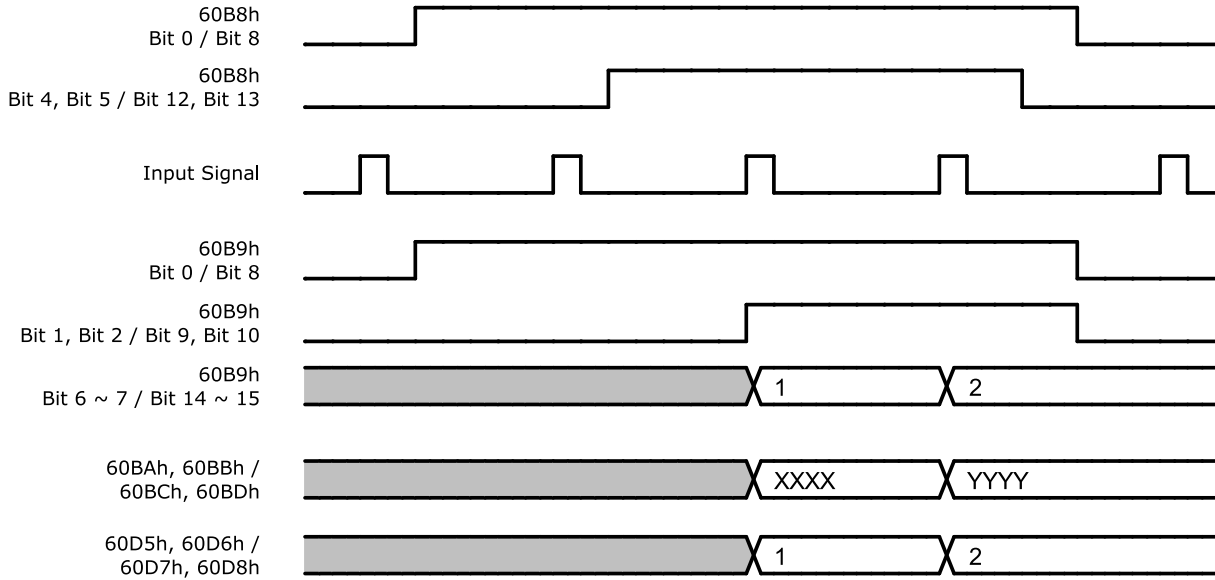


Figure 4.18: Touch Probe Operation (Bit 1 / Bit 9 = 1)

Touch probe status of bit number 6 ~ 7, 14 ~ 15 (Counter) value increases every single of input signal acknowledgement. (Range of this value is 0 ~ 3.)

For the frequency of input signal acknowledgement, please check Touch probe 1 positive edge counter, Touch probe 2 positive edge counter, Touch probe 1 negative edge counter, Touch probe 2 negative edge counter.

4.8 Digital Input and Output

4.8.1 Definition

Ezi-SERVOII EtherCAT and S-SERVO EtherCAT provides 3 default input (ORIGIN, LIMIT+, LIMIT-) and 7 user inputs and also 1 default output (BRAKE) and 6 user outputs.

4.8.2 Related Objects

Object	Access	Description
Digital inputs (60FDh)	RO	Indicates input signals.
Digital outputs (60FEh)	R/W	Set output signals.
Sensors logics (2001h)	R/W	Set Active Level of ORIGIN, LIMIT+, LIMIT- input signals.
Reverse limit direction (2002h)	R/W	Exchange LIMIT+ and LIMIT- input signals.
Digital input levels (2011h)	R/W	Active Level of user inputs.
Digital output levels (2012h)	R/W	Active Level of user outputs.
Brake delay (2010h)	R/W	Set Delay at BRAKE output.

Table 4.26: I/O related Objects

4.8.3 User I/O

Able to set Active Level of user I/O through Digital input levels, Digital output levels.

Following picture describes the relationship between Digital inputs and Digital input levels and Digital outputs and Digital output levels.

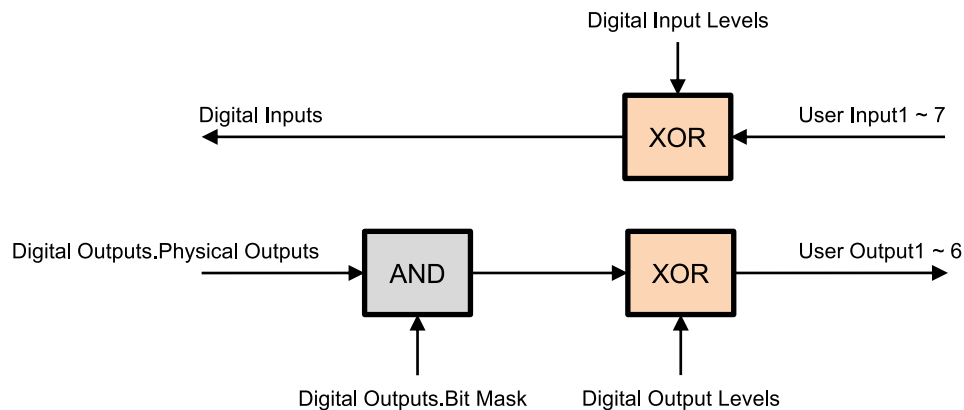
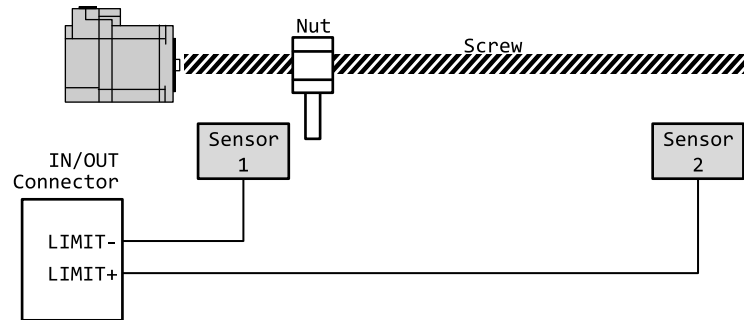


Figure 4.19: Digital I/O Level

4.8.4 ORIGIN and LIMIT Input

Active Level of ORIGIN and LIMIT input signal can be changed through Sensors logics (2001h) of Bit 0, 1. Please refer to Sensors logics.

LIMIT+ and LIMIT- input signals can be exchanged through Reverse limit direction (2002h). Interrelation between Reverse limit direction (2002h) and LIMIT+, LIMIT- is as follows.



Reverse Limit Direction	Sensor 1 Detect	Sensor 2 Detect
0	Negative Limit	Positive Limit
1	Positive Limit	Negative Limit

Table 4.27: Relationship between Reverse limit direction (2002h) and Limit Sensor

4.8.5 BRAKE Output

BRAKE output signal activates according to Operation Enabled of Status word (6041h). Timing of BRAKE ON can be set by Brake delay (2010h).

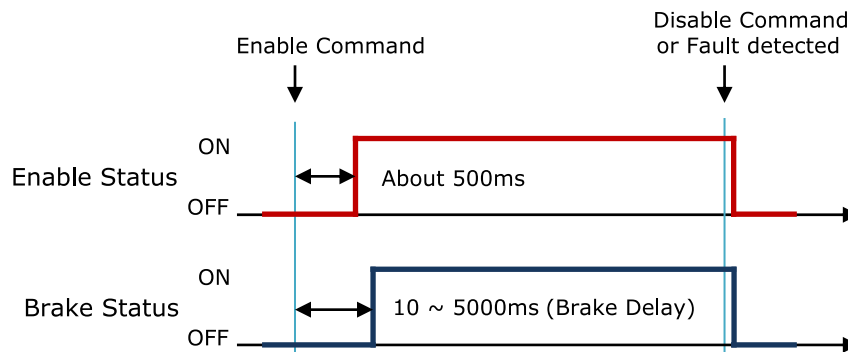


Figure 4.20: Brake Signal

BRAKE output can be manually released through Digital outputs (60FEh) Bit 0:Set Brake. For more detail information, please refer to [6.5.43 Object 60FEh: Digital outputs](#).

Chapter 5

Operation

5.1 Operation Sequence

Sequence of controller operation is as follow. Exampled operation sequence of Profile Position Mode listed at the table as below..

Step	Name		Action
1	Setting	Installation	Install motor/controller according to conditions of installation.
2		Wiring	Check power cable, motor/encoder cable, I/O cable, EtherCAT communication cables are properly connected.
3		Input power	Turn power on. Check controller status.
4		PDO Mapping	Set Module/PDO Mapping.
5		Set communication status	Change EtherCAT State Machine as 'OP'
6	Operation	Control Drive Status	Set Control Word then change Drive State Machine to Operation Enabled.
7		Set Mode	Set Object 6060h: Mode of operation.
8		Set Operation	Input value into Object needed for execution of Motion.
9		Movement Command	Execute command by setting of Control word.
10		Check Status	Check the status of Motion execution.
11	Set Drive		Reset object if need.

5.2 Setting

5.2.1 Installation

Install motor/controller according to conditions of installation. Check operation in advance under unload status and recommend to connect Load. Please refer to [2.1 Precautions of Installation](#)

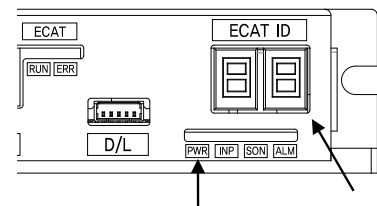
5.2.2 Wiring

Check power cable, motor/encoder cable, I/O cable, EtherCAT communication cables are properly connected. Please refer to [2.2 System Configuration](#)

5.2.3 Input Power

Turn power onto controller and check followings.

- Check Power LED (Red Color) of Drive status LED lights.
- Check 7-Segment indicates 0 or other value.



5.2.4 PDO Mapping

Set Module and PDO Mapping by setting function of Master.

Information

Trial operation explains operation by Profile Position Mode.
 Select the Module: 'Axis (Normal) : dynamic select operation mode'.
 Name of Module can be differentiated by each Master.



5.2.5 Set Communication Status

Change EtherCAT State Machine as 'OP' status by controlling Master.

- Check State Machine of Master can be changing to 'OP' status.
- Check State Machine of Controller can be changing to 'OP' status.

5.3 Operation

5.3.1 Drive Status Control

Change Drive State Machine as 'Operation Enabled' by setting of Control word (6040h).

- Check Status word (6041h) whether it can be changing to 'Operation Enabled'.
- In case of changing to 'Fault' status, check type of error by Error code (603Fh). Execute appropriate action according to type of error.

5.3.2 Set Mode

Set Mode of operation (6060h) according to operation mode will be used.

Information

Trial operation explains operation by Profile Position Mode.
Set Mode of operation (6060h) at 1.



- Check Mode of operation display (6061h) whether it has properly changed.

5.3.3 Set Operation

Set Objects according to Motion will be executed.

Information

Trial operation explains operation by Profile Position Mode.
Input 10000 at Target position (607Ah).
Input 1000 at Profile velocity (6081h).



5.3.4 Movement Command

Once setting of Motion related Object has completed, execute movement command by setting of Control word.

Information

Trial operation explains operation by Profile Position Mode.
Input 005Fh at Control word. This command is to rotate motor by setting value(distance) at Target position.



5.3.5 Check Statues

Check motor operates according to command or whether fault generated.

- Check motor achieves set operation visually.
- Check noise or abnormal vibration from motor during operation.
- After completion of motor operation, check Status word whether 'Target Reached' shown as 1.
- Check Status word whether 'Fault' shown as 1. If so, check Error code and execute appropriate action.

5.4 Drive Setting Adjustment

5.4.1 Change Rotation Direction

If rotation direction of motor goes opposite direction, set Polarity (607Eh) value then able to change rotation direction of motor.

5.4.1.1 Reverse limit direction

After changing Polarity, if LIMIT+, LIMIT- input signal acknowledgement reversed, able to change input value of 2 signals by setting the value of Reverse limit direction (2002h).

Regarding relationship between Reverse limit direction and Limit Sensors, please refer to [4.8.5 BRAKE Output](#).

5.4.2 Change I/O Signal Level

5.4.2.1 Limit+, Limit-, Origin Input Signal

If Active Level of Limit+, Limit-, Origin input signal has set different from actual connection, indication value of Actual signal input and Digital inputs can be different.

Reset Active Level of signals by setting the value of Sensors logics (2001h).

Able to set Active Level of Origin signal by Sensors logics.

5.4.2.2 User I/O

Active Level of User I/O, User Input 1 ~ 7 and User Output 1 ~ 6 can be changing by Digital input levels (2011h) and Digital output levels (2012h).

Chapter 6

EtherCAT Object Dictionary

6.1 Indication Type of Objects

Following table explains indication type of information for each object.

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
60C2h	0	Number of entries	U8	R0	No	No		2
	1	Interpolation time period value	U8	RW	Yes	No	0 ~ 65535	2
	2	Interpolation time index	I8	RW	Yes	No	-4 ~ 1	-3

Object indicates default information as like Device name (1008h), it is indicated as following type.

Index	Sub index	Name	Type	Access	Constant Value
1008h	0	Device name	STR(18)	R0	Ezi-SERV02 EtherCAT

6.1.1 Index and Sub index

All object divides into 4 digits of hexadecimal index and configured as following field.

INDEX	Field	Description
0000h ~ 0FFFh	Data type area	Data type definitions
1000h ~ 1FFFh	Communication profile area	
2000h ~ 5FFFh	Manufacture specific area	
6000h ~ 9FFFh	Standardized Device Profile Area	
A000h ~ FFFFh	Reserved	Reserved

Table 6.1: INDEX Table of Objects

If various parameter combined at the one object, able to access through Sub Index. Please refer to each object of Sub Index 0 : ‘Number of entries’ for Max. accessible sub index.

6.1.2 Name

Describes correspondent object.

6.1.3 Data Type

Parameter type of object is as follows.

Data Type	Length	Range
U8	1 byte	0 ~ 255
U16	2 byte	0 ~ 65535
U32	4 byte	0 ~ 4294967295
I8	1 byte	-128 ~ 127
I16	2 byte	-32768 ~ 32767
I32	4 byte	-2147483648 ~ 2147483647
BOOL	1 bit	0 ~ 1
STR(n)		Character string which length is n

Table 6.2: Data Type

6.1.4 Access

Property of each object is as following and describes authority to access each object.

Access	Description
RO	Read Only / Parameter only can be read.
RW	Read/Write / Parameter can be read or written.

Table 6.3: Access type of object

6.1.5 SAVE

Value of object can be saved at EEPROM through Store parameters (1010h).

6.1.6 PDO Mapping

Indicates object whether correspondent object can be mapping at PDO communication of EtherCAT.

PDO Type	Description
No	Object can not be mapping at PDO.
Tx PDO	Object can be mapping at Tx PDO.
Rx PDO	Object can be mapping at Rx PDO.

Table 6.4: PDO Mapping Description

6.1.7 Constant Value

Default value what correspondent object indicates. correspondent value can be differentially indicated by model or version of product.

6.1.8 Value Range

Value Range indicates input range of correspondent object. correspondent range can be indicated as any range or range of data type can be indicated.

6.1.9 Default Value

Indicates basic value of correspondent object. Can be initialized as a correspondent value when returns back to initial value through Restore default parameters (1011h).

6.2 Communication Object

6.2.1 Object 1000h: Device type

Index	Sub index	Name	Type	Access	Constant Value
1000h	0	Device type	U32	R0	0004 0192h

Object includes information of Device Type.

Bit	Name	Value	Description
0 ~ 15	Device Profile Number	0192h	CiA 402 Profile
16 ~ 23	Type	04h	Stepper Driver
24 ~ 31	Mode	00h	

Table 6.5: Device Type

6.2.2 Object 1001h: Error register

Index	Sub index	Name	Type	Access	SAVE	PD0 Mapping	Value Range	Default Value
1001h	0	Error register	U8	R0	No	No		00h

This object indicates type of error generated from the controller.

Bit	Meaning
0	Generic error
1	Current error
2	Voltage error
3	Temperature error
4	Communication error
5	Device profile specific
6	Reserved
7	Manufacture specific

Table 6.6: Type of Error

correspondent bit can be set if correspondent error generated. ‘General Error’ always goes to be set once bit error generated.

6.2.3 Object 1008h: Device name

Index	Sub index	Name	Type	Access	Constant Value
1008h	0	Device name	STR(18)	R0	Ezi-SERV02 EtherCAT

This object indicates name of device.

Information

The value of Device name can be differentially indicated by product model.



6.2.4 Object 1009h: Hardware version

Index	Sub index	Name	Type	Access	Constant Value
1009h	0	Hardware version	STR(8)	R0	01.00.00

This object indicates version of product hardware. Indicated value can be different by version of product.

6.2.5 Object 100Ah: Software version

Index	Sub index	Name	Type	Access	Constant Value
100Ah	0	Software version	STR(8)	RO	01.00.00

This object indicates version of software. Indicated value can be different by version of product.

6.2.6 Object 1010h: Store parameters

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
1010h	0	Number of entries	U8	RO	No	No		1
	1	Store parameters	U32	RW	No	No		

Able to save all storable object into EEPROM through this object.

Need to input '65766173h' into sub-index 01h to store objects into EEPROM.

	MSB			LSB
ASCII	'e'	'v'	'a'	's'
Hex	65h	76h	61h	73h

Table 6.7: Definition of Save Parameters Value

If fails to store, SDO Communication returns 'Abort SDO Transfer (abort code: 0606 0000h)'. If inputs incorrect value, device does not store EEPROM and returns 'Abort SDO Transfer (abort code:0800 002xh)'.

When reads Sub-index 01h, following value will be returned.

Bit	Value	Description
0	1	Support save Parameter.
1 ~ 31	0	Reserved

Table 6.8: Save Parameters State

Check 'SAVE' part for each object.

6.2.7 Object 1011h: Restore default parameters

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
1011h	0	Number of entries	U8	RO	No	No		1
	1	Restore default parameters	U32	RW	No	No		

It requests to device to restore objects value back to Default value to store into EEPROM.

Need to input '64616F6Ch' into sub-index 01h to restore objects back to original setting value.

	MSB			LSB
ASCII	'd'	'a'	'o'	'l'
Hex	64h	61h	6Fh	6Ch

Table 6.9: Definition of Restore Parameters Value

If failed to initialize, SDO communication returns 'Abort SDO Transfer (abort code: 0606 0000h)'. If inputs incorrect value, device will not be initialized and return 'Abort SDO Transfer (abort code: 0800002xh)'.

Information

the objects' value will be set to default after power cycle.



In case of reading Sub-index 01h, following values will be returned.

Bit	Value	Description
0	1	Support Restore Default Parameter.
1 ~ 31	0	Reserved

Table 6.10: Restore Parameters State

6.2.8 Object 1018h: Identity

Index	Sub index	Name	Type	Access	Constant Value
1018h	0	Number of entries	U8	R0	4
	1	Vendor ID	U32	R0	0FA0 0000h
	2	Product code	U32	R0	0000 1001h
	3	Revision number	U32	R0	0000 0000h
	4	Serial number	U32	R0	0000 0000h

This object indicates information of device.

Information

Value for each item of Identity can be differentially indicated by product model and version.

**6.2.9 Object 10F1h: Error settings**

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
10F1h	0	Number of entries	U8	R0	No	No		2
	1	Local error reaction	U32	R0	No	No		0000 0000h
	2	Sync error counter limit	U32	RW	No	No		0000 0004h

6.3 PDO Mapping Object

6.3.1 Object 1600h: RxPDO-Map 0

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
1600h	0	Number of entries	U8	RW	No	No	0 ~ 10	2
	1	1st PDO object	U32	RW	Yes	No		6040 0010h
	2	2nd PDO object	U32	RW	Yes	No		607A 0020h
	3	3rd PDO object	U32	RW	Yes	No		0000 0000h
	4	4th PDO object	U32	RW	Yes	No		0000 0000h
	5	5th PDO object	U32	RW	Yes	No		0000 0000h
	6	6th PDO object	U32	RW	Yes	No		0000 0000h
	7	7th PDO object	U32	RW	Yes	No		0000 0000h
	8	8th PDO object	U32	RW	Yes	No		0000 0000h
	9	9th PDO object	U32	RW	Yes	No		0000 0000h
	10	10th PDO object	U32	RW	Yes	No		0000 0000h

This object points RxPDO 0 information among RxPDO setting.

Following objects are basically mapping: Control word (6040h), Target position (607Ah)

RxPDO-Map 0 is configurable. Please refer to [3.2 PDO Mapping](#)

6.3.2 Object 1601h: RxPDO-Map 1

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
1601h	0	Number of entries	U8	RW	No	No	0 ~ 10	10
	1	1st PDO object	U32	RW	Yes	No		6040 0010h
	2	2nd PDO object	U32	RW	Yes	No		607A 0020h
	3	3rd PDO object	U32	RW	Yes	No		6081 0020h
	4	4th PDO object	U32	RW	Yes	No		6060 0008h
	5	5th PDO object	U32	RW	Yes	No		0000 0000h
	6	6th PDO object	U32	RW	Yes	No		0000 0000h
	7	7th PDO object	U32	RW	Yes	No		0000 0000h
	8	8th PDO object	U32	RW	Yes	No		0000 0000h
	9	9th PDO object	U32	RW	Yes	No		0000 0000h
	10	10th PDO object	U32	RW	Yes	No		0000 0000h

This object points RxPDO 1 information among RxPDO setting. RxPDO-Map 1 is configurable. Please refer to [3.2 PDO Mapping](#).

6.3.3 Object 1A00h: TxPDO-Map 0

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
1A00h	0	Number of entries	U8	RW	No	No	0 ~ 10	2
	1	1st PDO object	U32	RW	Yes	No		6041 0010h
	2	2nd PDO object	U32	RW	Yes	No		6064 0020h
	3	3rd PDO object	U32	RW	Yes	No		0000 0000h
	4	4th PDO object	U32	RW	Yes	No		0000 0000h
	5	5th PDO object	U32	RW	Yes	No		0000 0000h
	6	6th PDO object	U32	RW	Yes	No		0000 0000h
	7	7th PDO object	U32	RW	Yes	No		0000 0000h
	8	8th PDO object	U32	RW	Yes	No		0000 0000h
	9	9th PDO object	U32	RW	Yes	No		0000 0000h
	10	10th PDO object	U32	RW	Yes	No		0000 0000h

This object points TxPDO 0 information among TxPDO setting.

Following objects are already mapping: Status word (6041h), Position Actual Value (6064h)

TxPDO-Map 0 is configurable. Please refer to [3.2 PDO Mapping](#).

6.3.4 Object 1A01h: TxPDO-Map 1

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
1A01h	0	Number of entries	U8	RW	No	No	0 ~ 10	10
	1	1st PDO object	U32	RW	Yes	No		6041 0010h
	2	2nd PDO object	U32	RW	Yes	No		6064 0020h
	3	3rd PDO object	U32	RW	Yes	No		606C 0020h
	4	4th PDO object	U32	RW	Yes	No		6061 0008h
	5	5th PDO object	U32	RW	Yes	No		0000 0000h
	6	6th PDO object	U32	RW	Yes	No		0000 0000h
	7	7th PDO object	U32	RW	Yes	No		0000 0000h
	8	8th PDO object	U32	RW	Yes	No		0000 0000h
	9	9th PDO object	U32	RW	Yes	No		0000 0000h
	10	10th PDO object	U32	RW	Yes	No		0000 0000h

This object points TxPDO 1 information among TxPDO.

TxPDO-Map 1 is configurable. Please refer to [3.2 PDO Mapping](#).

6.3.5 Object 1C12h: RxPDO assign

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
1C12h	0	Number of entries	U8	RO	No	No		1
	1	RxPDO assign	U16	RW	No	No		1600h

6.3.6 Object 1C13h: TxPDO assign

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
1C13h	0	Number of entries	U8	RO	No	No		1
	1	TxPDO assign	U16	RW	No	No		1A00h

6.4 Sync Manager Object

6.4.1 Object 1C00h: Sync manager type

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
1C00h	0	Number of entries	U8	RO	No	No		4
	1	SM0	U8	RO	No	No		01h
	2	SM1	U8	RO	No	No		02h
	3	SM2	U8	RO	No	No		03h
	4	SM3	U8	RO	No	No		04h

Sync Manager Type	Description
1	Mailbox Out
2	Mailbox In
3	PDO Output
4	PDO Input

Table 6.11: Sync Manager Type Value

6.4.2 Object 1C32h: SM output parameter

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
1C32h	0	Number of entries	U8	RO	No	No		32
	1	Synchronization type	U16	RW	No	No		0100h
	2	Cycle time	U32	RO	No	No		0000 0000h
	4	Synchronization type supported	U16	RO	No	No		0780h
	5	Minimum cycle time	U32	RO	No	No		0000 0000h
	6	Calc and copy time	U32	RO	No	No		0000 0000h
	8	Get cycle time	U16	RW	No	No		0000h
	9	Delay time	U32	RO	No	No		0000 0000h
	10	Sync0 cycle time	U32	RW	No	No		0000 0000h
	11	SM-Event missed	U16	RO	No	No		0000h
	12	Cycle time too small	U16	RO	No	No		0000h
	32	Sync error	BOOL	RO	No	No		0000h

6.4.3 Object 1C33h: SM input parameter

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
1C33h	0	Number of entries	U8	RO	No	No		32
	1	Synchronization type	U16	RW	No	No		2200h
	2	Cycle time	U32	RO	No	No		0000 0000h
	4	Synchronization type supported	U16	RO	No	No		0780h
	5	Minimum cycle time	U32	RO	No	No		0000 0000h
	6	Calc and copy time	U32	RO	No	No		0000 0000h
	8	Get cycle time	U16	RW	No	No		0000h
	9	Delay time	U32	RO	No	No		0000 0000h
	10	Sync0 cycle time	U32	RW	No	No		0000 0000h
	11	SM-Event missed	U16	RO	No	No		0000h
	12	Cycle time too small	U16	RO	No	No		0000h
	32	Sync error	BOOL	RO	No	No		0000h

6.5 Drive Profile Object

6.5.1 Object 603Fh: Error code

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
603Fh	0	Error code	U16	RW	No	Tx PDO		0

This object indicates latest error value generated from controller.
Please refer to [4.2 Error Code](#) for the value of indicated value at Error code.

6.5.2 Object 6040h: Control word

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
6040h	0	Control word	U16	RW	No	Rx PDO		0

This object controls device status
Each bit of this object has a meaning as follows.

Bit	Name	Description
0	Switch On	Bits to control device status. Please refer to 4.1 Drive Status Control .
1	Enable Voltage	
2	Quick Stop	
3	Enable Operation	
4 ~ 6	Operation mode specific	
7	Fault Reset	Initialize Fault status.
8	Halt	Cancel command and stop.
9	Operation mode specific	
10 ~ 15	reserved	

Table 6.12: Definition of Control word

Bit 4 ~ 6 and 10 ~ 15 can differentially be activated according to the value of Mode of operation display (6061h). For details, please refer to each profile description.

6.5.3 Object 6041h: Status word

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
6041h	0	Status word	U16	RO	No	Tx PDO		

This object indicates the status of controller.
Each bit of this object has a meaning as follows.

Bit	Name	Description
0	Ready to switch on	Bits to indicate current status of controller. Please refer to 4.1 Drive Status Control .
1	Switched on	
2	Operation enabled	
3	Fault	
4	Voltage enabled	
5	Quick stop	
6	Switch on disabled	
7	Warning	Warning situation happens.
8	reserved	
9	Remote	Control word has settled
10	Target reached	Reached at target position.
11	Internal limit active	Software Limit has sensed from correspondent movement direction.
12 ~ 13	Operation mode specific	
14 ~ 15	reserved	

Table 6.13: Definition of Status word

Bit 12 ~ 13 can differentially be activated according to the value of Mode of operation display (6061h).
For details, please refer to each profile description.
Current status can be checked through number 0 ~ 6 bits according to controller.

Status word	Description
xxxx xxxx x0xx 0000b	Not ready to switch on
xxxx xxxx x1xx 0000b	Switch on disabled
xxxx xxxx x01x 0001b	Ready to switch on
xxxx xxxx x011 0011b	Switched on
xxxx xxxx x011 0111b	Operation enabled
xxxx xxxx x00x 0111b	Quick stop active
xxxx xxxx x0xx 1111b	Fault reaction active
xxxx xxxx x0xx 1000b	Fault

Table 6.14: Current status following by Status word

- Number 9 Remote bit indicates Control word has settled.
- Number 10 Target Reached bit indicates reached at target position. Meaning of target position can be different according to each mode of action and for details of meaning, please refer to Status word description of each operation mode. If Quick stop option code (605Ah) of value is 5 ~ 8, controller suddenly stops then Target Reached bit value goes to SET under immediate stop commands.
- Number 11 Internal Limit Active bit goes to SET once current position value is out of Software Position Limit (607Dh).
- Number 12 ~ 13 bits will has a different meaning according to operation mode. For details, please refer to Status word description of each operation mode.

6.5.4 Object 605Ah: Quick stop option code

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
605Ah	0	Quick stop option code	I16	RW	Yes	No		2

This object sets motion of immediate stop once controller status is Quick Stop.

Value	Description
0	Torque-Disable. Motor Free
1	After decelerated stop, changes to be 'switch On Disable' status.
2	After quick stop, changes to be 'Switch On Disable' status.

Table 6.15: Quick Stop Option Code

6.5.5 Object 605Bh: Shutdown option code

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
605Bh	0	Shutdown option code	I16	RW	Yes	No		0

This object is to set motion when controller goes Shutdown status.

Value	Description
0	Torque-Disable. Motor Free
1	After decelerated stop, disable Motor.

Table 6.16: Shutdown Option Code

6.5.6 Object 605Ch: Disable operation option code

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
605Ch	0	Disable operation option code	I16	RW	Yes	No		1

This object is to set operation in case of deactivated operation once controller goes Disable Operation status.

Value	Description
0	Torque-Disable. Motor Free
1	After decelerated stop, disable Motor.

Table 6.17: Disable Operation Option Code

6.5.7 Object 605Dh: Halt option code

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
605Dh	0	Halt option code	I16	RW	Yes	No		1

This object, Control word - bit 8: Set motion through Halt once stops command.

Value	Description
1	After decelerated stops, maintains Operation Enabled status.
2	After quick stops, maintain Operation Enabled status.

Table 6.18: Halt Option Code

6.5.8 Object 605Eh: Fault reaction option code

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
605Eh	0	Fault reaction option code	I16	RW	Yes	No		2

This object is to set operation once error occurs.

Value	Description
0	Torque-Disable. Motor Free
1	Decelerated stops.
2	Quick stops.

Table 6.19: Fault Reaction Option Code

6.5.9 Object 6060h: Mode of operation

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
6060h	0	Mode of operation	I8	RW	No	Rx PDO		0

This object is to set operation mode.

Value	Description
-128 ~ -1	Reserved
0	Operation mode has not set.
1	Profile Position Mode.
2 ~ 5	Reserved
6	Homing Mode.
7	Reserved
8	Cyclic Synchronous Position Mode.
9 ~ 127	Reserved

Table 6.20: Mode of operation value

This object indicates operation mode currently requested. Actual operation mode is indicated at Mode of operation display (6061h).

6.5.10 Object 6061h: Mode of operation display

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
6061h	0	Mode of operation display	I8	RO	No	Tx PDO		

This object indicates current operation mode. Definition of value is same as Mode of operation (6060h).

6.5.11 Object 6062h: Position demand value

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
6062h	0	Position demand value	I32	RO	No	Tx PDO		

This object indicates internal command position.

This position value is real time target position delivered from STEP Motor controller part to Motor.

6.5.12 Object 6064h: Position actual value

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
6064h	0	Position actual value	I32	RO	No	Tx PDO		

This object indicates current position.

This position value indicates Encoder value connected to controller.

It can be set to display the position of the external encoder using Object 2004h: External Encoder.

Please refer to the corresponding object.

6.5.13 Object 6065h: Following error window

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
6065h	0	Following error window	U32	RW	Yes	No		5000

Set the range of Follow Error Value.

Information

This object can NOT be set while it's 'Operation Enabled' state. Please set after 'Operation Disable'. Please refer to [4.1 Drive Status Control](#).



6.5.14 Object 6067h: Position window

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
6067h	0	Position window	U32	RW	Yes	No	0 ~ 63	0

Set the range of Positioning value.

Information

This object can NOT be set while it's 'Operation Enabled' state. Please set after 'Operation Disable'. Please refer to [4.1 Drive Status Control](#).



6.5.15 Object 606Bh: Velocity demand value

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
606Bh	0	Velocity demand value	I32	RO	No	Tx PDO		

This object indicates internal command velocity. The velocity value is a positive value when the motor rotates in the positive direction, and a negative value when the motor rotates in the negative direction.

Information

This object is supported only in Profile position mode and Homing mode. 0 value is displayed in Cyclic synchronous position mode.

**6.5.16 Object 606Ch: Velocity actual value**

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
606Ch	0	Velocity actual value	I32	RO	No	Tx PDO		

This object indicates internal command velocity. The velocity value is a positive value when the motor rotates in the positive direction, and a negative value when the motor rotates in the negative direction.

Information

This object does not display current actual velocity. it displays the same value as the value of Velocity demand value.

**6.5.17 Object 607Ah: Target position**

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
607Ah	0	Target position	I32	RW	No	Rx PDO	-2147483648 ~ 2147483647	0

This object sets target position under Profile Position Mode, Cyclic Synchronous Position Mode.

6.5.18 Object 607Ch: Home offset

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
607Ch	0	Home offset	I32	RW	Yes	No	-2147483648 ~ 2147483647	0

This object sets value of difference between sensor origin position and mechanical origin position. During origin search mode, completes origin search by set mode at Home Method then moves by Home Offset distance. If set value is over 0, move toward +direction and less than 0, move toward -direction.

6.5.19 Object 607Dh: Software position limit

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
607Dh	0	Number of entries	U8	RO	No	No		2
	1	Min position range limit	I32	RW	Yes	No	-2147483648 ~ 2147483647	-2147483648
	2	Max position range limit	I32	RW	Yes	No	-2147483648 ~ 2147483647	2147483647

Absolute position range where position objects can be positioned. Controller is unable to get out of this range. If needs to move position out of this range, target position can be adjusted within range and if current position currently is out of range, Status word of 'Internal Limit Active' Bit goes SET and unable to move to correspondent direction.

Software Position Limit is based on Sensor origin. If Home Offset has set by not 0 but other value, Actual Software Position Limit needs to be used after adjustment by Home Offset.
This object is operated under Profile Position Mode only.

Actual movable Min. position = Min Position Limit - Home Offset

Actual movable Max. position = Max Position Limit - Home Offset

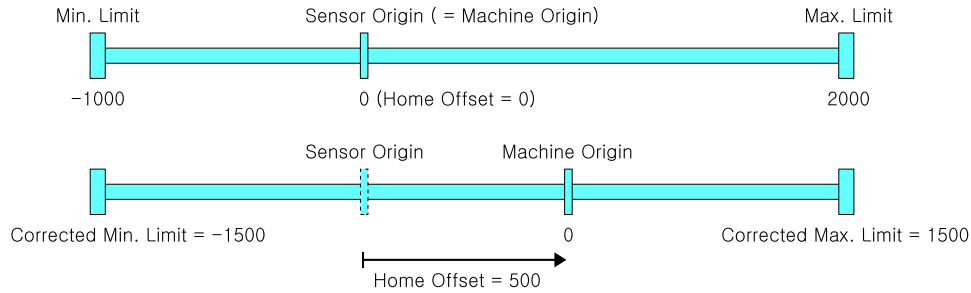


Figure 6.1: Origin Offset

Information

If you set both Min Position Range Limit and Max Position Range Limit to 0, you can disable the function of Software position limit.



6.5.20 Object 607Eh: Polarity

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
607Eh	0	Polarity	U8	RW	Yes	No		0

This object sets rotation direction of motor.

Bit	Description
0 ~ 6	Reserved
7	Position Polarity

Table 6.21: Polarity Value

Position Polarity	Description
0	Multiply position related Object by 1.
1	Multiply position related Object by -1.

Table 6.22: Position Polarity

6.5.21 Object 607Fh: Max profile velocity

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
607Fh	0	Max profile velocity	U32	RW	Yes	No	1 ~ 2500000	2500000

This object sets Max. allowable velocity.

Whatever it receives value of velocity, controller does not move faster than Max Profile Velocity.

6.5.22 Object 6081h: Profile velocity

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
6081h	0	Profile velocity	U32	RW	Yes	Rx PDO	1 ~ 2500000	10000

This object sets movement velocity under Profile Position Mode.

6.5.23 Object 6083h: Profile acceleration

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
6083h	0	Profile acceleration	U32	RW	Yes	Rx PDO	1000 ~ 1000000000	1000000

This object sets acceleration under Profile Position Mode.

Unit is speed of increasing per second [pulse/ s^2].

6.5.24 Object 6084h: Profile deceleration

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
6084h	0	Profile deceleration	U32	RW	Yes	Rx PDO	1000 ~ 1000000000	1000000

This object sets deceleration under Profile Position Mode.

Unit is speed of increasing per second [pulse/ s^2].

6.5.25 Object 6098h: Homing method

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
6098h	0	Homing method	I8	RW	Yes	Rx PDO		0

This object sets the method of sensor origin search under Homing Mode.

Homing Mode method is as follow.

Value	Name
0	No Mode
1	Homing on Negative Limit Switch and Index Pulse
2	Homing on Positive Limit Switch and Index Pulse
7	Homing on Origin Switch (Positive Direction, Negative Edge) and Index Pulse
11	Homing on Origin Switch (Negative Direction, Positive Edge) and Index Pulse
17	Homing on Negative Limit Switch
18	Homing on Positive Limit Switch
24	Homing on Origin Switch (Positive Direction, Negative Edge)
28	Homing on Origin Switch (Negative Direction, Positive Edge)
33	Homing Index Pulse (Negative Direction)
34	Homing Index Pulse (Positive Direction)
35	Set the current position origin
36	reserved
37	Set the current position origin and reset current position
-3	Homing on Negative Limit touch
-4	Homing on Positive Limit touch
-5	Homing on Negative Limit touch and Index Pulse
-6	Homing on Positive Limit touch and Index Pulse

Table 6.23: Origin Search Method

Please refer to origin search method for detail operation, direction and velocity of each Homing Method.

6.5.26 Object 6099h: Homing speeds

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
6099h	0	Number of entries	U8	RD	No	No		2
	1	Speed during search for switch	U32	RW	Yes	Rx PDO	1 ~ 2500000	5000
	2	Speed during search for zero	U32	RW	Yes	Rx PDO	1 ~ 500000	1000

This object sets values of velocity under Homing Mode.

Speed during search for switch (index 01h) is the velocity is used for correspondent Switch. Please set appropriate velocity to sense correspondent Switch.

Speed during search for zero (index 02h) is the velocity is used for searching sensor origin after searching correspondent Switch.

6.5.27 Object 609Ah: Homing acceleration

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
609Ah	0	Homing acceleration	U32	RW	Yes	Rx PDO	1000 ~ 1000000000	100000

This object sets Acc/Dec velocity under Homing Mode.

Unit is speed of increasing per second [pulse/s²].

6.5.28 Object 60B8h: Touch probe function

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
60B8h	0	Touch probe function	U16	RW	No	Rx PDO		0

This object sets and controls Touch Probe 1/2 operation.

Bit	Value	Description
0	0	Turn off Touch probe 1 function.
	1	Turn on Touch probe 1 function.
1	0	Sense 1st signal only.
	1	Sense signal continuously.
2 ~ 3	0	Sense origin signal.
	1	Sense Z-Phase signal.
	2	Sense signal set at 60D0h.
	3	reserved
4	1	Sense rising edge of 1 signal.
5	1	Sense falling edge of 1 signal.
6 ~ 7	0	reserved
8	0	Turn off Touch probe 2 function.
	1	Turn on Touch probe 2 function.
9	0	Sense 1st signal only.
	1	Sense signal continuously.
10 ~ 11	0	Sense origin signal.
	1	Sense Z-Phase signal.
	2	Sense signal set at 60D0h.
	3	reserved
12	1	Sense rising edge of 1 signal.
13	1	Sense falling edge of 1 signal.
14 ~ 15	0	reserved

6.5.29 Object 60B9h: Touch probe status

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
60B9h	0	Touch probe status	U16	RO	No	Tx PDO		

This object indicates status of Touch Probe 1/2.

Bit	Value	Description
0	0	Halt status of Touch probe 1 function.
	1	Touch probe 1 function already turn on.
1	0	Rising edge of set signal has not sensed.
	1	Rising edge of set signal has sensed.
2	0	Falling edge of set signal has not sensed.
	1	Falling edge of set signal has sensed.
3 ~ 5	0	reserved
6 ~ 7	0 ~ 3	Indicates frequency of Touch probe 1 acknowledgement.
8	0	Halt status of Touch probe 2 function.
	1	Touch probe 2 function already turn on.
9	0	Rising edge of set signal has not sensed.
	1	Rising edge of set signal has sensed.
10	0	Falling edge of set signal has not sensed.
	1	Falling edge of set signal has sensed.
11 ~ 13	0	reserved
14 ~ 15	0 ~ 3	Indicates frequency of Touch probe 2 acknowledgement.

Table 6.24: Definition of Touch probe status

6.5.30 Object 60BAh: Touch probe 1 positive value

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
60BAh	0	Touch probe 1 positive value	I32	RO	No	Tx PDO		

This object indicates encoder position value sensed by Touch Probe 1 at rising edge.

6.5.31 Object 60BBh: Touch probe 1 negative value

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
60BBh	0	Touch probe 1 negative value	I32	RO	No	Tx PDO		

This object indicates encoder position value sensed by Touch Probe 1 at falling edge.

6.5.32 Object 60BCh: Touch probe 2 positive value

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
60BCh	0	Touch probe 2 positive value	I32	RO	No	Tx PDO		

This object indicates encoder position value sensed by Touch Probe 2 at rising edge.

6.5.33 Object 60BDh: Touch probe 2 negative value

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
60BDh	0	Touch probe 2 negative value	I32	RO	No	Tx PDO		

This object indicates encoder position value sensed by Touch Probe 2 at falling edge.

6.5.34 Object 60C2h: Interpolation time period

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
60C2h	0	Number of entries	U8	RO	No	No		2
	1	Interpolation time period value	U8	RW	Yes	No	0 ~ 65535	2
	2	Interpolation time index	I8	RW	Yes	No	-4 ~ 1	-3

This object indicates and sets cycle time using at synchronous control mode (for example : Cyclic synchronous Position Mode)

$$\text{cycle time} = \text{Interpolation time period value} \times 10^{\text{Interpolation time index}} [\text{sec}]$$

Information

If uses DC mode for method of synchronization, cycle time ignores set value as above and automatically uses Sync0 cycle time.



6.5.35 Object 60D0h: Touch probe source

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
60D0h	0	Number of entries	U8	RO	No	No		2
	1	Touch probe 1 source	U16	RW	No	No		1
	2	Touch probe 2 source	U16	RW	No	No		1

If the value of Bit 2 ~ 3, 10 ~ 11 for Touch probe function (60B8h) as 2, uses input signal already set at this Object.

Value	Input Source
1	Origin Sensor
2	User Input 1
3	User Input 2
5	Z-Phase

Table 6.25: Touch probe 1 source

Value	Input Source
1	Origin Sensor
2	User Input 3
3	User Input 4
5	Z-Phase

Table 6.26: Touch probe 2 source

6.5.36 Object 60D5h: Touch probe 1 positive edge counter

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
60D5h	0	Touch probe 1 positive edge counter	U16	RO	No	Tx PDO		

This object indicates frequency for acknowledgement of Touch Probe 1 rising edge.

6.5.37 Object 60D6h: Touch probe 1 negative edge counter

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
60D6h	0	Touch probe 1 negative edge counter	U16	RO	No	Tx PDO		

This object indicates frequency for acknowledgement of Touch Probe 1 falling edge.

6.5.38 Object 60D7h: Touch probe 2 positive edge counter

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
60D7h	0	Touch probe 2 positive edge counter	U16	RO	No	Tx PDO		

This object indicates frequency for acknowledgement of Touch Probe 2 rising edge.

6.5.39 Object 60D8h: Touch probe 2 negative edge counter

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
60D8h	0	Touch probe 2 negative edge counter	U16	RO	No	Tx PDO		

This object indicates frequency for acknowledgement of Touch Probe 2 falling edge.

6.5.40 Object 60E3h: Supported homing methods

Index	Sub index	Name	Type	Access	Constant Value
60E3h	0	Number of entries	U8	RO	30
	1	1st supported homing method	I16	RO	1
	2	2nd supported homing method	I16	RO	2
	3	3rd supported homing method	I16	RO	7
	4	4th supported homing method	I16	RO	10
	5	5th supported homing method	I16	RO	11
	6	6th supported homing method	I16	RO	14
	7	7th supported homing method	I16	RO	17
	8	8th supported homing method	I16	RO	18
	9	9th supported homing method	I16	RO	24
	10	10th supported homing method	I16	RO	25
	11	11th supported homing method	I16	RO	28
	12	12th supported homing method	I16	RO	29
	13	13th supported homing method	I16	RO	33
	14	14th supported homing method	I16	RO	34
	15	15th supported homing method	I16	RO	35
	16	16th supported homing method	I16	RO	36
	17	17th supported homing method	I16	RO	37
	18	18th supported homing method	I16	RO	-3
	19	19th supported homing method	I16	RO	-4
	20	20th supported homing method	I16	RO	-5
	21	21st supported homing method	I16	RO	-6
	22	22nd supported homing method	I16	RO	0
		.			
	30	30th supported homing method	I16	RO	0

This object indicates lists of origin search methods supported by controller.

Information

Value of each index for Supported homing methods can be differentially indicates by product model or version.



6.5.41 Object 60F4h: Following error actual value

Index	Sub index	Name	Type	Access	SAVE	PD0 Mapping	Value Range	Default Value
60F4h	0	Following error actual value	I32	RO	No	Tx PDO		

This Object indicates value of position deviation.

Value of position deviation = Position Demand Value (6062h) - Position Actual Value (6064h)

If the value of position deviation goes far from Following Error Window (6065h) during certain timing, Following Error will be generated.

6.5.42 Object 60FDh: Digital inputs

Index	Sub index	Name	Type	Access	SAVE	PD0 Mapping	Value Range	Default Value
60FDh	0	Digital inputs	U32	RO	No	Tx PDO		

This Object indicates status of input signals.

Bit	Name
0	Negative Limit Switch
1	Positive Limit Switch
2	Origin Switch
3 ~ 15	Reserved
16	User Input 1
17	User Input 2
18	User Input 3
19	User Input 4
20	User Input 5
21	User Input 6
22	User Input 7

Table 6.27: Definition of Digital Input

Value	Definition
0	Input goes OFF.
1	Input goes ON.

Table 6.28: Definition of Input Value

6.5.43 Object 60FEh: Digital outputs

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
60FEh	0	Number of entries	U8	RO	No	No		2
	1	Physical outputs	U32	RW	No	Rx PDO		0000 0000h
	2	Bit mask	U32	RW	No	No		003F 0000h

Able to control User output through this Object and Brake.

Bit	Name
0	Set Brake
1 ~ 15	Reserved
16	User Output 1
17	User Output 2
18	User Output 3
19	User Output 4
20	User Output 5
21	User Output 6
22 ~ 31	Reserved

Table 6.29: Definition of Physical outputs and Bit mask

6.5.43.1 Set Brake

Bit 0: Set Brake controls Brake output signal. Able to manually control Brake as set the value of Bit mask as 1.

Value	Bit mask	Physical outputs
0		Brake Release (ON)
1	Brake Manual Control	Brake Engage (OFF)

Table 6.30: Set Brake

Information

Under Operation enabled status, Brake always released (ON). Even set Bit mask as 1 and Physical output as 1, set values are ignored and Brake released.



6.5.43.2 User Outputs

Bit 16 ~ 21: Controls User outputs output signal. The value of Output is 'Bit mask' AND 'Physical output'.

Value	Bit mask	Physical outputs
0	Non-use output	Output OFF
1	Use output	Output ON

Table 6.31: User Outputs

6.5.44 Object 6502h: Supported drive modes

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
6502h	0	Supported drive modes	U32	R0	No	No		

This Object indicates Operation modes currently supported.

Bit	Description
0	Profile Position Mode
1	Velocity Mode
2	Profile Velocity Mode
3	Torque Profile Mode
4	Reserved
5	Homing Mode
6	Interpolated Position Mode
7	Cyclic Sync Position Mode
8	Cyclic Sync Velocity Mode
9	Cyclic Sync Torque Mode
10 ~ 31	Reserved

Table 6.32: Supported Drive Modes

Current controller supports Profile Position Mode and Homing Mode.

6.6 Manufacture specific Object

6.6.1 Object 2001h: Sensors logics

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2001h	0	Sensors logics	U8	RW	Yes	No		00h

This Object sets Logic of specific input signals.

Bit	Name
0	Origin sensor active logic
1	Limit sensor active logic

Table 6.33: Sensor Logics

Value	Definition
0	Low active
1	High active

Table 6.34: Definition of Logic Value

6.6.2 Object 2002h: Reverse limit direction

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2002h	0	Reverse limit direction	U8	RW	Yes	No	0 ~ 1	0

This Object can set direction of Hardware Limit Sensor.

It sets 1, IN/OUT connection of LIMIT+ and LIMIT- inputs will be exchanged.

Information

Please use for exchanging of LIMIT+ and LIMIT- input from IN/OUT connection when it is unable to change current wiring due to incorrect wiring of Limit+ and Limit- input signal,



6.6.3 Object 2003h: Limit stop method

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2003h	0	Limit stop method	U8	RW	Yes	No	0 ~ 2	0

This Object sets the method of stop once Hardware Limit Sensor goes ON.

Value	Definition
0	Quick Stop
1	Decelerated Stop
2	Ignore (Does not stop)

Table 6.35: Stop Method

Declaration ratio during decelerated stop follows Deceleration of correspondent operation mode.

Information

Applicable only in Profile Position Mode and Homing Mode.



6.6.4 Object 2005h: Encoder resolution

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2005h	0	Encoder resolution	U32	RO	No	No		

This Object indicates Resolution of Encoder currently installed.

Information

Number of pulse to rotate 1 motor revolution follows the value of Reference resolution (200Ch).



6.6.5 Object 2006h: Start speed

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2006h	0	Start speed	U16	RW	Yes	No	1 ~ 50000	1

This Object sets initial velocity of motor[pps].

6.6.6 Object 2007h: Run current

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2007h	0	Run current	U8	RW	Yes	No	5 ~ 15	10

This Object sets Run Current of Motor. Unit is % and proportional to the value of rated current of motor.

$$\text{Run Current} = \text{Value} \times 10 [\%]$$

Information

This object can NOT be set while it's 'Operation Enabled' state. Please set after 'Operation Disable'. Please refer to [4.1 Drive Status Control](#).



6.6.7 Object 2008h: Boost current

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2008h	0	Boost current	U8	RW	Yes	No	0 ~ 7	0

This Object sets Boost Current of Motor. Boost Current can be added up to basic Run Current during acceleration operation.

$$\text{Boost Current} = \text{Value} \times 50 [\%]$$

Information

This object can NOT be set while it's 'Operation Enabled' state. Please set after 'Operation Disable'. Please refer to [4.1 Drive Status Control](#).



6.6.8 Object 2009h: Stop current

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2009h	0	Stop current	U8	RW	Yes	No	2 ~ 10	5

This Object sets Stop Current of Motor. Unit is % and proportional to the value of Run Current.

$$\text{Stop Current} = \text{Value} \times 10 [\%]$$

Information

This object can NOT be set while it's 'Operation Enabled' state. Please set after 'Operation Disable'. Please refer to [4.1 Drive Status Control](#).



6.6.9 Object 200Ah: Motor number

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
200Ah	0	Motor number	U16	RO	No	No		

This Object indicates number of motor currently set.

6.6.10 Object 200Ch: Reference resolution

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
200Ch	0	Reference resolution	U32	RW	Yes	No	500 ~ 20000	10000

This Object sets required number of Pulse to rotate 1 revolution of motor.

Information

Recommend to set same or lower value of Encoder resolution (2005h). In case of setting higher value than Encoder resolution, certain value of Following error can be generated.



Information

This object can NOT be set while it's 'Operation Enabled' state. Please set after 'Operation Disable'. Please refer to [4.1 Drive Status Control](#).



6.6.11 Object 200Dh: Position control gain

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
200Dh	0	Position control gain	U8	RW	Yes	No	0 ~ 63	3

This Object sets Position Control Gain.

Information

This object can NOT be set while it's 'Operation Enabled' state. Please set after 'Operation Disable'. Please refer to [4.1 Drive Status Control](#).



6.6.12 Object 200Eh: In-position mode

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
200Eh	0	In-position mode	U8	RW	Yes	No	0 ~ 1	0

This Object sets operation mode of In-position.

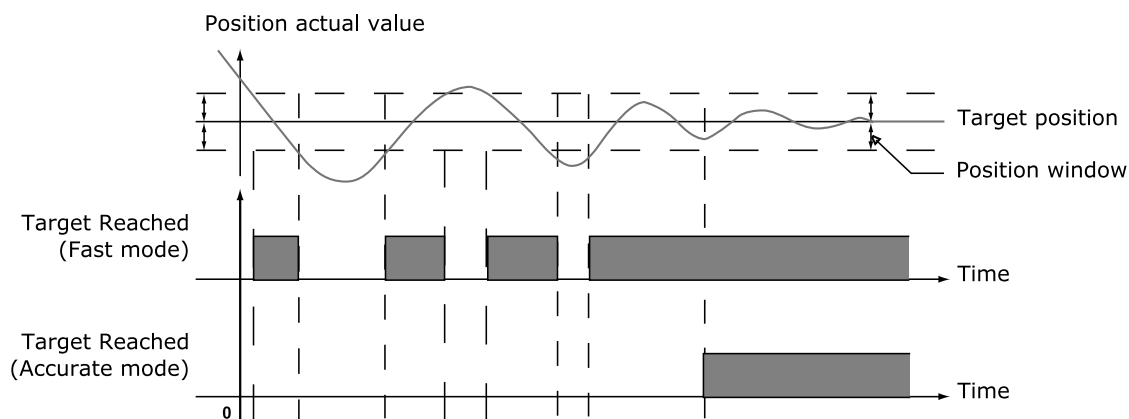


Figure 6.2: Target reached status changes according to In-position Mode

Information

This object can NOT be set while it's 'Operation Enabled' state. Please set after 'Operation Disable'. Please refer to [4.1 Drive Status Control](#).



6.6.13 Object 200Fh: Encoder filter time

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
200Fh	0	Encoder filter time	U8	RW	Yes	No	0 ~ 3	0

This object can set the Filter to the Encoder input that is input to the controller.

Value	Definition
0	Default value
1	Apply 500 ns Filter
2	Apply 1000 ns Filter
3	Apply 2000 ns Filter

Table 6.36: Encoder Filter Time

Information

This object can NOT be set while it's 'Operation Enabled' state. Please set after 'Operation Disable'. Please refer to [4.1 Drive Status Control](#).

**6.6.14 Object 2010h: Brake delay**

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2010h	0	Brake delay	U16	RW	Yes	No	0 ~ 1000	200

This Object sets timing up to Brake release after Enable commands.

Information

Ezi-SERVOII EtherCAT 86 model does not support Brake delay Object.

**6.6.15 Object 2011h: Digital input levels**

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2011h	0	Digital input levels	U16	RW	Yes	No		0000h

This Object sets Level of Digital inputs of User input.

Bit	Description
0	Set Level of User Input 1.
1	Set Level of User Input 2.
2	Set Level of User Input 3.
3	Set Level of User Input 4.
4	Set Level of User Input 5.
5	Set Level of User Input 6.
6	Set Level of User Input 7.
7 ~ 15	reserved

6.6.16 Object 2012h: Digital output levels

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2012h	0	Digital output levels	U16	RW	Yes	No		0000h

This Object sets Level of Digital outputs of User output.

Bit	Description
0	Set Level of User Output 1.
1	Set Level of User Output 2.
2	Set Level of User Output 3.
3	Set Level of User Output 4.
4	Set Level of User Output 5.
5	Set Level of User Output 6.
6 ~ 15	reserved

6.6.17 Object 2014h: Homing Torque Ratio

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2014h	0	Homing Torque Ratio	U8	RW	Yes	No	20 ~ 90	50

This Object is used in -3, -4, -5, -6 of Object 6098h: Homing method during the origin search operation, and set the standard load value to determine the Load sensing point. The unit is % , and proportional to Run current value of the motor .

Homing method	
-3	Homing on Negative Limit touch
-4	Homing on Positive Limit touch
-5	Homing on Negative Limit touch and Index Pulse
-6	Homing on Positive Limit touch and Index Pulse

Table 6.37: List of Homing methods which uses Homing Torque Ratio

6.6.18 Object 2018h: Internal Current Monitor

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2018h	0	Internal Current Monitor	U16	RO	No	Tx PDO		0

This Object displays the Torque value in the Drive. The unit of the value is mA.

6.6.19 Object 2020h: Error code history setting

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2020h	0	Number of entries	U8	RO	No	No		3
	1	Function	U32	RO	No	No		0
	2	Interval for same Error Code	U32	RW	Yes	No	0 ~ 3600000	0
	3	Interval for last Error Code	U32	RW	Yes	No	0 ~ 3600000	0

This object can delete the record of Error code history or adjust the recording time.

6.6.19.1 Function

The Function can delete the record of Error code history. If you enter '0x00726C63' value in the Function, all the history in the list is initialized.

6.6.19.2 Interval for same Error Code

If the same kind of Error code occurs again within the set time, the corresponding Error code is not recorded. The unit of setting value is ms.

If the value is set to 0, all occurrences of Error code are recorded without any restrictions.

6.6.19.3 Interval for last Error Code

If an error occurs again within the set time, the corresponding Error code is not recorded. The unit of setting value is ms.

If the value is set to 0, all occurrences of Error code are recorded without any restrictions.

6.6.20 Object 2021h: Error code history

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2021h	0	Number of entries	U8	RO	No	No		30
	1	Latest error code	U16	RO	No	No		0
	2	2nd latest error code	U16	RO	No	No		0
	3	3rd latest error code	U16	RO	No	No		0
	4	4th latest error code	U16	RO	No	No		0
		.						
	30	30th latest error code	U16	RO	No	No		0

Displays the most recent Error code list. The maximum number of Error code that can be stored is 30. The list of Error code stored in Error code history will not be erased even if the controller is powered off. Please refer to the function of Error code history setting to initialize the list of Error code history.

6.6.21 Object 2030h: Advanced settings

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2030h	0	Number of entries	U8	RO	No	No		1
	1	Automatic recovery from communication error	U8	RW	Yes	No	0 ~ 1	0

6.6.21.1 Automatic Recovery from Communication Error

This object can set 'EtherCAT communication error (0x7500)' to be clear when EtherCAT communication status is activated again. If the value is set to 1, the 'EtherCAT communication error (0x7500)' is automatically cleared when the EtherCAT state machine state changes from SAFE-OP to OP.

6.6.22 Object 2031h: Encoder count error

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2031h	0	Number of entries	U8	RO	No	No		3
	1	Enable encoder count error	U8	RW	Yes	No	0 ~ 1	1
	2	Acceptable encoder count limit value	U32	RW	Yes	No	0 ~ 2147483647	1
	3	Encoder count error time out	U16	RW	Yes	No	500 ~ 10000	1000

This object can adjust an 'Encoder Count Error'.

6.6.22.1 Enable Encoder Count Error

This object can enable or disable the 'Encoder Count Error'.

6.6.22.2 Acceptable Encoder Count Limit Value

This object can set the maximum allowable position error value to judge 'Encoder Count Error'.

6.6.22.3 Encoder Count Error Time Out

This object can set the test time to judge 'Encoder Count error'.

Changelog

Date	Revision	Changes
2015-06-09	Rev.01.03	Document updated.
2015-07-22	Rev.01.04	Update Object 1011h: Restore default parameters. Add 'Info' boxes in '6.6 Manufacture specific Object'.
2015-08-03	Rev.01.05	Document updated
2015-12-28	Rev.01.06	Correct homing method -4 and -5 description error in '4.6.4 Homing Method List'
2016-02-05	Rev.01.07	Add Object 2014h: Homing Torque Ratio.
2016-04-21	Rev.01.08	Add Ezi-SERVOII EtherCAT 86 model. Update Object 60E3h: Supported homing methods. Update Object 2001h: Sensors logics.
2016-11-23	Rev.01.09	Update '4.8.4 ORIGIN and LIMIT Input'. Update 'Ezi-SERVO2 EtherCAT 86' part in '2.2 System Configuration'. Update cables and connectors of Ezi-SERVOII EtherCAT 86 model.
2016-12-21	Rev.01.10	Deleted 'Input voltage error' from '4.2 Error Code'.
2017-02-13	Rev.01.11	Add 'Distributed Clock' in the '1.3 EtherCAT specification'.
2017-04-03	Rev.01.12	Fix temperature value of 'Over temperature error' in '4.2 Error Code'. Add Object 2016h: Internal Torque Monitor.
2017-06-15	Rev.01.14	Add Object 2018h: Internal Current Monitor. Update 'Figure 4.2: CSP Mode Objects', 'Figure 4.3: Profile Position Mode'. Update Object 6064h: Position actual value. Update 'Table 4.12: Profile Position Mode of Control Word'. Update 'Table 4.24: Homing Method List'. Update 'Table 4.5: Error code Lists'. Update object table in Object 60E3h: Supported homing methods.
2017-06-26	Rev.15	Add 'Changelog'.
2017-09-26	Rev.16	Update Object 605Dh: Halt option code. Update Object 2003h: Limit stop method. Update Object 607Dh: Software position limit. Update the EtherCAT minimum cycle time to 250us. Update the PDO Mapping information of Homing Mode related objects.
2018-04-13	Rev.17	Update the Data Type of Object 60D0h: Touch probe source. Add Object 200Fh: Encoder filter time. Add Object 2020h: Error code history setting. Add Object 2021h: Error code history. Add Object 2031h: Encoder count error. Add new error code: E-070. Fixed typo.
2018-06-19	Rev.18	Add new model: Ezi-SERVOII EtherCAT 4X. Delete '3.2.3 Module'. Update Object 2018h: Internal Current Monitor.
2018-08-07	Rev.19	Update Object 606Ch: Velocity actual value. Add Object 606Bh: Velocity demand value.
2018-11-22	Rev.20	Update Object 6065h: Following error window, Object 6067h: Position window. Update 'Error Code Lists'. Add Voltage Limit of Back-EMF. Add Object 2004h: External Encoder.
2019-02-25	Rev.21	Add Object 2030h: Advanced settings

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