

# UNIMOTION

Manual

Closed Loop Stepping System Manual

STDF EC EtherCAT





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**Warning**

If the user does not properly handle the product, the user may get seriously or slightly injured and damage may occur to the machine.

**Danger**

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

**Information**

Necessary information and/or extra attention required for operation.

Precaution is advised when operating and handling the equipment. Serious consequences may occur, depending on the situation.

## Check the product

### **Warning**

Check the product for damaged or missing components. If this is the case, the machine may get damaged or the user may get injured.

## Installation

### **Warning**

Handle with caution, damage to the product or injury to the handler may occur if dropped. Use non-flammable materials (such as metal) where the product is to be installed, to reduce any fire hazards.

When installing several units of STDF EC drives in a sealed place, install a cooling fan to keep the ambient temperature below 50 °C. Fire or other kinds of heat-related accidents may occur due to overheating.

### **Danger**

The process of installation, connection, operation, checking and repairing should be done by a qualified person.

## Connecting cables

### **Warning**

Keep within the rated input voltage of the drive. If exceeded, fire or other kinds of accidents may occur.

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

### **Danger**

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

The case of STDF EC drive is insulated from the ground of the internal circuit with a condenser so please ground the product, otherwise, an electric shock or 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 continue the operation without removing the root of the cause, the machine may get damaged or the user injured.

Switch all input signals to OFF before supplying the input voltage to the drive. Fail to do so and the motor will keep running causing damage to the machine or injury to the user.

All parameter values of the STDF EC drive 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

Stop the power supply to the main circuit and wait for a while before checking or repairing the STDF EC drive. Electricity remaining in the capacitor may cause electric shock. Do not change cabling while the power is supplied, otherwise, the user may get injured or the product may get damaged.

Do not take apart the product. Electric shock may occur. After-sales service does not apply to any product that has been taken apart.

## 1 PRODUCT SPECIFICATION

### 1.1 Model naming

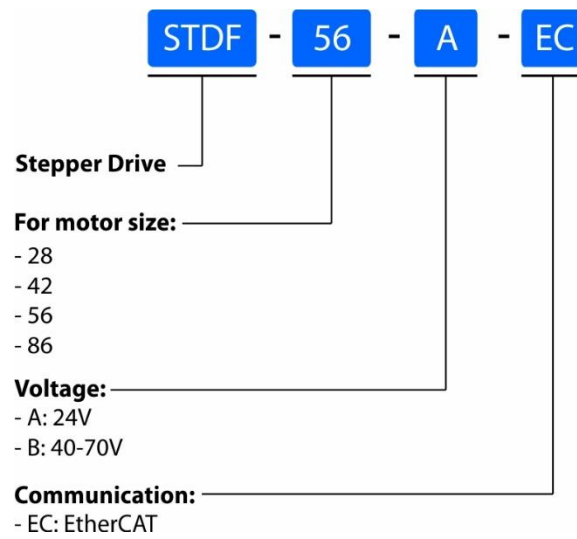


Figure 1-1: Model naming.

### 1.2 Product dimension

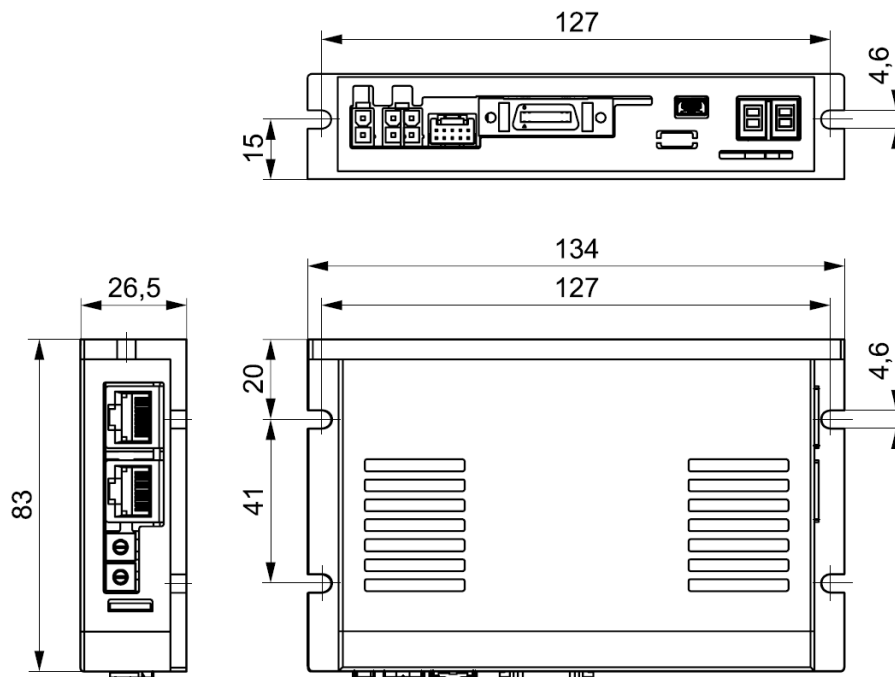


Figure 1-2: Dimensions of the STDF A EC drive.

### 1.3 EtherCAT specifications

*Table 1-1: Communication specifications.*

<b>Communication type</b>	EtherCAT
<b>Physical layer</b>	RJ45 (shielded) ECAT IN: EtherCAT Input ECAT OUT: EtherCAT Output
<b>ECAT device ID</b>	Set configured station alias by ECAT ID switch: 0 ~ 99 Set physical address at master: 1 ~ 65535
<b>Topology</b>	Line (structured by products only) Tree, star (when using a switch hub)
<b>Support protocol</b>	CoE (CANopen application protocol over EtherCAT) FoE (File access over EtherCAT)
<b>Control profile</b>	CiA 402 drive profile (IEC618007)
<b>Supported operation mode</b>	Cyclic synchronous position mode Profile position mode Homing mode
<b>Distributed clock</b>	Free run, SM event, DC SYNC event (minimum cycle time: 250 $\mu$ s)
<b>Processing data</b>	Configurable PDO mapping

## 1.4 Drive specification

Table 1-2: Drive specifications.

<b>Model</b>		STDF A EC
<b>Input voltage</b>		24 VDC $\pm$ 10 %
<b>Control method</b>		Closed loop control with 32 bit MCU
<b>Current consumption</b>		Max. 500 mA (except motor current)
<b>Operating conditions</b>	<b>Ambient temperature</b>	In use: 0 ~ 50 °C In storage: 20 ~ 70 °C
	<b>Humidity</b>	In use: 35 ~ 85 % RH (non-condensing) In storage: 10 ~ 90 % RH (non-condensing)
	<b>Vib. Resist.</b>	0.5 G
<b>Function</b>	<b>Rotation speed</b>	0 ~ 3000 rpm
	<b>Resolution [ppr]</b>	500 ~ 100000 (selectable by parameter)
	<b>Protection functions</b>	Over Current Error, Over Speed Error, Position Tracking Error, Over Load Error, Over Temperature Error, Over Regenerated Voltage Error, Motor Connect Error, Encoder Connect Error, In-Position Error, ROM Error, Position Overflow Error
	<b>LED Display</b>	Power status, In-Position status, Servo-On status, Alarm status
<b>I/O Signal</b>	<b>Input signals</b>	3 dedicated input (LIMIT+, LIMIT-, ORIGIN) 7 user inputs (Photocoupler Input)
	<b>Output signals</b>	Brake 6 user outputs (Photocoupler Output)

## 2 INSTALLATION

### 2.1 Precautions of installation

1. This product is designed for indoor usage with an ambient temperature of 0 ~ 55 °C.
2. If the temperature of the case reaches 50 °C, ventilate the outside of the case to cool down.
3. Do not install this product in direct sunlight, near magnetic or radioactive objects.
4. If more than 2 drives are installed next to each other, maintain at least 50 mm of vertical and 20 mm of horizontal distance between two drives.

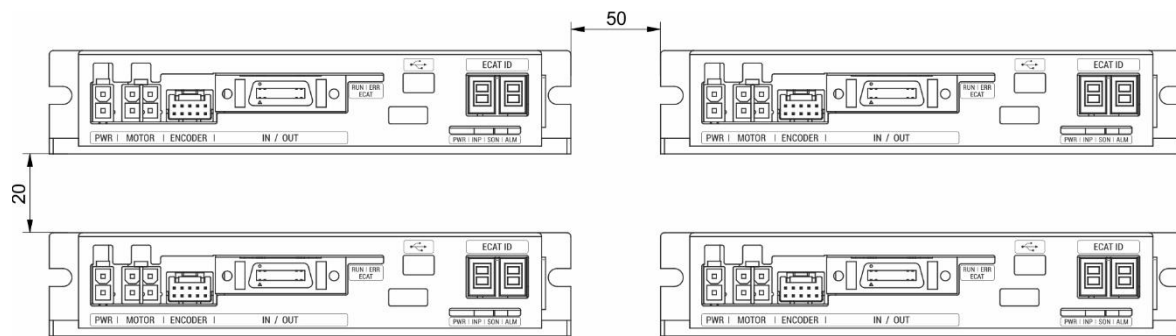


Figure 2-1: Vertical/parallel mounting of the drives.

## 2.2 System configuration (only for motor sizes 42 and 56)

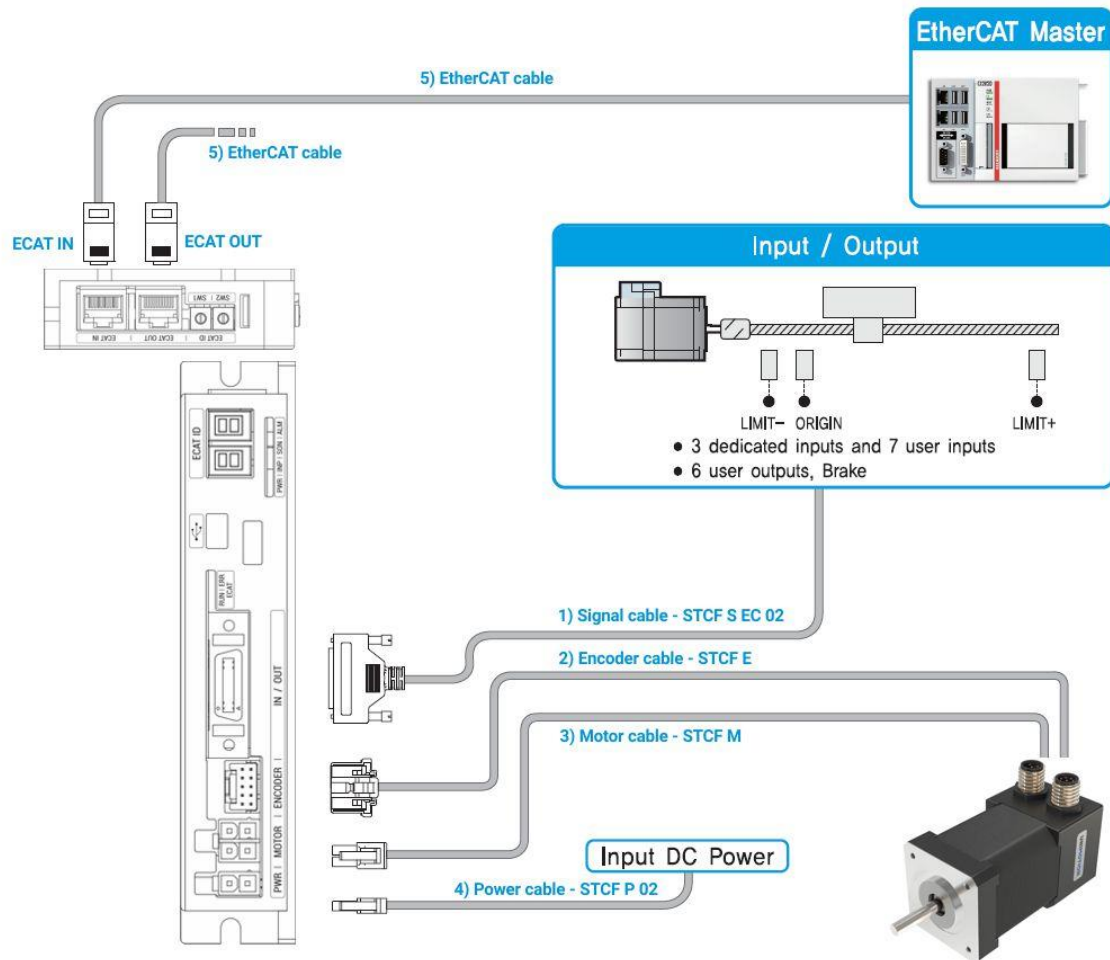
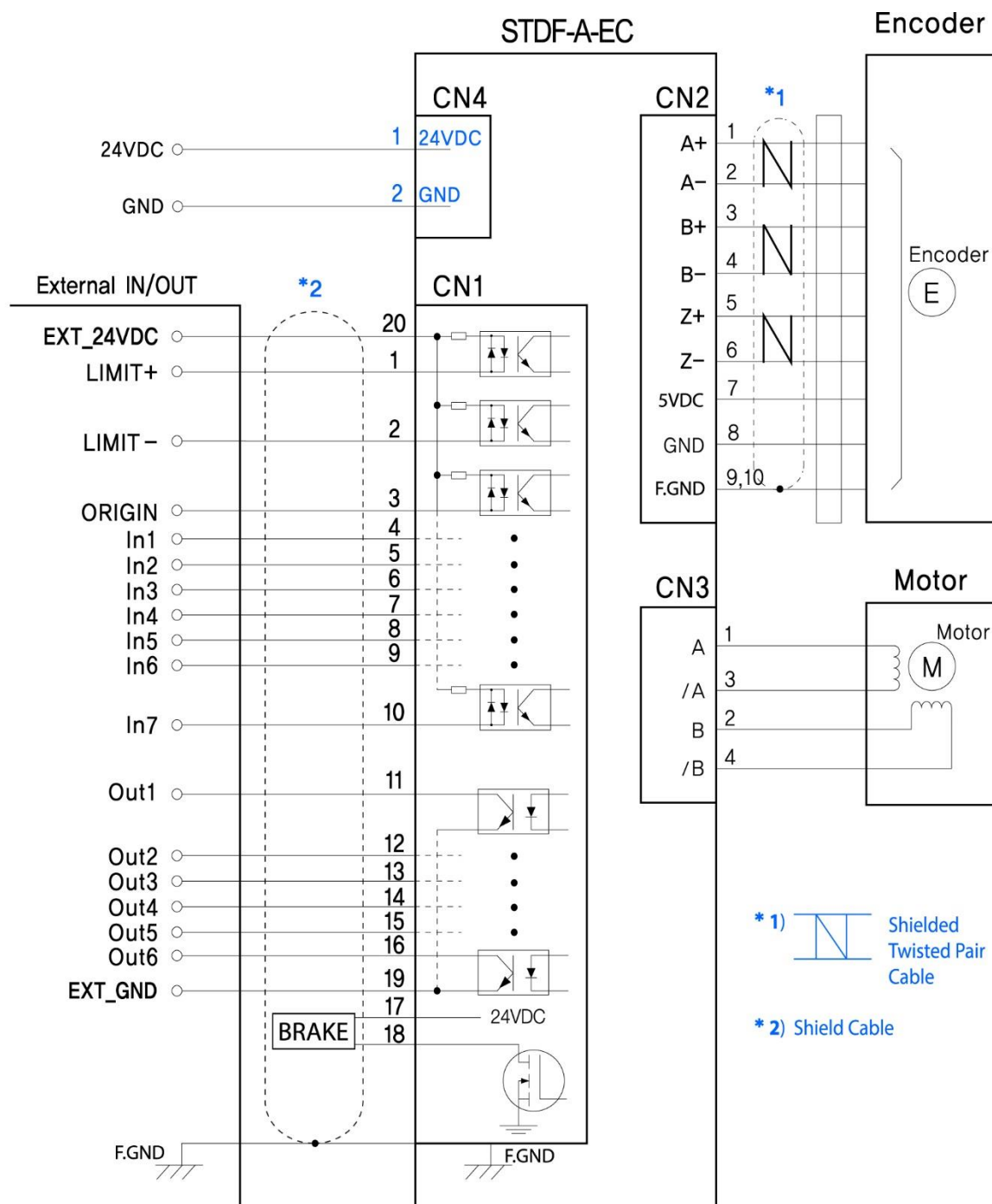


Figure 2-2: System configuration diagram of the STDF EC. \*

## 2.3 External wiring diagram



※ When connecting the I/O cables between the controller and drive, please turn off the power of both controller and drive to protect the drive from any damage.

Figure 2-3: External wiring diagram of the STDF A EC drive.

## 2.4 Appearance and part name

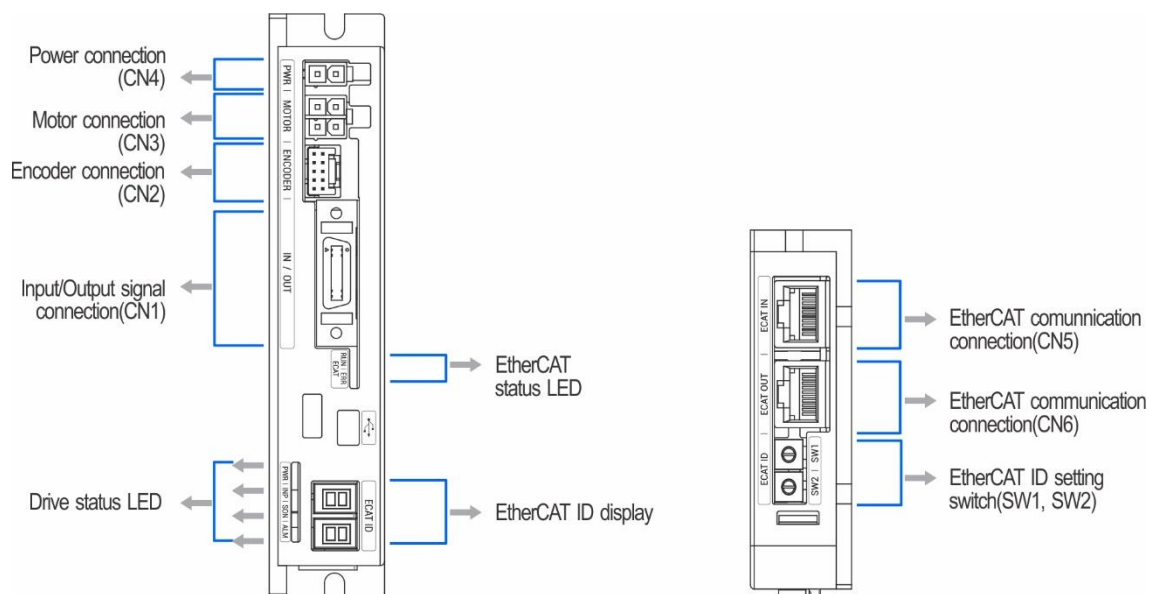


Figure 2-4: Appearance of the STDF A EC drive.

### 2.4.1 EtherCAT ID

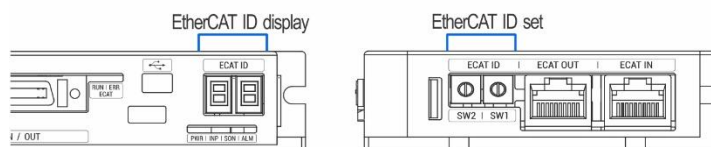


Figure 2-5: EtherCAT ID.

#### 2.4.1.1 ID Setting

Change EtherCAT ID (configured alias ID) value by the rotary switch setting. The right switch indicates tens and the left switch indicates units.

The setting range is 0 ~ 99.

#### Information

ID value (configured alias ID) set by the rotary switch applies when the power of the controller turns on.

## 2.4.1.2 ID Indication

The 7-segment display indicates physical address or EtherCAT ID (EtherCAT configured alias) value. Conditions for value indication as below.

- When the rotary switch is set to all '0', 7-segment indicates EtherCAT physical address value. Physical address assigned due to no connection between controller and master, it indicates 0. Once master assigns a physical address to each controller, it indicates relevant value.
- If the rotary switch is set to other than '0', 7-segment indicates the relevant set value (EtherCAT configured alias).
- If 7-segment of ID blinks, it indicates that the ID value is not applied yet. It can be applied once power turns on again.

## 2.4.1.3 Error value indication

If an error is generated from the controller (Fault status), 7-segment indicates Error value instead of EtherCAT ID value.

The error value is 'E000' type then 2 digits will be indicated at 7-segment at a time, see example below.

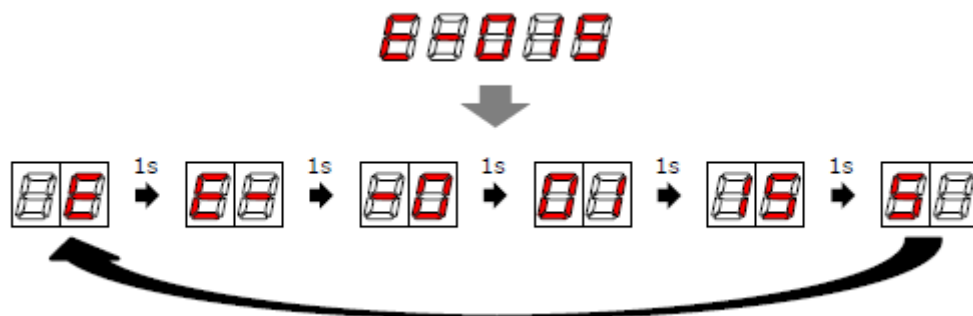


Figure 2-6: Error value indication (ex: E015).

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

## 2.4.2 EtherCAT status LED

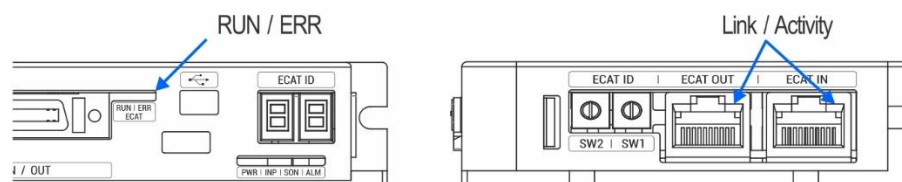


Figure 2-7: EtherCAT status LED.

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

Table 2-1: EtherCAT status LED.

Indication	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
ERR	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 the physical layer
		ON	Link established in the physical layer
		Flickering	In operation after establishing the link

#### 2.4.2.1 Type of status indication

Visual EtherCAT LED status indication is shown in the picture below.

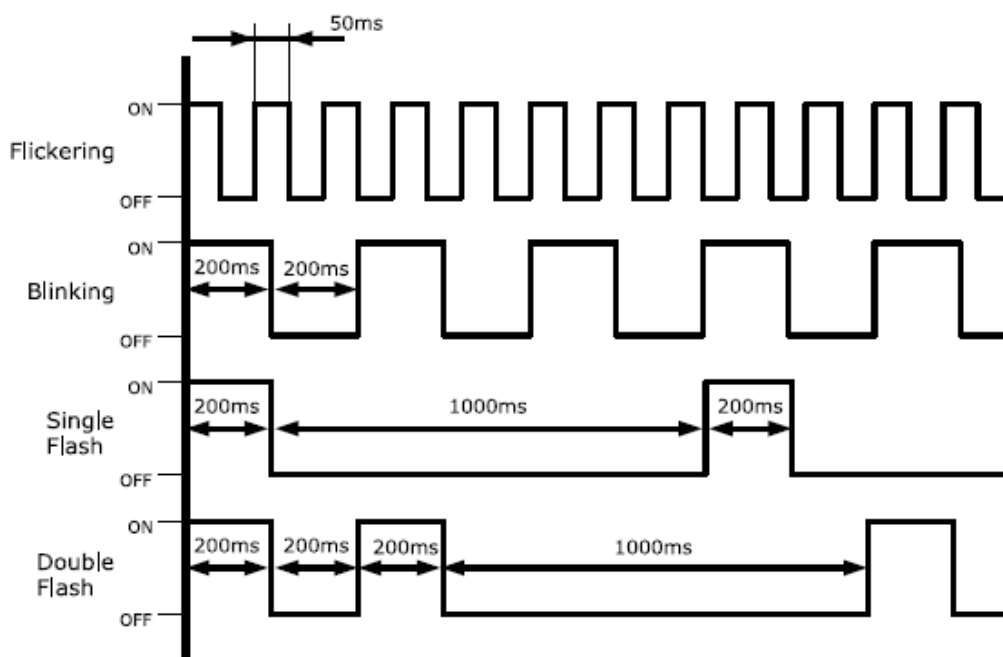


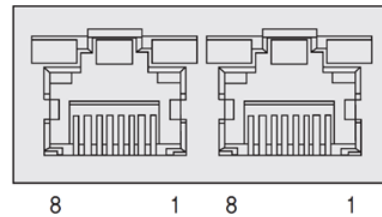
Figure 2-8: EtherCAT LED.

## 2.4.3 EtherCAT communication connection (CN5, CN6)

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

Table 2-2: EtherCAT connector.

No.	Function
1	TD+
2	RD-
3	RD+
4	-
5	-
6	RD-
7	-
8	-
Connection hood	F. GND



### 2.4.3.1 EtherCAT communication cable

Recommended communication cable should be:

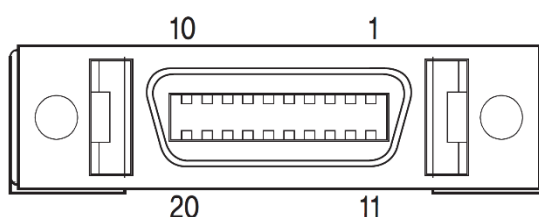
- CAT5e or above
- Shield type: SF/FTP, S/FTP, SF/UTP
- Length: Max. 50 m (Distance between the nodes)

#### 2.4.4 I/O Connector (CN1)

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

Table 2-3: I/O Connector.

No.	Function	I/O
1	LIMIT+	Input
2	LIMIT-	Input
3	ORIGIN	Input
4	Digital In1	Input
5	Digital In2	Input
6	Digital In3	Input
7	Digital In4	Input
8	Digital In5	Input
9	Digital In6	Input
10	Digital In7	Input
11	Digital Out1	Output
12	Digital Out2	Output
13	Digital Out3	Output
14	Digital Out4	Output
15	Digital Out5	Output
16	Digital Out6	Output
17	BRAKE +	Output
18	BRAKE -	Output
19	EXT GND	Input
20	EXT 24VDC	Input



##### 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 the origin of the mechanisms.

##### 2.4.4.2 Brake and Output signal

Brake function prevents motor rotation under Servo OFF Status by BRAKE+/BRAKE- pin of I/O Connector (2.4.4 I/O Connector). BRAKE+ is +24 V externally supplied to operate brake circuit and BRAKE- is the output signal for actual motor control. Control signal automatically generates according to Servo ON/OFF status and alarm generation.

## 2.4.4.3 Input signal

Please individually prepare power for input circuit as DC 24 V  $\pm$  10 % (current consumption is around 5 mA/Circuit)

## 2.4.4.4 Output signal

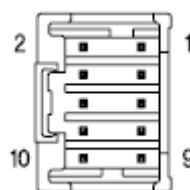
Please individually prepare Power Supply for Output circuit. It is possible to share with power supply for input circuit and in this case, please add capacity of power supply for output into capacity of power supply for input. Supply voltage and capacity of power for control output connection as below.

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

## 2.4.5 Encoder connector (CN2)

Table 2-4: Encoder connector.

No.	Function	I/O
1	A+	Input
2	A-	Input
3	B+	Input
4	B-	Input
5	Z+	Input
6	Z-	Input
7	5 VDC	Output
8	GND	Output
9	F.GND	-
10	F.GND	-



Encoder Connector (Type of Connector: Molex 559591030)

## 2.4.6 Motor connector (CN3)

Table 2-5: Motor connector.

No.	Function	I/O
1	A Phase	Output
2	B Phase	Output
3	/A Phase	Output
4	/B Phase	Output



Type of Connector: Molex 556904A2

#### 2.4.7 Power connector (CN4)

---

*Table 2-6: Power connector.*

No.	Function	I/O
1	24 VDC	Input
2	GND	Input



Type of Connector: Molex 556902A2

## 3 ETHERCAT COMMUNICATION

### 3.1 CAN application protocol over EtherCAT

STDF EC is an EtherCAT communication embedded type of controller to support CAN application protocol over EtherCAT (CoE). EtherCAT slave structure is as below.

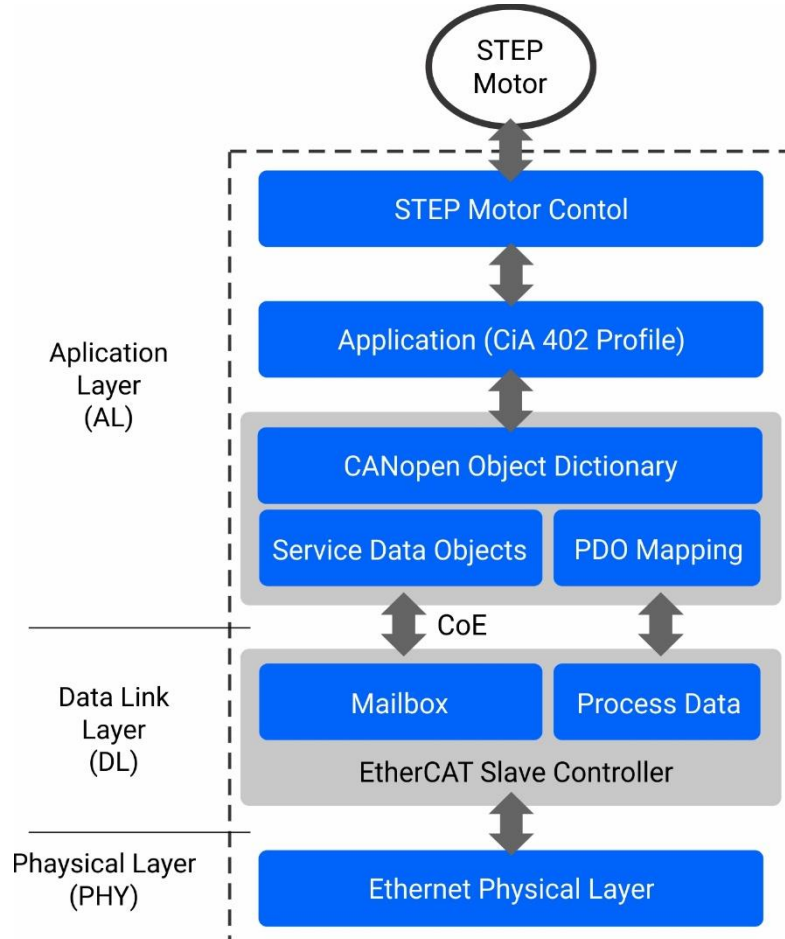


Figure 3-1: EtherCAT Structure.

#### 3.1.1 Object dictionary

Object dictionary is a dictionary of objects of the product.

#### 3.1.2 Mailbox communication

Master and Slave commands receive service data object (SDO) at mailbox communication (SDO communication). This communication method is the way of message transfer and the master delivers commanded slave responses. SDO communication is used for setting or confirmation of objects in the object dictionary. This communication can be used under the pre-operation, safe-operation, and operation status of the 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 the master. This communication can be used under the operational status of the controller and Tx PDO is only available for Safe-Operation status.

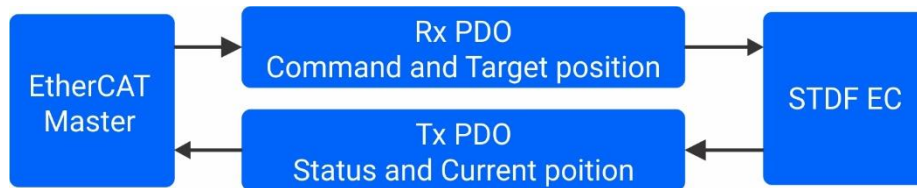


Figure 3-2: EtherCAT PDO Communication.

## 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.

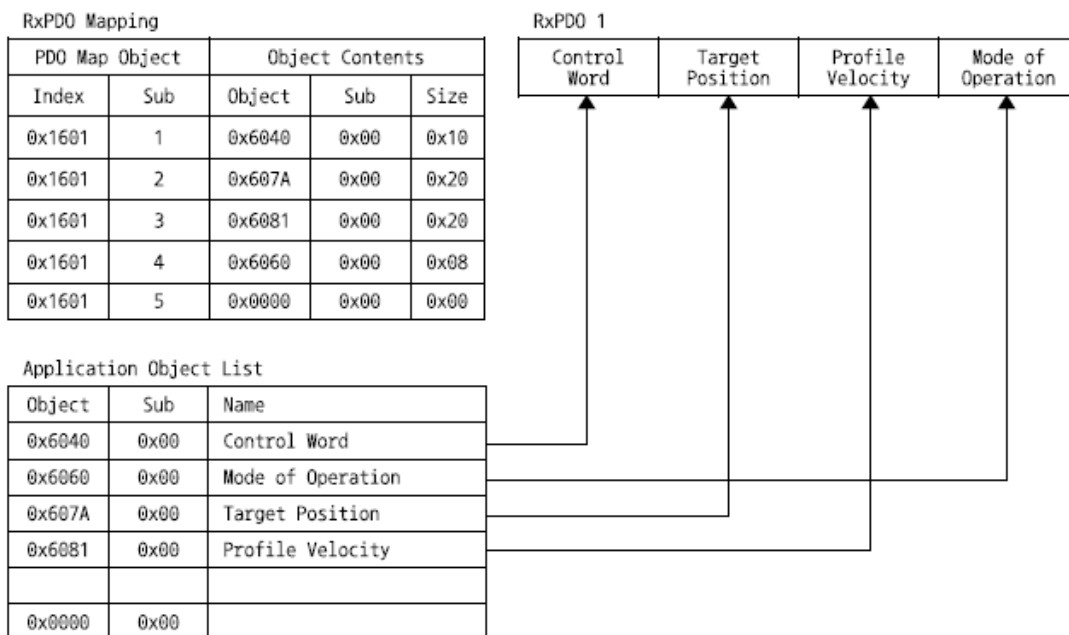


Figure 3-3: PDO Mapping.

## 3.2.2 PDO Assign

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

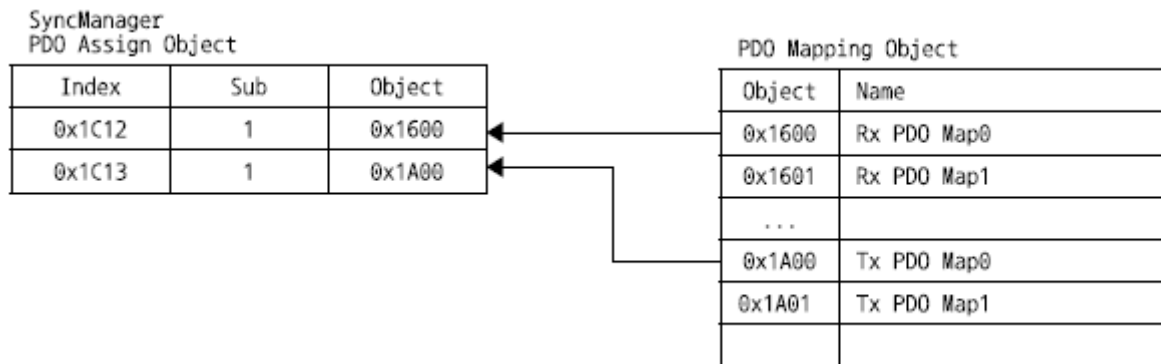


Figure 3-4: PDO Assign.

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

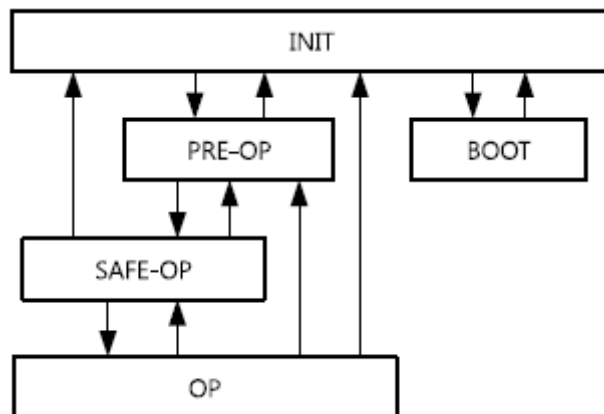


Figure 3-5: EtherCAT State Machine.

EtherCAT controller of status motion is controlled by EtherCAT Master.

Table 3-1: EtherCAT Operational state.

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.

### 3.4 Synchronization

Synchronization modes provided from controller are as below.

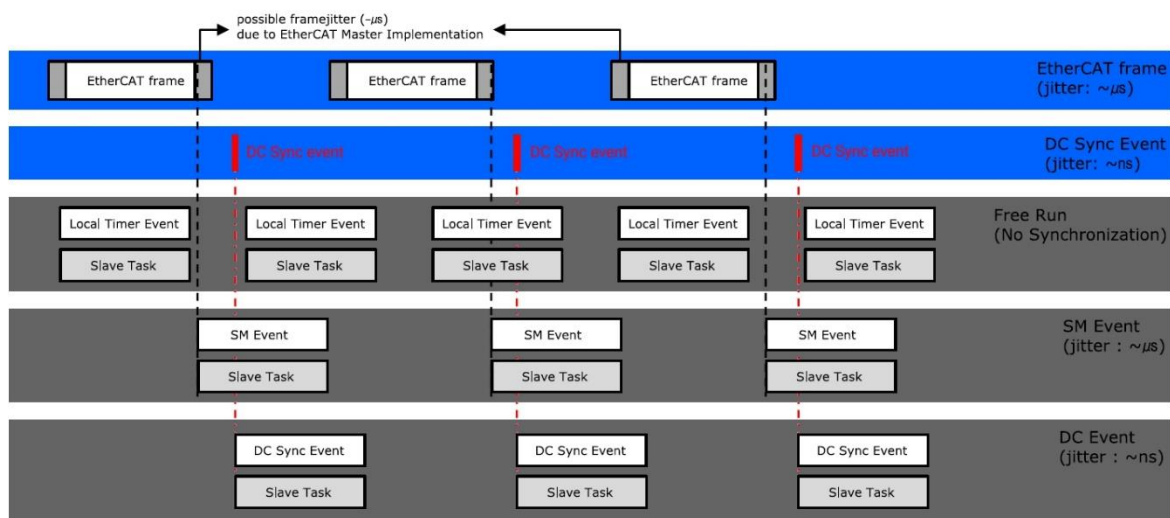


Figure 3-6: Type of EtherCAT Synchronization and differences.

## 3.4.1 Free Run

---

The controller runs under non-synchronization with Master. Under Free Run mode, Master and Controller have an individual independent cycle.

## 3.4.2 SM Event

---

The controller runs under synchronization with SM event of EtherCAT communication. SM event is generated once the controller receives EtherCAT frame.

Once synchronization by SM event, each one of the controllers has a little bit of jitter.

## 3.4.3 DC Sync Event

---

The synchronized controller runs under sync Interrupt which is generated according to distributed Clock (following DC).

DC is synchronized time shared between Master and Slave. With a synchronized clock, interrupt is generated under accurate synchronization and the controller executes commands under accurate timing. In this case, each controller has a little bit of jitter.

## 3.5 EtherCAT Slave Information

---

EtherCAT slave Information file (XML File) is needed to connect the controller with EtherCAT master. This file is described slave device information as XML format based on EtherCAT specifications. Recording the XML file into EtherCAT master equipment through EtherCAT setting equipment, easily implement PDO and SDO setting to a Slave device.

<b>Information</b>
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The XML file can be downloaded from the product website.
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## 4 CIA 402 DRIVE PROFILE

### 4.1 Drive Status Control

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

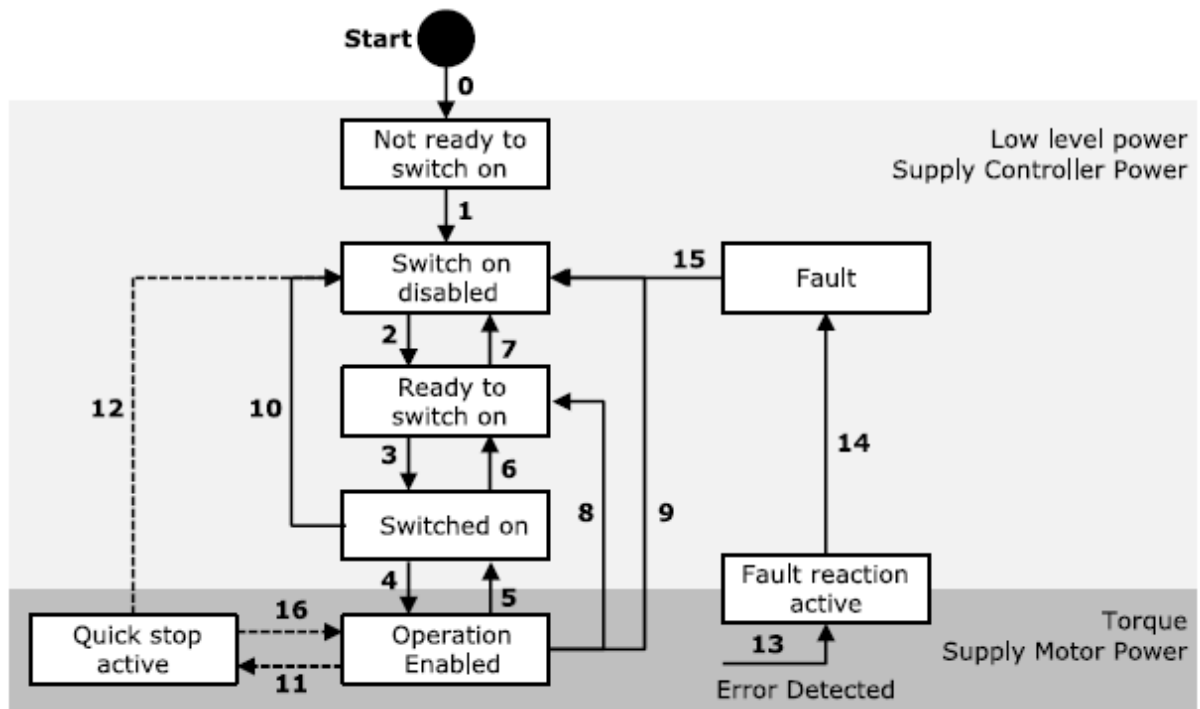


Figure 4-1: Drive State Machine.

Status movement and meaning of each status is as follows.

Table 4-1: State transition.

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	Automatic transition <sup>1</sup> or 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.

<sup>1</sup>This transition is configurable. Please refer to Object 2030h: Advanced settings Sub-Index 2 – Disable Automatic transition 2.

Each status of functions supported by the controller as follows.

Table 4-2: Function per Status.

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

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

Table 4-3: Set Control word for status movement.

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

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.

Table 4-4: Current status following by Status word.

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

## 4.2 Error Code

Once an Error generates, the Controller (Sense Fault signal), changes to Fault reaction active status.

Under 'Fault'/'Fault reaction active' status, types of error can be checked by Error code (603Fh).

Table 4-5: Error codes.

Error code Hex/Dec	External indication <sup>1</sup>	Status	Description
0x7500/29952	E-500	EtherCAT Communication Error	An error occurred in EtherCAT Communication.
0xFF01/65281	E-001	Over Current Error	The current through power devices in inverter exceeds 4.8 A.
0xFF02/65282	E-002	Over Speed Error	Motor speed exceed 3000 rpm.
0xFF03/65283	E-003	Position Tracking Error	Position error value is higher than set value. <sup>2</sup> Following error window (6065h).
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. <sup>3</sup>
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.
0xFF0A/65290	E-010	In-position Error	After operation is finished, position error (over 1) generated more than 3 seconds.
0xFF0C/65292	E-012	ROM Error	Error occurs in parameter storage device (ROM).
0xFF0F/65295	E-015	Position Overflow Error	Position error value is higher than given value after completion of position movement command. <sup>4</sup>
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.
0xFF41/65345	E-065	Torque enable Failure	In-position signal is unstable or not detected during Torque Enable.
0xFF43/65347	E-067	Homing Failure	In-position signal is unstable or not detected during the homing process.
0xFF46/65350	E-070	Encoder Count Error	Encoder input signal is abnormal and normal measurement is impossible.
0xFF47/65351	E-071	Network Initialization Error	An error occurred while initializing the hardware of EtherCAT communication.
0xFF4B/65355	E-075	Abnormal Safety Input State <sup>5</sup>	Abnormal connection of Safety Inputs.
0xFF64/65380	E-100	ROM Initialization Error	ROM is blank status.
0xFF65/65381	E-101	ROM Initialization Error	Check sum of ROM is not matched.
0xFF66/65382	E-102	FRAM Access Error	Error generated during FRAM accessing.
0xFF6E/65390	E-110	ROM Reading Error	Error generated during ROM reading.
0xFF79/65401	E-121	ROM Writing Error	Error generated during ROM writing.
0xFF7A/65402	E-122	ROM Writing Error	Error generated during ROM writing.
0xFF7B/65403	E-123	ROM Writing Error	Error generated during ROM writing.
0xFF7C/65404	E-124	ROM Writing Error	Error generated during ROM writing.
0xFFC8/65480	E-200	ROM Data Out of Range Error	Some parameter values stored in ROM are out of range.

<sup>1</sup> Products 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.

<sup>2</sup> The given value can be changed. Please refer to the Following error window (6065h).

<sup>3</sup> Voltage limit of Back-EMF depends on the motor model. Please refer to [4.5 Voltage Limit of Back-EMF](#).

<sup>4</sup> The given value can be changed. Please refer to the Following error window (6065h).

<sup>5</sup> The 'Abnormal Safety Input State' alarm can be clear by recycling the power of the controller. It cannot clear by 'Fault Reset' command of Control word.

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

*Table 4-6: Voltage Limit of Back-EMF.*

Motor Model	42L	56L
STDF EC	70 V	70 V

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### 4.3 Mode of operation

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Currently activated Mode of operation display (6061h) decides the action of the 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 the Mode of operation display (6061h).

Operation modes supported by the current controller are as follows.

*Table 4-7: Supported operation modes.*

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

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### 4.4 Cyclic synchronous position mode

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#### 4.4.1 Definition

---

Cyclic Synchronous Position mode (CSP Mode) assigns target position to the 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 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

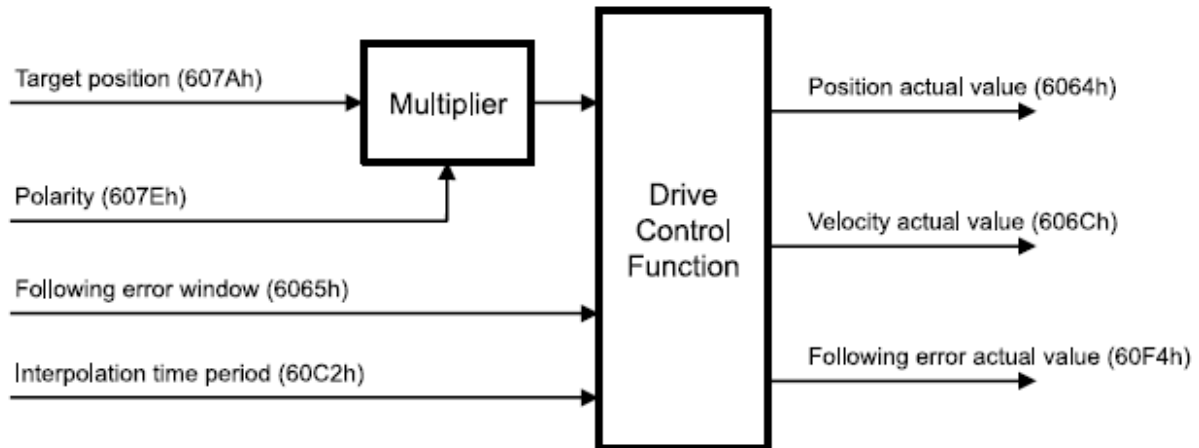


Figure 4-2: CSP Mode Objects.

#### 4.4.3 Control word and Status word

Control word under CSP Mode are as follows.

Table 4-8: Control word of CSP Mode.

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

Please refer to [4.1 Drive Status Control for the rest of bits](#).

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

Table 4-9: Status word of CSP Mode.

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	Whether target position moved

13	Following Error	Following Error
14	Reserved	
15	Safety Activated	

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

*Table 4-10: Status word of Bit 12.*

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

*Table 4-11: Status word of Bit 13.*

Bit	Value	Description
13	1	Following Error generated.

*Table 4-12: Status word of Bit 15.*

Bit	Value	Description
15	1	Safety Function was activated and motor is disabled.

---

## 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

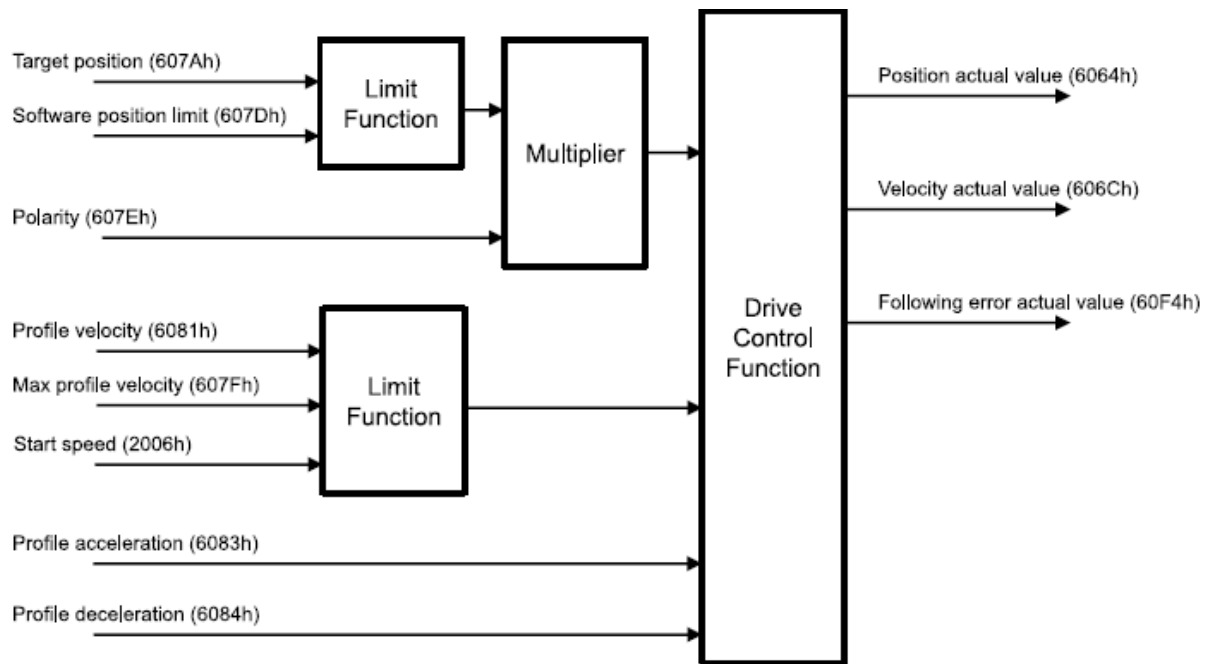


Figure 4-3: Profile position mode.

## 4.5.3 Control word and Status word

Control word under position control mode are as follows.

Table 4-13: Profile position mode of control word.

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	
7	Fault Reset	Stop command
8	Halt	
9 ~ 11	Reserved	Push Mode Set Non-stop Push
12	Push Mode	
13	Non-stop Push	
14 ~ 15	Reserved	

Please refer to [4.1 Drive Status Control for the rest of bits](#).

Table 4-14: Control word of Bit 4, 5.

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

Table 4-15: Control word of Bit 6.

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

Table 4-16: Control word of Bit 8.

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

Table 4-17: Control word of Bit 12, 13.

Bit 12	Bit 13	Description
1	0	Push Motion is executed when the Position movement command is executed. Motor stops and it finished the Push Motion when a force is detected.

1	10	Push Motion is executed when the Position movement command is executed. Motor stops when a force is detected. Motor push again if the force has disappeared. The Push Motion is finished when the stop command is given.
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Status word (6041h) under position control mode is as follows.

Table 4-18: Profile position mode of status word.

Bit	Name	Description
0	Ready to switch on	In Push Mode state
1	Switched on	
2	Operation enabled	
3	Fault	
4	Voltage enabled	
5	Quick stop	
6	Switch on disabled	
7	Warning	
8	Push State	
9	Remote	
10	Target Reached	
11	Internal Limit Active	
12	Set-point Acknowledge	
13	Following Error	
14	Push Detected	
15	Safety Activated	

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

Table 4-19: Status word of Bit 10.

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

Table 4-20: Status word of Bit 12.

Bit	Value	Description
12	0	Control Word of New Set-Point(Bit 4) has reset and the 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 4-21: Status word of Bit 13.

Bit	Value	Description
13	1	Following Error generated.

Table 4-22: Status word of Bit 15.

Bit	Value	Description
15	1	Safety Function was activated and the motor is disabled.

Table 4-23: Status word of Bit 8.

Bit	Value	Description
8	1	Push Motion is activated.

Table 4-24: Status word of Bit 14.

Bit	Value	Description
14	1	A force detected.

## 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).

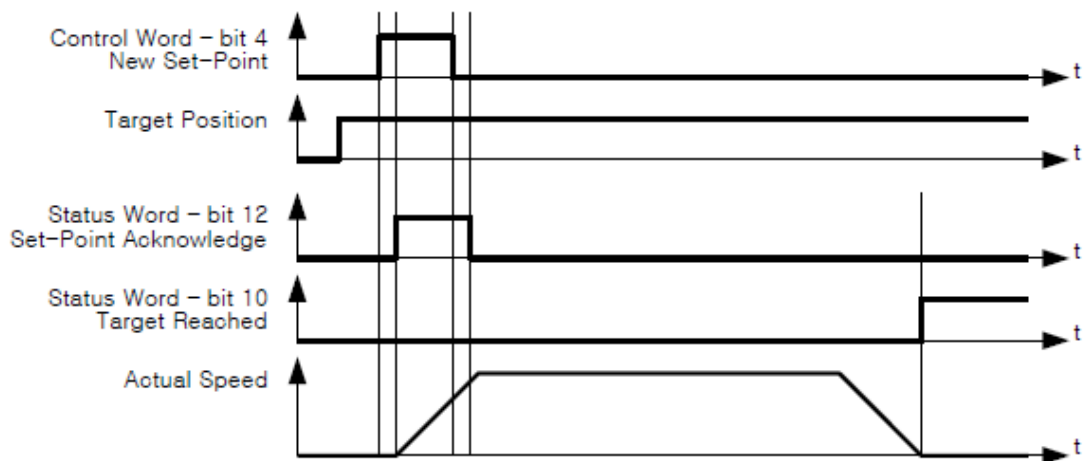


Figure 4-4: New Set-Point.

Once the target position is reached, Status word of Target Reached (Bit 10) goes to SET. If it does not reach the target position due to error or status as below, Target Reached (Bit 10) cannot 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.

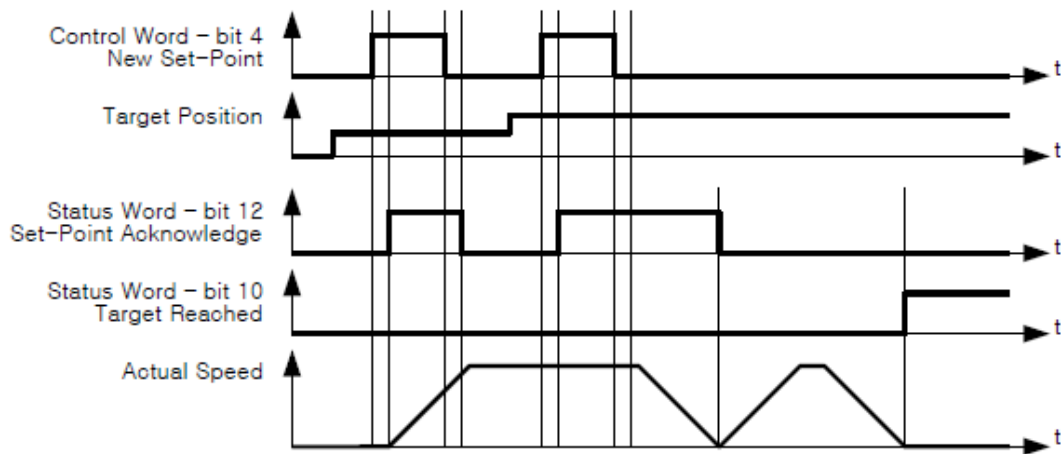


Figure 4-5: Next Set-Point.

At this time, the 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 the previous position movement command. Target Reached (Bit 10) goes to SET once all of the position movements are 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 a new target position.

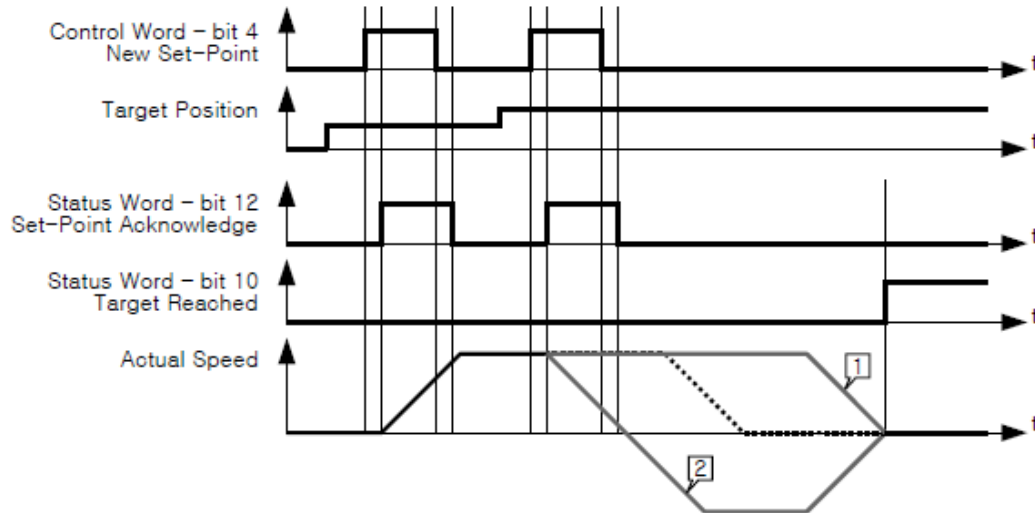


Figure 4-6: Change set immediately.

1. If the new target position is sufficiently ahead of the previous target position, it will move to a new target position passing by the previous target position.
2. If the new target position is behind of previous target position, it will decelerate according to the correspondent position and if needed, it can stop and move in the opposite direction.

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

## 4.5.4.4 Push Motion (Stop Mode)

The Push Motion (Stop Mode) of STDF EC moves the motor to the Target Position while maintaining the specified torque, and stops and finishes Push Motion when work is detected. The motor torque during the Push Motion can be set through the Push ratio of Object 201Ah: Push Mode. Pull back distance of Object 201Ah: Push Mode allows to set the distance to pull back the motor when the Push Motion is finished.

To do Push Motion (Stop Mode) to the new Target Position, Set Push Mode (Bit 12) and Reset Non-stop Push (Bit 13) before changing New Set-Point (Bit 4) of Control word from RESET to SET. Once the controller receives this request, Set-Point Acknowledge (Bit 12) and Push State (Bit 8) of Status word become SET and the Push Motion is executed. Target position refers to the Target position (607Ah) and the Position value can be absolute coordinates or relative coordinates by Control word of Relative (Bit 6).

In the Push Motion (Stop Mode), the Push Motion is finished when work is detected or the target position is reached.

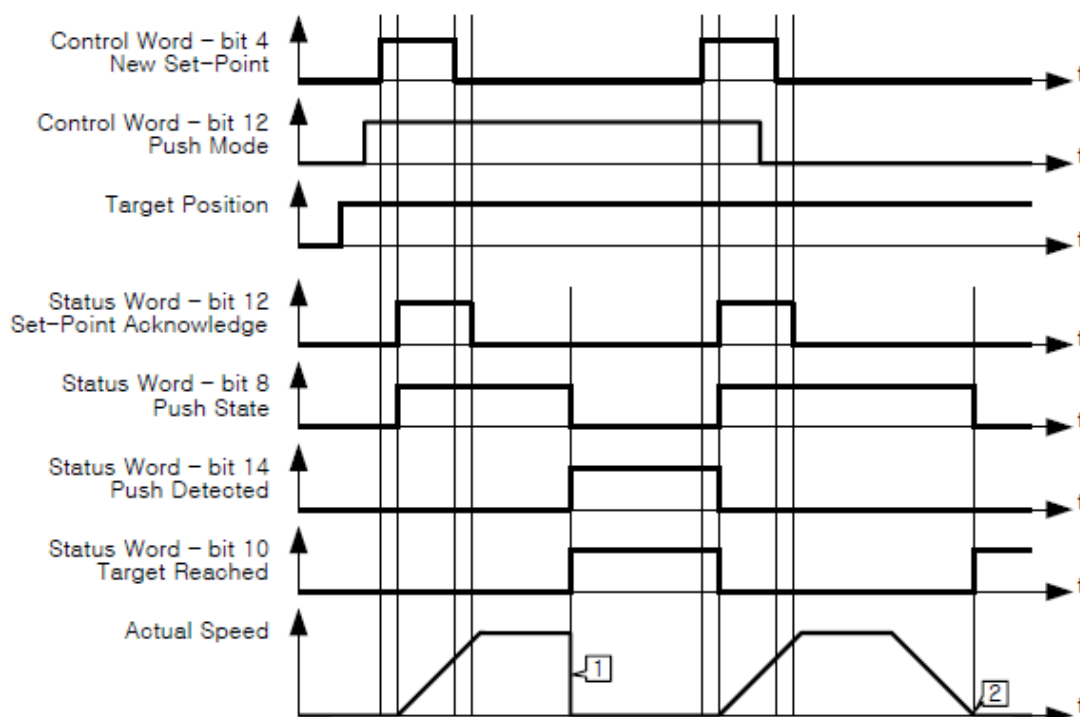


Figure 4-7: Push Motion (Stop Mode).

1. A work was detected before reaching the target position. The detection status can be judged by Push Detected (Bit 14) of Status word. Controller does quick-stop when work is detected.
2. The target position has been reached without detecting a work.

#### Information

If the motor speed is fast or the value of the Push ratio is low, it may be determined that work is detected even if a work is not detected actually. In this case, lower the motor speed or increase the Push ratio.

#### Information

The 'Input next target position' and 'Target position override' commands are not allowed during the Push Motion.

#### 4.5.4.5 Push Motion (Non-stop Mode)

The Push Motion (Stop Mode) of STDF EC moves the motor to the Target Position while maintaining the specified torque. Stops motor when work is detected, but it moves again when work is gone. It continues the Push Motion until a stop command is received. The motor torque during the Push Motion can be set through the Push ratio of Object 201Ah: Push Mode. Pull back distance of Object 201Ah: Push Mode allows to set the distance to pull back the motor when the Push Motion is finished.

Push (Bit 13) before change New Set-Point (Bit 4) of the Control word from RESET to SET. Once the controller receives this request, Set-Point Acknowledge (Bit 12) and Push State (Bit

8) of Status word become SET and the Push Motion is executed. Target position refers to the Target position (607Ah) and Position value can be absolute coordinates or relative coordinates by Control word of Relative (Bit 6). In the Push Motion (Non-stop Mode), the Push Motion is not finished even if a work is detected or the target position is reached. the Push Motion is finished when Halt (Bit 8) of Control word becomes SET.

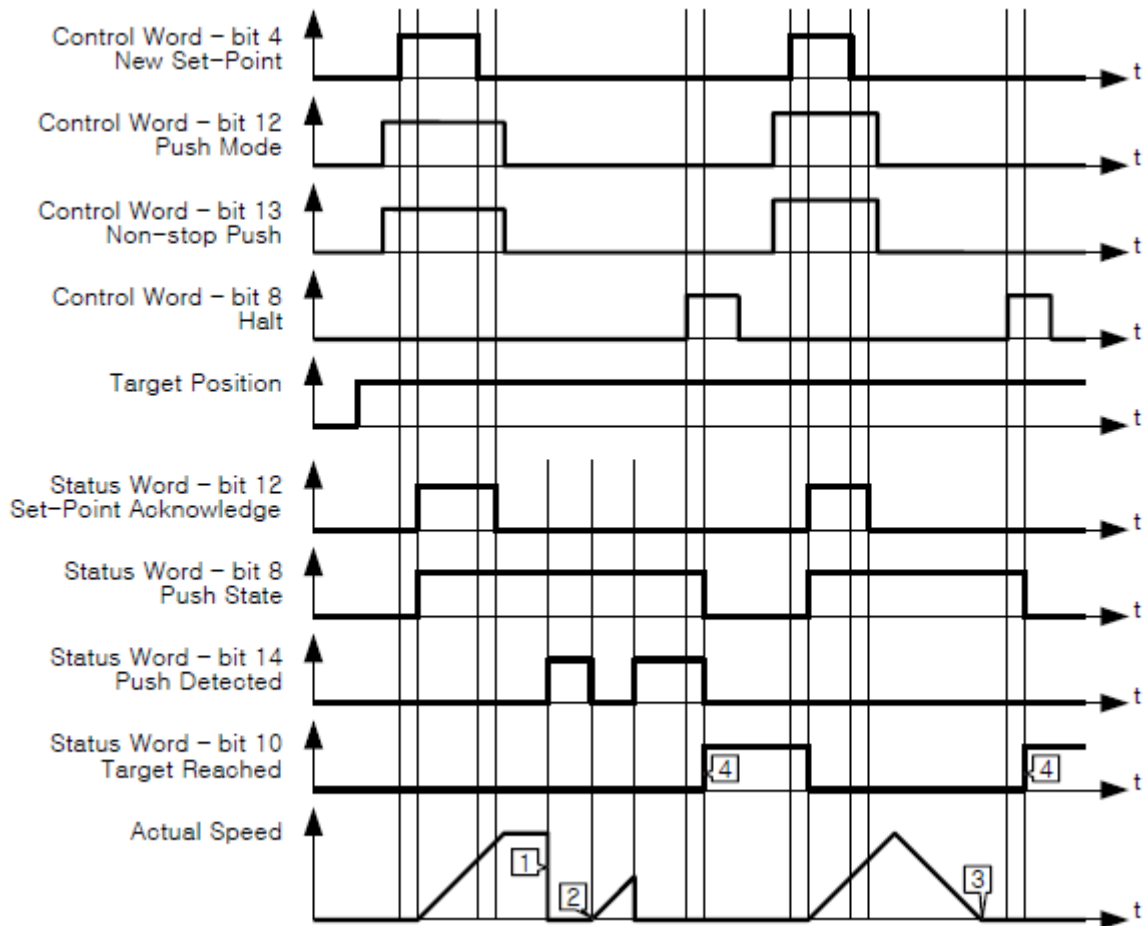


Figure 4-8: Push Motion (Non-stop Mode).

1. A work was detected. The detection status can be judged by Push Detected (Bit 14) of the Status word.
2. It continues the Push Motion when work disappears.
3. The target position is reached. But the Push Motion is not finished.
4. When Halt (Bit 8) of Control word becomes SET, the motor stops, and the Push Motion is finished. the Target Reached (Bit 10) of Status word becomes SET after finished the Push Motion.

**Information**

If the motor speed is fast or the value of Push ratio is low, it may be determined that a work is detected even if a work is not detected actually. In this case, lower the motor speed or increase the Push ratio.

**Information**

The 'Input next target position' and 'Target position override' commands are not allowed during the Push Motion.

## 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

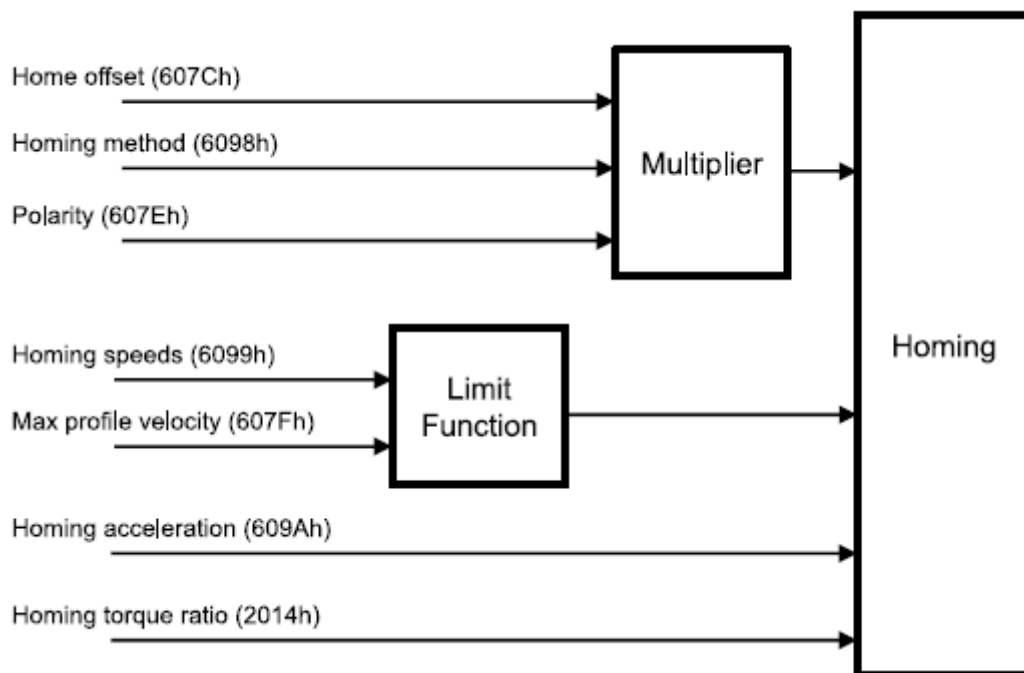


Figure 4-9: Homing mode objects.

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 the opposite direction, if the opposite side of Limit Switch goes ON, origin search goes failure. If Sensor origin and mechanical origin are different, able to set with using Home

Offset (607Ch). Once the 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.

When Limit Switch is ON during Homing operation, it stops to change the direction. How to stop after detection of Limit Switch follows Object 2003h: Limit stop method setting.

## 4.6.3 Control word and status word

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

Table 4-25: Homing mode of control word.

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	

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

Table 4-26: Control word of Bit 4, 8.

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).

Status word at Homing Mode are as follows.

Table 4-27: Homing mode of status word.

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  Origin search completed Origin search failed
11	Internal Limit Active	
12	Homing attained	
13	Homing Error	
14	Reserved	
15	Safety Activated	

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

Table 4-28: Status word of bit 13, 12, 10.

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 the controller is still under operation.
0	1	1	Origin search has been completed successfully.
1	0	x	Origin search has failed. Controller stops.
1	1	x	Reserved

Table 4-29: Status word of Bit 15.

Bit	Value	Description
15	1	Safety Function was activated and the motor is disabled.

#### 4.6.4 Origin Search Method

Origin search methods supported by this product are as follows.

Table 4-30: Homing method list.

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
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

Supported origin searching method lists can be also checked from Supported homing methods (60E3h). In the description below, 'Index pulse' refers to the Z-Phase signal of the encoder.

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

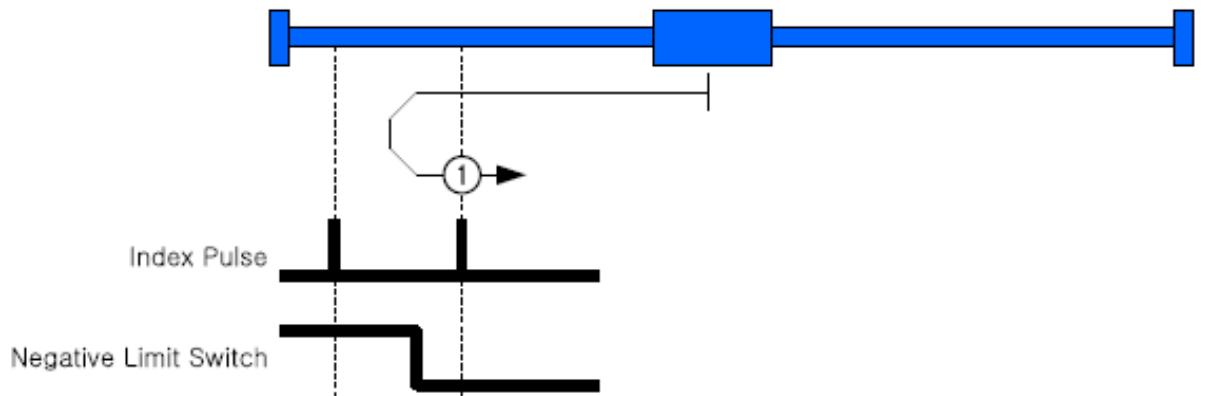


Figure 4-10: Homing method 1.

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

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

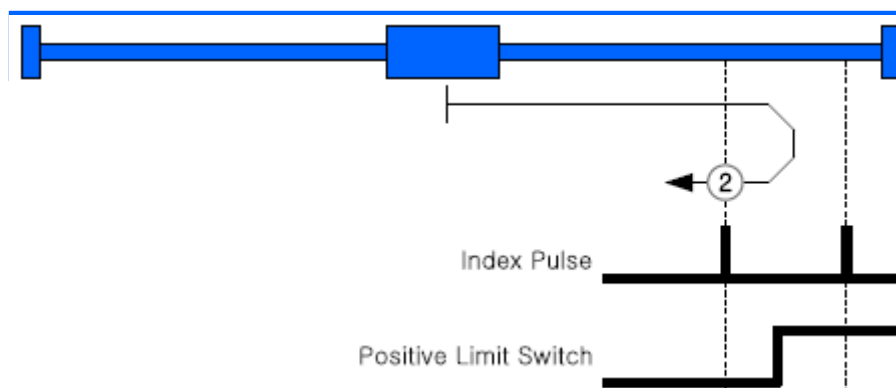


Figure 4-11: Homing method 2.

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

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

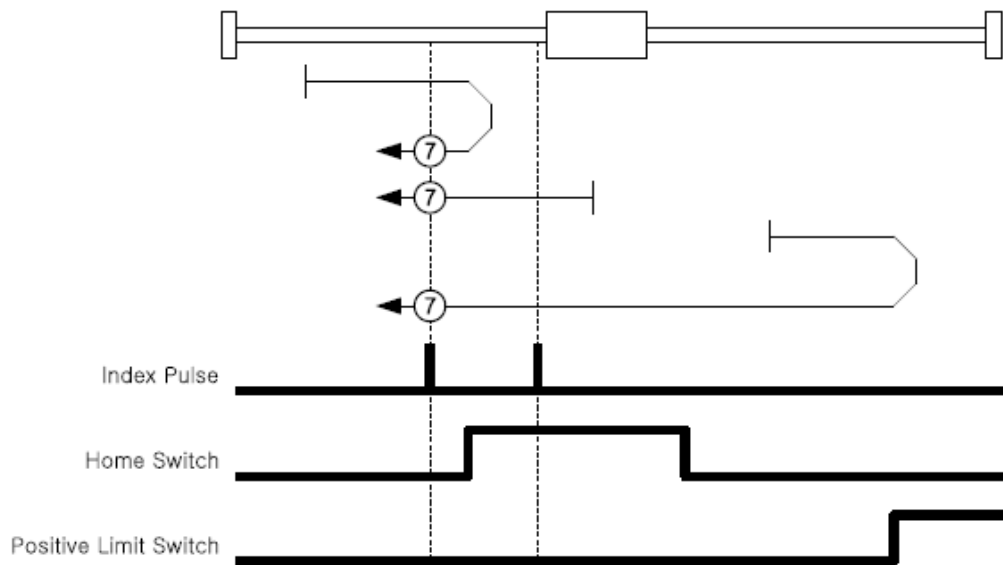


Figure 4-12: Homing method 7.

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

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

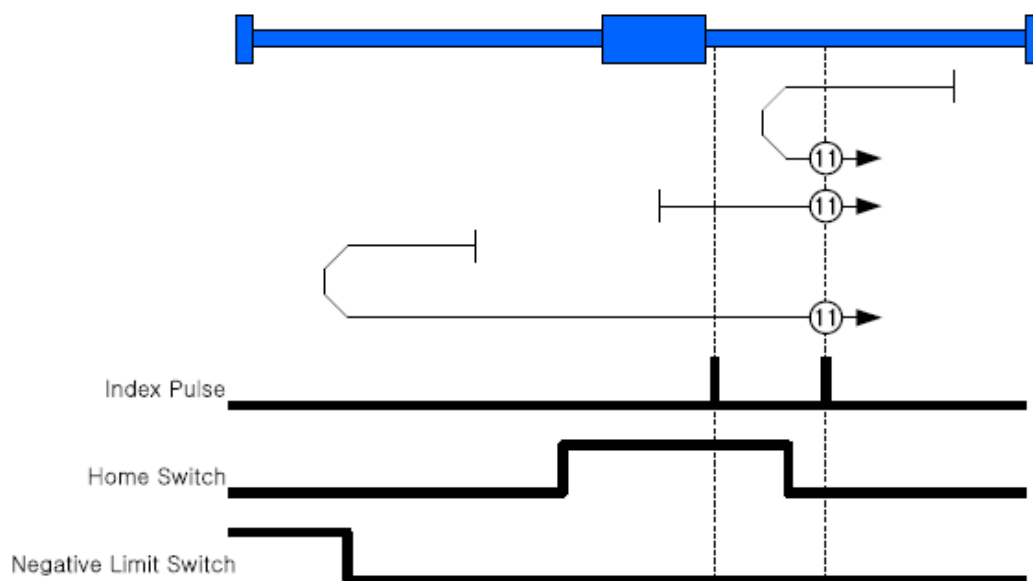


Figure 4-13: Homing method 11.

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

#### 4.6.4.5 Method 17: Homing on Negative Limit Switch

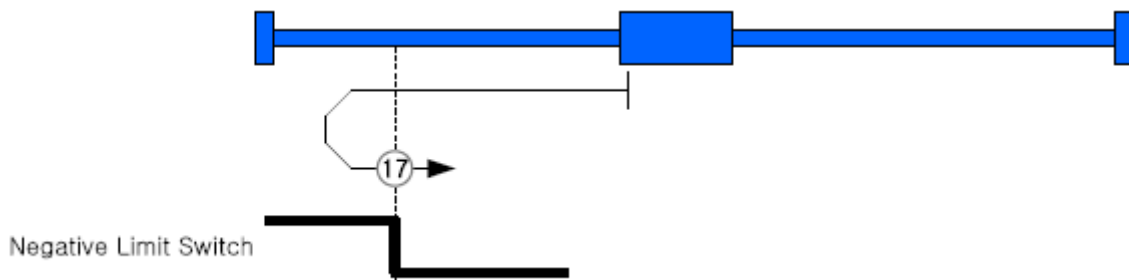


Figure 4-14: Homing method 17.

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

#### 4.6.4.6 Method 18: Homing on Positive Limit Switch

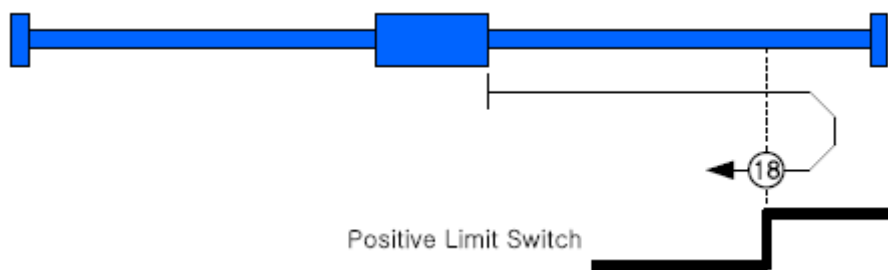


Figure 4-15: Homing method 18.

This origin method goes for Positive Direction and movement velocity of the value of Speed during the search for a switch (6099h, index 01h). Positive Limit Switch goes ON, it goes to the opposite direction by velocity of Speed during the 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)

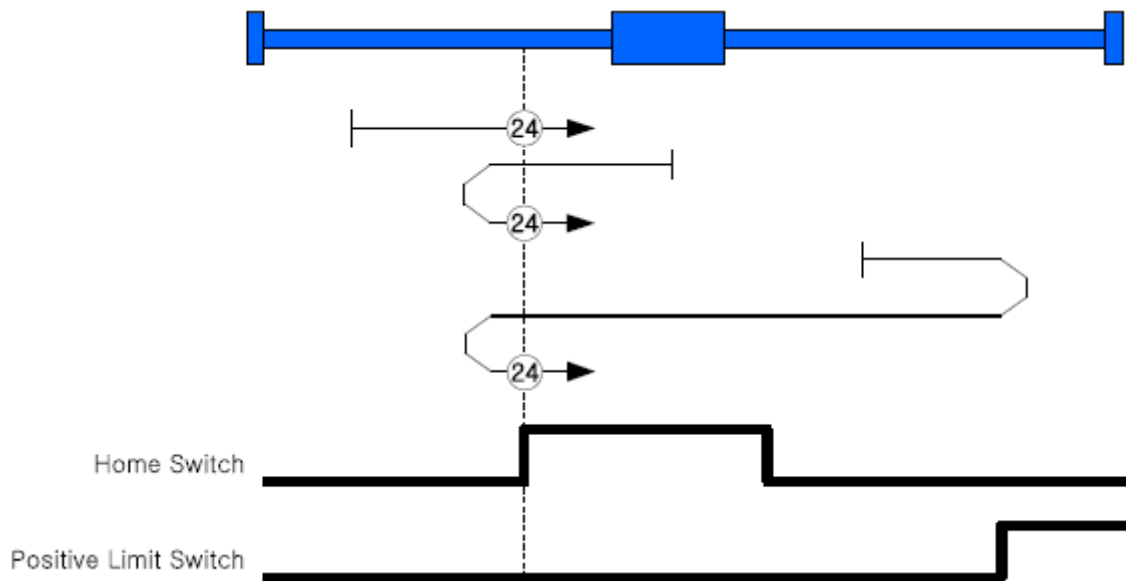


Figure 4-16: Homing method 24.

The initial movement direction of this origin search method is Positive Direction and movement velocity is the value of Speed during the search for a switch (6099h, index 01h). Positive Limit Switch goes ON, it goes to the opposite direction by velocity of Speed during the search for zero (6099h, index 02h) and gets out of Origin Switch. If it gets out of Origin Switch, start to search origin by velocity of Speed during the 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)

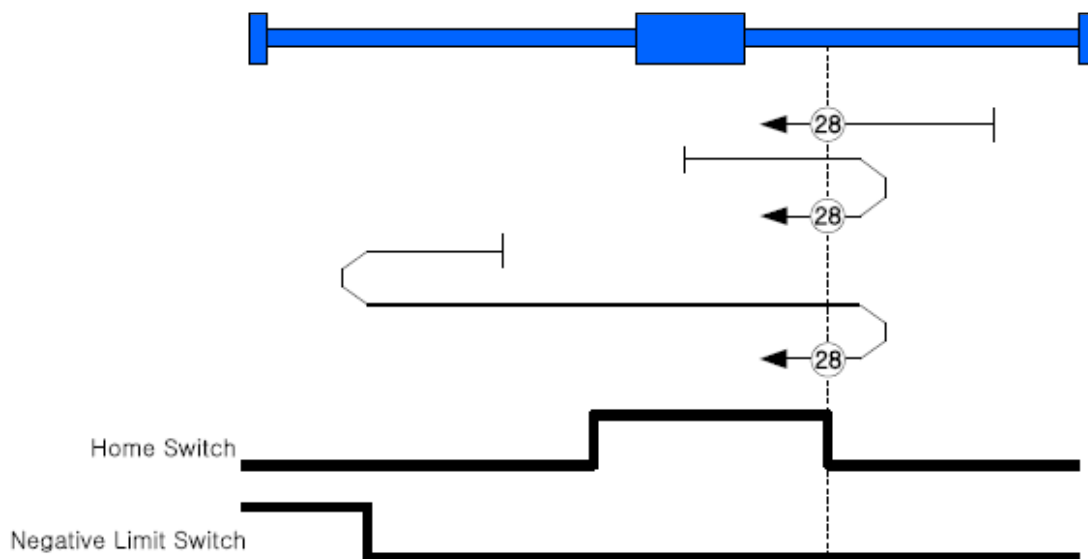


Figure 4-17: Homing method 28.

The initial movement direction of this origin search method is Negative Direction and movement velocity is the value of Speed during the search for a switch (6099h, index 01h). Negative Limit Switch goes ON, it goes in the opposite direction. If Origin Switch goes ON, it goes out of Origin Switch toward the opposite direction by velocity of Speed during the search for zero (6099h, index 02h). If it gets out of Origin Switch, it searches Origin Switch again by the velocity of Speed during the 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

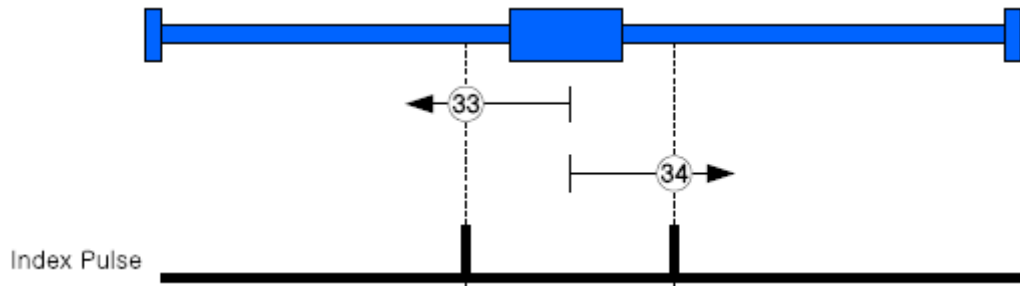


Figure 4-18: Homing method 33.

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 the search for zero (6099h, index 02h). Index Pulse goes ON then stops then sets correspondent position as sensor origin position.

#### 4.6.4.10 Method 35: Set the current position origin

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

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

This origin search method is to set the current position as the sensor origin position. If the 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 the search for zero (6099h, index 02h). If it senses certain Load then stops and sets correspondent position as sensor origin position.

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

**4.6.4.12 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 the search for zero (6099h, index 02h). If it senses a certain Load then stops and sets the 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 -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 the search for zero (6099h, index 02h). If it senses a certain Load then stops and moves to the opposite direction and movement velocity is Speed during the search for zero (6099h, index 02h). Index Pulse goes ON then stops and sets 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 -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 the search for zero (6099h, index 02h). If it senses a certain Load then stops and moves to the opposite direction and movement velocity is Speed during the search for zero (6099h, index 02h). Index Pulse goes ON then stops and sets correspondent position as sensor origin position.

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

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## 4.7 Touch probe

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### 4.7.1 Definition

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

### 4.7.2 Related objects

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*Table 4-31: Touch Probe 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 1 negative value	RO	Indicate detected position of Falling edge of Touch Probe 1.
Touch probe 2 positive 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 1 negative edge counter	RO	Indicate detected frequency of Falling edge of Touch Probe 1.
Touch probe 2 positive 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.

### 4.7.3 Touch Probe Status and Control

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#### 4.7.3.1 Touch Probe Operation : Acknowledge initial signal

If Touch probe function of bit number 1, 9 has set as 0, Touch probe only uses initially acknowledged signal after Enable. Please refer to Timing chart as follow.

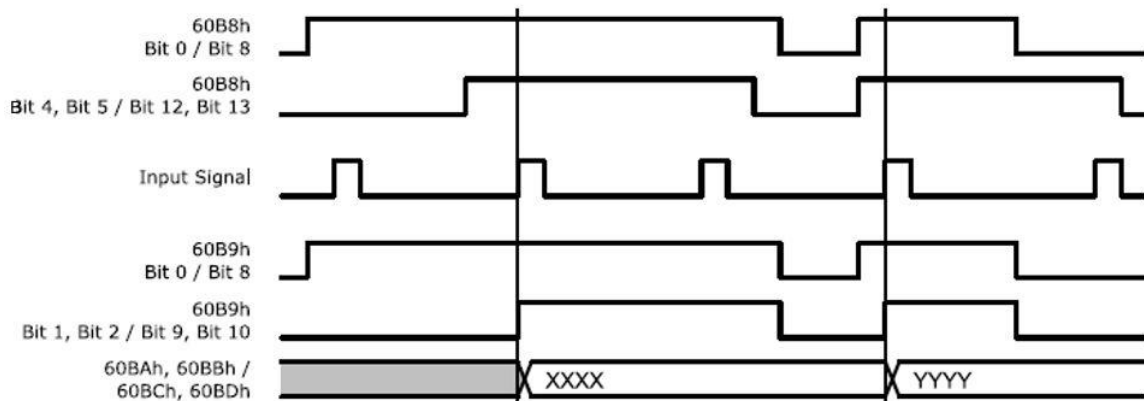


Figure 4-19: Touch Probe Operation (Bit 1/Bit 9 = 0).

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 acknowledgment

If the Touch probe function of bit number 1, 9 has set as 1, the Touch probe uses all acknowledged signals after Enable. Please refer to the Timing chart as follows.

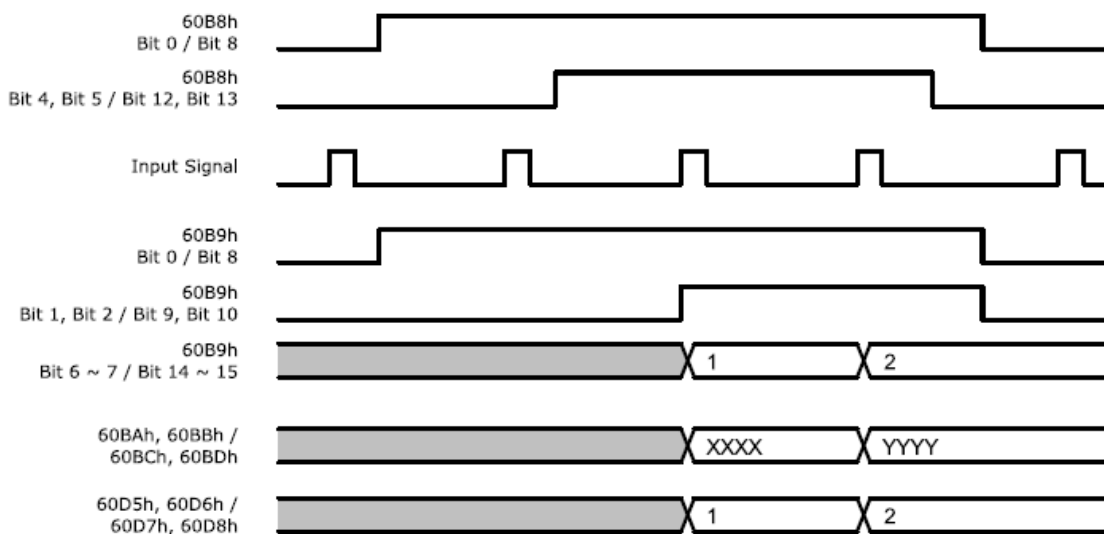


Figure 4-20: Touch Probe Operation (Bit 1/Bit 9 = 1).

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

STDF EC provides 3 default inputs (ORIGIN, LIMIT+, LIMIT-) and 7 user inputs and also 1 default output (BRAKE) and 6 user outputs.

### 4.8.2 Related Objects

Table 4-32: I/O related Objects.

Object	Access	Description
Object 60FDh: Digital inputs	RO	Indicates input signals.
Object 60FEh: Digital outputs Sub-Index 1 - Physical Output Sub-Index 2 - Bit Mask	R/W R/W	Set output signals. Set output signals.
Object 2001h: Sensors logics	R/W	Set Active Level of ORIGIN, LIMIT+, LIMIT- input signals.
Object 2002h: Reverse limit direction	R/W	Exchange LIMIT+ and LIMIT- inputsignals.
Object 2011h: Digital input levels	R/W	Active Level of user inputs.
Object 2012h: Digital output levels	R/W	Active Level of user outputs.
Object 2010h: Brake delay	R/W	Set Delay at BRAKE output.

### 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.

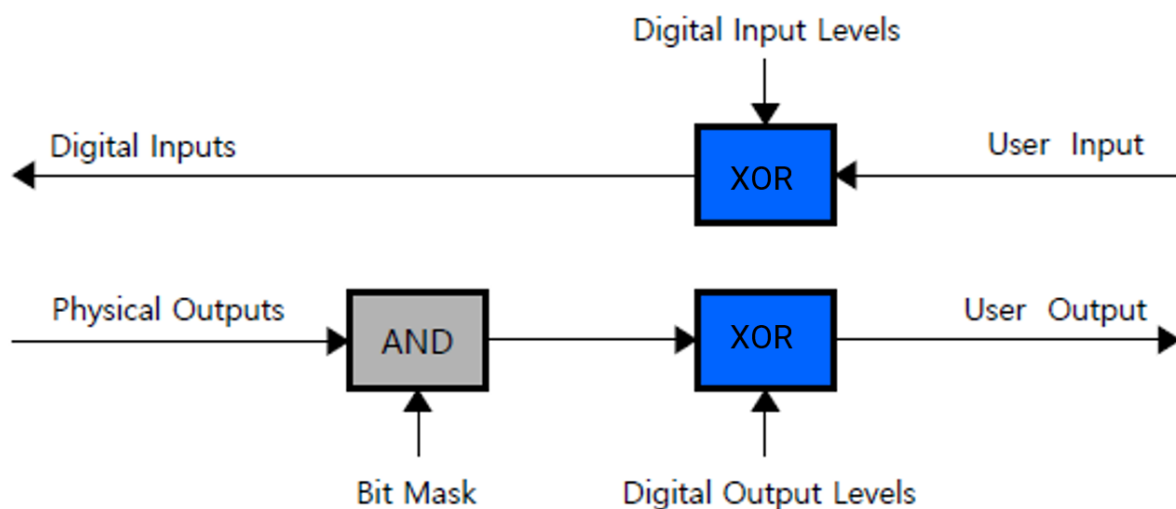


Figure 4-21: Digital I/O Level.

#### 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 (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.

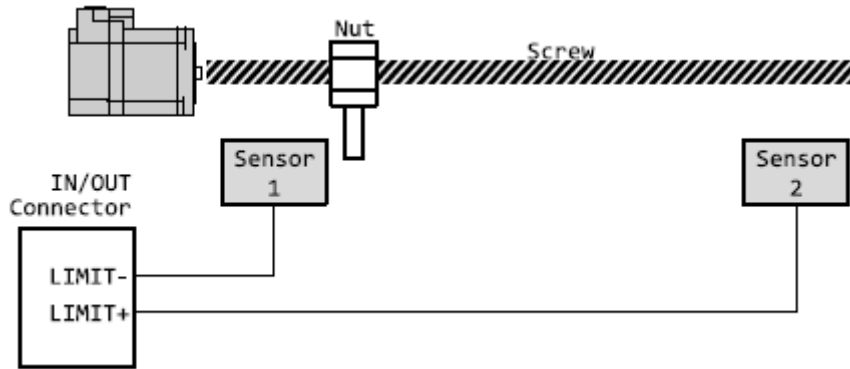


Table 4-33: Relationship between reverse limit direction (2002h) and limit sensor.

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

#### 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).

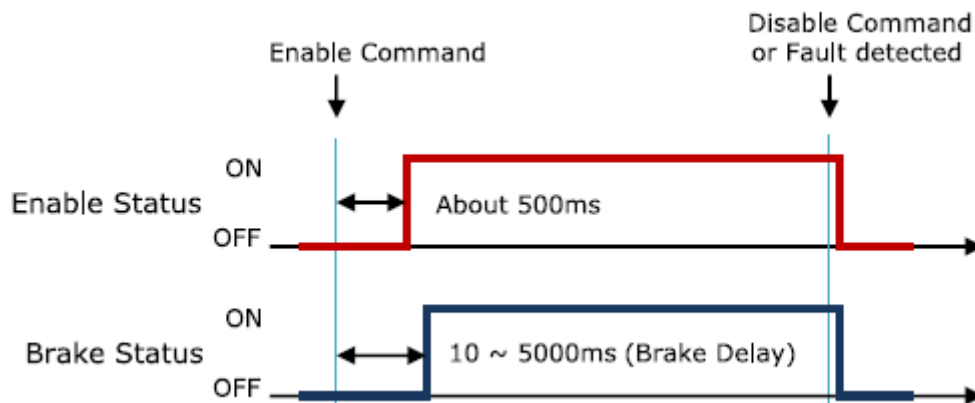


Figure 4-22: Brake signal.

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](#)

## 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](#)

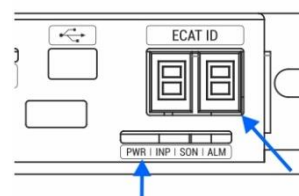
#### 5.2.2 Wiring

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

#### 5.2.3 Input power

Turn power ON on the controller and check the following.

- Check Power LED (Red Color) of Drive status LED lights.
- Check if 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'.  
The name of the 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

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

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

### Information

Trial operation explains operation by Profile Position Mode.

Input 005Fh at Control word. This command is to rotate the motor by setting value (distance) at the Target position.

## 5.3.5 Check Status

---

Check motor operates according to command or whether fault generated.

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

## 5.4 Drive Setting Adjustment

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### 5.4.1 Change Rotation Direction

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

#### 5.4.1.1 Reverse limit direction

After changing Polarity, if LIMIT+, LIMIT- input signal acknowledgment reversed, able to change input value of 2 signals by setting the value of Reverse limit direction (2002h). Regarding the relationship between Reverse limit direction and Limit Sensors, please refer to [4.8.5 BRAKE Output](#).

### 5.4.2 Change I/O Signal Level

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#### 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 the 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).

## 6 ETHERCAT OBJECT DICTIONARY

### 6.1 Indication Type of Objects

Following table explains the 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	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

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)	RO	STDF EC

#### 6.1.1 Index and Sub-Index

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

Table 6-1: INDEX Table of Objects.

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

If various parameters 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.

Table 6-2: Data type.

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

### 6.1.4 Access

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

Table 6-3: Access type of object.

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

### 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.

Table 6-4: PDO Mapping description.

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

### 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	U32	RO	0004 0192h

Object includes information of Device Type.

Table 6-5: 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	

### 6.2.2 Object 1001h: Error register

Index	Sub Index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
1001h	0	Error register	U8	RO	No	No		00h

This object indicates type of error generated from the controller.

Table 6-6: Type of Error.

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

The correspondent bit can be set if a correspondent error is generated. 'General Error' always goes to be set once bit error is generated.

### 6.2.3 Object 1008h: Device name

Index	Sub Index	Name	Type	Access	Constant Value
1008h	0	Device name	STR (18)	RO	STDF EC

This object indicates the name of the device.

#### Information

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

### 6.2.4 Object 1009h: Hardware version

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

This object indicates the version of product hardware. Indicated value can be different by the version of the 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 the version of the software. Indicated value can be different by the version of the 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 objects into EEPROM through this object.

Need to input "65766173h" into SubIndex 01h to store objects into EEPROM.

Table 6-7: Definition of Save Parameters Value.

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

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

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

Table 6-8: Save Parameters State.

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

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 for the device to restore objects to Default value to store into EEPROM.

Need to input '64616F6Ch' into SubIndex 01h to restore objects to original setting value.

Table 6-9: Definition of Restore Parameters Value.

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

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 the power cycle.

In case of reading SubIndex 01h, the following values will be returned.

Table 6-10: Restore Parameters State.

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

## 6.2.8 Object 1018h: Identity

Index	Sub Index	Name	Type	Access	Constant Value
1018h	0	Number of entries	U8	RO	4
	1	Vendor ID	U32	RO	0000 0CC8h
	2	Product code	U32	RO	0001 0001h
	3	Revision number	U32	RO	0000 0000h
	4	Serial number	U32	RO	0000 0000h

This object indicates information about the 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	RO	No	No		2
	1	Local error reaction	U32	RO	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 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	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

Table 6-11: Sync Manager Type Value.

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

#### 6.4.2 Object 1C32h: SM output parameter

Index	Sub Index	Name	Type	Access	SAVE	PDO Mapping	Range Value	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 the latest error value generated from the 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.

Table 6-12: Definition of Control word.

Bit	Name	Description
0	Switch On	Bits to control device status. Please refer to <a href="#">4.1 Drive Status Control</a> .
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	

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.

Table 6-13: Definition of Status word.

Bit	Name	Description
0	Ready to switch on	Bits to indicate current status of controller. Please refer to <a href="#">4.1 Drive Status Control</a> .
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	

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.

Table 6-14: Current status following by Status word.

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

- Bit 9 Remote indicates Control word has settled.
- Bit 10 Target Reached indicates reached the target position. The meaning of the target position can be different according to each mode of action and for details of meaning, please refer to the Status word description of each operation mode. If Quick stop option code (605Ah) of value is 5 ~ 8, the controller suddenly stops then the Target Reached bit value goes to SET under immediate stop commands.

- Bit 11 Internal Limit Active goes to SET once the current position value is out of Object 607Dh: Software position limit. If Object 2030h: Advanced settings Sub-Index 3 Config Internal Limit Active bit is set, Internal Limit Active will SET even if H/W Limit switch is detected.

- Bit 12 ~ 13 will have 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	116	RW	Yes	No		2

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

Table 6-15: Quick Stop Option Code.

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.

## 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	116	RW	Yes	No		0

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

Table 6-16: Shutdown Option Code.

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

## 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	116	RW	Yes	No		1

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

Table 6-17: Disable Operation Option Code.

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

#### 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.

Table 6-18: Halt Option Code.

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

#### 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.

Table 6-19: Fault Reaction Option Code.

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

## 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.

Table 6-20: Mode of operation value.

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

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 the current operation mode. The definition of value is the same as the 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 demand value	I32	RO	No	Tx PDO		

This object indicates current position.

This position value indicates Encoder value connected to controller.

#### 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](#).

If the value of Following error actual value is greater than the value of Following error window, '0xFF03 - Position Tracking Error' or '0xFF0F - Position Overflow Error' alarm occurs and Drive is in Fault state.

#### 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
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.

#### 6.5.17 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
607Ah	0	Target position	I32	RW	No	Rx PDO	-2147483648 ~ 2147483647	0

This object sets the value of the 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 the 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. The 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.

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

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

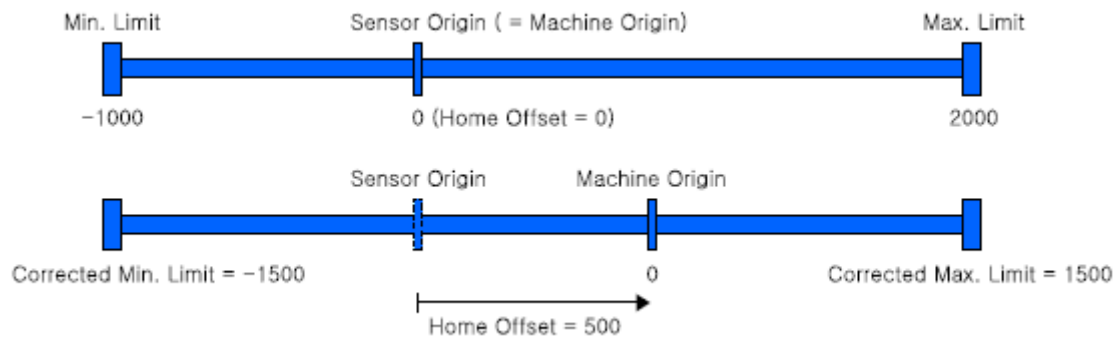


Figure 6-1: Origin Offset.

#### 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.

Table 6-21: Polarity.

Bit	Description
0	Reserved
1	Reserved
2	Reserved
3	Reserved
4	Reserved
5	Reserved
6	Reserved
7	Position Polarity

Position related Objects will be multiplied by -1 when Position Polarity is 1.

## 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 ~ 10e8	10e5

This object sets deceleration under Profile Position Mode.

Unit is speed of increasing per second [pulse/s<sup>2</sup>].

#### 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 ~ 10e8	10e5

This object sets deceleration under Profile Position Mode.

Unit is speed of increasing per second [pulse/s<sup>2</sup>].

#### 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.

*Table 6-22: Origin Search Method*

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
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

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

Speed during search for zero (index 02h) is the velocity that 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 ~ 10e8	100000

This object sets Acc/Dec velocity under Homing Mode.

Unit is speed of increasing per second [pulse/s<sup>2</sup>].

### 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.

Table 6-23: Touch Probe function bits.

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.

Table 6-23: Definition of Touch probe status.

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.

#### 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)

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

#### Information

If using 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.

Table 6-24: Touch probe 1 source.

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

Table 6-25: Touch probe 2 source.

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

## 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 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 indicated by product model or version.

## 6.5.41 Object 60F4h: Following error actual value

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

This Object indicates status of input signals.

Table 6-26: Definition of Digital Input.

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
23 ~ 25	Reserved
26	Motor Power
27	Z-Phase Signal
28	Reserved
29	Reserved
30 ~ 31	Reserved

Table 6-27: Definition of Input Value.

Value	Definition
0	Input goes OFF
1	Input goes ON

#### 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 the User output through this Object and Brake.

Table 6-28: Definition of Physical outputs and Bit mask.

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

##### 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.

Table 6-28: Set Brake.

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

#### 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'.

Table 6-29: User Outputs.

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

## 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	RO	No	No		

This Object indicates Operation modes currently supported.

Table 6-30: Supported Drive Modes.

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

## 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		

This Object sets Logic of specific input signals.

Table 6-31: Sensor Logic.

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

Table 6-32: Definition of Logic Value.

Value	Definition
0	Low active
1	High active

### 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 Switch.

If 1 is set, 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 ~ 4	0

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

Table 6-33: Stop Method.

Value	Definition (pp, hm)	Definition (csp)
0	Quick Stop	Ignore (Does not stop)
1	Decelerated Stop	Ignore (Does not stop)
2	Ignore (Does not stop)	Ignore (Does not stop)
3	Quick Stop	Quick Stop
4	Decelerated Stop	Decelerated Stop

If the value is 0 or 1, it stops when Limit switch is detected in Profile Position Mode and Homing Mode only. It doesn't stop in Cyclic Synchronous Position Mode. If the value is 3 or 4, it stops even in Cyclic Synchronous Position Mode.

Declaration ratio during decelerated stop follows Deceleration of correspondent operation mode. The deceleration ratio for Cyclic Synchronous Position Mode follows Object 201Bh: Limit Deceleration.

## 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 %.

Run current means that current value flowing through the motor while the motor is running. It is set based on the rated current of the motor. This value is related to the torque during operation of the motor. If this value is high, torque during operation will increase. Therefore, if you think that the torque is insufficient, increase the value of this parameter to increase the torque.

Run current = Value × 10 [%]

### Information

- If Run current value is high, the heating temperature of a motor can be increased. So please be careful.
- The maximum setting of Run current (150 %) is limited to 4.4 A. Therefore, a motor (56 mm) that rated current value exceeds 2.7 A will not increase as much as the set value even if the set value is raised.
- Run current is set automatically as load. Therefore use only when torque value during running is insufficient.

**Information**

This object can NOT be set while it is in '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 is a setting that improves the acceleration characteristics by increasing the current supplied to the motor in case the acceleration time cannot be set sufficiently. Boost current only applies to acceleration.

Boost current = Value × 50 [%]

**Information**

The control current is limited to 4.4 A same as Run current. Therefore, a motor (56 mm) that rated current value exceeds 2.7 A will not increase as much as the set value even if the set value is raised.

**Information**

This object can NOT be set while it is in '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.

Stop current means that the current of the motor which is set automatically after 0.1 seconds after the motor stops running. This setting can be used to reduce heat when the motor is stopped for a long time. Please be careful that the temperature of the motor may rise if it is set more than 60 %.

Stop current = Value × 10 [%]

**Information**

This object can NOT be set while it is in '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 motors currently set.

## 6.6.10 Object 200Ch: Reference resolution

Index	Sub Index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
200Ch	0	Motor number	U32	RW	Yes	No	500 ~ 100000	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 is in '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 function is used to control the response to the load attached to the motor after stopping the motor. If this set value is small, the operation of stopping the motor becomes sensitive, and the time it takes for the motor to stop is reduced. If the setting value is large, the operation of stopping the motor becomes insensitive, and the time taken for the motor to stop increases relatively.

Position control gain is determined by a combination of bandwidth and gain.

Position control gain = Bandwidth Setting × 8 + Gain Setting

Table 6-34: Position control gain.

Value	Bandwidth Setting	Gain Setting	Value	Bandwidth Setting	Gain Setting	Value	Bandwidth Setting	Gain Setting	Value	Bandwidth Setting	Gain Setting
0	0	0	16	2	0	32	4	0	48	6	0
1	0	1	17	2	1	33	4	1	49	6	1
2	0	2	18	2	2	34	4	2	50	6	2
3	0	3	19	2	3	35	4	3	51	6	3
4	0	4	20	2	4	36	4	4	52	6	4
5	0	5	21	2	5	37	4	5	53	6	5
6	0	6	22	2	6	38	4	6	54	6	6
7	0	7	23	2	7	39	4	7	55	6	7
8	1	0	24	3	0	40	5	0	56	7	0
9	1	1	25	3	1	41	5	1	57	7	1
10	1	2	26	3	2	42	5	2	58	7	2
11	1	3	27	3	3	43	5	3	59	7	3
12	1	4	28	3	4	44	5	4	60	7	4
13	1	5	29	3	5	45	5	5	61	7	5
14	1	6	30	3	6	46	5	6	62	7	6
15	1	7	31	3	7	47	5	7	63	7	7

If the bandwidth set value is small, the target following (control) become fast. If the bandwidth set value is large, the target following become slow.

If the gain setting is small, reactivity to positional deviation increases, and overshoot/vibration increases.

If the gain setting is large, reactivity to positional deviation decreases, and overshoot/vibration in decreases.

Bandwidth and gain values are relative values used inside the drive. Changing the value from 3 to 6 does not mean that the response time become twice.

#### Information

This object can NOT be set while it is in '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.

In Profile Position Mode, if the position deviation from the target position is within the set value (Position Window) after the position command pulse is completed, it is judged that the positioning is completed (Target Reached).

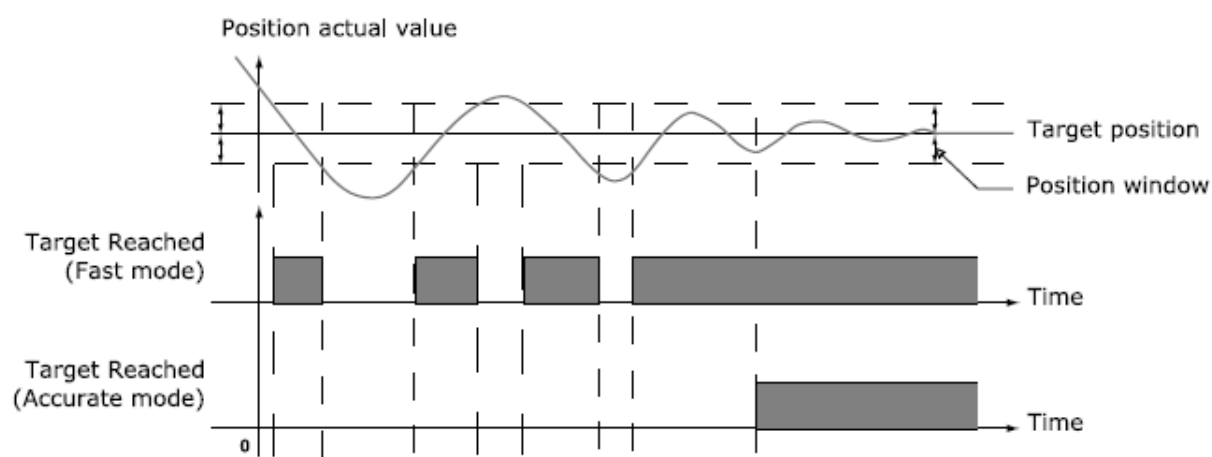


Figure 6-2: Target reached status changes according to In-position Mode.

### Information

This object can NOT be set while it is in '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.

Table 6-35: Encoder Filter Time.

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

#### Information

This object can NOT be set while it is in '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.

#### 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.

Table 6-36: List of Homing methods which uses Homing Torque Ratio.

Homing method	Name
-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

## 6.6.18 Object 201Ah: Push Mode

Index	Sub Index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
201Ah	0	Number of entries	U8	RO	No	No		2
	1	Push ratio	U32	RW	Yes	No	0 ~ 100	50
	2	Pull back distance	U32	RW	Yes	No	0 ~ 2147483647	100

This object is used in the Push Motion of Profile Position Mode.

### 6.6.18.1 Push ratio

This object set the motor torque at the Push Motion and the value is the ratio of the maximum motor torque. The unit is %. If a force greater than the torque set is applied to the motor in the opposite direction of the push direction, it is determined that a work is detected.

### 6.6.18.2 Pull back distance

The motor can be pulled back a certain distance when the Push Motion is finished. The position where the motor pulls back is the position added from Position actual value by Pull back distance (in the opposite direction to the Push Motion). The unit is pulse.

### 6.6.19 Object 2018h: Internal Current Value

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

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

### 6.6.20 Object 201Bh: Limit Deceleration

This object sets deceleration ratio applied in deceleration stop in Cyclic Synchronous Position Mode.

Index	Sub Index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
201Bh	0	Limit Deceleration	U32	RW	Yes	No	1000 ~ 10e8	10e5

Unit is speed of increasing per second [pulse/s<sup>2</sup>].

### 6.6.21 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	RW	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.

### 6.6.21.1 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.

### 6.6.21.2 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.

### 6.6.21.3 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.

## 6.6.22 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.

### 6.6.23 Object 2025h: Lifetime Record

Index	Sub Index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2025h	0	Number of entries	U8	RO	No	No		6
	1	LTR Operating Time	U32	RO	No	No		0
	2	LTR Enable Time	U32	RO	No	No		0
	3	LTR Rotating Count	U32	RO	No	No		0
	4	POR Operating Time	U32	RO	No	No		0
	5	POR Enable Time	U32	RO	No	No		0
	6	POR Rotating Count	U32	RO	No	No		0

This Object shows the time the controller has operated and the distance traveled.

For example, if the controller operates as follows, each value is as follows:

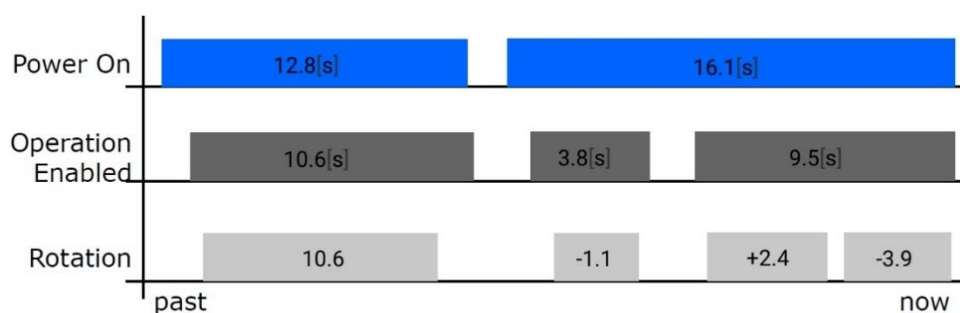


Table 6-37: Lifetime Record.

Item	Value	Details
LTR Operating Time	28 [s]	$12 + 16.1 = 28.1$
LTR Enable Time	23 [s]	$10 + (3.8 + 9.5) = 23.3$
LTR Rotating Count	17 [rev]	$10 + (1.1 + 2.4 + 3.9) = 17.4$
POR Operating Time	16 [s]	16.1
POR Enable Time	13 [s]	$3.8 + 9.5 = 13.3$
POR Rotating Count	7 [rev]	$1.1 + 2.4 + 3.9 = 7.4$

## **LTR Operating Time**

It displays the total time it has been powered on and operated for a lifetime (Since the product was shipped).

The unit is [s]. Times below the decimal point are discarded when the controller is powered off.

## **LTR Enable Time**

It displays the total time it has been powered on and the drive is the Operation enabled state for a lifetime (Since the product was shipped).

The unit is [s]. Times below the decimal point are discarded when the controller is powered off.

## **LTR Rotating Count**

It displays the total number of revolutions the motor has rotated through the command for a lifetime (Since the product was shipped).

The unit is [rev] and the number of revolutions below the decimal point is discarded when the controller is powered off.

## **POR Operating Time**

It displays the time [s] that has elapsed after the controller was recently powered up.

## **POR Enable Time**

It displays the time [s] the drive has been in Operation Enabled after the controller was recently powered up.

## **POR Rotating Count**

It displays the number of revolutions the motor has rotated through the command after the controller was recently powered up.

#### 6.6.24 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		3
	1	Automatic recovery from communication error	U8	RW	Yes	No	0 ~ 1	0
	2	Disable Automatic transition 2	U8	RW	Yes	No	0 ~ 1	0
	3	Config Internal Limit Active bit	U8	RW	Yes	No	0 ~ 1	0

##### 6.6.24.1 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 the state of EtherCAT State Machine changes from SAFE-OP to OP.

##### 6.6.24.2 Disable Automatic transition 2

This object can set whether 'Transition 2' of Drive State Machine occurs automatically or not. If the value is set to 1, Transition 2 will not occur automatically, but rather through the 'Shutdown' command.

##### 6.6.24.3 Config Internal Limit Active bit

This object can change how to operate Status word bit 11: Internal Limit Active. If the value is set to 1, the Internal Limit Active bit also displays the H/W Limit Switch status.

### 6.6.25 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	28
	3	Encoder count error time out	U16	RW	Yes	No	500 ~ 10000	1000

This object can set the Error Code '0xFF46 Encoder Count Error'.

#### 6.6.25.1 Enable Encoder Count Error

This object can enable or disable the 'Error Code 0xFF46 Encoder Count Error'.

#### 6.6.25.2 Acceptable Encoder Count Limit Value

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

#### 6.6.25.3 Encoder Count Error Time Out

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



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