



E Series Servo Drive

EtherCAT Communication Command Manual

Revision History

The version of the guide is also indicated on the bottom of the front cover.

MD08UE01-2507_V1.7

Version

Release Date

Release Date	Version	Applicable Product	Revision Contents
Jul. 31 st , 2025	1.7	E1 series EtherCAT drive E2 series EtherCAT drive	1. Update section 2.2 Specifications. 2. Update section 3.1 Communication profile area. 3. Update section 3.1.1 Default PDO mapping. 4. Update section 3.1.2 Mapping objects to PDO. 5. Update section 3.2 Standardized device profile area. 6. Update section 3.2.3 Cyclic synchronous position mode (csp). 7. Update section 3.2.6 Cyclic synchronous velocity mode (csv). 8. Update section 3.2.7 Profile torque mode (tq). 9. Update section 3.2.10 Modulo system. 10. Update section 3.3 Manufacturer specific profile area. 11. Update section 3.4 Object dictionary list.
Dec. 31 st , 2024	1.6	E1 series EtherCAT drive E2 series EtherCAT drive	1. Update section 2.2 Specifications. 2. Update section 2.8.1 PDO mapping object. 3. Update section 3.1 Communication profile area. 4. Update section 3.2 Standardized device profile area. 5. Update section 3.2.2 Profile position mode (pp). 6. Update section 3.2.3 Cyclic synchronous position mode (csp). 7. Add section 3.2.10 Modulo system. 8. Update section 3.3 Manufacturer specific profile area. 9. Add section 3.3.2 Host controller's operation warning. 10. Update section 3.4 Object dictionary list.
Aug. 15 th , 2024	1.5	E1 series EtherCAT drive E2 series EtherCAT drive	1. Delete section 1.3 General precautions. 2. Delete section 1.4 Safety precautions. 3. Update section 3.2 Standardized device profile area. 4. Update section 3.2.1 PDS (Power Drive System). 5. Update section 3.2.2 Profile position mode (pp). 6. Update section 3.2.4 Homing mode (hm). 7. Update section 3.2.5 Profile velocity

Release Date	Version	Applicable Product	Revision Contents
			mode (pv). 8. Update section 3.2.9 Touch probe function. 9. Update section 3.3 Manufacturer specific profile area. 10. Update section 3.4 Object dictionary list.
Dec. 15 th , 2023	1.4	E1 series EtherCAT drive E2 series EtherCAT drive	1. Update manual's name. 2. Update section 2.1 System configuration. 3. Update section 2.2 Specifications. 4. Update section 3.2 Standardized device profile area. 5. Update section 3.2.1 PDS (Power Drive System). 6. Update section 3.2.4 Homing mode (hm). 7. Update section 3.2.9 Touch probe function. 8. Update section 3.3 Manufacturer specific profile area. 9. Update section 3.3.1 Absolute encoder initialization. 10. Update section 3.4 Object dictionary list.
May 15 th , 2023	1.3	E1 series EtherCAT drive E2 series EtherCAT drive	1. Update manual's name. 2. Update section 2.2 Specifications. 3. Update section 3.2 Standardized device profile area. 4. Update section 3.2.2 Profile position mode (pp). 5. Update section 3.2.5 Profile velocity mode (pv). 6. Update section 3.2.9 Touch probe function. 7. Update section 3.3 Manufacturer specific profile area. 8. Update section 3.3.1 Absolute encoder initialization. 9. Update section 3.4 Object dictionary list.
Nov. 10 th , 2022	1.2	E1 series EtherCAT drive	1. Add section 2.9.3, EtherCAT panel status display. 2. Revise section 3.2 · 60FDh definition table. 3. Delete related information about object 607Dh.
Nov. 20 th , 2020	1.1	E1 series EtherCAT drive	1. Add a new instruction in 1.3 general precautions: For the instructions of Fieldbus installation and wiring, please refer to "ETG.1600 G (R) V1.0.2" issued by EtherCAT Technology Group. 2. Add information in 2.1: After Thunder is installed in a computer with Windows, a user can get the ESI file from the route (C:\HIWIN\doc\CoE). 3. Revise table 2.4.1. Move "Master initializes DC clock synchronization" from "PreOp to SafeOp" (PS) section to "Init to PreOp" (IP) section. 4. Change figure 2.9.1. 5. Add "0x603F Error Code mapping table" to table 3.2.1. 6. Revise below content in 3.2: Change the unit of 0x6071 from "-3000 ~ 3000" to "-32768 ~ 32767". Change the unit of 0x6072 from "0 ~ 3000" to "0 ~ 65535". Change the unit of 0x6077 from "-3000 ~ 3000" to "-

Release Date	Version	Applicable Product	Revision Contents
			32768 ~ 32767".Chang the description of 0x6077 from "The actual torque of the motor. The value is only for referenece." to "The value is given per thousand of rated torque. The value is only for referenece."
Dec. 04 th , 2018	1.0	E1 series EtherCAT drive	First edition.

Related Documents

Through related documents, users can quickly understand the positioning of this manual and the correlation between manuals and products. Go to HIWIN MIKROSYSTEM's official website → Download → Manual Overview for details (https://www.hiwinmikro.tw/Downloads/ManualOverview_EN.htm).

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1. About this manual



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1.1 Preface

This manual introduces communication specification and CiA 402 drive profile applied to EtherCAT (Ethernet for Control Automation Technology) drive. As for basic specifications, wiring and settings of E series servo drive, please refer to “E1 Series Servo Drive User Manual” and “E2 Series Servo Drive User Manual”.

Note:

For the instructions of Fieldbus installation and wiring, please refer to “ETG.1600 G (R) V1.0.2” issued by “EtherCAT Technology Group”.

1.2 Trademark

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

2. EtherCAT communication

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2.1 System configuration

The connection type of EtherCAT is a network system that connects a master and multiple slaves. The number of the connected slaves depends on the factors such as master's performance, communication cycle, etc. The master generates EtherCAT Network Information (ENI) by a configuration tool based on EtherCAT Slave Information (ESI). The ESI file, which provides the peculiar information of the slaves, is an XML-format file given by HIWIN. After Thunder is installed in a computer with Windows, a user can get the ESI file from the route (C:\Thunder\doc\ESI Files).

2.2 Specifications

Table 2.2.1

Item	Specification
Physical layer	100BASE-TX (IEEE 802.3)
Baud	100Mbps
Connecting cable	Ethernet Category 5 or higher (A twisted-pair cable with double, aluminum tape and braided shielding is recommended.)
Cable length	Maximum 100m between nodes
Connectors	RJ45 x2 CN9 IN: EtherCAT input CN9 OUT: EtherCAT output
EtherCAT indicators	L/A IN x1 L/A OUT x1 RUN x1 ERR x1
Station alias (ID)	Setting 1: 8 bits from 2-digit rotary switch at front panel (Range: 0~255) Setting 2: value saved in EEPROM (Range:0~65535)
Communication profile	CoE (CANopen over EtherCAT), EoE (Ethernet over EtherCAT)
SyncManager	4
FMMU	3
CiA 402 drive profile	Profile position mode Profile velocity mode Profile torque mode

Item	Specification
	Homing mode Cyclic synchronous position mode Cyclic synchronous velocity mode Cyclic synchronous torque mode Touch probe function Torque limit function
Synchronous mode	DC Sync0 FreeRun
Cycle time	125 μ s*, 250 μ s, 500 μ s, 750 μ s (After 250 μ s, in increments of 250 μ s)
Communication object	SDO (service data object) PDO (process data object)
SDO message	SDO request, SDO response, emergency message
PDO mapping	Configurable
Maximum number of PDO mapping objects	RxPDO: 10 TxPDO: 10
Maximum PDO data length	RxPDO: 40 Bytes TxPDO: 40 Bytes

Note:

1. Only E2 series servo drive supports the cycle time of 125 μ s.
2. Although the cycle time of EtherCAT can be 125 μ s, the profile planning cycle time of E series servo drive is 250 μ s. Therefore, when the operation mode is profile position mode (pp), profile velocity mode (pv), profile torque mode (tq) or homing mode (hm), the effective cycle of the command is still 250 μ s.

2.3 EtherCAT frame structure

EtherCAT frames (Ethernet frames with EtherType 0x88A4, see Figure 2.3.1) are processed by EtherCAT Slave Controller (ESC) on the fly. EtherCAT datagrams are processed before the complete frame is received. If frame checksum is invalid, the slave will set the data invalid for local application.

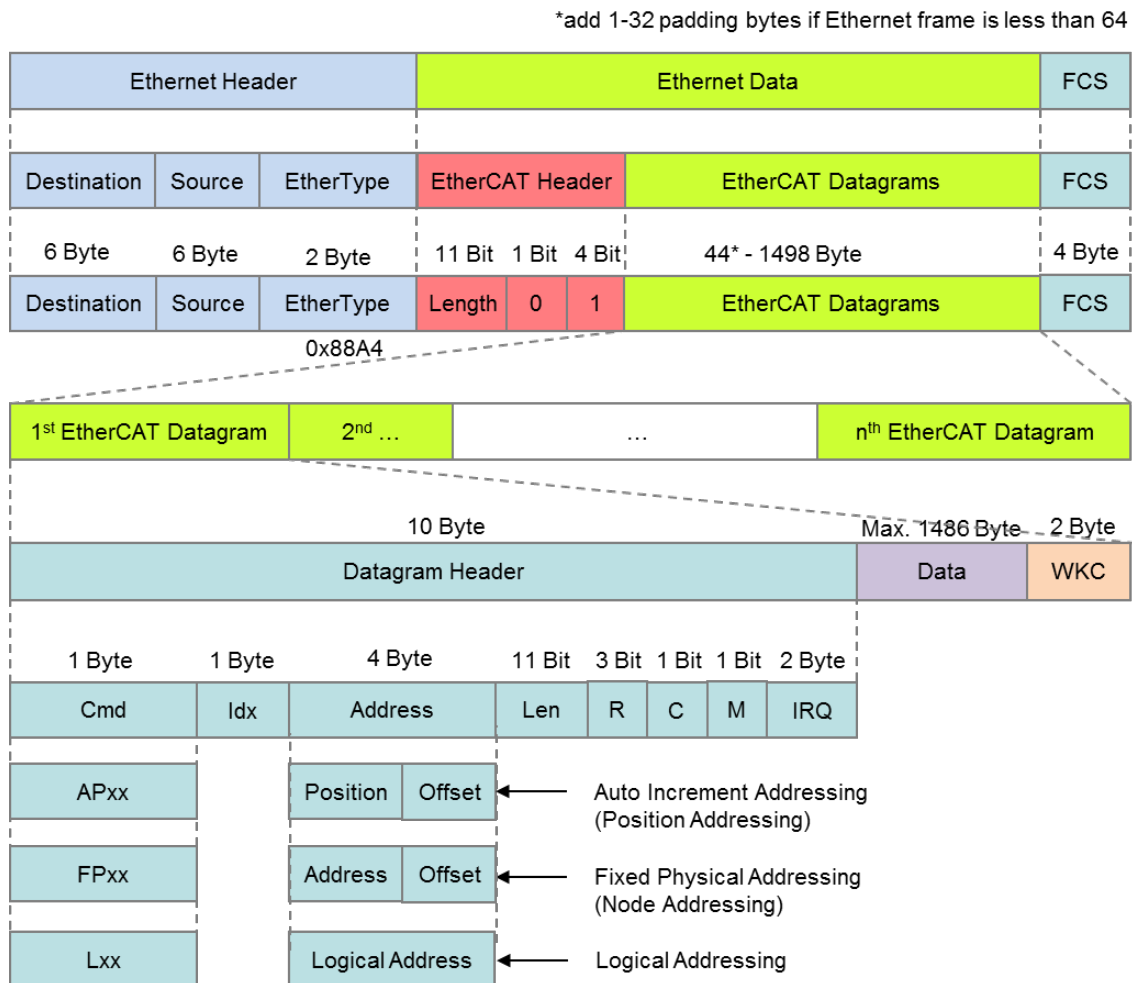


Figure 2.3.1

2.3.1 EtherCAT commands

Table 2.3.1.1

CMD	Abbr.	Name	Description
0	NOP	No operation	Slave ignores command.
1	APRD	Auto increment read	Slave increases address. Slave puts read data into EtherCAT datagram if received address is zero.
2	APWR	Auto increment write	Slave increases address. Slave writes data into memory location if received address is zero.
3	APRW	Auto increment read write	Slave increases address. Slave puts read data into EtherCAT datagram and writes data into the same memory location if received address is zero.
4	FPRD	Configured address read	Slave puts read data into EtherCAT datagram if address matches one of its configured addresses.
5	FPWR	Configured address write	Slave writes data into memory location if address matches one of its configured addresses.
6	FPRW	Configured address read write	Slave puts read data into EtherCAT datagram and writes data into the same memory location if address matches one of its configured addresses.
7	BRD	Broadcast read	All slaves put logical OR of data of memory area and data of EtherCAT datagram into EtherCAT datagram. All slaves increase position field.
8	BWR	Broadcast write	All slaves write data into memory location. All slaves increase position field.
9	BRW	Broadcast read write	All slaves put logical OR of data of memory area and data of EtherCAT datagram into EtherCAT datagram, and write data into memory location. All slaves increase position field. BRW is typically not used.
10	LRD	Logical memory read	Slave puts read data into EtherCAT datagram if received address matches one of the configured FMMU areas for reading.
11	LWR	Logical memory write	Slaves writes data to into memory location if received address matches one of the configured FMMU areas for writing.
12	LRW	Logical memory read write	Slave puts read data into EtherCAT datagram if received address matches one of the configured FMMU areas for reading. Slaves writes data into memory location if received address matches one of the configured FMMU areas for writing.
13	ARMW	Auto increment read multiple write	Slave increases address. Slave puts read data into EtherCAT datagram if received address is zero, otherwise slave writes the data into memory location.
14	FRMW	Configured address read multiple write	Slave puts read data into EtherCAT datagram if address matches one of its configured addresses, otherwise slave writes the data into memory location.

2.3.2 WKC (Working Counter)

Working Counter (WKC) is a 16-bit field placed at the end of each EtherCAT datagram. The addressed slave increases WKC based on Table 2.3.2.1 for the master to check if the number of nodes of the corresponding EtherCAT PDU is in line with expectations.

Table 2.3.2.1

Command	Data type	Increment
Read	Fail	0
	Succeed	+1
Write	Fail	0
	Succeed	+1
Read write	Fail	0
	Read succeed	+1
	Write succeed	+2
	Read write succeed	+3

2.4 EtherCAT State Machine

EtherCAT State Machine (ESM) is responsible for the coordination of the applications for master and slaves at start up and during operation. State changes are typically initiated by the requests of the master. They are acknowledged by the local application after the associated operations have been executed. Unsolicited state changes of the local application are also possible.

E series servo drive supports the following four states.

- Init
- Pre-Operational
- Safe-Operational
- Operational

The states and the allowed state changes are shown in Figure 2.4.1.

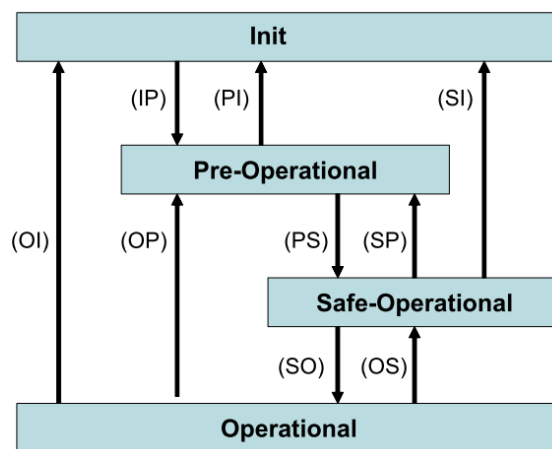


Figure 2.4.1

Note: Not all state changes are possible. For example, the transition from 'Init' to 'Operational' requires the following sequence: Init → Pre-Operational → Safe-Operational → Operational.

Table 2.4.1

State / State change	Description
Init	No communication on Application Layer (AL) Master accesses to Data Link (DL)-Information registers
Init to PreOp (IP)	Master configures registers - DL address register - SyncManager channels for Mailbox communication Master initializes DC clock synchronization Master requests 'Pre-Operational' state - Master sets AL Control register Wait for AL Status register confirmation
Pre-Operational (PreOp)	Mailbox communication on AL No Process Data communication
PreOp to SafeOp (PS)	Master configures parameters via Mailbox - e.g., Process Data Mapping Master configures DL Register - SyncManager channels for Process Data communication - FMMU channels Master requests 'Safe-Operational' state Wait for AL Status register confirmation
Safe-Operational (SafeOp)	Mailbox communication on AL Process Data communication (Only Inputs are valid) Drive remains in Safe state (Outputs are blocked)
SafeOp to Op (SO)	Master sends valid Outputs Master requests 'Operational' state (AL Control / Status) Wait for AL Status register confirmation
Operational (Op)	Inputs and Outputs are valid

Table 2.4.2

ESM state	Communication operation		
	send / receive SDO (Mailbox)	TxPDO	RxPDO
Init	-	-	-
PreOp	O	-	-
SafeOp	O	O	-
Op	O	O	O

Table 2.4.3 shows the relationship between PDS (Power Drive System) and ESM states.

Table 2.4.3

PDS \ ESM	Init	PreOp	SafeOp	Op
Not ready to switch on	O	-	-	O
Switch on disabled	O	O	O	O
Ready to switch on	-	O	O	O
Switched on	-	O	O	O
Operation enabled	-	O	O	O
Fault reaction active	O	O	O	O
Fault	O	O	O	O

Note:

1. When ESM state receives a transition command from PreOp, SafeOp and Op to Init, PDS state changes to Switched on disabled.
2. When PDS is at Operation enabled state but ESM changes to other states except Op, an error occurs and PDS state changes to Fault.
3. Change of PDS state has no effect on ESM state.

2.5 Synchronous mode

There are two types of synchronous mode, DC and FreeRun.

2.5.1 DC

The synchronization of EtherCAT communication is based on DC. The local cycle and the servo process of the drive are triggered by Sync0 event.

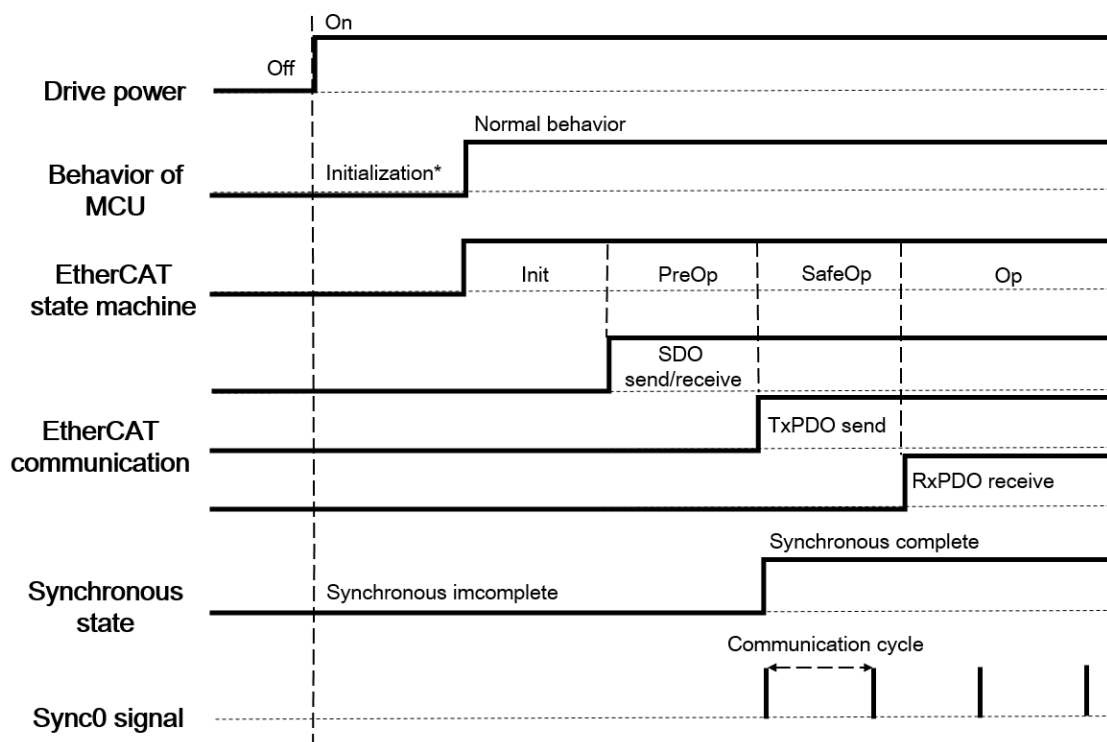


Figure 2.5.1.1

2.5.2 FreeRun

FreeRun is started by the local timer interrupt of the drive. The local cycle runs independently of the communication cycle and the master cycle.

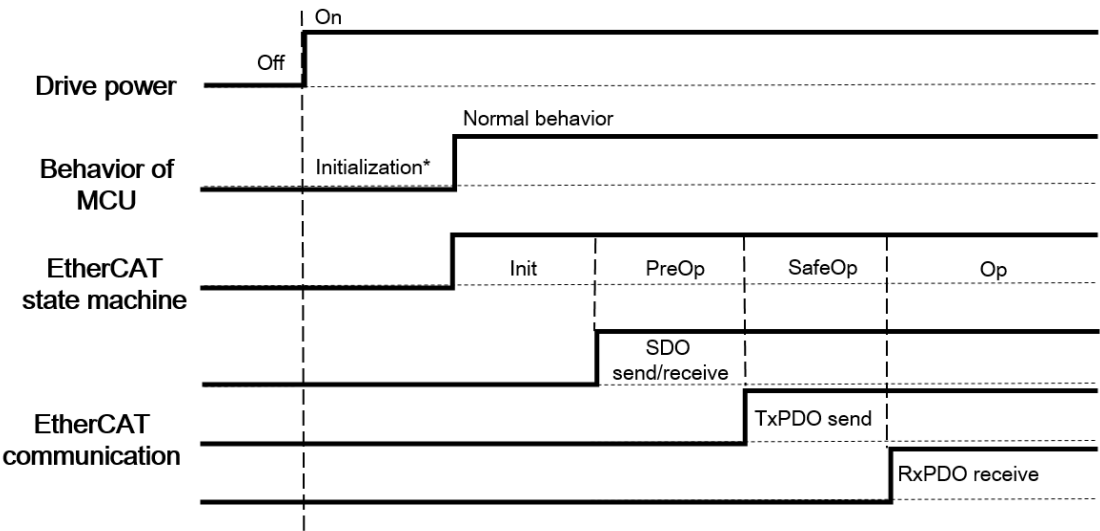


Figure 2.5.2.1

Note: In FreeRun mode, the PDO transmission interval should not be less than 250 μ s.

2.6 SDO abort code

When SDO communication error occurs, SDO abort code is returned. The supported SDO abort codes are listed in Table 2.6.1.

Table 2.6.1

Value	Description
06010000h	Unsupported access to an object
06010002h	Attempt to write to a read-only object
06020000h	The object does not exist in the object dictionary
06040042h	Number and length of the objects to be mapped would exceed PDO length
06090030h	Value range of parameter exceeded (only for write access)

2.7 Emergency message

When an error occurs, a slave notifies the master of the emergency message through the mailbox communication. An emergency message consists of 8 Bytes of data, as Table 2.7.1 shows.

Table 2.7.1

Byte	0	1	2	3	4	5	6	7
Description	Error code (603Fh) (L) (H)		Error register (1001h)	Reserved				

The validity or the invalidity of emergency message transmission can be set via 10F3h (diagnosis history). The default is validity.

Error code: the same value as 603Fh (error code)

Error register: the same value as the one in 1001h (error register)

2.8 PDO (Process Data Object)

The PDOs are used to transfer data during cyclic communication in realtime. RxPDOs receive data from the master. TxPDOs send status from the drive to the master. Objects updated by PDO are not updated by SDO.

2.8.1 PDO mapping object

Before using PDO communication, application objects should be mapped to the PDO mapping object. Each PDO mapping object can store up to ten application objects, and the maximum length of the PDO mapping object is 40 Bytes. In the object dictionary, index 1600h to 1603h are for RxPDOs, and index 1A00h to 1A03h are for TxPDOs. The content of PDO mapping object is defined as follows:

Bit	31	16	15	8	7	0	
	Object index				Subindex		Length

Bit 16 ~ 31: Index of PDO mapping object

Bit 8 ~ 15: Subindex of PDO mapping object

Bit 0 ~ 7: Size of PDO mapping object in bits

Note:

1. It is not allowed to write PDO mapping object in SafeOp or Op state. Otherwise, SDO abort code 0x06010002 will be returned.
2. If unsupported object is written to PDO mapping object, SDO abort code 0x06020000 will be returned.

An example of PDO mappings is shown in Figure 2.8.1.1. Three application objects (Obj A, Obj C and Obj F) are mapped to the PDO mapping object 1600h. Please refer to Section 3.1.1 for the default of each PDO mapping object.

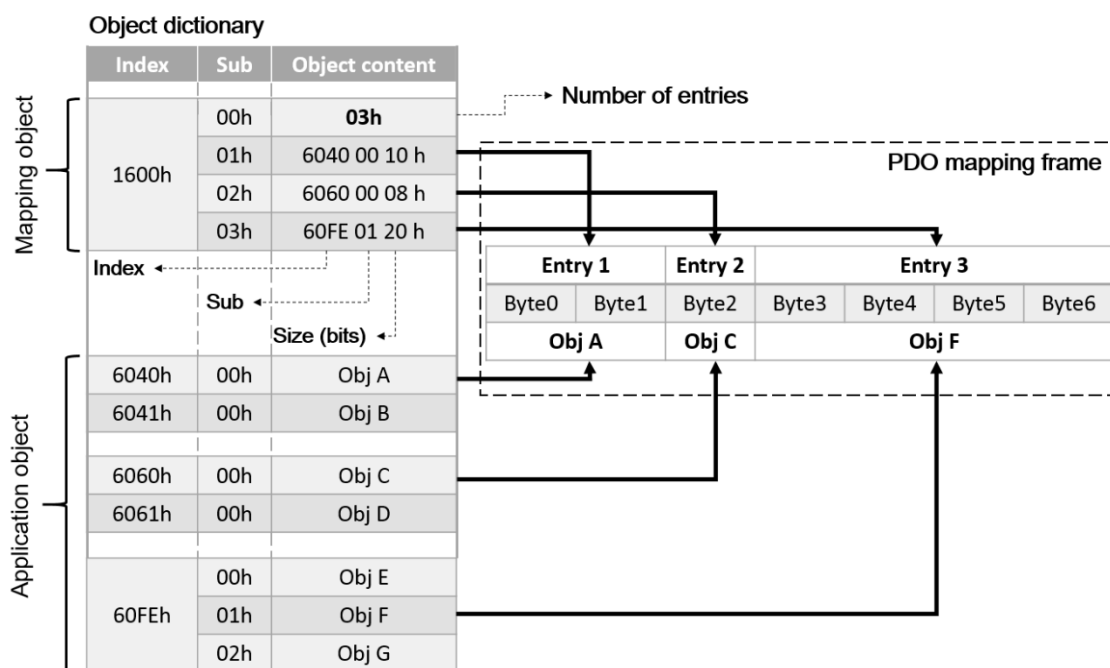


Figure 2.8.1.1

2.8.2 PDO assign object

Besides PDO mappings described above, it is also necessary to assign PDO mapping table in SyncManager. SyncManager PDO assignment objects describe the relationship between PDO mapping tables and SyncManagers.

In E series servo drive, 1C12h for RxPDO (SyncManager 2) and 1C13h for TxPDO (SyncManager 3) are set to be SyncManager assign objects. The maximum number of mapping objects can be mapped to an assign object is one. Please refer to Section 3.1.2 for the complete procedure of setting PDO mapping.

An example of SyncManager PDO assignment is shown in Figure 2.8.2.1. 1C12h is mapped to the assign object 1600h, which means the first set of the application objects will be used for RxPDO communication.

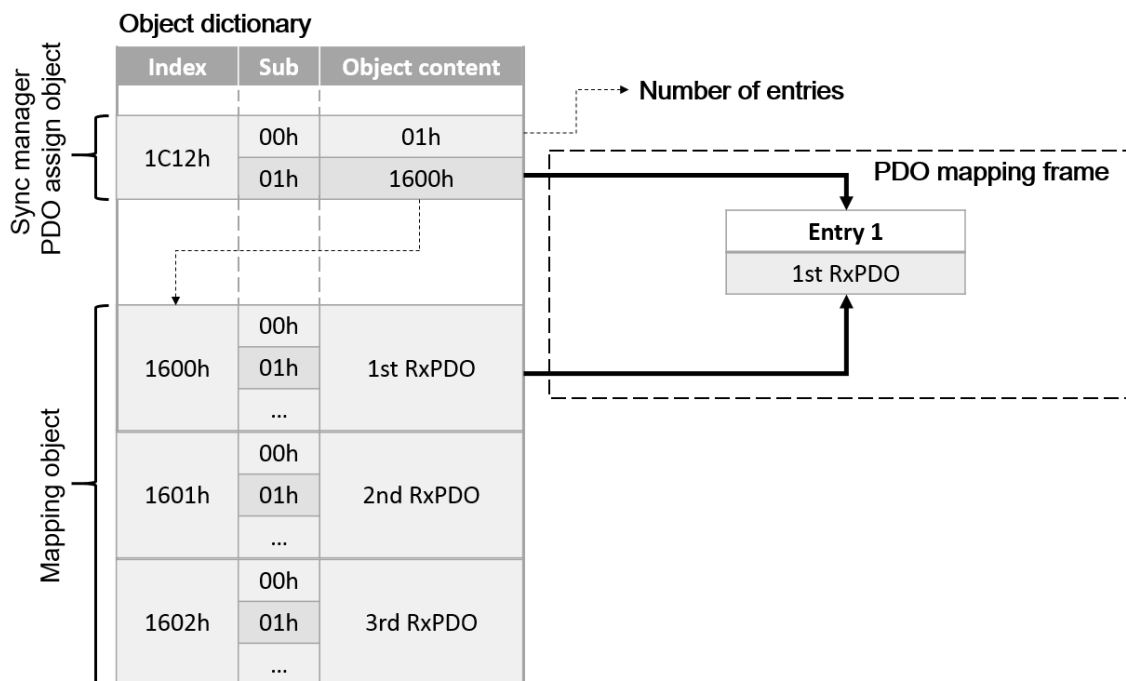


Figure 2.8.2.1

2.9 EtherCAT display and setting area

Figure 2.9.1 shows the EtherCAT display and setting area of E series servo drive.

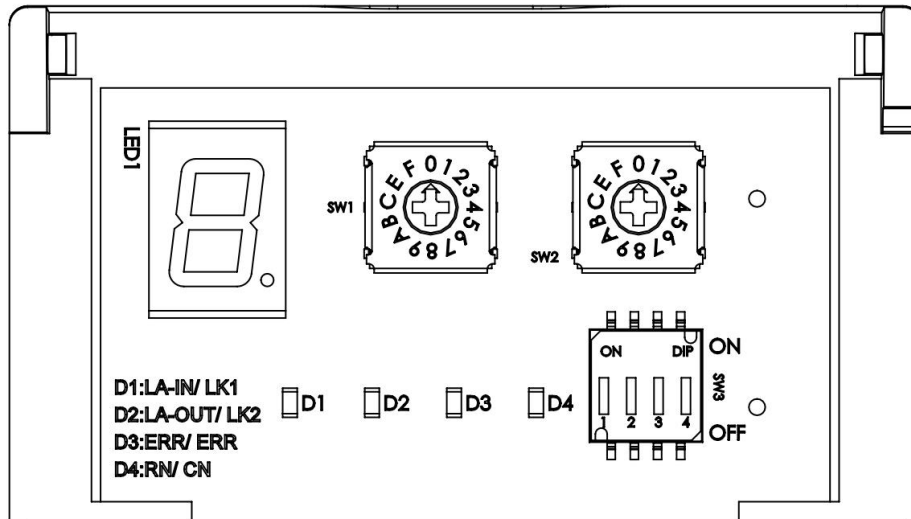


Figure 2.9.1

2.9.1 Node address setting

When communication starts, the master detect the slaves through auto-increment addressing. The slaves are accessed by the master according to the connection order (physical position). That being said, users can define station aliases to enable other network topologies.

The rotary switches are used to set the node address (station alias). The station alias is a unique ID for the master to specify the slave.

Note: If the station number of the rotary switches are not set, please finish the corresponding settings to the controller according to the serial connection order of the servo drive.

■ Station Alias Register (0012h)

The station alias is set in the ESC Configured Station Alias register (0012h) when power supply is on. The value of the register can be read as follows:

Configured station alias = (left set value) × 16 + (right set value)

Table 2.9.1.1

Node address switch setting	Description
00h	The node address is set by the controller.
01h~FFh	The node address switch setting is used as the node address.

Note: Do not change node address setting after control power-on.

2.9.2 EtherCAT indicators

There are four EtherCAT indicators (LED), RUN, ERR, L/A IN and L/A OUT, on E series EtherCAT drive. RUN indicator shows the status of ESM. ERR indicator shows the error status of EtherCAT communication. As for L/A IN and L/A OUT indicator, they show the physical link states and operation statuses of EtherCAT IN and OUT port. The states of each indicator are described in Table 2.9.2.1.

Table 2.9.2.1

Name	LED color	State	Description
RUN	Green	Off	Init
		Blinking	PreOp
		Single flash	SafeOp
		On	Op
ERR	Red	Off	No error
		Blinking	Communication setting error
		Single flash	Synchronization error
		Double flash	Application watchdog timer (WDT) timeout
L/A IN	Green	Flickering	Initialization error
		Off	Link not established in physical layer
		Flickering	In operation after establishing link
L/A OUT	Green	On	Link established in physical layer
		Off	Link not established in physical layer
		Flickering	In operation after establishing link
L/A OUT	Green	On	Link established in physical layer
		Off	Link not established in physical layer

The states of the indicators are shown in Figure 2.9.2.1.

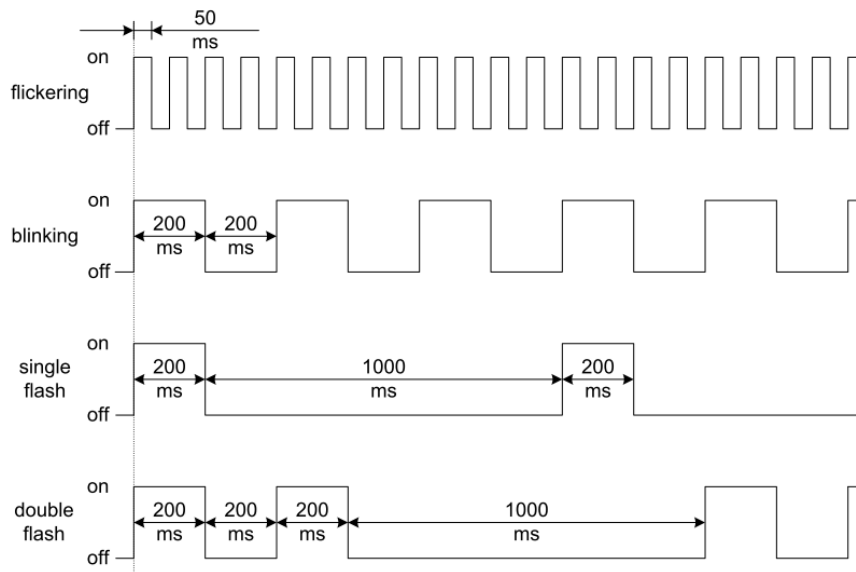


Figure 2.9.2.1

2.9.3 EtherCAT panel status display

Table 2.9.3.1

Display	Function Description
	Status of rotation detection output (TGON) signal Light up when the rotary velocity of the servo motor exceeds the setting value. (Set via Pt502 or Pt581. The default setting is 20 rpm or 20 mm/s.) Do not light up when the rotary velocity of the servo motor is below the setting value.
	Servo ready display Light up when servo OFF. Do not light up when servo ON.
	Display of command input Light up during command input.
	Display of connection Light up during connection.

2.10 EtherCAT related errors

In case of an EtherCAT communication error, the AL status code register (0134h:0135h) will be set. After the error is cleared, the AL status code will also be cleared. The AL status codes of E series servo drive are defined in Table 2.10.1.

Table 2.10.1

Code	Description	Current state / State change	Result state	ERR Indicator
0x0000	No error	Any	Current state	Off
0x0011	Invalid request state change	I→S, I→O, P→O, O→B, S→B, P→B	I + E, P + E, S + E	Blinking
0x0012	Unknown requested state	Any	I + E, P + E, S + E	Blinking
0x0013	Bootstrap not supported	I→B	I + E	Blinking
0x0016	Invalid mailbox configuration	I→P	I + E	Blinking
0x001A	Synchronization error	O, S→O	S + E	Single flash
0x001B	SyncManager watchdog	O, S	S + E	Double flash
0x001D	Invalid output configuration	O, S, P→S	P + E	Blinking
0x001E	Invalid input configuration	O, S, P→S	P + E	Blinking
0x0035	DC invalid sync cycle time	P→S	P + E	Blinking
0x8000	The drive is not in communication mode	Any	Init	Blinking

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3. Object dictionary

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Every object in the object dictionary is addressed by a 16-bit index and an 8-bit subindex. The standard object dictionary layout is shown in Table 3.1.

Table 3.1

Index	Description
0000h ~ 0FFFh	Data type
1000h ~ 1FFFh	Communication profile area
2000h ~ 5FFFh	Manufacturer specific profile area
6000h ~ 9FFFh	Standardized device profile area
A000h ~ FFFFh	Reserved

3.1 Communication profile area

Table 3.1.1

Index	Sub-Index	Name	Data type	Access	PDO	Valid value	Unit						
1000h	00h	Device type	U32	ro	-	0x00020192	-						
		The object displays device type and functionality. The value of a servo drive is 0x00020192.											
1001h	00h	Error register	U8	ro	-	0x0 ~ 0xFF	-						
		The error status of the drive. The value of this object is a part of an emergency message.											
		<table><tr><th>Bit</th><th>Descriptpon</th></tr><tr><td>0</td><td>Generic error 0: no error; 1: error</td></tr><tr><td>1~7</td><td>Always 0</td></tr></table>	Bit	Descriptpon	0	Generic error 0: no error; 1: error	1~7	Always 0					
		Bit	Descriptpon										
0	Generic error 0: no error; 1: error												
1~7	Always 0												
1010h	-	Store parameters	-	-	-	-	-						
	-	Save the parameter setting in non-volatile memory											
	00h	Number of entries	U8	ro	-	1	-						
	01h	Save all parameters	U32	rw	-	0x0 ~ 0xFFFFFFFF	-						
		Write 0x65766173 ("save") to save parameter setting in non-volatile memory. The saving process may take up to 10 seconds. If the object is read during parameter saving process, 0 will be returned. Otherwise, 1 will be returned. During parameter saving process, other SDO commands will be ignored.											
1011h	-	Restore default parameter	-	-	-	-	-						
	-	Initialize the parameters to default settings											
	00h	Number of entries	U8	ro	-	1	-						
	01h	Restore all default parameters	U32	rw	-	0x0 ~ 0xFFFFFFFF	-						
		Write 0x64616F6C ("load") to initilaize the parameters to default settings. The initializing process may take up to 10 seconds. If parameter initialization succeeds, 1 will be returned. Otherwise, 0 will be returned. After parameter initialization is completed, power on the drive again or reset the drive via object 3215h to make the initialized default settings become effective. During parameter initializing process, other SDO commands will be ignored. When the motor is enabled, parameter initialization is not allowed and failure will be reported.											
1018h	-	Identity object	-	-	-	-	-						
	-	Display device information											
	00h	Number of entries	U8	ro	-	4	-						
	01h	Vendor ID	U32	ro	-	0xAAAA	-						

		EtherCAT vendor ID. The value is 0xAAAA.																																	
	02h	Product code	U32	ro	-	0x05				-																									
		The product code of E series servo drive is 0x05.																																	
	03h	Revision number	U32	ro	-	0 ~ 4294967295				-																									
	04h	Serial number	U32	ro	-	0 ~ 4294967295				-																									
10F1h	-	Error settings	-	-	-	-				-																									
		Error setting for Sync error																																	
	00h	Number of entries	U8	ro	-	1				-																									
	02h	Sync error counter limit	U16	rw	-	0 ~ 15				-																									
		It is the process data reception failure threshold. If the value of the internal error counter in the drive exceeds the threshold, the drive will issue an error (AL status code 0x1A) and ESM state will change to SafeOp. The drive increases sync error counter by 3 in case of a missed a SM2 event, while it decreases sync error counter by 1 in case of a received SM2 event. An example of sync error counter is shown as follows.																																	
		<table><tr><td>SM2 event</td><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td></tr><tr><td>Sync error counter (Error counter limit = 9)</td><td>0</td><td>3</td><td>2</td><td>5</td><td>4</td><td>7</td><td>6</td><td>9</td><td>9</td><td>9</td><td>9</td></tr></table>										SM2 event	1	0	1	0	1	0	1	0	1	0	1	Sync error counter (Error counter limit = 9)	0	3	2	5	4	7	6	9	9	9	9
		SM2 event	1	0	1	0	1	0	1	0	1	0	1																						
Sync error counter (Error counter limit = 9)	0	3	2	5	4	7	6	9	9	9	9																								
If sync error counter limit is set to 0, the drive will not detect any missing SM2 event.																																			
1600h	-	1 st RxPDO mapping	-	-	-	-				-																									
		They are the mapping parameters of PDOs that the drive can receive. The value of the object can only be changed when ESM state is PreOp. If subindex 00h is not cleared as 0, subindex 01h to 08h cannot be changed.																																	
	00h	Number of entries	U8	rw	-	0 ~ 10				-																									
	01h	Mapping entry 1	U32	rw	-	0x0 ~ 0xFFFFFFFF				-																									
		It is the 1 st RxPDO object to be mapped. The content is defined as follows.																																	
		<table><tr><td>Bit</td><td>31</td><td>...</td><td>16</td><td>15</td><td>...</td><td>08</td><td>07</td><td>...</td><td>01</td></tr><tr><td></td><td colspan="3">Index number</td><td colspan="3">Subindex number</td><td colspan="3">Bit length</td></tr></table>										Bit	31	...	16	15	...	08	07	...	01		Index number			Subindex number			Bit length						
		Bit	31	...	16	15	...	08	07	...	01																								
		Index number			Subindex number			Bit length																											
	The same setting method applies to the rest of the mapping entries. Note: Mapping the same object to different mapping entries is not supported by the drive.																																		
	02h	Mapping entry 2	U32	rw	-	0x0 ~ 0xFFFFFFFF				-																									
	03h	Mapping entry 3	U32	rw	-	0x0 ~ 0xFFFFFFFF				-																									
	04h	Mapping entry 4	U32	rw	-	0x0 ~ 0xFFFFFFFF				-																									
	05h	Mapping entry 5	U32	rw	-	0x0 ~ 0xFFFFFFFF				-																									
	06h	Mapping entry 6	U32	rw	-	0x0 ~ 0xFFFFFFFF				-																									
	07h	Mapping entry 7	U32	rw	-	0x0 ~ 0xFFFFFFFF				-																									
08h	Mapping entry 8	U32	rw	-	0x0 ~ 0xFFFFFFFF				-																										
09h	Mapping entry 9	U32	rw	-	0x0 ~ 0xFFFFFFFF				-																										
0Ah	Mapping entry 10	U32	rw	-	0x0 ~ 0xFFFFFFFF				-																										
1601h	-	2 nd RxPDO mapping	-	-	-	-				-																									
		The specification is the same as that of 1 st RxPDO mapping object.																																	
	00h	Number of entries	U8	rw	-	0 ~ 10				-																									
	01h	Mapping entry 1	U32	rw	-	0x0 ~ 0xFFFFFFFF				-																									
	02h	Mapping entry 2	U32	rw	-	0x0 ~ 0xFFFFFFFF				-																									
	03h	Mapping entry 3	U32	rw	-	0x0 ~ 0xFFFFFFFF				-																									
	04h	Mapping entry 4	U32	rw	-	0x0 ~ 0xFFFFFFFF				-																									
	05h	Mapping entry 5	U32	rw	-	0x0 ~ 0xFFFFFFFF				-																									
	06h	Mapping entry 6	U32	rw	-	0x0 ~ 0xFFFFFFFF				-																									
	07h	Mapping entry 7	U32	rw	-	0x0 ~ 0xFFFFFFFF				-																									
	08h	Mapping entry 8	U32	rw	-	0x0 ~ 0xFFFFFFFF				-																									
	09h	Mapping entry 9	U32	rw	-	0x0 ~ 0xFFFFFFFF				-																									
	0Ah	Mapping entry 10	U32	rw	-	0x0 ~ 0xFFFFFFFF				-																									

1602h	-	3 rd RxPDO mapping	-	-	-	-	-																				
		The specification is the same as that of 1 st RxPDO mapping object.																									
	00h	Number of entries	U8	rw	-	0 ~ 10	-																				
	01h	Mapping entry 1	U32	rw	-	0x0 ~ 0xFFFFFFFF	-																				
	02h	Mapping entry 2	U32	rw	-	0x0 ~ 0xFFFFFFFF	-																				
	03h	Mapping entry 3	U32	rw	-	0x0 ~ 0xFFFFFFFF	-																				
	04h	Mapping entry 4	U32	rw	-	0x0 ~ 0xFFFFFFFF	-																				
	05h	Mapping entry 5	U32	rw	-	0x0 ~ 0xFFFFFFFF	-																				
	06h	Mapping entry 6	U32	rw	-	0x0 ~ 0xFFFFFFFF	-																				
	07h	Mapping entry 7	U32	rw	-	0x0 ~ 0xFFFFFFFF	-																				
	08h	Mapping entry 8	U32	rw	-	0x0 ~ 0xFFFFFFFF	-																				
	09h	Mapping entry 9	U32	rw	-	0x0 ~ 0xFFFFFFFF	-																				
	0Ah	Mapping entry 10	U32	rw	-	0x0 ~ 0xFFFFFFFF	-																				
1603h	-	4 th RxPDO mapping	-	-	-	-	-																				
		The specification is the same as that of 1 st RxPDO mapping object.																									
	00h	Number of entries	U8	rw	-	0 ~ 10	-																				
	01h	Mapping entry 1	U32	rw	-	0x0 ~ 0xFFFFFFFF	-																				
	02h	Mapping entry 2	U32	rw	-	0x0 ~ 0xFFFFFFFF	-																				
	03h	Mapping entry 3	U32	rw	-	0x0 ~ 0xFFFFFFFF	-																				
	04h	Mapping entry 4	U32	rw	-	0x0 ~ 0xFFFFFFFF	-																				
	05h	Mapping entry 5	U32	rw	-	0x0 ~ 0xFFFFFFFF	-																				
	06h	Mapping entry 6	U32	rw	-	0x0 ~ 0xFFFFFFFF	-																				
	07h	Mapping entry 7	U32	rw	-	0x0 ~ 0xFFFFFFFF	-																				
	08h	Mapping entry 8	U32	rw	-	0x0 ~ 0xFFFFFFFF	-																				
	09h	Mapping entry 9	U32	rw	-	0x0 ~ 0xFFFFFFFF	-																				
	0Ah	Mapping entry 10	U32	rw	-	0x0 ~ 0xFFFFFFFF	-																				
1A00h	-	1 st TxPDO mapping	-	-	-	-	-																				
		They are the mapping parameters of PDOs that the drive can transmit. The value of the object can only be changed when ESM state is PreOp. If subindex 00h is not cleared as 0, subindex 01h to 08h cannot be changed.																									
	00h	Number of entries	U8	rw	-	0 ~ 10	-																				
	01h	Mapping entry 1	U32	rw	-	0x0 ~ 0xFFFFFFFF	-																				
		It is the 1 st TxPDO object to be mapped. The content is defined as follows.																									
		<table><tr><td>Bit</td><td>31</td><td>...</td><td>16</td><td>15</td><td>...</td><td>08</td><td>07</td><td>...</td><td>01</td></tr><tr><td></td><td colspan="3">Index number</td><td colspan="3">Subindex number</td><td colspan="3">Bit length</td></tr></table>	Bit	31	...	16	15	...	08	07	...	01		Index number			Subindex number			Bit length							
		Bit	31	...	16	15	...	08	07	...	01																
		Index number			Subindex number			Bit length																			
	The same setting method applies to the rest of the mapping entries. Note: Mapping the same object to different mapping entries is not supported by the drive.																										
	02h	Mapping entry 2	U32	rw	-	0x0 ~ 0xFFFFFFFF	-																				
	03h	Mapping entry 3	U32	rw	-	0x0 ~ 0xFFFFFFFF	-																				
	04h	Mapping entry 4	U32	rw	-	0x0 ~ 0xFFFFFFFF	-																				
	05h	Mapping entry 5	U32	rw	-	0x0 ~ 0xFFFFFFFF	-																				
06h	Mapping entry 6	U32	rw	-	0x0 ~ 0xFFFFFFFF	-																					
07h	Mapping entry 7	U32	rw	-	0x0 ~ 0xFFFFFFFF	-																					
08h	Mapping entry 8	U32	rw	-	0x0 ~ 0xFFFFFFFF	-																					
09h	Mapping entry 9	U32	rw	-	0x0 ~ 0xFFFFFFFF	-																					
0Ah	Mapping entry 10	U32	rw	-	0x0 ~ 0xFFFFFFFF	-																					
1A01h	-	2 nd TxPDO mapping	-	-	-	-	-																				
		The specification is the same as that of 1 st TxPDO mapping object.																									
	00h	Number of entries	U8	rw	-	0 ~ 10	-																				

	01h	Mapping entry 1	U32	rw	-	0x0 ~ 0xFFFFFFFF	-
	02h	Mapping entry 2	U32	rw	-	0x0 ~ 0xFFFFFFFF	-
	03h	Mapping entry 3	U32	rw	-	0x0 ~ 0xFFFFFFFF	-
	04h	Mapping entry 4	U32	rw	-	0x0 ~ 0xFFFFFFFF	-
	05h	Mapping entry 5	U32	rw	-	0x0 ~ 0xFFFFFFFF	-
	06h	Mapping entry 6	U32	rw	-	0x0 ~ 0xFFFFFFFF	-
	07h	Mapping entry 7	U32	rw	-	0x0 ~ 0xFFFFFFFF	-
	08h	Mapping entry 8	U32	rw	-	0x0 ~ 0xFFFFFFFF	-
	09h	Mapping entry 9	U32	rw	-	0x0 ~ 0xFFFFFFFF	-
	0Ah	Mapping entry 10	U32	rw	-	0x0 ~ 0xFFFFFFFF	-
1A02h	-	3 rd TxPDO mapping	-	-	-	-	-
	The specification is the same as that of 1 st TxPDO mapping object.						
	00h	Number of entries	U8	rw	-	0 ~ 10	-
	01h	Mapping entry 1	U32	rw	-	0x0 ~ 0xFFFFFFFF	-
	02h	Mapping entry 2	U32	rw	-	0x0 ~ 0xFFFFFFFF	-
	03h	Mapping entry 3	U32	rw	-	0x0 ~ 0xFFFFFFFF	-
	04h	Mapping entry 4	U32	rw	-	0x0 ~ 0xFFFFFFFF	-
	05h	Mapping entry 5	U32	rw	-	0x0 ~ 0xFFFFFFFF	-
	06h	Mapping entry 6	U32	rw	-	0x0 ~ 0xFFFFFFFF	-
	07h	Mapping entry 7	U32	rw	-	0x0 ~ 0xFFFFFFFF	-
	08h	Mapping entry 8	U32	rw	-	0x0 ~ 0xFFFFFFFF	-
	09h	Mapping entry 9	U32	rw	-	0x0 ~ 0xFFFFFFFF	-
	0Ah	Mapping entry 10	U32	rw	-	0x0 ~ 0xFFFFFFFF	-
1A03h	-	4 th TxPDO mapping	-	-	-	-	-
	The specification is the same as that of 1 st TxPDO mapping object.						
	00h	Number of entries	U8	rw	-	0 ~ 10	-
	01h	Mapping entry 1	U32	rw	-	0x0 ~ 0xFFFFFFFF	-
	02h	Mapping entry 2	U32	rw	-	0x0 ~ 0xFFFFFFFF	-
	03h	Mapping entry 3	U32	rw	-	0x0 ~ 0xFFFFFFFF	-
	04h	Mapping entry 4	U32	rw	-	0x0 ~ 0xFFFFFFFF	-
	05h	Mapping entry 5	U32	rw	-	0x0 ~ 0xFFFFFFFF	-
	06h	Mapping entry 6	U32	rw	-	0x0 ~ 0xFFFFFFFF	-
	07h	Mapping entry 7	U32	rw	-	0x0 ~ 0xFFFFFFFF	-
	08h	Mapping entry 8	U32	rw	-	0x0 ~ 0xFFFFFFFF	-
	09h	Mapping entry 9	U32	rw	-	0x0 ~ 0xFFFFFFFF	-
	0Ah	Mapping entry 10	U32	rw	-	0x0 ~ 0xFFFFFFFF	-
1C00h	-	SyncManager communication type	-	-	-	-	-
	Set the communication type of each SyncManager (SM).						
	00h	Number of entries	U8	ro	-	4	-
	01h	Communication type SyncManager 0	U8	ro	-	1	-
		SM0 is responsible for receiving data through Mailbox. The value is 1.					
	02h	Communication type SyncManager 1	U8	ro	-	2	-
		SM1 is responsible for sending data through Mailbox. The value is 2.					
	03h	Communication type SyncManager 2	U8	ro	-	3	-
		SM2 is responsible for process data output (RxPDO). The value is 3.					
	04h	Communication type SyncManager 3	U8	ro	-	4	-
		SM3 is responsible for process data input (TxPDO). The value is 4.					

1C12h	-	SyncManager 2 PDO assignment	-	-	-	-	-																	
	-	It is the PDO mapping object entry for SM2, which is responsible for process data output (RxPDO). The value of the object can only be changed when ESM state is PreOp. If subindex 00h is not cleared as 0, subindex 01h to 08h cannot be changed.																						
	00h	Number of assigned PDOs	U8	rw	-	0 ~ 1	-																	
	01h	Index of assigned RxPDO 1	U16	rw	-	1600h ~ 1603h	-																	
		RxPDO mapping object index																						
1C13h	-	SyncManager 3 PDO assignment	-	-	-	-	-																	
	-	It is the PDO mapping object entry for SM3, which responsible is for process data input (TxPDO). The value of the object can only be changed when ESM state is PreOp. If subindex 00h is not cleared as 0, subindex 01h to 08h cannot be changed.																						
	00h	Number of assigned PDOs	U8	rw	-	0 ~ 1	-																	
	01h	Index of assigned TxPDO 1	U16	rw	-	1A00h ~ 1A03h	-																	
		TxPDO mapping object index																						
1C32h	-	SyncManager 2 synchronization	-	-	-	-	-																	
	00h	Number of synchronization parameters	U8	ro	-	12	-																	
	01h	Synchronization type	U16	ro	-	0 ~ 2	-																	
		Mode of SM2 synchronization 0: FreeRun (not synchronized) 2: DC Sync0 (synchronized with Sync0 event)																						
	02h	Cycle time	U32	ro	-	250000 ~ 4000000	ns																	
		It is the communication cycle of SM. The value is defined as follows.																						
		<table><tr><td>Sync mode</td><td>Description</td></tr><tr><td>FreeRun</td><td>The local cycle time of the application controller</td></tr><tr><td>DC Sync0</td><td>Sync0 cycle time (09A0h~09A3h)</td></tr></table>						Sync mode	Description	FreeRun	The local cycle time of the application controller	DC Sync0	Sync0 cycle time (09A0h~09A3h)											
	Sync mode	Description																						
	FreeRun	The local cycle time of the application controller																						
	DC Sync0	Sync0 cycle time (09A0h~09A3h)																						
	04h	Synchronization types supported	U16	ro	-	5	-																	
		The bits corresponding to the supported synchronization modes are set to 1. The meaing of each bit is defined as follows.																						
		<table><tr><td>Bit</td><td>Description</td></tr><tr><td>0</td><td>FreeRun</td><td>The bit is 1.</td></tr><tr><td>1</td><td>SM synchronous mode</td><td>The bit is 0.</td></tr><tr><td>2~4</td><td>DC synchronous mode</td><td>001b: DC Sync0 event supported</td></tr><tr><td>5~6</td><td>output shift support</td><td>00b: not supported</td></tr><tr><td>7~15</td><td>reserved</td><td></td></tr></table>						Bit	Description	0	FreeRun	The bit is 1.	1	SM synchronous mode	The bit is 0.	2~4	DC synchronous mode	001b: DC Sync0 event supported	5~6	output shift support	00b: not supported	7~15	reserved	
		Bit	Description																					
		0	FreeRun	The bit is 1.																				
		1	SM synchronous mode	The bit is 0.																				
	2~4	DC synchronous mode	001b: DC Sync0 event supported																					
	5~6	output shift support	00b: not supported																					
	7~15	reserved																						
05h	Minimum cycle time	U32	ro	-	187500	ns																		
	Minimum cycle time supported by slaves																							
06h	Calc and copy time	U32	ro	-	31250	ns																		
	Minimum time for outputs to sync event. Used in DC mode																							
09h	Delay time	U32	ro	-	31250	ns																		
	Hardware delay time of the slaves																							
0Ch	Cycle time too small	U16	ro	-	0	-																		
	This error counter increases when the cycle time is too small. Therefore, local cycle cannot be completed and input data cannot be provided before the next SM event. Used in DC Mode.																							
1C33h	-	SyncManager 3 synchronization	-	-	-	-	-																	
	00h	Number of synchronization parameters	U8	ro	-	10	-																	
	01h	Synchronization type	U16	ro	-	0 ~ 2	-																	
		Mode of SM3 synchronization 0: FreeRun (not synchronized) 2: DC Sync0 (synchronized with Sync0 event)																						
	02h	Cycle time	U32	ro	-	250000 ~ 4000000	ns																	
		the same as 1C32:02h																						
	04h	Synchronization types supported	U16	ro	-	5	-																	
the same as 1C32:04h																								

	05h	Minimum cycle time	U32	ro	-	187500	ns
		the same as 1C32:05h					
	06h	Calc and copy time	U32	ro	-	31250	ns
		Minimum time for Inputs after Input Latch					
	09h	Delay time	U32	ro	-	-	ns
		the same as 1C32:09h					
	0Ch	Cycle time too small	U16	ro	-	0	-
		the same as 1C32:0Ch					

3.1.1 Default PDO mapping

The definition of the default PDO mapping in E series servo drive is described as follows.

■ PDO mapping 1 (csp, touch probe, torque limit)

Table 3.1.1.1

	Subindex	Value	Name
RxPDO (1600h)	01h	60400010h	Controlword
	02h	60600008h	Modes of operation
	03h	607A0020h	Target position
	04h	60B80010h	Touch probe function
	05h	60FE0120h	Digital outputs: physical output
TxPDO (1A00h)	01h	603F0010h	Error code
	02h	60410010h	Statusword
	03h	60610008h	Modes of operation display
	04h	60640020h	Position actual value
	05h	60B90010h	Touch probe status
	06h	60BA0020h	Touch probe 1 positive edge
	07h	60F40020h	Following error actual value
	08h	60FD0020h	Digital inputs

■ PDO mapping 2 (csv)

Table 3.1.1.2

	Subindex	Value	Name
RxPDO (1601h)	01h	60400010h	Controlword
	02h	60600008h	Modes of operation
	03h	60FF0020h	Target velocity
	04h	60FE0120h	Digital outputs: physical output
TxPDO (1A01h)	01h	603F0010h	Error code
	02h	60410010h	Statusword
	03h	60610008h	Modes of operation display
	04h	60640020h	Position actual value
	05h	606C0020h	Velocity actual value
	06h	60770010h	Torque actual value
	07h	60FD0020h	Digital inputs

■ PDO mapping 3 (cst)

Table 3.1.1.3

	Subindex	Value	Name
RxPDO (1602h)	01h	60400010h	Controlword
	02h	60600008h	Modes of operation
	03h	60710010h	Target torque
	04h	60FE0120h	Digital outputs: physical output
TxPDO (1A02h)	01h	603F0010h	Error code
	02h	60410010h	Statusword
	03h	60610008h	Modes of operation display
	04h	60640020h	Position actual value
	05h	606C0020h	Velocity actual value
	06h	60770010h	Torque actual value
	07h	60FD0020h	Digital inputs

■ PDO mapping 4 (position, velocity, torque, torque limit, touch probe)

Table 3.1.1.4

	Subindex	Value	Name
RxPDO (1603h)	01h	60400010h	Controlword
	02h	60600008h	Modes of operation
	03h	60710010h	Target torque
	04h	607A0020h	Target position
	05h	60B80010h	Touch probe function
	06h	60FF0020h	Target velocity
	07h	60FE0120h	Digital outputs: physical output
TxPDO (1A03h)	01h	60410010h	Statusword
	02h	60610008h	Modes of operation display
	03h	60640020h	Position actual value
	04h	606C0020h	Velocity actual value
	05h	60770010h	Torque actual value
	06h	60B90010h	Touch probe status
	07h	60BA0020h	Touch probe 1 positive edge
	08h	60FD0020h	Digital inputs

3.1.2 Mapping objects to PDO

The procedure of setting PDO mapping is described as follows.

Step 1. Set ESM state to PreOp.

Step 2. Disable PDO mapping assignment. Set subindex 00h of object 1C12h and 1C13h to 0.

Step 3. Set the number of mapping entries for PDO mapping object 1600h~1603h and 1A00h~1A03h to 0.

Step 4. Set all of the mapping entries for PDO mapping object 1600h~1603h and 1A00h~1A03h.

Step 5. Set the assigned PDO mapping object. Set subindex 1 of object 1C12h and 1C13h.

Step 6. Enable PDO mapping assignment. Set subindex 0 of object 1C12h and 1C13h to 1.

Step 7. Set ESM state from PreOp to SafeOp. TxPDO will be effective.

Step 8. Set ESM state from SafeOp to Op. RxPDO will be effective.

Note:

1. The PDO mapping settings will be checked after Step 6. If the mapped objects exceeds the maximum number of PDO mapping objects or maximum PDO data length, SDO abort code 0x06040042 will be returned.
2. It is not allowed to write PDO mapping object in SafeOp or Op state. Otherwise, SDO abort code 0x06010002 will be returned.
3. If unsupported object is written to PDO mapping object, SDO abort code 0x06020000 will be returned.

An example of adding object 607Fh to 1600h and using 1600h as the assigned RxPDO is explained as follows.

Before change (default setting)

Table 3.1.2.1

	Subindex	Value	Name
RxPDO (1600h)	01h	60400010h	Controlword
	02h	60600008h	Modes of operation
	03h	607A0020h	Target position
	04h	60B80010h	Touch probe function
	05h	60FE0120h	Digital outputs: physical output

After change

Table 3.1.2.2

	Subindex	Value	Name
RxPDO (1600h)	01h	60400010h	Controlword
	02h	60600008h	Modes of operation
	03h	607A0020h	Target position
	04h	60B80010h	Touch probe function
	05h	60FE0120h	Digital outputs: physical output
	06h	607F0020h	Max profile velocity

- Step 1. Set ESM state to PreOp.
- Step 2. Disable PDO mapping assignment. Set 1C12:00h to 0.
- Step 3. Set 1600:00h to 0.
- Step 4. Set the value of 1600:06h to 607F0020h. Then, set 1600:00h to 6.
- Step 5. Set the value of 1C12:01h to 1600h.
- Step 6. Set 1C12:00h to 1 to enable PDO mapping assignment.
- Step 7. Set ESM state from PreOp to SafeOp. TxPDO will be effective.
- Step 8. Set ESM state from SafeOp to Op. RxPDO will be effective.

3.1.3 PDO data exchange timing

Figure 3.1.3.1 shows an example of PDO exchange between the master and the slaves in DC synchronous mode.

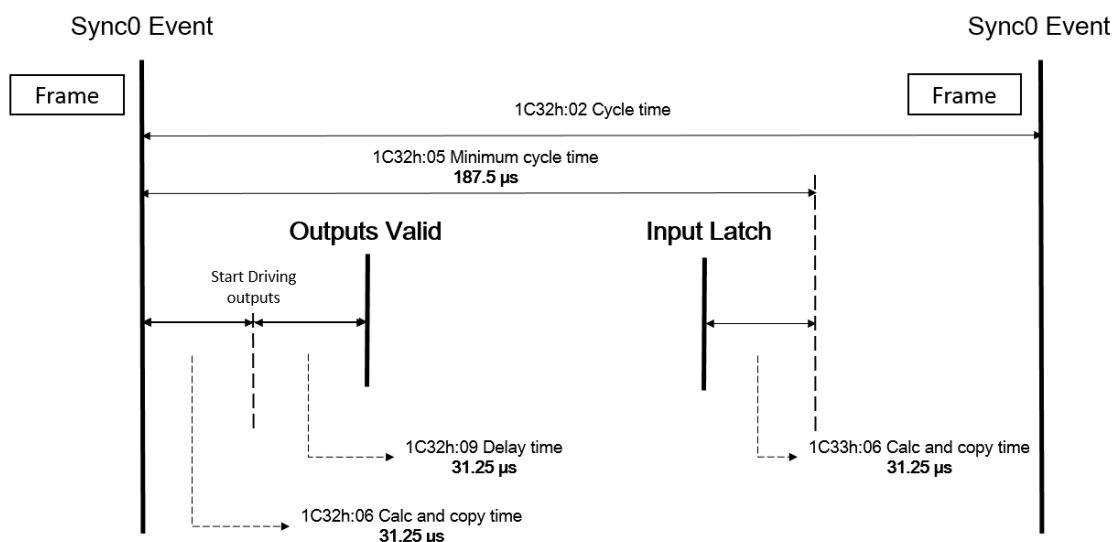


Figure 3.1.3.1

Figure 3.1.3.2 shows an example of PDO exchange between the master and the slaves in FreeRun (DC unused) mode.

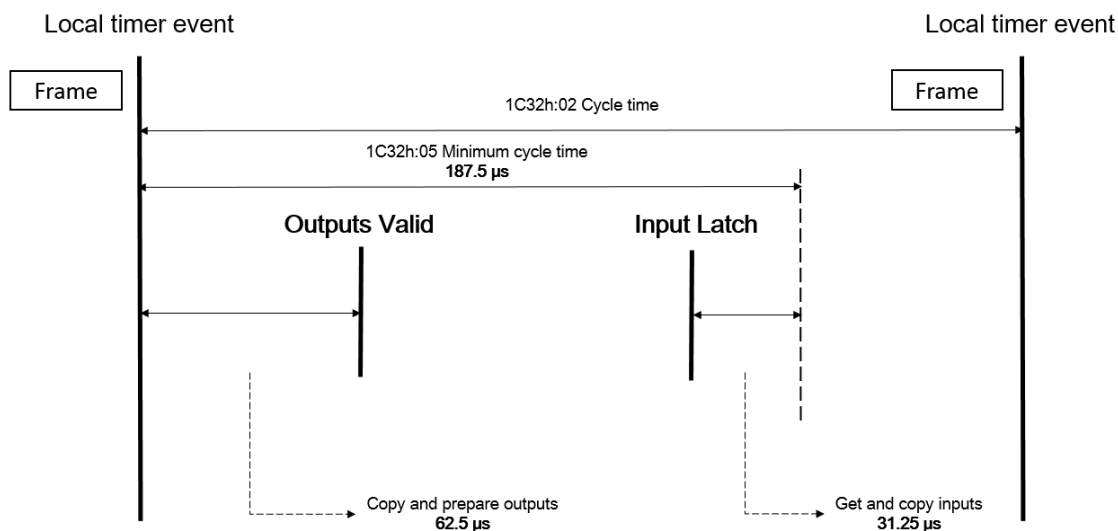


Figure 3.1.3.2

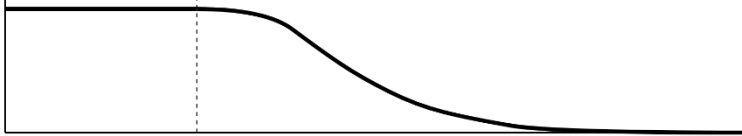
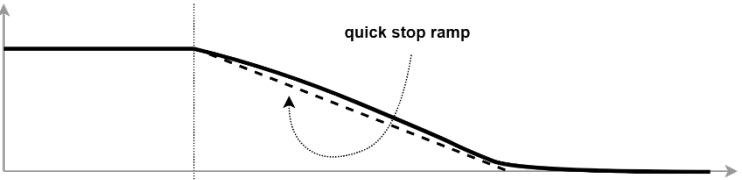
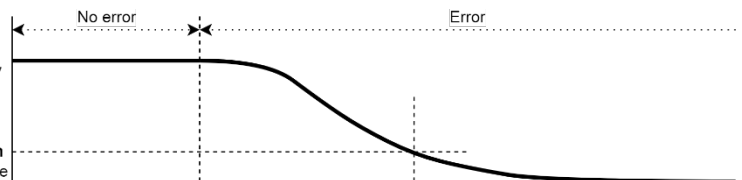
3.2 Standardized device profile area

Table 3.2.1

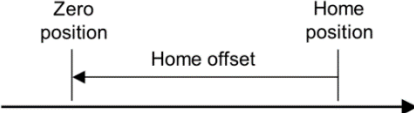
Index	Sub-Index	Name	Data type	Access	PDO	Valid value	Unit
603Fh	00h	Error code	U16	ro	Y	0x0 ~ 0xFFFF	-
		Display the last error that occurs. The value of the error code is FF**h, where ** is the error code from E series servo drive. Take FF10h as an example. 10h = 16d → Error 16 occurs.					
		0x603F Error Code mapping table					
		0x603F Error Code (hex)	Alarm No.	Alarm Name			
		FF04	AL.024	System alarm 1			
		FF05	AL.025	System alarm 2			
		FF06	AL.030	Main circuit detector error			
		FF07	AL.040	Parameter setting error			
		FF0B	AL.050	Combination error			
		FF0C	AL.070	Motor type change detected			
		FF0E	AL.0b0	Invalid Servo ON command alarm			
		FF0F	AL.100	Over current detected			
		FF10	AL.320	Regenerative overload			
		FF11	AL.400	Over voltage			
		FF12	AL.410	Under voltage			
		FF13	AL.510	Over speed			
		FF14	AL.511	Encoder output pulse overspeed			
		FF18	AL.710	Instantaneous overload			
		FF19	AL.720	Continuous overload			
		FF1D	AL.7A1	Drive overload			
		FF1E	AL.7A2	Internal overheat error 2 (power board)			
		FF21	AL.800	Data backup error			
		FF22	AL.810	Battery error			
		FF23	AL.820	Encoder com. error			
		FF24	AL.830	Encoder data error			
		FF25	AL.840	Encoder crc error			
		FF26	AL.850	Encoder counting error			
		FF27	AL.860	Write data fail error			
		FF28	AL.870	Encoder over heat error			
		FF29	AL.880	Encoder sensor phase error (AqB)			
		FF2A	AL.890	ESC ALM - Incremental encoder cable not connected			
		FF2B	AL.8A0	ESC ALM - CH1 ESC side error			
		FF2C	AL.8b0	ESC ALM - CH1 Encoder side error			
		FF2D	AL.8C0	ESC ALM - CH2 ESC side error			
		FF2E	AL.8d0	ESC ALM - CH2 Encoder side error			
		FF2F	AL.8E0	Digital encoder cable not connected			
		FF30	AL.8F0	ESC ALM - Internal fault			
		FF31	AL.861	Motor overheated			
		FF32	AL.b10	Speed reference A/D error			
		FF34	AL.b20	Torque reference A/D error			
		FF35	AL.b33	Current detection error			
		FF36	AL.C10	Servomotor out of control			
		FF37	AL.C20	Phase detection error			
		FF38	AL.C21	Polarity sensor error (Hall sensor)			
		FF3A	AL.C50	Polarity detection failure			
		FF3B	AL.C51	Overtravel detected during polarity detection			
		FF3C	AL.C52	Polarity detection not completed			
		FF3E	AL.d00	Position error too big			
		FF41	AL.d10	Hybrid deviation error (motor to load)			
		FF42	AL.Eb0	Safety function alarm			
		FF43	AL.Eb1	Safety function signal input timing error			
		FF44	AL.Eb2	Safety function self-check error			
		FF45	AL.F10	Power supply line open phase			
		FF46	AL.F50	Servomotor main circuit cable disconnection (motor maybe disconnected)			
		FF47	AL.FA0	Power supply for encoder error (5V card fail)			
		FF48	AL.FB0	FieldBus Hardware Fault			
		FF49	AL.FB1	FieldBus Communication Fault			

Index	Sub-Index	Name	Data type	Access	PDO	Valid value	Unit																																														
		<table><tr><td>FF4A</td><td>AL.FC0</td><td>Group Communication Fault</td></tr><tr><td>FF4B</td><td>AL.FC1</td><td>Gantry system slave alarm</td></tr><tr><td>FF4C</td><td>AL.891</td><td>Incremental encoder signal error</td></tr><tr><td>FF4D</td><td>AL.FB2</td><td>Fieldbus communication setup error</td></tr><tr><td>FF4F</td><td>AL.Fd0</td><td>Electronic cam control system alarm</td></tr><tr><td>FF50</td><td>AL.EF9</td><td>Multi-motion alarm</td></tr></table>	FF4A	AL.FC0	Group Communication Fault	FF4B	AL.FC1	Gantry system slave alarm	FF4C	AL.891	Incremental encoder signal error	FF4D	AL.FB2	Fieldbus communication setup error	FF4F	AL.Fd0	Electronic cam control system alarm	FF50	AL.EF9	Multi-motion alarm																																	
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FF50	AL.EF9	Multi-motion alarm																																																			
6040h	00h	Controlword	U16	rw	Y	0x0 ~ 0xFFFF	-																																														
		The object controls the drive's PDS state transition and the specific commands in operation mode. The details of the bits are described as follows.																																																			
		<table><tr><td>15 ... 10</td><td>9</td><td>8</td><td>7</td><td>6 ... 4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr><tr><td>N/A</td><td>Op mode specific</td><td>halt</td><td>Fault reset</td><td>Op mode specific</td><td>Enable operation</td><td>Quick stop</td><td>Enable voltage</td><td>Switch on</td></tr></table>							15 ... 10	9	8	7	6 ... 4	3	2	1	0	N/A	Op mode specific	halt	Fault reset	Op mode specific	Enable operation	Quick stop	Enable voltage	Switch on																											
		15 ... 10	9	8	7	6 ... 4	3	2	1	0																																											
		N/A	Op mode specific	halt	Fault reset	Op mode specific	Enable operation	Quick stop	Enable voltage	Switch on																																											
		Bit 8 (halt): If it is set to 1, the motor decelerates and stops according to object 605Dh (halt option code). Setting the bit to 0 will resume the halt operation. It is only applicable in pp, pv, tq and hm mode.																																																			
		Bit 7, 3~0: PDS commands. The codes of the commands are described in Section 3.2.1 PDS (Power Drive System).																																																			
		Bit 9, 6~4 (operation mode specific): The availability of each bit in each mode is listed as follows.																																																			
		<table><tr><td>Op mode</td><td>9</td><td>6</td><td>5</td><td>4</td></tr><tr><td>fc</td><td>-</td><td>-</td><td>-</td><td>-</td></tr><tr><td>pp</td><td>change on set-point</td><td>absolute / relative</td><td>change set immediately</td><td>new set-point</td></tr><tr><td>pv</td><td>-</td><td>-</td><td>-</td><td>-</td></tr><tr><td>tq</td><td>-</td><td>-</td><td>-</td><td>-</td></tr><tr><td>hm</td><td>-</td><td>-</td><td>-</td><td>homing operation start</td></tr><tr><td>csp</td><td>-</td><td>-</td><td>-</td><td>-</td></tr><tr><td>csv</td><td>-</td><td>-</td><td>-</td><td>-</td></tr><tr><td>cst</td><td>-</td><td>-</td><td>-</td><td>-</td></tr></table>							Op mode	9	6	5	4	fc	-	-	-	-	pp	change on set-point	absolute / relative	change set immediately	new set-point	pv	-	-	-	-	tq	-	-	-	-	hm	-	-	-	homing operation start	csp	-	-	-	-	csv	-	-	-	-	cst	-	-	-	-
		Op mode	9	6	5	4																																															
fc	-	-	-	-																																																	
pp	change on set-point	absolute / relative	change set immediately	new set-point																																																	
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csp	-	-	-	-																																																	
csv	-	-	-	-																																																	
cst	-	-	-	-																																																	
6041h	00h	Statusword	U16	ro	Y	0 ~ FFFFh	-																																														
		The object provides the status of PDS FSA and the specific information in operation mode. The details of the bits are described as follows.																																																			
		<table><tr><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td><td>7</td></tr><tr><td>Reserved</td><td>Op mode specific</td><td>Internal limit active</td><td>Target reached</td><td>Remote</td><td>Reserved</td><td>Warning</td><td></td><td></td></tr><tr><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td><td></td><td></td></tr><tr><td>Switch on disabled</td><td>Quick stop</td><td>Voltage enabled</td><td>Fault</td><td>Operation enabled</td><td>Switched on</td><td>Ready to Switch on</td><td></td><td></td></tr></table>							15	14	13	12	11	10	9	8	7	Reserved	Op mode specific	Internal limit active	Target reached	Remote	Reserved	Warning			6	5	4	3	2	1	0			Switch on disabled	Quick stop	Voltage enabled	Fault	Operation enabled	Switched on	Ready to Switch on											
		15	14	13	12	11	10	9	8	7																																											
		Reserved	Op mode specific	Internal limit active	Target reached	Remote	Reserved	Warning																																													
		6	5	4	3	2	1	0																																													
		Switch on disabled	Quick stop	Voltage enabled	Fault	Operation enabled	Switched on	Ready to Switch on																																													
		Bit 6, 5, 3~0: PDS states. The codes of the states are described in Section 3.2.1 PDS (Power Drive System).																																																			
		Bit 4 (voltage enabled): If the main power normal input is normal, the bit should be 1.																																																			
		Bit 5 (quick stop): If PDS is reacting on a quick stop request, the bit is set to 0.																																																			
Bit 7 (warning): If the bit is 1, it indicates a warning occurs. PDS does not change and the operation of the motor continues during warning (no error occurs).																																																					
Bit 9 (remote): Controlword is processed if the bit is set to 1. It will be set to 1 after ESM state becomes PreOp (SDO available).																																																					
Bit 10 (target reached):																																																					
<table><tr><td>Value</td><td>Definition</td></tr><tr><td rowspan="2">0</td><td>Halt (Bit 8 in controlword) = 0: target not reached</td></tr><tr><td>Halt = 1: axis decelerates</td></tr><tr><td rowspan="2">1</td><td>Halt = 0: target reached</td></tr><tr><td>Halt = 1: axis stops (velocity = 0)</td></tr></table>							Value	Definition	0	Halt (Bit 8 in controlword) = 0: target not reached	Halt = 1: axis decelerates	1	Halt = 0: target reached	Halt = 1: axis stops (velocity = 0)																																							
Value	Definition																																																				
0	Halt (Bit 8 in controlword) = 0: target not reached																																																				
	Halt = 1: axis decelerates																																																				
1	Halt = 0: target reached																																																				
	Halt = 1: axis stops (velocity = 0)																																																				
Bit 11 (internal limit active): The bit is set to 1 if one of the following conditions occurs.																																																					
<table><tr><td colspan="2">Op mode</td><td>Condition</td><td>Servo on / off</td></tr><tr><td rowspan="3">Position control</td><td rowspan="3">pp, csp</td><td>Software limit</td><td>on / off</td></tr><tr><td>Hardware limit</td><td>on / off</td></tr><tr><td>Torque limit</td><td>on</td></tr></table>							Op mode		Condition	Servo on / off	Position control	pp, csp	Software limit	on / off	Hardware limit	on / off	Torque limit	on																																			
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Position control	pp, csp	Software limit	on / off																																																		
		Hardware limit	on / off																																																		
		Torque limit	on																																																		

Index	Sub-Index	Name		Data type	Access	PDO	Valid value	Unit	
				Interpolation speed exceeded in csp		on			
			hm	Torque limit		on			
		Velocity control	pv, csv	Hardware limit		on / off			
				Torque limit		on			
		Torque control	tq, cst	Hardware limit		on / off			
				Torque limit		on			
		Bit 13, 12, 10 (operation mode specific): The availability of each bit in each mode is listed below.							
		Op mode	13	12	10				
		fc	-	drive follows command value		-			
		pp	following error	set-point acknowledge		target reached			
pv	max slippage error	speed		target reached					
tq	-	-		target reached					
hm	homing error	homing attained		target reached					
csp	following error	drive follows command value		target reached					
csv	-	drive follows command value		target reached					
cst	-	drive follows command value		target reached					
605Ah	00h	Quick stop option code			I16	rw	-	2	-
		The object indicates the action when quick stop function is executed. E series servo drive only supports <u>option 2: slow down</u> according to 6085h (quick stop deceleration). PDS state changes to Switch on disabled.							
605Bh	00h	Shutdown option code			I16	rw	-	0	-
		The object indicates the action when PDS state transits from Operation enabled to Ready to switch on. E series servo drive only supports <u>option 0: Disable drive function</u> . PDS state changes to Ready to switch on.							
605Ch	00h	Disable operation option code			I16	rw	-	0	-
		The object indicates the action when PDS state transits from Operation enabled to Switched on. E series servo drive only supports <u>option 0: Disable drive function</u> . PDS state changes to Switched on.							

Index	Sub-Index	Name	Data type	Access	PDO	Valid value	Unit																														
		Actual velocity  6040_h Enable operation Disable operation PDS state Operation enabled Switched on																																			
605Dh	00h	Halt option code I16rw-1, 2- The object indicates the action when halt function is executed. E series servo drive only supports <u>option 2: Slow down</u> on quick stop ramp. PDS state stays in Operation enabled. Note: Only pp mode can set the object to 1. The motor will be stopped according to 6084h (profile deceleration). Actual velocity  6040_h Enable operation Halt PDS state Operation enabled	I16	rw	-	1, 2	-																														
605Eh	00h	Fault reaction option code I16rw-0 ~ 2- The object indicates the action during Fault reaction. The supported values are described as follows. 0: Disable drive function. The motor is free to rotate. 2: Slow down according to 6085h (quick stop deceleration). PDS state changes to Fault. Actual velocity  2507_h Velocity to trigger brake 6040_h Enable operation Disable operation PDS state Operation enabled Fault reaction active Fault	I16	rw	-	0 ~ 2	-																														
6060h	00h	Modes of operation I8rwY-2 ~ 10- Set the operation mode of the drive. The supported operation modes are listed as follows. <table><thead><tr><th>Value</th><th>Op mode</th><th>abbreviation</th></tr></thead><tbody><tr><td>-2</td><td>force control</td><td>fc</td></tr><tr><td>0</td><td>no mode change / assigned</td><td>-</td></tr><tr><td>1</td><td>profile position</td><td>pp</td></tr><tr><td>3</td><td>profile velocity</td><td>pv</td></tr><tr><td>4</td><td>profile torque</td><td>tq</td></tr><tr><td>6</td><td>homing</td><td>hm</td></tr><tr><td>8</td><td>cyclic synchronous position</td><td>csp</td></tr><tr><td>9</td><td>cyclic synchronous velocity</td><td>csv</td></tr><tr><td>10</td><td>cyclic synchronous torque</td><td>cst</td></tr></tbody></table> The default value is 0. If the object is set to 0 or an unsupported value, there will be no mode change. Stop the motor before switching the operation mode. If the operation mode is changed during motion, the behavior will not be guaranteed	Value	Op mode	abbreviation	-2	force control	fc	0	no mode change / assigned	-	1	profile position	pp	3	profile velocity	pv	4	profile torque	tq	6	homing	hm	8	cyclic synchronous position	csp	9	cyclic synchronous velocity	csv	10	cyclic synchronous torque	cst	I8	rw	Y	-2 ~ 10	-
Value	Op mode	abbreviation																																			
-2	force control	fc																																			
0	no mode change / assigned	-																																			
1	profile position	pp																																			
3	profile velocity	pv																																			
4	profile torque	tq																																			
6	homing	hm																																			
8	cyclic synchronous position	csp																																			
9	cyclic synchronous velocity	csv																																			
10	cyclic synchronous torque	cst																																			

Index	Sub-Index	Name	Data type	Access	PDO	Valid value	Unit
		If dual-loop control is adopted, only pp, hm and csp modes can be used.					
6061h	00h	Modes of operation display	I8	ro	Y	-2 ~ 10	-
		The actual operation mode in the drive. The object will change to the commanded mode after internal mode is successfully changed. If the commanded mode is not supported, the object will remain unchanged.					
6062h	00h	Position demand value	I32	ro	Y	-2147483648 ~ 2147483647	inc
		The required position value.					
6063h	00h	Position actual internal value	I32	ro	Y	-2147483648 ~ 2147483647	count
		The actual value of motor position. In dual-loop control, the value is from external scale unit.					
6064h	00h	Position actual value	I32	ro	Y	-2147483648 ~ 2147483647	inc
		The actual value of motor position.					
6065h	00h	Following error window	U32	rw	Y	0 ~ 4294967295	inc
		The threshold of 60F4h (following error actual value). When 60F4h (following error actual value) exceeds 6065h, bit 13 of 6041h (statusword) will be 1. If the object is set to 0, a following error will always occur.					
6066h	00h	Following error time out	U16	rw	Y	0 ~ 65535	ms
		Refer to description of 6065h (following error window).					
6067h	00h	Position window	U32	rw	Y	0 ~ 4294967295	inc
		If the difference between 6062h (position demand value) and 6064h (position actual value) is within 6067h (position window) for longer than the time set by 6068h (position window time), bit 10 of 6041h (statusword) will be set to 1. Once the position deviation exceeds 6067h, bit 10 of 6041h (statusword) will be set to 0.					
6068h	00h	Position window time	U16	rw	Y	0 ~ 65535	ms
		Refer to description of 6067h (position window).					
606Bh	00h	Velocity demand value	I32	ro	Y	-2147483648 ~ 2147483647	inc/s
		Internal command velocity					
606Ch	00h	Velocity actual value	I32	ro	Y	-2147483648 ~ 2147483647	inc/s
		The actual velocity of the motor. By setting Pt0A0 = t.□□□X, users can determine the feedback source of this object, either the original velocity feedback value or the velocity feedback value filtered by Pt308.					
606Dh	00h	Velocity window	U16	rw	Y	0 ~ 65535	inc/s
		If the difference between 60FFh (target velocity) + 60B1h (velocity offset) and 606Ch (velocity actual value) is within 606Dh (velocity window) for longer than the time set by 606Eh (velocity window time), bit 10 of 6041h (statusword) will be set to 1. Once the velocity deviation exceeds 6067h (position window), bit 10 of 6041h (statusword) will be set to 0.					
606Eh	00h	Velocity window time	U16	rw	Y	0 ~ 65535	ms
		Refer to description of 606Dh (velocity window).					
6071h	00h	Target torque	I16	rw	Y	-32768 ~ 32767	0.1%
		Torque command. The value is limited by 6072h (max torque). Output target torque (force) of the drive = motor torque (force) constant x motor rated current x object 6071h (target torque) / 1000					
6072h	00h	Max torque	U16	rw	Y	0 ~ 65535	0.1%
		The configured maximum torque. The value is limited by the motor's ability.					
6074h	00h	Torque demand	I16	ro	Y	-32768 ~ 32767	0.1%
		Internal torque command.					
6075h	00h	Motor rated current	U32	ro	-	0 ~ 4294967295	mA
		The rated current of the motor.					
6076h	00h	Motor rated torque	U32	ro	-	0 ~ 4294967295	mNm
		The rated torque of the motor.					
6077h	00h	Torque actual value	I16	ro	Y	-32768 ~ 32767	0.1%
		The value is given per thousand of rated torque. The value is only for reference.					
607Ah	00h	Target position	I32	rw	Y	-2147483648 ~ 2147483647	inc
		Position command.					
607Bh	-	Position range limit	-	-	-	-	-
		Position data's range, refer to section 3.2.10 Modulo system for details.					

Index	Sub-Index	Name	Data type	Access	PDO	Valid value	Unit
	00h	Number of entries	U8	ro	-	2	-
	01h	Min position range limit	I32	rw	Y	-2147483648 ~ 0	inc
		Lower limit value of position data's range.					
	02h	Max position range limit	I32	rw	Y	0 ~ 2147483647	inc
		Upper limit value of position data's range.					
607Ch	00h	Home offset	I32	rw	Y	-2147483648 ~ 2147483647	inc
		After homing procedure is done, the detected index position is set to the value of 607Ch (home offset). Zero position = home position + home offset 					
607Fh	00h	Max profile velocity	U32	rw	Y	0 ~ 4294967295	inc/s
		The configured maximum velocity. The value is limited by the motor's ability.					
6081h	00h	Profile velocity	U32	rw	Y	0 ~ 4294967295	inc/s
		The velocity during profile motion. The value is limited by 607Fh.					
6083h	00h	Profile acceleration	U32	rw	Y	0 ~ 4294967295	inc/s ²
		The configured acceleration of profile motion.					
6084h	00h	Profile deceleration	U32	rw	Y	0 ~ 4294967295	inc/s ²
		The configured deceleration of profile motion.					
6085h	00h	Quick stop deceleration	U32	rw	Y	0 ~ 4294967295	inc/s ²
		The deceleration is used to stop the motor when quick stop function is activated and 605Ah (quick stop option code) is set to 2 or 6. Quick stop deceleration is also used when 605Dh (halt option code) and 605Eh (fault reaction option code) is 2.					
6087h	00h	Torque slope	U32	rw	Y	0 ~ 4294967295	0.1%/s
		The rate of change of torque.					
6098h	00h	Homing method	I8	rw	Y	-128 ~ 127	-
		The homing method used in hm mode. The homing method can not be changed during homing. The supported homing methods are method -3, 1, 2, 7~14, 17, 18, 23~30, 33, 34 and 37. If homing procedure starts with unsupported homing method, bit 13 of 6041h (statusword) will be set to 1.					
6099h	-	Homing speeds	-	-	-	-	-
		The velocity during hm mode.					
	00h	Number of entries	U8	ro	-	2	-
	01h	Speed during search for switch	U32	rw	Y	0 ~ 4294967295	inc/s
		The velocity during searching for switch signal.					
	02h	Speed during search for zero	U32	rw	Y	0 ~ 4294967295	inc/s
		The velocity during searching for index signal.					
609Ah	00h	Homing acceleration	U32	rw	Y	0 ~ 4294967295	inc/s ²
		The acceleration and deceleration in hm mode.					
60B1h	00h	Velocity offset	I32	rw	Y	-2147483648 ~ 2147483647	inc/s
		The offset of velocity command. It is only supported in csv mode currently.					
60B2h	00h	Torque offset	I16	rw	Y	-3000 ~ 3000	0.1%
		The offset of torque command. It is only supported in cst mode currently.					

Index	Sub-Index	Name	Data type	Access	PDO	Valid value	Unit
60B8h	00h	Touch probe function	U16	rw	Y	0 ~ 65535	-
		In this object, bit 0~7 mentions the setting of Touch probe 1 and bit 8~15 mentions the setting of Touch probe 2.					
		The setting definition of Touch probe 1 (bit 0~7) is described as follows.					
		Bit	Value	Definition			
		0	0	Switch off Touch probe 1.			
			1	Enable Touch probe 1.			
		1	0	Designate Touch probe 1 as single latch (only trigger first event).			
			1	Designate Touch probe 1 as continuous latch.			
		2	0	Trigger Touch probe 1 with digital input signal (EXT-PROBE1).			
			1	Trigger Touch probe 1 with zero impulse signal (encoder index signal).			
3	-	Reserved					
4	0	Switch off sampling at positive edge of Touch probe 1.					
	1	Enable sampling at positive edge of Touch probe 1.					
5	0	Switch off sampling at negative edge of Touch probe 1.					
	1	Enable sampling at negative edge of Touch probe 1.					
		6, 7	-	Reserved			
60B8h	00h	The setting definition of Touch probe 2 (bit 8~15) is described as follows.					
		Bit	Value	Definition			
		8	0	Switch off Touch probe 2.			
			1	Enable Touch probe 2.			
		9	0	Designate Touch probe 2 as single latch (only trigger first event).			
			1	Designate Touch probe 2 as continuous latch.			
		10	0	(Not support)			
			1	Trigger Touch probe 2 with zero impulse signal (encoder index signal).			
		11	-	Reserved			
		12	0	Switch off sampling at positive edge of Touch probe 2.			
1	Enable sampling at positive edge of Touch probe 2.						
13	0	Switch off sampling at negative edge of Touch probe 2.					
	1	Enable sampling at negative edge of Touch probe 2.					
		14, 15	-	Reserved			
		Note:					
		1. E series servo drive does not support enabling touch probe 1 and touch probe 2 at the same time. In this case, only touch probe 1 will be executed.					
		2. Do not enable sampling at positive edge and negative edge (bit 4 and bit 5, bit 12 and bit 13) at the same time. Otherwise, only positive edge sampling will be executed.					
60B9h	00h	Touch probe status	U16	ro	Y	0 ~ 65535	-
		In this object, bit 0~7 mentions the state of Touch probe 1 and bit 8~15 mentions the state of Touch probe 2.					
		Each bit is described as follows.					
		Bit	Value	Definition			
		0	0	Touch probe 1 is switched off.			
			1	Touch probe 1 is enabled.			
		1	0	Touch probe 1 no positive edge value stored.			
			1	Touch probe 1 positive edge value stored.			
		2	0	Touch probe 1 no negative edge value stored.			
			1	Touch probe 1 negative edge value stored.			
3~7		-	Reserved				
8	0	Touch probe 2 is switched off.					
	1	Touch probe 2 is enabled.					
9	0	Touch probe 2 no positive edge value stored.					
	1	Touch probe 2 positive edge value stored.					
10	0	Touch probe 2 no negative edge value stored.					
	1	Touch probe 2 negative edge value stored.					
11~15		-	Reserved				

Index	Sub-Index	Name	Data type	Access	PDO	Valid value	Unit						
60BAh	00h	Touch probe 1 positive edge	I32	ro	Y	-2147483648 ~ 2147483647	inc						
		The position value of touch probe 1 at positive edge.											
60BBh	00h	Touch probe 1 negative edge	I32	ro	Y	-2147483648 ~ 2147483647	inc						
		The position value of touch probe 1 at negative edge.											
60BCh	00h	Touch probe 2 positive edge	I32	ro	Y	-2147483648 ~ 2147483647	inc						
		The position value of touch probe 2 at positive edge.											
60C2h	-	Interpolation time period	-	-	-	-	-						
		The interpolation time cycle is set up automatically based on the used communication cycle.											
		Communication cycle		60C2:01h		60C2:02h							
		250µs		25		-5							
		500µs		50		-5							
		1ms		10		-4							
		2ms		20		-4							
		4ms		40		-4							
	00h	Number of entries	U8	ro	-	2	-						
	01h	Interpolation time period value	U8	rw	-	0 ~ 255	-						
02h	Interpolation time index	I8	rw	-	-128 ~ 63	-							
60C5h	00h	Max acceleration	U32	rw	Y	0 ~ 4294967295	inc/s ²						
60C6h	00h	Max deceleration	U32	rw	Y	0 ~ 4294967295	inc/s ²						
60E0h	00h	Positive torque limit value	U16	rw	Y	0 ~ 65535	0.1%						
		The configured maximum positive torque in the motor.											
60E1h	00h	Negative torque limit value	U16	rw	Y	0 ~ 65535	0.1%						
		The configured maximum negative torque in the motor.											
60F2h	00h	Position option code	U16	rw	Y	0x0 ~ 0x00C0	-						
		Position positioning behavior option, this object affects how certain functions operate in pp mode. Currently, rotary axis direction option is only supported when Modulo system is activated.											
		Bit	Value	Name	Operational behavior								
		0 ~ 5	0	-	(Not support)								
		6, 7	00	Linear	Linear movement, the motor will move based on the position with absolute value.								
			01	Only negative direction	Negative direction only, the motor will only move in reverse direction.								
			10	Only positive direction	Positive direction only, the motor will only move in forward direction.								
			11	Shortest way	Shortest distance, the motor will move with the shortest distance.								
8 ~ 15	0	-	(Not support)										
60F4h	00h	Following error actual value	I32	ro	Y	-2147483648 ~ 2147483647	inc						
		60F4h (following error actual value) = 6062h (position demand value) – 6064h (position actual value)											
60FCh	00h	Position demand internal value	I32	ro	Y	-2147483648 ~ 2147483647	count						
		Internal command position											
60FDh	00h	Digital inputs	U32	ro	Y	0 ~ FFFFFFFFh	-						
		The input status of external input signal. The definition of each bit is as follows.											
		31 ... 27	26	25	24	23	22	21	20	19	18	17	16
		Reseved	STO	SF2	SF1	I8	I7	I6	I5	I4	I3	I2	I1
		15 ... 3									2	1	0
		Reseved									Home switch	Positive limit switch	Negative limit switch

Index	Sub-Index	Name	Data type	Access	PDO	Valid value	Unit																																		
		The value of each bit is defined as follows. 0: switched off 1: switched on Note: Servo drive with STO function security approval will execute a self-diagnosis procedure periodically to check the hardware functionality. The procedure takes turns triggering either SF1 or SF2 for 3 ms every 12 hours. The flow of the procedure: 12-hour interval →Run SF1 diagnosis → 12-hour interval →Run SF2 diagnosis → 12-hour interval →Run SF1 diagnosis → ...																																							
60FEh		Digital outputs	-	-	-	-	-																																		
		They are used to control the external output signal.																																							
		<table><tr><td>31 ... 21</td><td>20</td><td>19</td><td>18</td><td>17</td><td>16</td><td>15 ... 0</td></tr><tr><td>Reserved</td><td>O5</td><td>O4</td><td>O3</td><td>O2</td><td>O1</td><td>Reserved</td></tr></table>	31 ... 21	20	19	18	17	16	15 ... 0	Reserved	O5	O4	O3	O2	O1	Reserved																									
	31 ... 21	20	19	18	17	16	15 ... 0																																		
	Reserved	O5	O4	O3	O2	O1	Reserved																																		
	-	This object controls the status of the general-purpose output signals from CN6 on E series servo drive. Subindex 1 is used to control the status of the output signals. Subindex 2 determines which output signals in subindex 1 are enabled. If drive status outputs are assigned to O1~O5 signals in object 2514h, 2515h, 2516h and 2517h (please refer to the chapter “I/O signals setting” in each servo drive user manual), the status of this object will be output in the logic of ORs. If any of these signals is assigned to functions that are enabled with object 2514h, 2515h, 2516h, or 2517h, use Bit Masks in subindex 2 to disable the corresponding signal. By doing so, the signal will not be duplicated. Brake can only be controlled by this object when servo is not on.																																							
	00h	Number of entries	U8	ro	-	2	-																																		
	01h	Physical outputs	U32	rw	Y	0 ~ FFFFFFFFh	-																																		
		Control the output of the external signal. The value of each bit is defined as follows. 0: switched off 1: switched on																																							
	02h	Bit mask	U32	rw	Y	0 ~ FFFFFFFFh	-																																		
The output signal mask. The value of each bit is defined as follows. 0: disable output 1: enable output																																									
60FFh	00h	Target velocity	I32	rw	Y	-2147483648 ~ 2147483647	inc/s																																		
		Velocity command. The value is limited by 607Fh (max profile velocity).																																							
6502h	00h	Supported drive modes	U32	ro	-	0 ~ FFFFFFFFh	-																																		
		The object indicates the operation modes supported by the drive. When the bit value is 1, the operation mode is supported.																																							
		<table><tr><td>Bit</td><td>31...10</td><td>9</td><td>8</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr><tr><td>Op mode</td><td>-</td><td>cst</td><td>csv</td><td>csp</td><td>ip</td><td>hm</td><td>-</td><td>tq</td><td>pv</td><td>vl</td><td>pp</td></tr><tr><td>Value</td><td>0</td><td>1</td><td>1</td><td>1</td><td>0</td><td>1</td><td>0</td><td>1</td><td>1</td><td>0</td><td>1</td></tr></table>	Bit	31...10	9	8	7	6	5	4	3	2	1	0	Op mode	-	cst	csv	csp	ip	hm	-	tq	pv	vl	pp	Value	0	1	1	1	0	1	0	1	1	0	1			
Bit	31...10	9	8	7	6	5	4	3	2	1	0																														
Op mode	-	cst	csv	csp	ip	hm	-	tq	pv	vl	pp																														
Value	0	1	1	1	0	1	0	1	1	0	1																														

3.2.1 PDS (Power Drive System)

PDS that controls the drive can be operated by 6040h (controlword) from the master, drive internal control, or error detection signal. The state of PDS is reported by 6041h (statusword) from the drive. PDS FSA (Finite State Automaton) in Figure 3.2.1.1 defines the status and the control sequence of PDS.

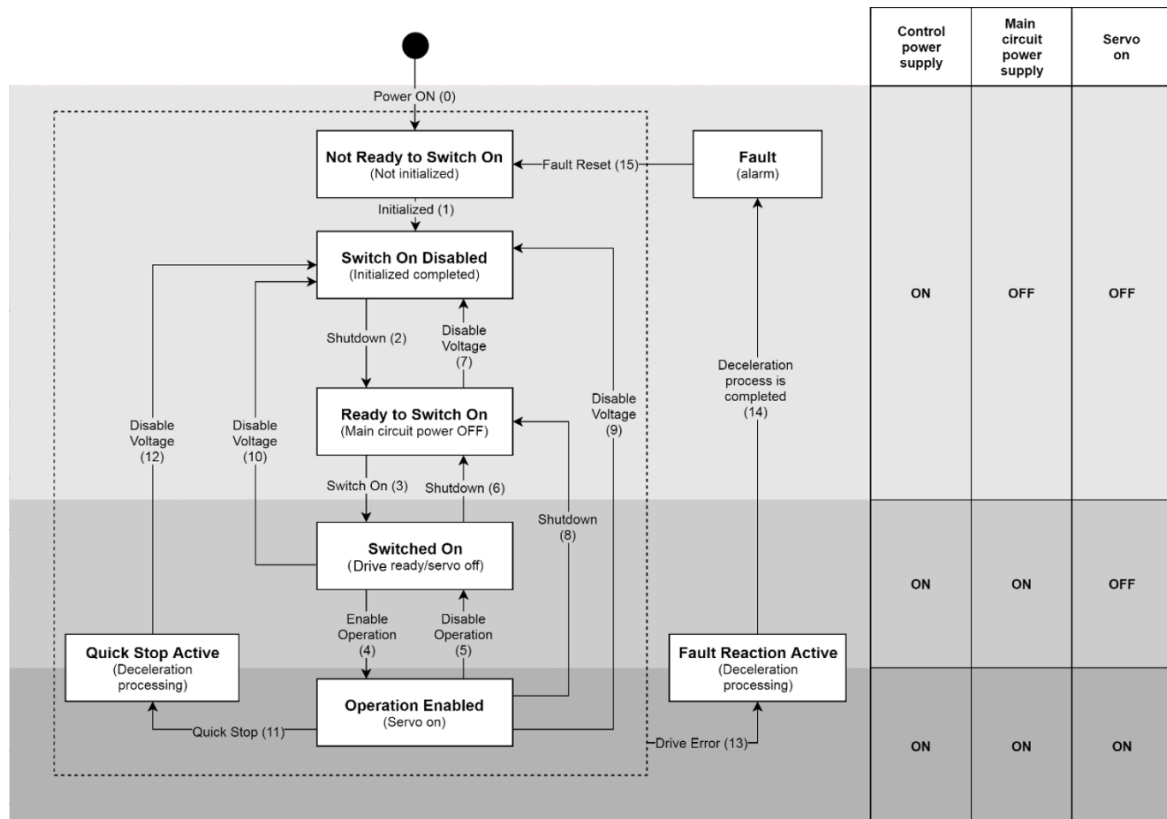


Figure 3.2.1.1

The events and actions of PDS state transition in E series servo drive are listed in Table 3.2.1.1. After the action is performed, the state transition will be done.

Table 3.2.1.1

Trans	Event	Action
0	Control power is ON or drive is reset.	Drive performs initialization and self-test.
1	Initialization is completed.	Communication is activated.
2	Receive "Shutdown" command.	None
3	Receive "Switch on" command when high-level power is ON.	None
4	Receive "Enable operation" command.	The motor and the drive functions are enabled, and all command settings are cleared.
5	Receive "Disable operation" command.	The motor and the drive functions are disabled.
6	Receive "Shutdown" command.	None

Trans	Event	Action
7	1. Receive "Quick stop" or "Disable voltage" command. 2. ESM is in Init state.	None
8	Receive "Shutdown" command.	The motor and the drive functions are disabled.
9	Receive "Disable voltage" command.	The motor and the drive functions are disabled.
10	1. Receive "Quick stop" or "Disable voltage" command. 2. ESM is transited to Init state.	None
11	Receive "Quick stop" command.	"Quick stop" function starts.
12	An automatic transition when "Quick stop" function is completed	The motor and the drive functions are disabled.
13	The drive detects an error.	The drive-defined or user-configured fault reactions are executed.
14	An automatic transition after deceleration process is completed	The motor and the drive functions are disabled.
15	Receive "Fault reset" command.	Reset the fault state if the fault situation of drive is no longer stayed.

■ PDS command code

Table 3.2.1.2

Command	Bits of 6040h (controlword)					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
Fault reset	0→1	X	X	X	X	15

*It will automatically transit to "Enable operation" after "Switched on" is executed.

■ PDS state code

Table 3.2.1.3

6041h (statusword)	PDS FSA state
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 x01x 0011b	Switched on
xxxx xxxx x01x 0111b	Operation enabled
xxxx xxxx x00x 0111b	Quick stop active
xxxx xxxx x0xx 1111b	Fault reaction active
xxxx xxxx x0xx 1000b	Fault

■ The procedure of clearing errors

There are drive errors and EtherCAT related communication errors. The procedure of clearing errors are described as follows.

If there is a drive error,

- (1) Eliminate the cause of the drive error.
- (2) Execute “Fault reset” command to clear the drive’s error status.

If there is a EtherCAT related communication error,

- (1) Eliminate the cause of the communication error.
- (2) Set bit 4 of AL control register to 1 to clear the error state in ESC.
- (3) Master commands the drive to change ESM state to Op.
- (4) Master change bit 7 of 6040h (controlword) from 0 to 1 in Fault state to reset fault.
- (5) After the error is cleared, the PDS state changes from Fault to Switch on disabled.

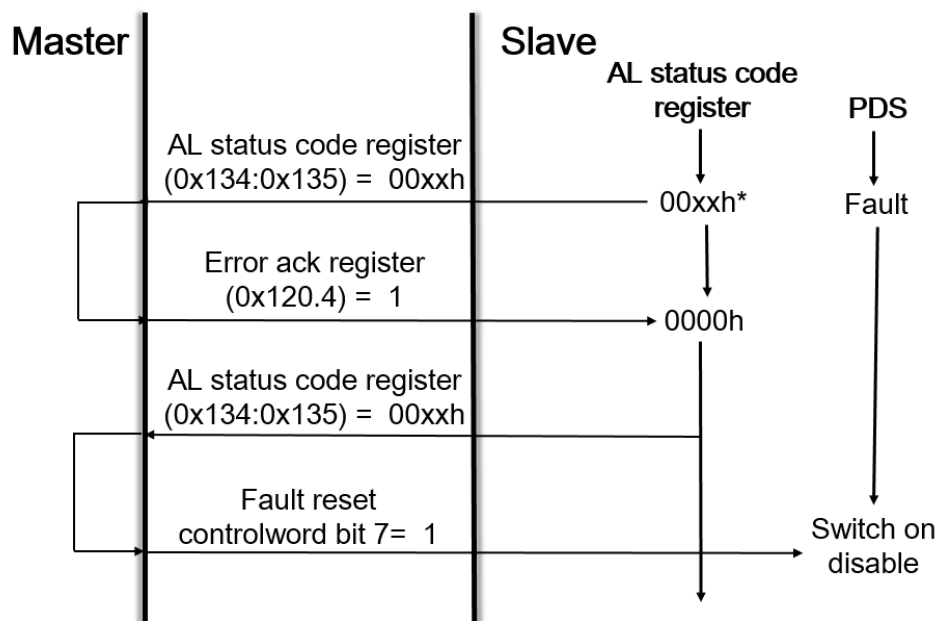


Figure 3.2.1.2

Note: Be sure to eliminate all errors detected before clearing error status.

3.2.2 Profile position mode (pp)

Profile position mode is for moving to the target position at the profile velocity and the profile acceleration. The structure of the trajectory generation is shown in Figure 3.2.2.1.

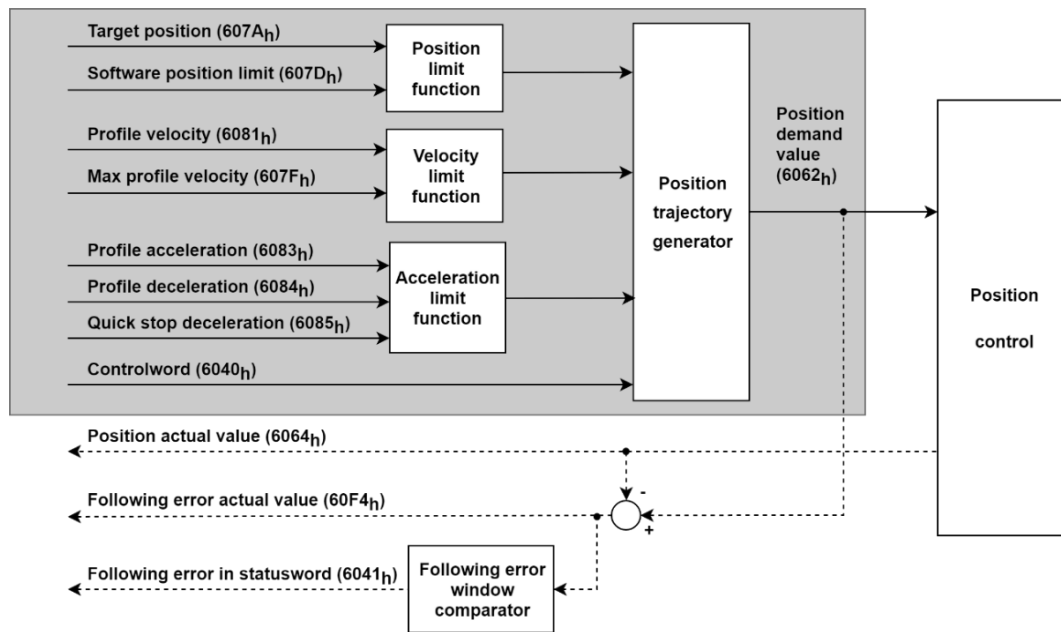


Figure 3.2.2.1

Note: When the motor is moving, the change of Profile acceleration (6083_h) and Profile deceleration (6084_h) will not be executed until the moving is done.

Related objects for pp mode are listed in Table 3.2.2.1.

Table 3.2.2.1

Index	Sub-Index	Name	Data type	Access	PDO	Valid value	Unit
6040h	00h	Controlword	U16	rw	Y	0x0 ~ 0xFFFF	-
6041h	00h	Statusword	U16	ro	Y	0x0 ~ 0xFFFF	-
605Dh	00h	Halt option code	I16	ro	-	1, 2	-
6062h	00h	Position demand value	I32	ro	Y	-2147483648 ~ 2147483647	inc
6063h	00h	Position actual internal value	I32	ro	Y	-2147483648 ~ 2147483647	count
6064h	00h	Position actual value	I32	ro	Y	-2147483648 ~ 2147483647	inc
6065h	00h	Following error window	U32	rw	Y	0 ~ 4294967295	inc
6066h	00h	Following error time out	U16	rw	Y	0 ~ 65535	ms
6067h	00h	Position window	U32	rw	Y	0 ~ 4294967295	inc
6068h	00h	Position window time	U16	rw	Y	0 ~ 65535	ms
606Ch	00h	Velocity actual value	I32	ro	Y	-2147483648 ~ 2147483647	inc/s
6072h	00h	Max torque	U16	rw	Y	0 ~ 65535	0.1%

Index	Sub-Index	Name	Data type	Access	PDO	Valid value	Unit
6074h	00h	Torque demand	I16	ro	Y	-32768 ~ 32767	0.1%
6076h	00h	Motor rated torque	U32	ro	-	0 ~ 4294967295	mNm
6077h	00h	Torque actual value	I16	ro	Y	-32768 ~ 32767	0.1%
607Ah	00h	Target position	I32	rw	Y	-2147483648 ~ 2147483647	inc
607Bh	00h	Position range limit	U8	ro	-	2	-
	01h	Min position range limit	I32	rw	Y	-2147483648 ~ 0	inc
	02h	Max position range limit	I32	rw	Y	0 ~ 2147483647	inc
607Fh	00h	Max profile velocity	U32	rw	Y	0 ~ 4294967295	inc/s
6081h	00h	Profile velocity	U32	rw	Y	0 ~ 4294967295	inc/s
6083h	00h	Profile acceleration	U32	rw	Y	0 ~ 4294967295	inc/s ²
6084h	00h	Profile deceleration	U32	rw	Y	0 ~ 4294967295	inc/s ²
6085h	00h	Quick stop deceleration	U32	rw	Y	0 ~ 4294967295	inc/s ²
60C5h	00h	Max acceleration	U32	rw	Y	0 ~ 4294967295	inc/s ²
60C6h	00h	Max deceleration	U32	rw	Y	0 ~ 4294967295	inc/s ²
60F2h	00h	Position option code	U16	rw	Y	0x0 ~ 0x00C0	-
60F4h	00h	Following error actual value	I32	ro	Y	-2147483648 ~ 2147483647	inc
60FCh	00h	Position demand internal value	I32	ro	Y	-2147483648 ~ 2147483647	count

■ Controlword (6040h) for pp mode

Table 3.2.2.2

Bit 9	Bit 5	Bit 4	Definition
change on set-point	change set immediately	new set-point	
0	0	0→1	Positioning is completed (target reached) before the next one gets started.
X	1	0→1	Immediately start next positioning.
1	0	0→1	Execute positioning with current profile velocity to the current set-point and then apply next positioning.

Table 3.2.2.3

Bit	Value	Definition
6 (absolute / relative)	0	Target position is an absolute value.
	1	Target position is a relative value.
8 (halt)	0	Execute or continue positioning.
	1	Axis is stopped according to 605Dh (halt option code).

■ Statusword (6041h) for pp mode

Table 3.2.2.4

Bit	Value	Definition
10 (target reached)	0	Halt (Bit 8 in controlword) = 0: target position not reached Halt = 1: axis decelerates
	1	Halt = 0: target position reached Halt = 1: velocity of axis is 0

Bit	Value	Definition
12 (set-point acknowledge)	0	The last set-point is already processed. Wait for new set-point (the buffer is empty).
	1	Previous set-point is still in process.
13 (following error)	0	No following error
	1	Following error

■ Halt option code (605Dh) for pp mode

Table 3.2.2.5

Value	Definition
0	Reserved
1	Axis is stopped according to 6084h (profile deceleration) and remains in Operation enabled state.
2	Axis is stopped according to 6085h (quick stop deceleration) and remains in Operation enabled state.

■ Example of setting basic set-point

- [1] The master sets 607Ah (target position), and then sets bit 4 of 6040h (controlword) from 0 to 1 (edge trigger).
- [2] The drive acknowledges the new set-point by setting bit 12 of 6041h (statusword) to 1. Then, the drive starts to move toward target position from 607Ah (target position).
- [3] The master sets bit 4 of 6040h (controlword) to 0 after bit 12 of 6041h (statusword) is set to 1.
- [4] The drive sets bit 12 of 6041h (statusword) to 0 after bit 4 of 6040h (controlword) is set to 0.
- [5] When the motor reaches the target position, the drive sets bit 10 of 6041h (statusword) to 1.

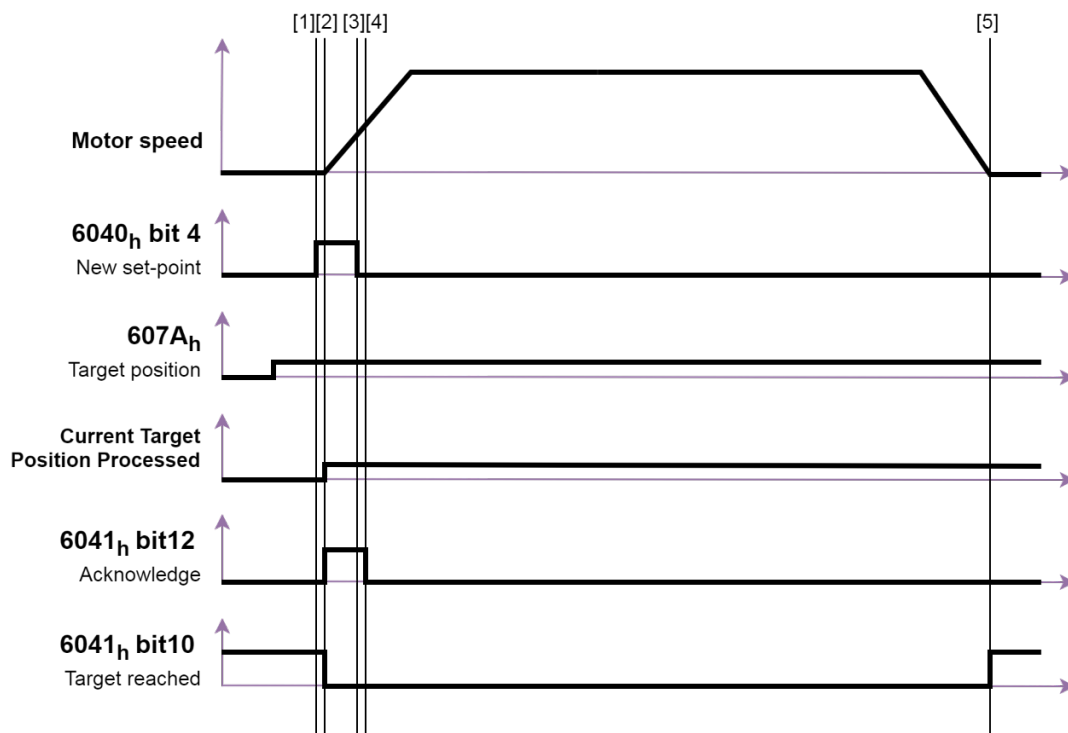


Figure 3.2.2.2

Note: The velocity of the motion is from 6081h (profile velocity), which is limited by 607Fh (max profile velocity).

■ Example of setting single set-point

When bit 5 of 6040h (controlword) is 1, the new set-point is immediately validated by bit 4 of 6040h (controlword). Thus, the set-point in progress will be interrupted.

- [1] After bit 12 of 6041h (statusword) is set to 0, the master changes the value of 607Ah (target position) and sets bit 4 of 6040h from 0 to 1 (edge trigger).
- [2] The drive acknowledges the new set-point by setting bit 12 of 6041h (statusword) to 1. Then, the drive starts to move toward the new target position from 607Ah (target position).
- [3] The master sets bit 4 of 6040h (controlword) to 0 after bit 12 of 6041h (statusword) is set to 1.
- [4] The drive sets bit 12 of 6041h (statusword) to 0 after bit 4 of 6040h (controlword) is set to 0.

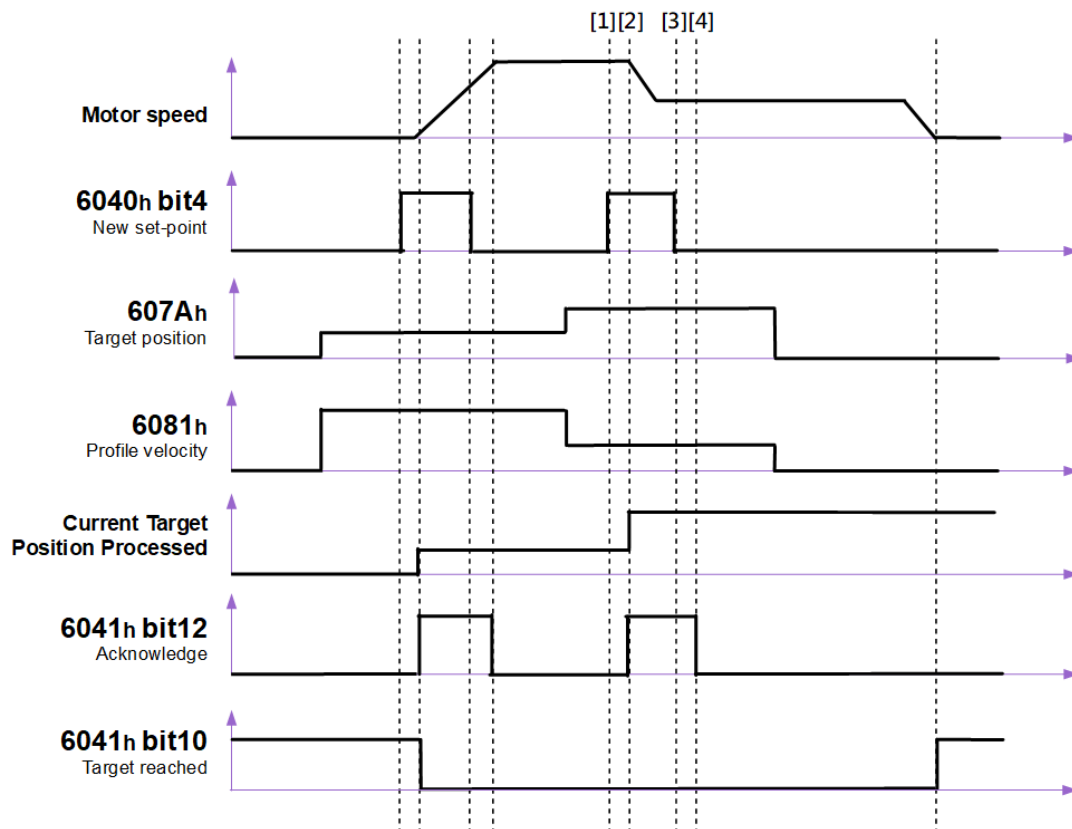


Figure 3.2.2.3

- Example of setting set of set-points (change target during motion)

- [1] After bit 12 of 6041h (statusword) is set to 0, the master changes the value of 607Ah (target position) and sets bit 4 of 6040h (controlword) from 0 to 1 (edge trigger).
- [2] The drive acknowledges the new set-point by setting bit 12 of 6041h (statusword) to 1. The drive buffers 607Ah (target position) as a new target position and continues the ongoing target position.
- [3] The master sets bit 4 of 6040h (controlword) to 0 after bit 12 of 6041h (statusword) is set to 1.
- [4] The drive starts to move to the new target position after the ongoing set-point is completed. Then, the buffer becomes empty, and bit 12 of 6041h (statusword) is set to 0.

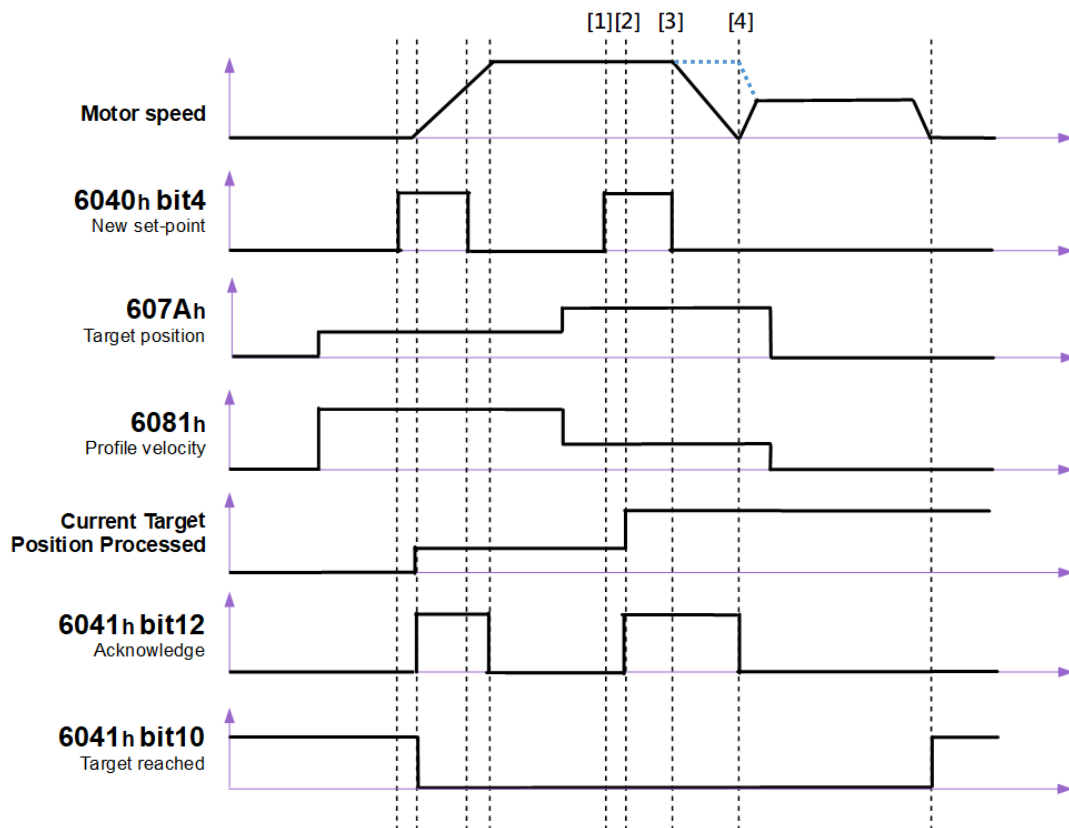


Figure 3.2.2.4

Note: The dashed line on the motor speed in the figure is the situation that bit 9 (change of setpoint) of 6040h (controlword) is set to 1. However, if the new target position is in the opposite direction, the motor will still complete the movement of the current target position first and then execute the reverse movement.

■ Example of buffering set-points

E series servo drive only supports 2 set-points maximum. The handling of the set-points is shown as follows.

- [1] When there is no set-point in progress, a new set-point A is immediately effective.
- [2] When there is a set-point in progress, the new set-point B and C are stored in the buffers.
- [3] When all set-point buffers are all in use (bit 12 of 6041h is 1), the new set-point D is discarded.
- [4] When all set-point buffers are all in use (bit 12 of 6041h is 1) and bit 5 of 6040h (controlword) is set to 1, the new set-point E is immediately processed as a single set-point. All previous setpoints are discarded.
- [5] Bit 10 of 6041h (statusword) remains 0 until all set-points are processed.

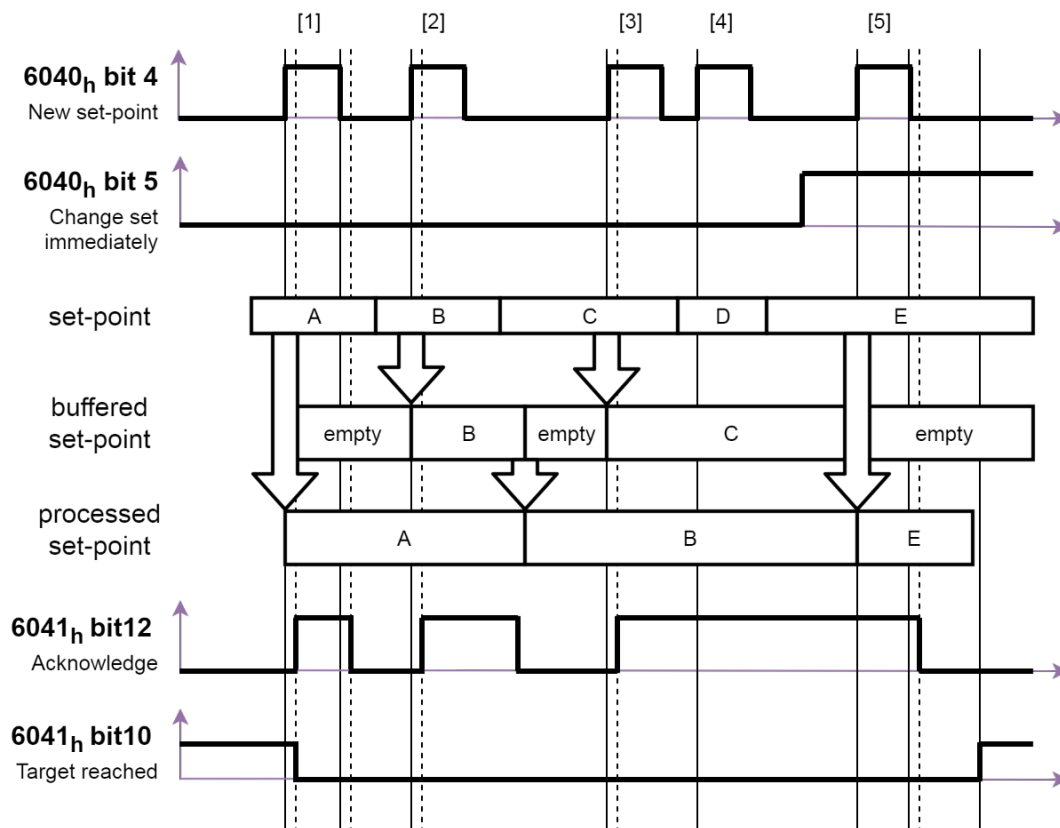


Figure 3.2.2.5

■ Example of halt bit

When bit 8 of 6040h (controlword) is set to 1 in pp mode, the motion will be temporarily stopped. After bit 8 of 6040h (controlword) returns to 0, unfinished set-points will be resumed.

- [1] When there is no set-point in process, the new set-point A is taken immediately.
- [2] When set-point A is still in process, the new set-point B is stored if the buffer is empty.
- [3] When set-point A is still in process but bit 8 of 6040h (controlword) is set to 1, the motion is halted. After the motor speed decelerates to 0, bit 10 of 6041h (statusword) changes to 1.
- [4] When bit 8 of 6040h (controlword) returns to 0, the motion towards set-point A is resumed. Bit 10 of 6041h (statusword) changes to 0.
- [5] After set-point A is reached, set-point B is processed.
- [6] Bit 10 of 6041h (statusword) remains 0 until all set-points are processed.

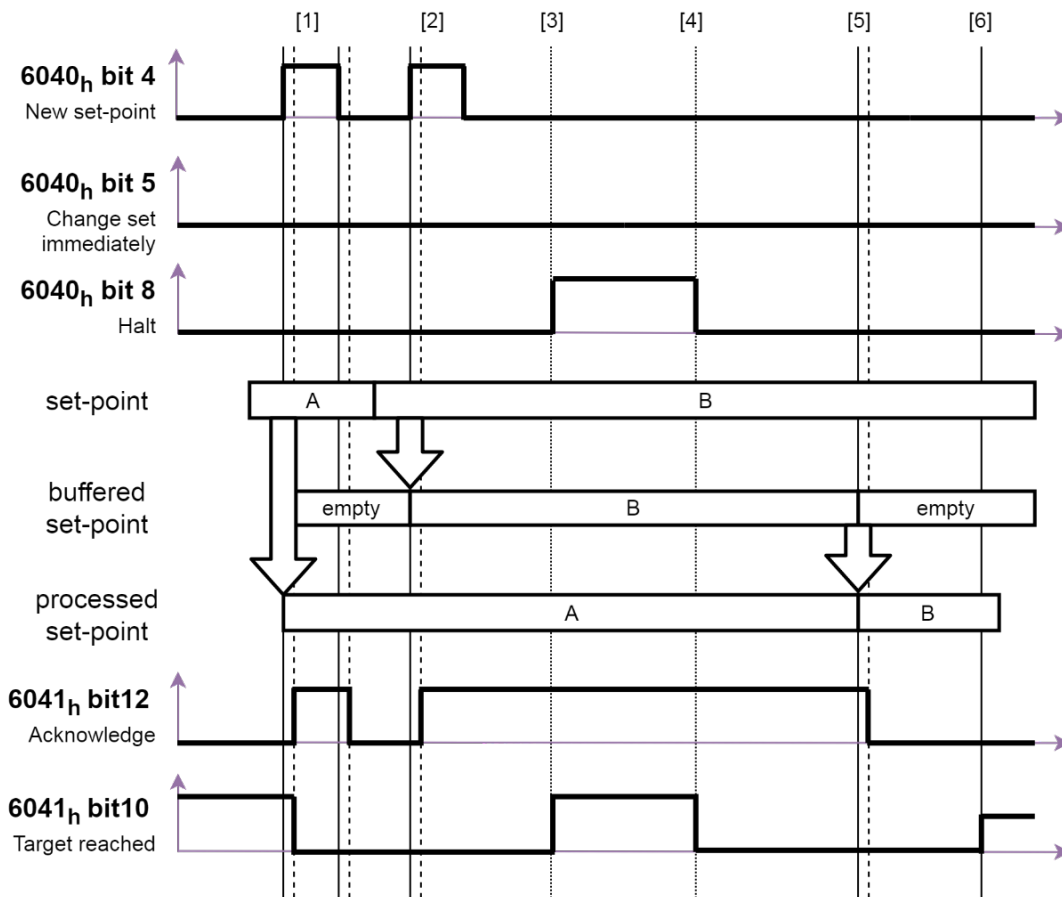


Figure 3.2.2.6

3.2.3 Cyclic synchronous position mode (csp)

The motion profile (trajectory) is generated by the master. Therefore, the position command is updated by the master every communication cycle. Cyclic synchronous position mode is used in DC mode. Before enabling the motor in csp mode or switching to csp mode, be sure to align 607Ah (target position) with 6064h (position actual value) first. Otherwise, it may cause dangerous behavior. To prevent the dangerous behavior of the motor, if the change amount of 607Ah (target position) exceeds the following speed range, the target position will be ignored and the warning of host controller's position command error (AL.990) will be triggered.

$$\frac{(\text{Target position (607A}_h\text{)} - \text{Position demand value (6062}_h\text{)})}{\text{Interpolation time period (60C2}_h\text{)}} < \text{Velocity limit (2316}_h\text{)} [\text{unit: rpm}]$$

Note:

If users do not want to display the warning AL.990, set Pt0A1 = t.□□1□ to disable the detection of the warning.

(Even if the detection of the warning is disabled, the protection still works.)

The structure of the trajectory generation is shown in Figure 3.2.3.1.

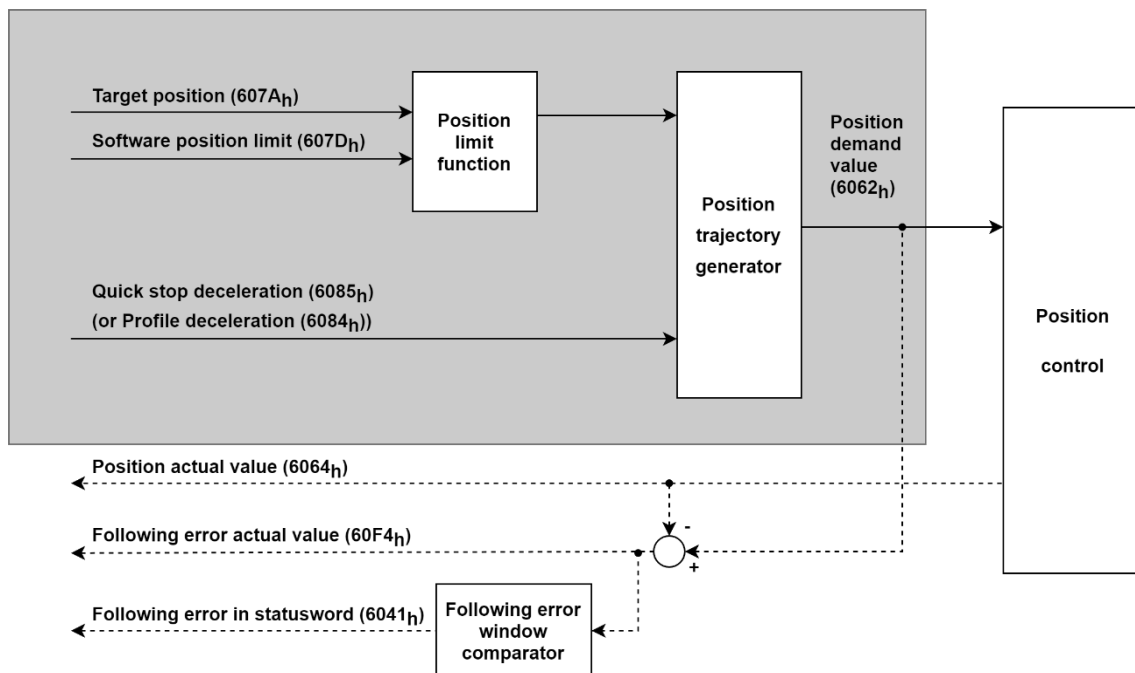


Figure 3.2.3.1

Related objects for csp mode are listed in Table 3.2.3.1.

Table 3.2.3.1

Index	Sub-Index	Name	Data type	Access	PDO	Valid value	Unit
6040h	00h	Controlword	U16	rw	Y	0x0 ~ 0xFFFF	-
6041h	00h	Statusword	U16	ro	Y	0x0 ~ 0xFFFF	-
6062h	00h	Position demand value	I32	ro	Y	-2147483648 ~ 2147483647	inc
6063h	00h	Position actual internal value	I32	ro	Y	-2147483648 ~ 2147483647	count
6064h	00h	Position actual value	I32	ro	Y	-2147483648 ~ 2147483647	inc
6065h	00h	Following error window	U32	rw	Y	0 ~ 4294967295	inc
6066h	00h	Following error time out	U16	rw	Y	0 ~ 65535	ms
606Ch	00h	Velocity actual value	I32	ro	Y	-2147483648 ~ 2147483647	inc/s
6072h	00h	Max torque	U16	rw	Y	0 ~ 65535	0.1%
6074h	00h	Torque demand	I16	ro	Y	-32768 ~ 32767	0.1%
6076h	00h	Motor rated torque	U32	ro	-	0 ~ 4294967295	mNm
6077h	00h	Torque actual value	I16	ro	Y	-32768 ~ 32767	0.1%
607Ah	00h	Target position	I32	rw	Y	-2147483648 ~ 2147483647	inc
607Bh	00h	Position range limit	U8	ro	-	2	-
	01h	Min position range limit	I32	rw	Y	-2147483648 ~ 0	inc
	02h	Max position range limit	I32	rw	Y	0 ~ 2147483647	inc
6084h	00h	Profile deceleration	U32	rw	Y	0 ~ 4294967295	inc/s ²
6085h	00h	Quick stop deceleration	U32	rw	Y	0 ~ 4294967295	inc/s ²
60C2h	-	Interpolation time period	-	-	-	-	-
	00h	Number of entries	U8	ro	-	2	-
	01h	Interpolation time period value	U8	rw	-	0 ~ 255	-
	02h	Interpolation time index	I8	rw	-	-128 ~ 63	-
60F4h	00h	Following error actual value	I32	ro	Y	-2147483648 ~ 2147483647	inc
60FCh	00h	Position demand internal value	I32	ro	Y	-2147483648 ~ 2147483647	count

■ Statusword (6041h) for csp mode

Table 3.2.3.2

Bit	Value	Definition
12 (drive follows command value)	0	Drive does not follow the command value. (Ignore target position.)
	1	Drive follows the command value. (Target position is viewed as an input to position control loop.)
13 (following error)	0	No following error
	1	Following error

3.2.4 Homing mode (hm)

This mode is for incremental encoder. After homing procedure is done, the home position of the machine will be defined. To make position zero offset from the home position, set an offset value to the object 607Ch. After homing is completed, the values of the following position objects will be recalculated accordingly.

6062h (position demand value) = 6064h (position actual value) = 607Ch (home offset)

6063h (position actual internal value) = 60FCh (position demand internal value) = 0

The input and output objects of hm mode are shown in Figure 3.2.4.1.

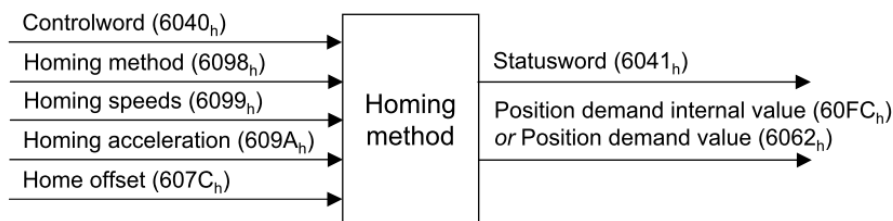


Figure 3.2.4.1

Related objects for hm mode are listed in Table 3.2.4.1.

Table 3.2.4.1

Index	Sub-Index	Name	Data type	Access	PDO	Valid value	Unit
6040h	00h	Controlword	U16	rw	Y	0x0 ~ 0xFFFF	-
6041h	00h	Statusword	U16	ro	Y	0x0 ~ 0xFFFF	-
6062h	00h	Position demand value	I32	ro	Y	-2147483648 ~ 2147483647	inc
6063h	00h	Position actual internal value	I32	ro	Y	-2147483648 ~ 2147483647	count
6064h	00h	Position actual value	I32	ro	Y	-2147483648 ~ 2147483647	inc
606Ch	00h	Velocity actual value	I32	ro	Y	-2147483648 ~ 2147483647	inc/s
6072h	00h	Max torque	U16	rw	Y	0 ~ 65535	0.1%
6074h	00h	Torque demand	I16	ro	Y	-32768 ~ 32767	0.1%
6076h	00h	Motor rated torque	U32	ro	-	0 ~ 4294967295	mNm
6077h	00h	Torque actual value	I16	ro	Y	-32768 ~ 32767	0.1%
607Ch	00h	Home offset	I32	rw	Y	-2147483648 ~ 2147483647	inc
607Fh	00h	Max profile velocity	U32	rw	Y	0 ~ 4294967295	inc/s
6085h	00h	Quick stop deceleration	U32	rw	Y	0 ~ 4294967295	inc/s ²
6098h	00h	Homing method	I8	rw	Y	-128 ~ 127	-
6099h	-	Homing speeds	-	-	-	-	-
	00h	Number of entries	U8	ro	-	2	-
	01h	Speed during search for switch	U32	rw	Y	0 ~ 4294967295	inc/s
	02h	Speed during search for zero	U32	rw	Y	0 ~ 4294967295	inc/s
609Ah	00h	Homing acceleration	U32	rw	Y	0 ~ 4294967295	inc/s ²

Index	Sub-Index	Name	Data type	Access	PDO	Valid value	Unit
60C5h	00h	Max acceleration	U32	rw	Y	0 ~ 4294967295	inc/s ²
60C6h	00h	Max deceleration	U32	rw	Y	0 ~ 4294967295	inc/s ²

■ Controlword (6040h) for hm mode

Table 3.2.4.2

Bit	Value	Definition
4 (homing operation start)	0	Do not start homing procedure.
	1	Start or continue homing procedure.
8 (halt)	0	Enable bit 4.
	1	Stop axis.

■ Statusword (6041h) for hm mode

Table 3.2.4.3

Bit 13	Bit 12	Bit 10	Definition
homing error	homing attained	target reached	
0	0	0	Homing procedure is in progress.
0	0	1	Homing procedure is interrupted or not started.
0	1	0	Homing is attained, but target is not reached.
0	1	1	Homing procedure is successfully completed.
1	0	0	Homing error occurs, and velocity is not 0.
1	0	1	Homing error occurs, and velocity is 0.
1	1	X	Reserved

Note:

- Bit 12 will be cleared to zero in the following cases.
 - The drive is power cycled
 - The operation mode is changed to other modes.
- If multi-turn absolute encoder is used, bit 12 will always be 1.

■ Example of successful homing procedure

- [1] Set 6098h (homing method) to the required homing method. Homing methods supported by E series EtherCAT drive are given in Table 3.2.4.4.
- [2] Accordingly set homing parameters, 609Ah (homing acceleration), 6099:01h (speed during search for switch), 6099:02h (speed during search for zero) and 607Ch (home offset).
- [3] Set bit 4 of 6040h (controlword) from 0 to 1. Then, the homing procedure starts.
- [4] When the homing procedure is successfully completed, the drive sets bit 10 and bit 12 of 6041h (statusword) to 1.

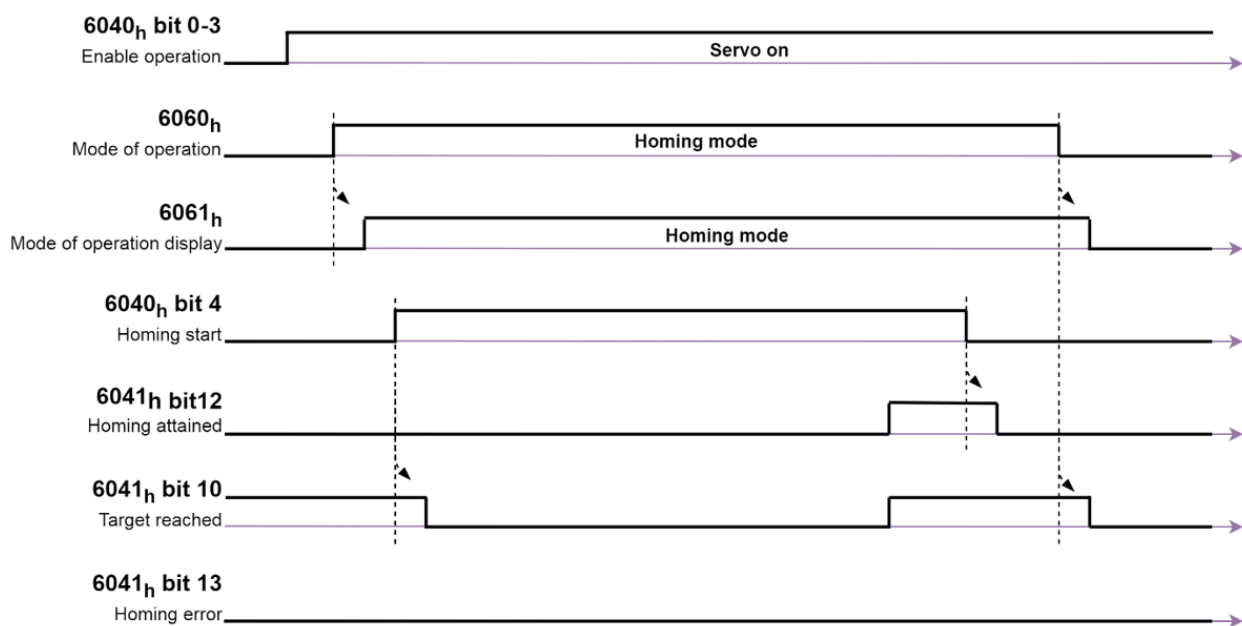
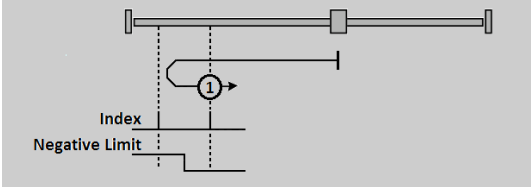
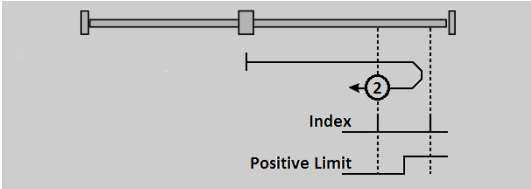
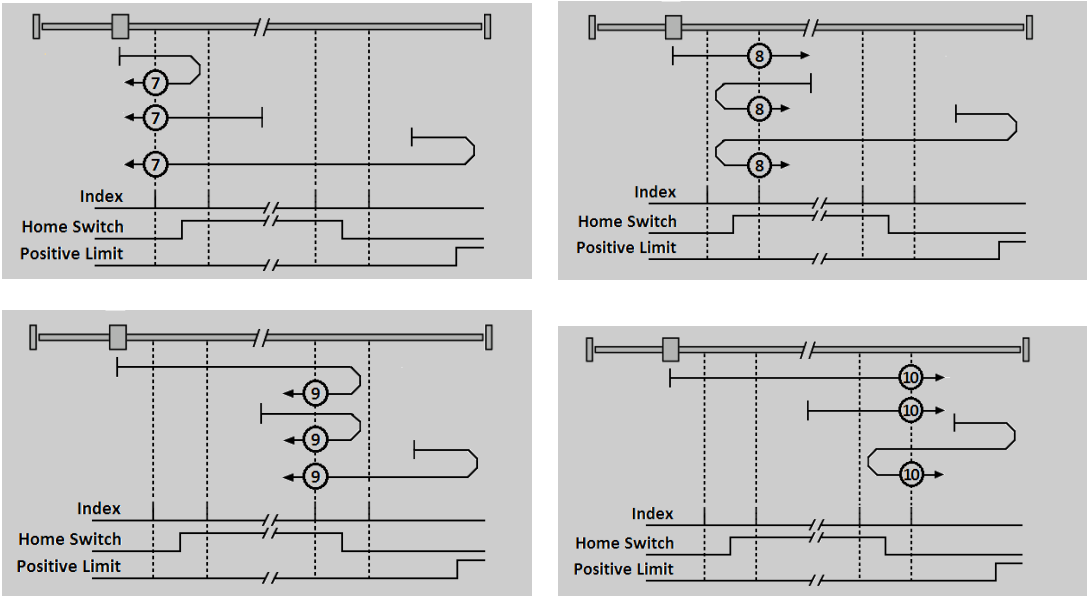
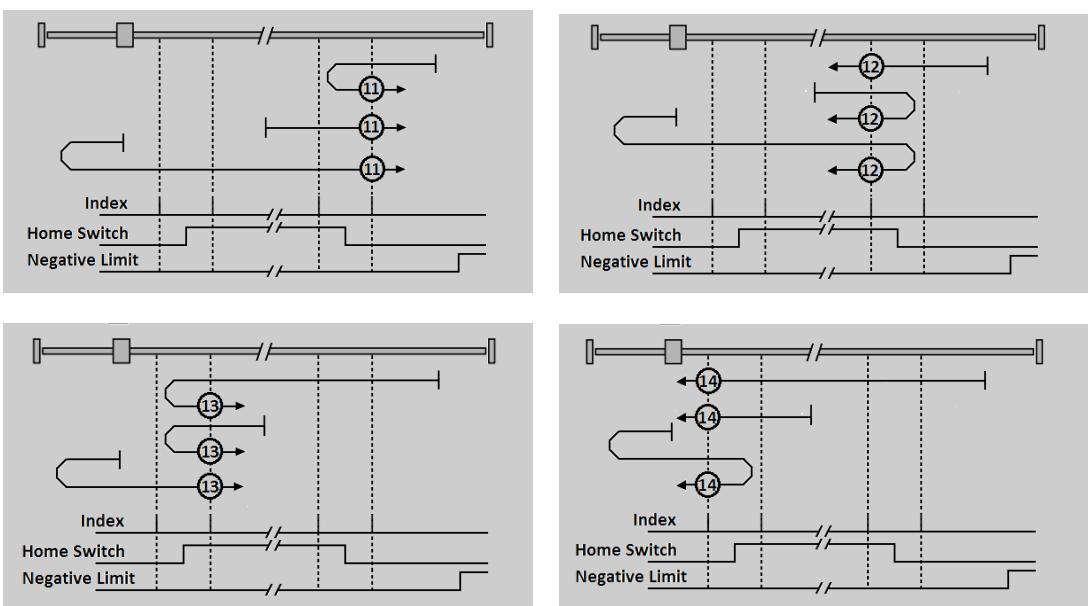
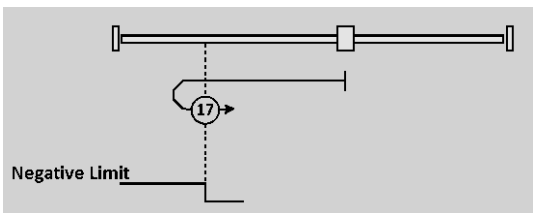
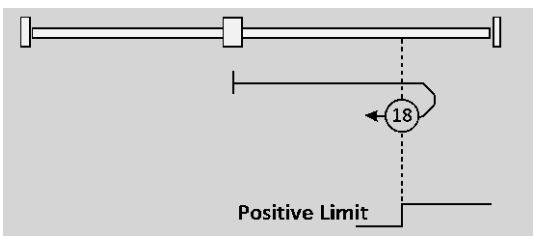
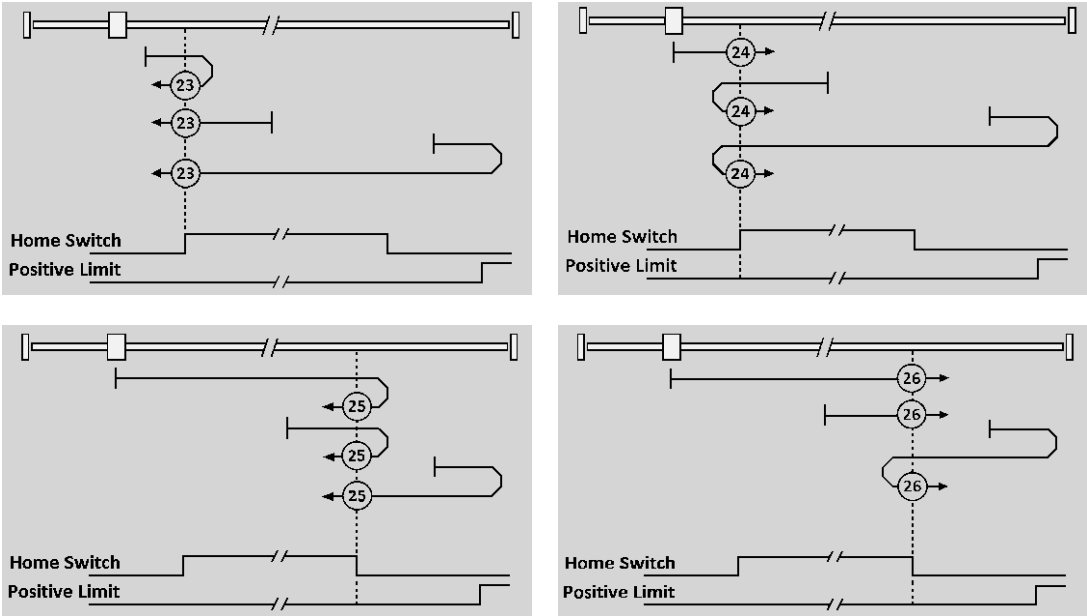
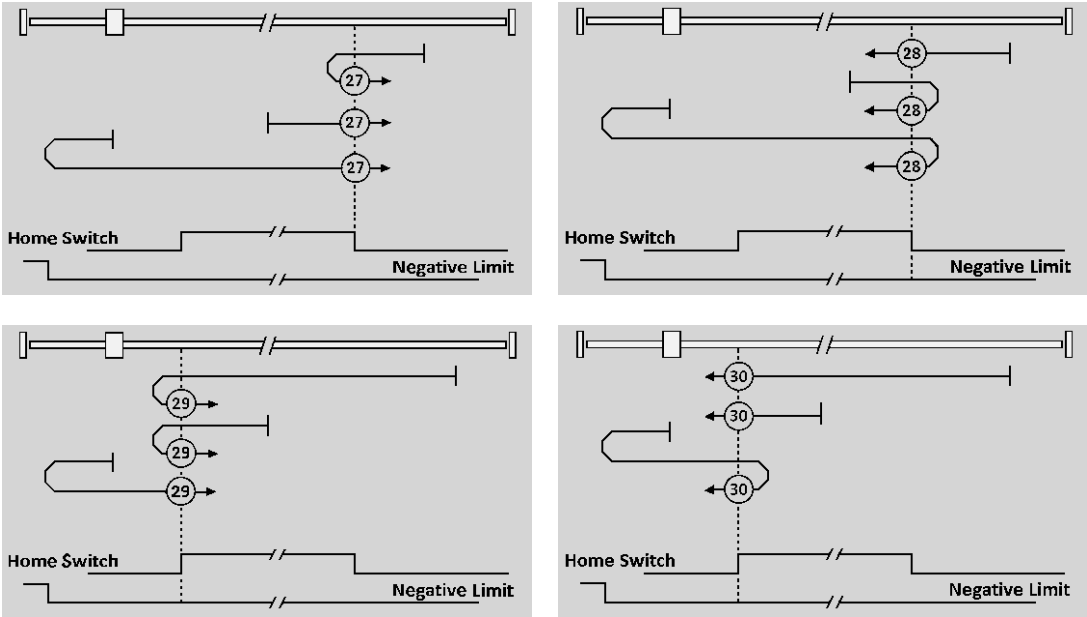


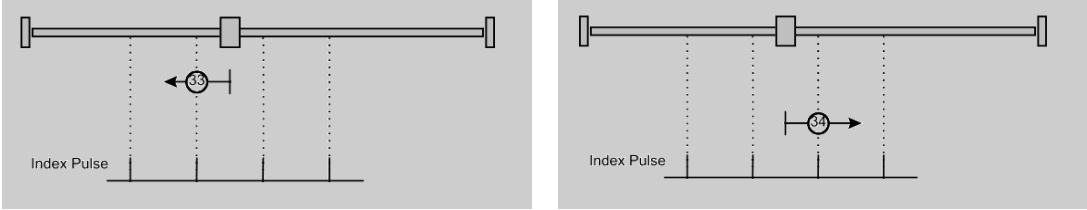
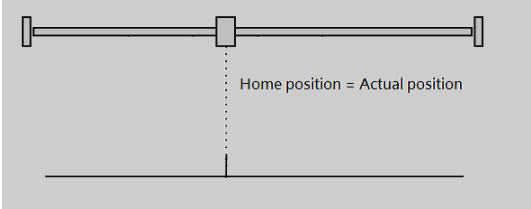
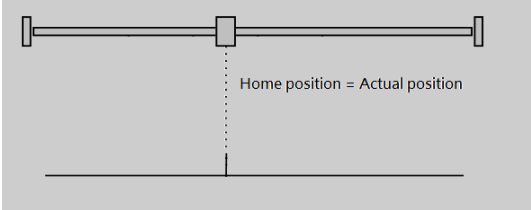
Figure 3.2.4.2

Table 3.2.4.4

Method	Description
1	Homing on negative limit switch and index pulse If the negative limit switch is inactive, the initial direction of the movement is leftward. The home position is at the first index pulse to the right of the position where the negative limit switch becomes inactive. If the negative limit is not assigned, homing will fail. 
2	Homing on positive limit switch and index pulse If the positive limit switch is inactive, the initial direction of the movement is rightward. The home position is at the first index pulse to the left of the position where the positive limit switch becomes inactive. If the positive limit is not assigned, homing will fail. 
7~10	Homing on home switch and index pulse – positive initial direction The initial direction of the movement depends on the home switch edge being sought. If the home switch is active at the beginning, the initial direction of method 7 and 8 is negative. The initial direction of all other cases is positive. If the home switch and the positive limit are not assigned, homing will fail. 

Method	Description
11~14	Homing on home switch and index pulse – negative initial direction The initial direction of the movement depends on the home switch edge being sought. If the home switch is active at the beginning, the initial direction of method 11 and 12 is positive. The initial direction of all other cases is negative. If the home switch and the negative limit are not assigned, homing will fail. 
17	Homing on negative limit switch If the negative limit switch is inactive, the initial direction of the movement is leftward. The home position is at the right of the position where the negative limit switch becomes inactive. If the negative limit is not assigned, homing will fail. 
18	Homing on positive limit switch If the positive limit switch is inactive, the initial direction of the movement is rightward. The home position is at the left of the position where the positive limit switch becomes inactive. If the positive limit is not assigned, homing will fail. 

Method	Description
23~26	Homing on home switch – positive initial direction The initial direction of the movement depends on the home switch edge being sought. If the home switch is active at the beginning, the initial direction of method 23 and 24 is negative. The initial direction of all other cases is positive. If the home switch and the positive limit are not assigned, homing will fail.  The diagrams show the motor moving in the positive direction (indicated by arrows) until the home switch is triggered, then reversing to the positive limit. The diagrams are labeled 23, 24, 25, and 26.
27~30	Homing on home switch – negative initial direction The initial direction of the movement depends on the home switch edge being sought. If the home switch is active at the beginning, the initial direction of method 27 and 28 is positive. The initial direction of all other cases is negative. If the home switch and the negative limit are not assigned, homing will fail.  The diagrams show the motor moving in the negative direction (indicated by arrows) until the home switch is triggered, then reversing to the negative limit. The diagrams are labeled 27, 28, 29, and 30.

Method	Description
33~34	Homing on index pulse The direction of homing is negative (33) or positive (34) respectively. The home position is at the index pulse found in the selected direction. 
37	Homing on current position Current position of the motor is defined as the home position. In this method, the drive does not need to be in Operation enabled state. Objects are initialized as follows. 6062h (position demand value) = 6064h (position actual value) = 607Ch (home offset) 6063h (position actual internal value) = 60FCh (position demand internal value) = 0 
-3	Homing on current position Current position of the motor is defined as the home position, and it is regarded as new index. After the setting is done, this position will be used as index when other homing methods are used. In this method, the drive does not need to be in Operation enabled state. This homing method is suitable for application using rotary motor (multi-turn absolute encoder) and linear motor (absolute encoder). Note: If Pt002 = t.X□□ is not correctly set, homing could fail. 

3.2.5 Profile velocity mode (pv)

The motor speed is output according to the profile acceleration and the profile deceleration until it reaches the target velocity. The structure of the trajectory generation is shown in Figure 3.2.5.1.

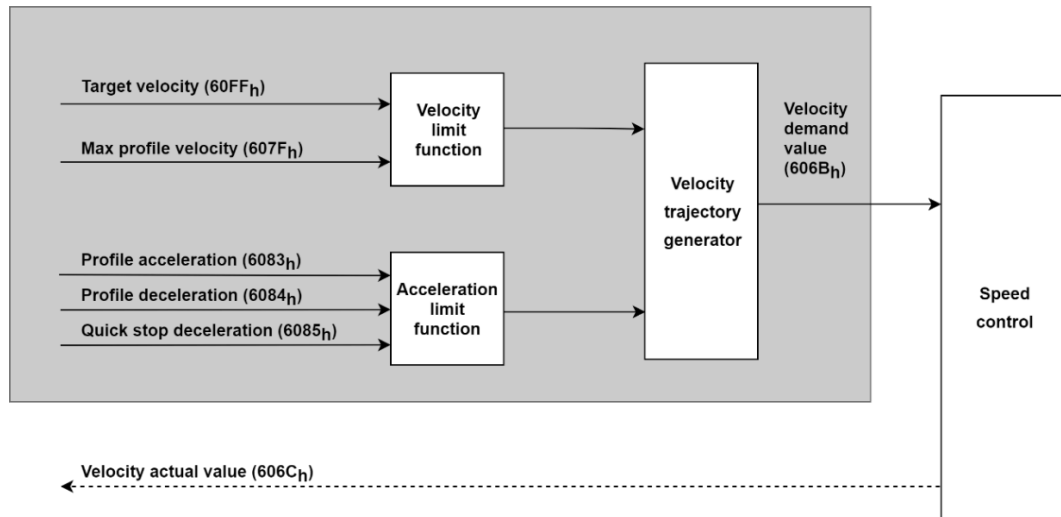


Figure 3.2.5.1

Note: When the motor is moving, the change of Profile acceleration (6083h) and Profile deceleration (6084h) will not be executed until the moving is done.

Related objects for pv mode are listed in Table 3.2.5.1.

Table 3.2.5.1

Index	Sub-Index	Name	Data type	Access	PDO	Valid value	Unit
6040h	00h	Controlword	U16	rw	Y	0x0 ~ 0xFFFF	-
6041h	00h	Statusword	U16	ro	Y	0x0 ~ 0xFFFF	-
6062h	00h	Position demand value	I32	ro	Y	-2147483648 ~ 2147483647	inc
6063h	00h	Position actual internal value	I32	ro	Y	-2147483648 ~ 2147483647	count
6064h	00h	Position actual value	I32	ro	Y	-2147483648 ~ 2147483647	inc
606Bh	00h	Velocity demand value	I32	ro	Y	-2147483648 ~ 2147483647	inc/s
606Ch	00h	Velocity actual value	I32	ro	Y	-2147483648 ~ 2147483647	inc/s
606Dh	00h	Velocity window	U16	rw	Y	0 ~ 65535	inc/s
606Eh	00h	Velocity window time	U16	rw	Y	0 ~ 65535	ms
6072h	00h	Max torque	U16	rw	Y	0 ~ 65535	0.1%
6076h	00h	Motor rated torque	U32	ro	-	0 ~ 4294967295	mNm
6077h	00h	Torque actual value	I16	ro	Y	-32768 ~ 32767	0.1%
607Fh	00h	Max profile velocity	U32	rw	Y	0 ~ 4294967295	inc/s
6083h	00h	Profile acceleration	U32	rw	Y	0 ~ 4294967295	inc/s ²
6084h	00h	Profile deceleration	U32	rw	Y	0 ~ 4294967295	inc/s ²
6085h	00h	Quick stop deceleration	U32	rw	Y	0 ~ 4294967295	inc/s ²

Index	Sub-Index	Name	Data type	Access	PDO	Valid value	Unit
60C5h	00h	Max acceleration	U32	rw	Y	0 ~ 4294967295	inc/s ²
60C6h	00h	Max deceleration	U32	rw	Y	0 ~ 4294967295	inc/s ²
60FFh	00h	Target velocity	I32	rw	Y	-2147483648 ~ 2147483647	inc/s

■ Controlword (6040h) for pv mode

Table 3.2.5.2

Bit	Value	Definition
8 (halt)	0	Execute or continue the motion.
	1	Axis is stopped according to 605Dh (halt option code).

■ Statusword (6041h) for pv mode

Table 3.2.5.3

Bit	Value	Definition
10 (target reached)	0	Halt (Bit 8 in controlword) = 0: target velocity not reached Halt = 1: axis decelerates
	1	Halt = 0: target velocity reached Halt = 1: velocity of axis is 0
12 (speed)	0	Speed is not equal to 0.
	1	Speed is equal to 0.

3.2.6 Cyclic synchronous velocity mode (csv)

The motion profile (trajectory) is generated by the master. 60C2h (interpolation time period) indicates the cycle of updating 60FFh (target velocity). The structure of the trajectory generation is shown in Figure 3.2.6.1.

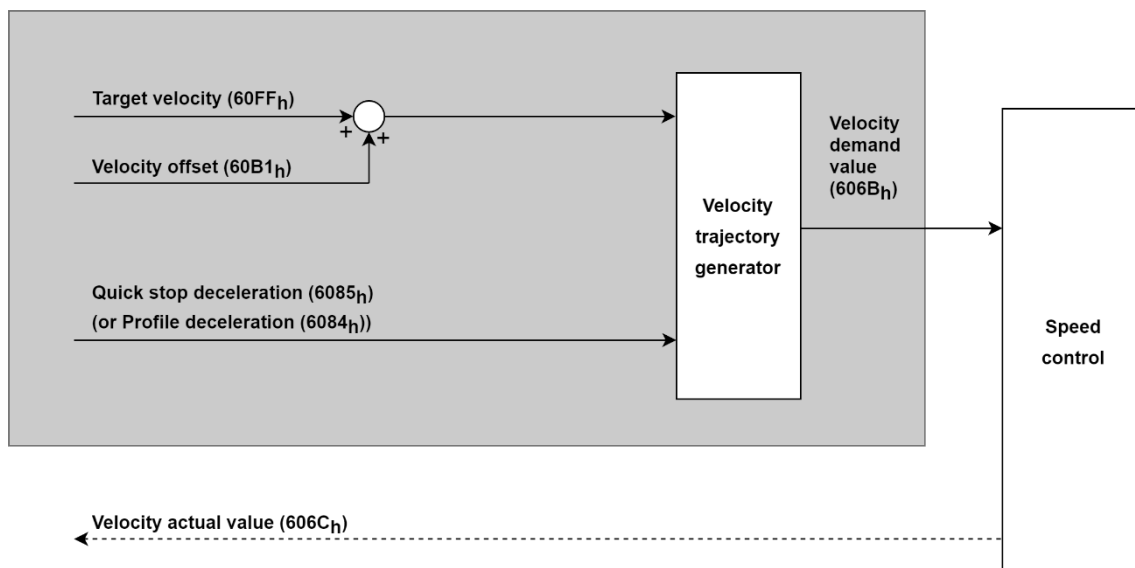


Figure 3.2.6.1

Related objects for csv mode are listed in Table 3.2.6.1.

Table 3.2.6.1

Index	Sub-Index	Name	Data type	Access	PDO	Valid value	Unit
6040h	00h	Controlword	U16	rw	Y	0x0 ~ 0xFFFF	-
6041h	00h	Statusword	U16	ro	Y	0x0 ~ 0xFFFF	-
6063h	00h	Position actual internal value	I32	ro	Y	-2147483648 ~ 2147483647	count
6064h	00h	Position actual value	I32	ro	Y	-2147483648 ~ 2147483647	inc
606Bh	00h	Velocity demand value	I32	ro	Y	-2147483648 ~ 2147483647	inc/s
606Ch	00h	Velocity actual value	I32	ro	Y	-2147483648 ~ 2147483647	inc/s
606Dh	00h	Velocity window	U16	rw	Y	0 ~ 65535	inc/s
606Eh	00h	Velocity window time	U16	rw	Y	0 ~ 65535	ms
6072h	00h	Max torque	U16	rw	Y	0 ~ 65535	0.1%
6074h	00h	Torque demand	I16	ro	Y	-32768 ~ 32767	0.1%
6076h	00h	Motor rated torque	U32	ro	-	0 ~ 4294967295	mNm
6077h	00h	Torque actual value	I16	ro	Y	-32768 ~ 32767	0.1%
6085h	00h	Quick stop deceleration	U32	rw	Y	0 ~ 4294967295	inc/s ²
60B1h	00h	Velocity offset	I32	rw	Y	-2147483648 ~ 2147483647	inc/s
60C2h	-	Interpolation time period	-	-	-	-	-
	00h	Number of entries	U8	ro	-	2	-
	01h	Interpolation time period value	U8	rw	-	0 ~ 255	-

Index	Sub-Index	Name	Data type	Access	PDO	Valid value	Unit
	02h	Interpolation time index	I8	rw	-	-128 ~ 63	-
60FFh	00h	Target velocity	I32	rw	Y	-2147483648 ~ 2147483647	inc/s

■ Statusword (6041h) for csv mode

Table 3.2.6.2

Bit	Value	Definition
12 (drive follows command value)	0	Drive does not follow the command value. (Ignore target velocity.)
	1	Drive follows the command value. (Target velocity is viewed as an input to velocity control loop.)

3.2.7 Profile torque mode (tq)

The torque is output up to the target torque according to the torque slope setting. Torque command is generated from 6071h (target torque) and 6087h (torque slope), as Figure 3.2.7.1 shows.

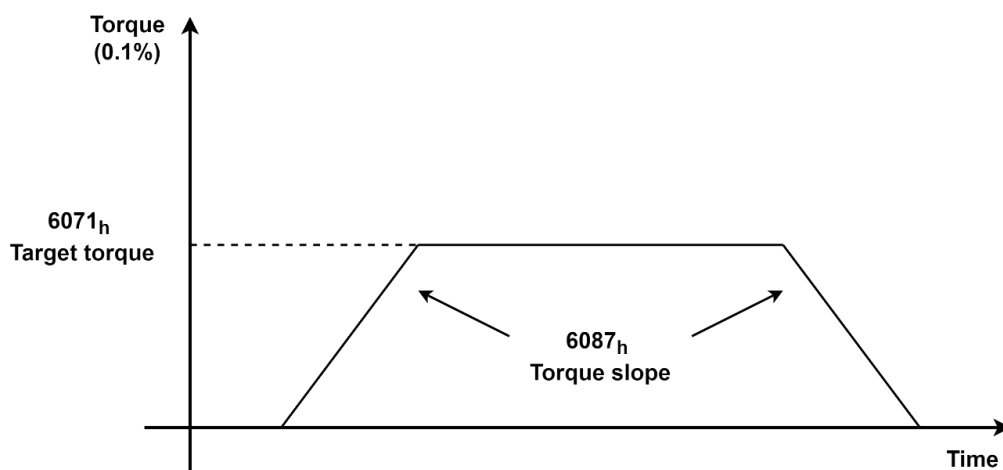


Figure 3.2.7.1

The structure of the trajectory generation is shown in Figure 3.2.7.2.

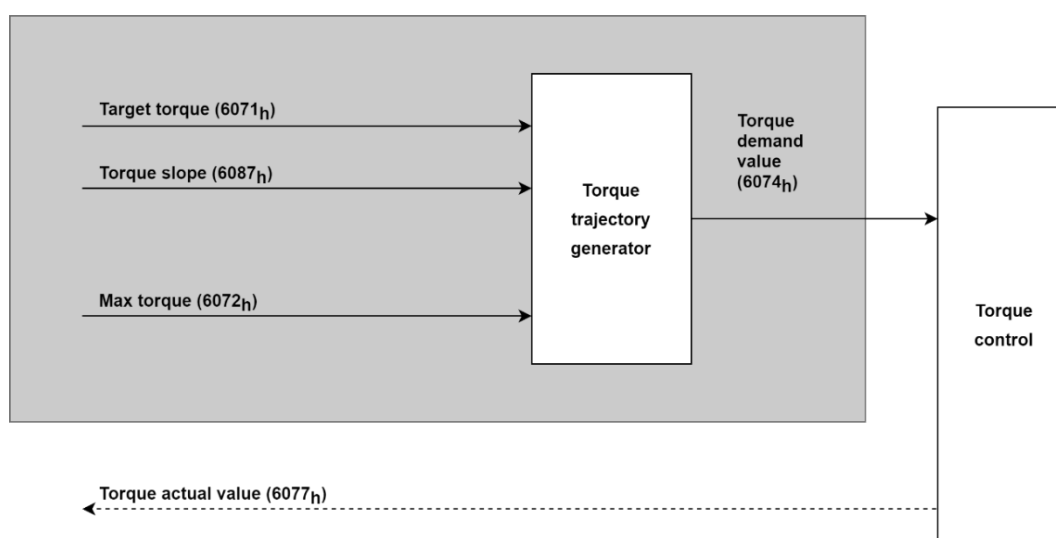


Figure 3.2.7.2

Related objects for tq mode are listed in Table 3.2.7.1.

Table 3.2.7.1

Index	Sub-Index	Name	Data type	Access	PDO	Valid value	Unit
6040h	00h	Controlword	U16	rw	Y	0x0 ~ 0xFFFF	-
6041h	00h	Statusword	U16	ro	Y	0x0 ~ 0xFFFF	-
6063h	00h	Position actual internal value	I32	ro	Y	-2147483648 ~ 2147483647	count
6064h	00h	Position actual value	I32	ro	Y	-2147483648 ~ 2147483647	inc
606Ch	00h	Velocity actual value	I32	ro	Y	-2147483648 ~ 2147483647	inc/s
6071h	00h	Target torque	I16	rw	Y	-32768 ~ 32767	0.1%
6072h	00h	Max torque	U16	rw	Y	0 ~ 65535	0.1%
6074h	00h	Torque demand	I16	ro	Y	-32768 ~ 32767	0.1%
6075h	00h	Motor rated current	U32	ro	-	0 ~ 4294967295	mA
6076h	00h	Motor rated torque	U32	ro	-	0 ~ 4294967295	mNm
6077h	00h	Torque actual value	I16	ro	Y	-32768 ~ 32767	0.1%
6087h	00h	Torque slope	U32	rw	Y	0 ~ 4294967295	0.1%/s
60E0h	00h	Positive torque limit value	U16	rw	Y	0 ~ 65535	0.1%
60E1h	00h	Negative torque limit value	U16	rw	Y	0 ~ 65535	0.1%

■ Controlword (6040h) for tq mode

Table 3.2.7.2

Bit	Value	Definition
8 (halt)	0	Execute or continue the motion.
	1	Axis is stopped according to 605Dh (halt option code).

■ Statusword (6041h) for tq mode

Table 3.2.7.3

Bit	Value	Definition
10 (target reached)	0	Halt (Bit 8 in controlword) = 0: target torque not reached Halt = 1: axis decelerates
	1	Halt = 0: target torque reached Halt = 1: velocity of axis is 0

3.2.8 Cyclic synchronous torque mode (cst)

The motion profile (trajectory) is generated by the master. 60C2h (interpolation time period) indicates the cycle of update 6071h (target torque). The structure of the trajectory generation is shown in Figure 3.2.8.1.

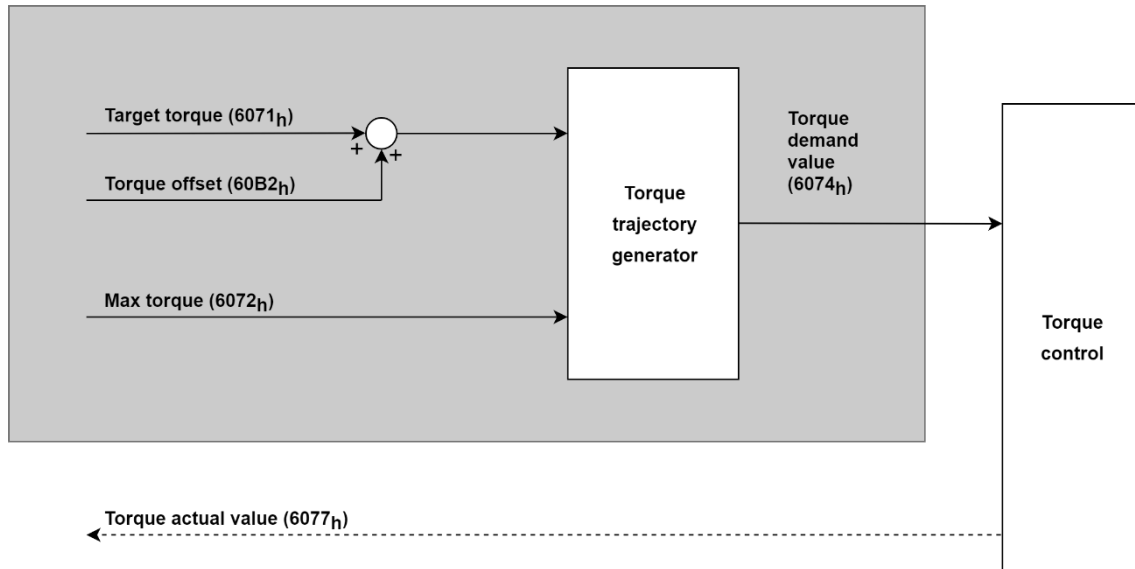


Figure 3.2.8.1

Related objects for cst mode are listed in Table 3.2.8.1.

Table 3.2.8.1

Index	Sub-Index	Name	Data type	Access	PDO	Valid value	Unit
6040h	00h	Controlword	U16	rw	Y	0x0 ~ 0xFFFF	-
6041h	00h	Statusword	U16	ro	Y	0x0 ~ 0xFFFF	-
6063h	00h	Position actual internal value	I32	ro	Y	-2147483648 ~ 2147483647	count
6064h	00h	Position actual value	I32	ro	Y	-2147483648 ~ 2147483647	inc
606Ch	00h	Velocity actual value	I32	ro	Y	-2147483648 ~ 2147483647	inc/s
6071h	00h	Target torque	I16	rw	Y	-32768 ~ 32767	0.1%
6072h	00h	Max torque	U16	rw	Y	0 ~ 65535	0.1%
6074h	00h	Torque demand	I16	ro	Y	-32768 ~ 32767	0.1%
6075h	00h	Motor rated current	U32	ro	-	0 ~ 4294967295	mA
6076h	00h	Motor rated torque	U32	ro	-	0 ~ 4294967295	mNm
6077h	00h	Torque actual value	I16	ro	Y	-32768 ~ 32767	0.1%
60B2h	00h	Torque offset	I16	rw	Y	-32768 ~ 32767	0.1%
60C2h	-	Interpolation time period	-	-	-	-	-
	00h	Number of entries	U8	ro	-	2	-
	01h	Interpolation time period value	U8	rw	-	0 ~ 255	-
	02h	Interpolation time index	I8	rw	-	-128 ~ 63	-
60E0h	00h	Positive torque limit value	U16	rw	Y	0 ~ 65535	0.1%
60E1h	00h	Negative torque limit value	U16	rw	Y	0 ~ 65535	0.1%

■ Statusword (6041h) for cst mode

Table 3.2.8.2

Bit	Value	Definition
12 (drive follows command value)	0	Drive does not follow the command value. (Ignore target torque.)
	1	Drive follows the command value. (Target torque is viewed as an input to torque control loop.)

3.2.9 Touch probe function

The function latches feedback position triggered by the index signal (Z-phase) or EXT-PROBE1. When the operation mode is homing mode, this function is invalid. Do not set rising edge and falling edge at the same time.

Related objects for touch probe function are listed in Table 3.2.9.1.

Table 3.2.9.1

Index	Sub-Index	Name	Data type	Access	PDO	Valid value	Unit
60B8h	00h	Touch probe function	U16	rw	Y	0 ~ 65535	-
60B9h	00h	Touch probe status	U16	ro	Y	0 ~ 65535	-
60BAh	00h	Touch probe 1 positive edge	I32	ro	Y	-2147483648 ~ 2147483647	inc
60BBh	00h	Touch probe 1 negative edge	I32	ro	Y	-2147483648 ~ 2147483647	inc
60BCh	00h	Touch probe 2 positive edge	I32	ro	Y	-2147483648 ~ 2147483647	inc

- Example of touch probe 1 triggering first event

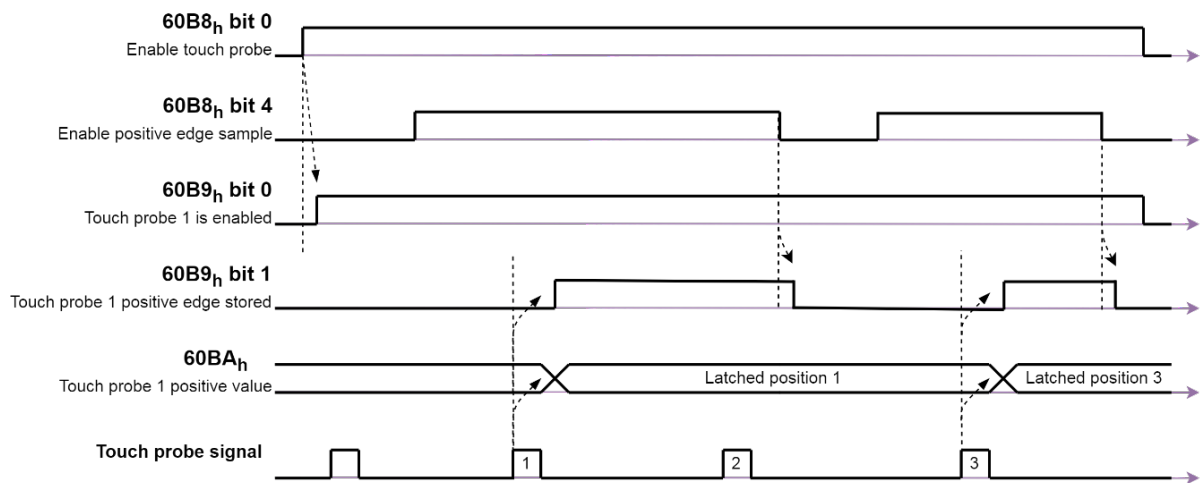


Figure 3.2.9.1

Table 3.2.9.2

#	Value	Description
(1)	60B8h bit 0 = 1 60B8h bit 1 = 0 60B8h bit 4 = 1	Touch probe 1 is enabled. First event is triggered. Touch probe 1 positive edge is configured and enabled.
(2)	→ 60B9h bit 0 = 1	Status "Touch probe 1 is enabled" is set to 1.
(3)		There is a positive edge in external touch probe signal.
(4)	→ 60B9h bit 1 = 1 → 60BAh	Status "Touch probe 1 positive edge stored" is set to 1. Touch probe position 1 positive value is stored.
(5)	60B8h bit 4 = 0	Positive edge sampling is switched off.
(6)	→ 60B9h bit 1 = 0 → 60BAh	Status "Touch probe 1 positive edge stored" is reset to 0. Touch probe position 1 positive value is not changed.
(7)	60B8h bit 4 = 1	Positive edge sampling is enabled.
(8)		There is another positive edge in external touch probe signal.
(9)	→ 60B9h bit 1 = 1 → 60BAh	Status "Touch probe 1 positive edge stored" is set to 1. New touch probe position 1 positive value is stored.
(10)	→ 60B8h bit 0 = 0	Touch probe 1 is switched off.
(11)	→ 60B9h bit 0 and bit 1 = 0	Status bits are reset.

■ Example of touch probe 1 continuous latch

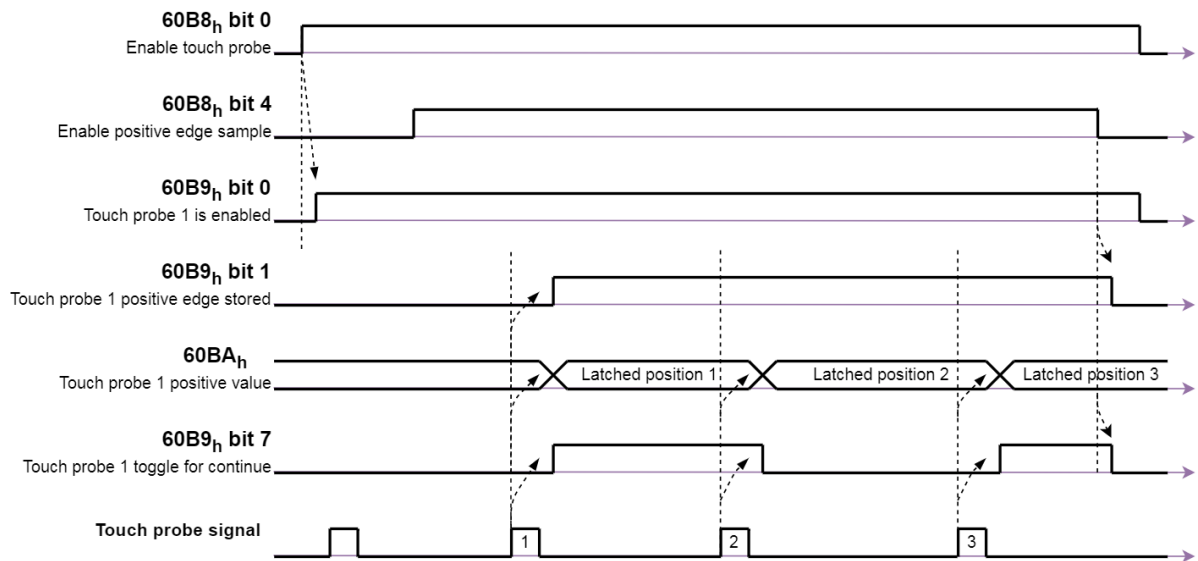


Figure 3.2.9.2

Table 3.2.9.3

#	Value	Description
(1)	60B8h bit 0 = 1 60B8h bit 1 = 1 60B8h bit 4 = 1	Touch probe 1 is enabled. Continuous latch. Touch probe 1 positive edge is configured and enabled.
(2)	→ 60B9h bit 0 = 1	Status "Touch probe 1 is enabled" is set to 1.
(3)		There is a positive edge in external touch probe signal.
(4)	→ 60B9h bit 1 = 1 → 60B9h bit 7 = 1 → 60BAh	Status "Touch probe 1 positive edge stored" is set to 1. Touch probe 1 positive edge is updated. Touch probe position 1 positive value is stored.
(5)		There is the 2nd positive edge in external touch probe signal.
(6)	→ 60B9h bit 7 = 0 → 60BAh	Touch probe 1 positive edge is updated. The 2nd touch probe position 1 positive value is stored.
(7)		There is the 3rd positive edge in external touch probe signal.
(8)	→ 60B9h bit 7 = 1 → 60BAh	Touch probe 1 positive edge is updated. The 3rd touch probe position 1 positive value is stored.
(9)	60B8h bit 4 = 0	Positive edge sampling is switched off.
(10)	→ 60B9h bit 1 = 0 → 60B9h bit 7 = 0 → 60BAh	Status "Touch probe 1 positive edge stored" is reset to 0. Continuous latch status is reset to 0. Touch probe position 1 positive value is not changed.
(11)	→ 60B8h bit 0 = 0	Touch probe 1 is switched off.
(12)	→ 60B9h bit 0 = 0	Status bit is reset.

3.2.10 Modulo system

Modulo system can be used for rotational positioning. By setting 607Bh (Position range limit), users can standardize the range of position data. The affected position data includes 6062h (Position demand value) and 6064h (Position actual value), etc.

If the value of either 607B:01h (Min position range limit) or 607B:02h (Max position range limit) is not 0, Modulo system will be activated.

When Modulo system is activated, if the motor moves more than 607B:02h (Max position range limit) or less than 607B:01h (Min position range limit), the position data will be processed by “Wrap around”, and the values will be accumulated or subtracted from the other end, as Figure 3.2.10.1 shows.

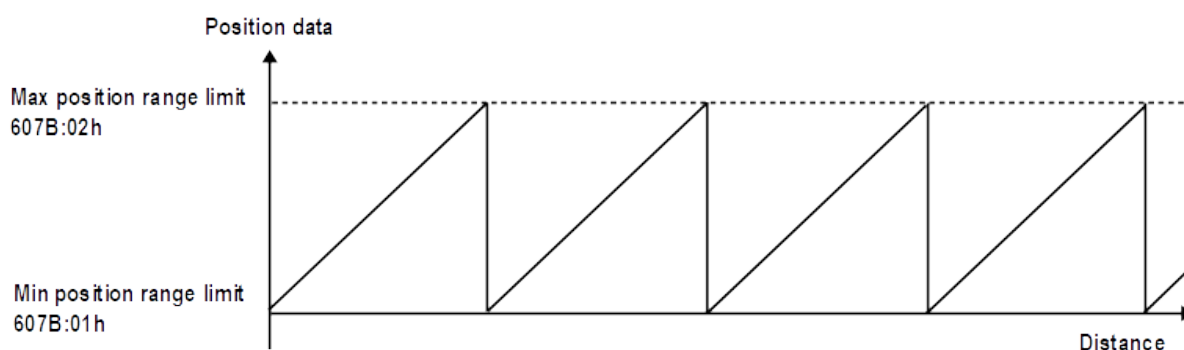


Figure 3.2.10.1

Table 3.2.10.1

Index	Sub-Index	Name	Data type	Access	PDO	Valid value	Unit
607Bh	00h	Position range limit	U8	ro	-	2	-
	01h	Min position range limit	I32	rw	Y	-2147483648 ~ 0	inc
	02h	Max position range limit	I32	rw	Y	0 ~ 2147483647	inc

Note:

1. The modified values of 607B:01h (Min position range limit) and 607B:02h (Max position range limit) are only effective in disabled state. In enabled state, even if the objects are modified, the settings currently used in Modulo system will not be affected.
2. The maximum setting range is 2,147,483,647 (0x7FFFFFFF). The setting will be invalid when it exceeds the range.
3. When the value set by 607Bh is not valid, the drive will pop up the warning AL.980 to remind users.

■ Rotational positioning

One of the ways to use Modulo system is to set Modulo's range to the range of one revolution of motor, such as setting Modulo's range to 0°~359° (Min position range limit is set to 0°; Max position range limit is set to 359°). Figure 3.2.10.2 shows the numerical changes in the actual position when the motor rotates in the range of 0°~359°.

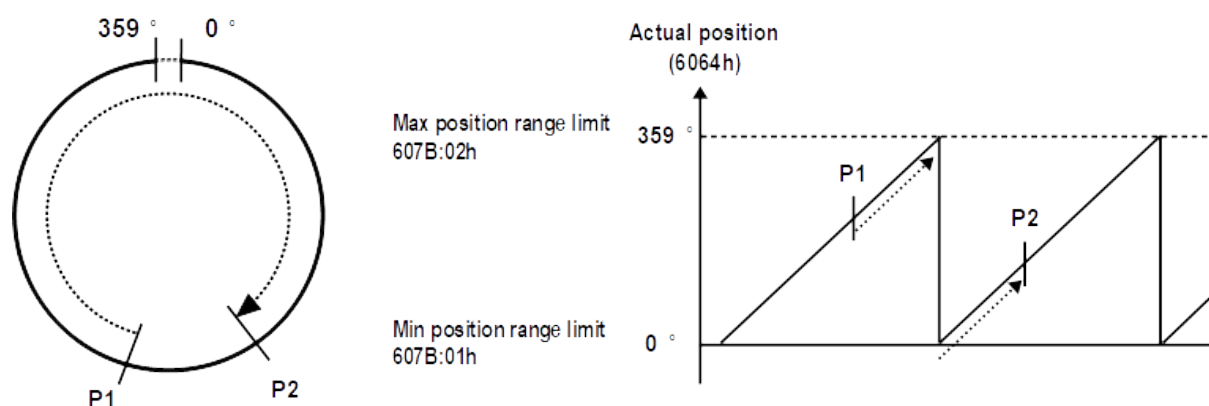


Figure 3.2.10.2

■ Rotary axis direction option

When using rotational positioning, 607Ah (Target position) can be reached by rotating the motor in either forward or reverse direction. Therefore, when Modulo system is activated, the moving method of 607Ah (Target position) must be set via 60F2h (Position option code). The operational behaviors are shown in Table 3.2.10.2.

Table 3.2.10.2

Bit	Value	Name	Operational behavior
0 ~ 5	0	-	(Not support)
6, 7	00	Linear	Linear movement, the motor will move based on the position with absolute value.
	01	Only negative direction	Negative direction only, the motor will only move in reverse direction.
	10	Only positive direction	Positive direction only, the motor will only move in forward direction.
	11	Shortest way	Shortest distance, the motor will move with the shortest distance.
8 ~ 15	0	-	(Not support)

Note:

- Only profile position mode (pp) supports 60F2h (Position option code); cyclic synchronous position mode (csp) only supports the command execution in Shortest way.
- If profile position mode (pp) uses relative movement (Controlword Bit 6 = 1), the motor will not move in the way set by 60F2h (Position option code).

■ Example of 60F2h (Position option code)

If Modulo's range is set to $0^{\circ}\sim 359^{\circ}$ (Min position range limit is set to 0° ; Max position range limit is set to 359°), which exactly corresponds to one revolution of motor, different executions of $45^{\circ} \rightarrow 270^{\circ} \rightarrow 90^{\circ} \rightarrow 540^{\circ} \rightarrow -135^{\circ}$ are displayed in the following figures.

➤ Linear

When the method "Linear movement" is executed, if Target position is within 360° , the motor will move to the designated set-point without passing through the intersection point of $359^{\circ}\sim 0^{\circ}$, as the movements of $45^{\circ} \rightarrow 270^{\circ}$ and $270^{\circ} \rightarrow 90^{\circ}$ in Figure 3.2.10.3. If Target position is less than Min position range limit ($<0^{\circ}$) or more than Max position range limit ($>359^{\circ}$), additional movement will be carried out based on the exceeded value and the motor will stop at the designated set-point, as the movements of $90^{\circ} \rightarrow 540^{\circ}$ and $180^{\circ} \rightarrow -135^{\circ}$ in Figure 3.2.10.3.

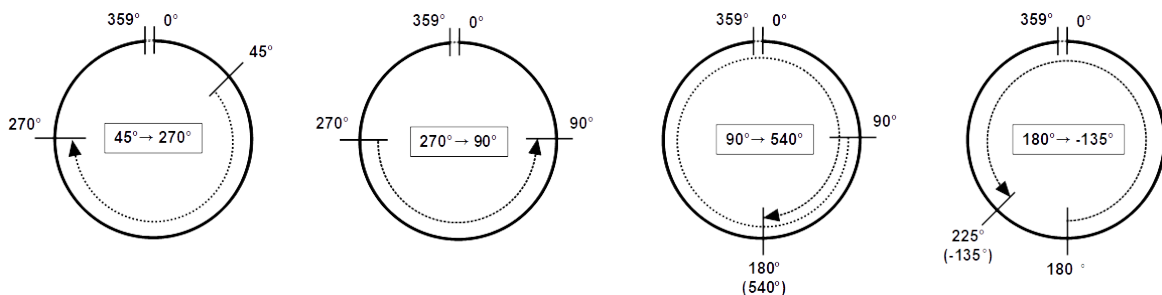


Figure 3.2.10.3

➤ Only negative direction

When the method "Negative direction only" is executed, the motor will move in reverse direction to Target position processed by "Wrap around." In this method, the motor will not rotate more than one revolution.

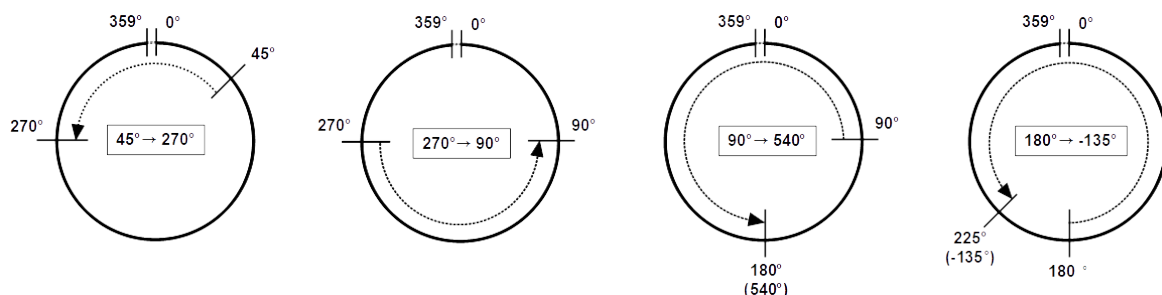


Figure 3.2.10.4

➤ Only positive direction

When the method "Positive direction only" is executed, the motor will move in forward direction to Target position processed by "Wrap around." In this method, the motor will not rotate more than one revolution.

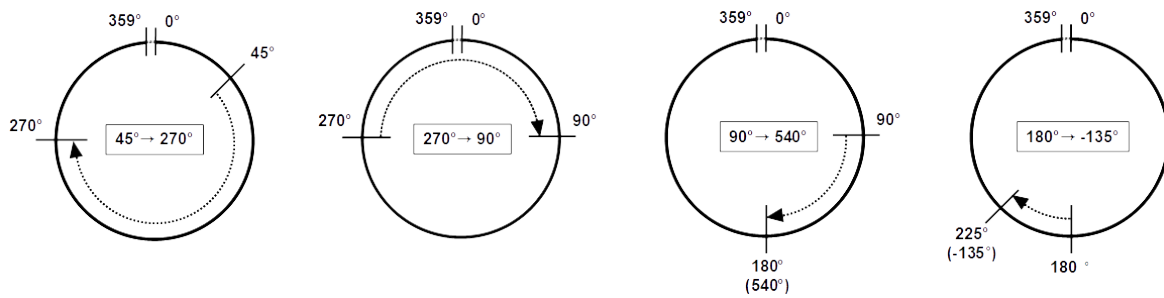


Figure 3.2.10.5

➤ Shortest way

When the method “Shortest distance” is executed, the motor will move to Target position processed by “Wrap around” with the shortest distance. In this method, the motor will not rotate more than half revolution. If the moving distance is exactly 180°, the motor will move in positive direction.

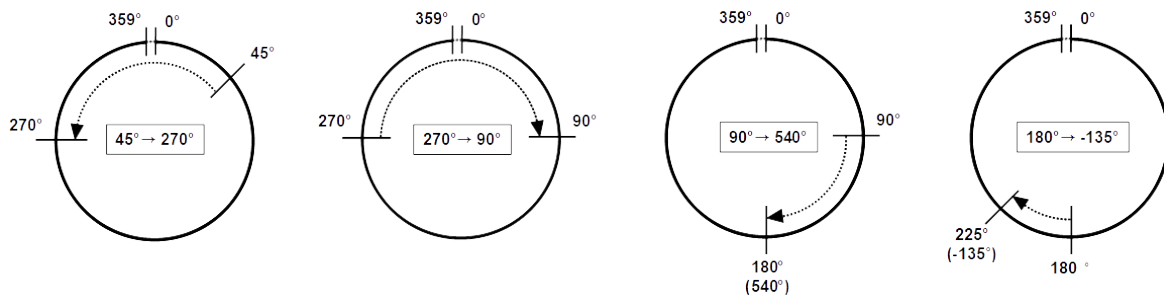


Figure 3.2.10.6

■ Modulo reference setting steps—pp mode

- [1] Refer to the chapter “Electronic gear ratio setting” in “E Series Servo Drive Thunder Software Operation Manual” to set the electronic gear ratio so that one revolution of motor is 3,600,000 control units.
- [2] Refer to the chapter “Settings of infinite rotation function” in each servo drive user manual to set Pt205: Upper limit of motor rotation number.
- [3] Save drive’s parameters and reset the drive.
- [4] Ensure the drive is disabled (Switch on disabled).
- [5] Set 607B:01h (Min position range limit) = 0.
- [6] Set 607B:02h (Max position range limit) = 3599999 (user-defined, the value must be the total travel distance minus one).
- [7] Set 60F2h (Position option code).
- [8] Perform pp motion.

■ Modulo reference setting steps—csp mode

- [1] Refer to the chapter “Electronic gear ratio setting” in “E Series Servo Drive Thunder Software Operation Manual” to set the electronic gear ratio so that one revolution of motor is 3,600,000 control units.
- [2] Refer to the chapter “Settings of infinite rotation function” in each servo drive user manual to set Pt205: Upper limit of motor rotation number.
- [3] Save drive's parameters and reset the drive.
- [4] Set the relevant parameters of Modulo system in controller settings.
- [5] Ensure the drive is disabled (Switch on disabled).
- [6] Set 607B:01h (Min position range limit) = 0.
- [7] Set 607B:02h (Max position range limit) = 3599999 (user-defined, the value must be the total travel distance minus one).
- [8] Perform csp motion.

Note:

When Modulo function is executed in csp mode, the controller must also support the command parsing of Modulo system. For example, Target position given to the drive must be set in the way of “Wrap around.” If the controller settings do not match Modulo system, forced operation may cause the motor to malfunction.

3.3 Manufacturer specific profile area

Table 3.3.1

Index	Sub-Index	Name	Data type	Access	PDO	Op Mode	Valid value	Unit
2XXXh	00h	The 2000h series objects are from servo Pt parameters. Please refer to the chapter “List of parameters” in each servo drive user manual. The mapping relationship between servo Pt parameter numbers and object indexes is as follows: Object index = 2000h + servo Pt parameter number Example: Servo drive's parameter Pt100 is “Velocity loop gain”, and its corresponding object is 2100h.						
3000h	00h	Motor type	U16	ro	-	All	0 ~ 2	-
		Motor type used with the drive 0: Linear motor (LM) 1: Direct drive motor / Torque motor (DM / TM) 2: AC servo motor (AC)						
3001h	00h	Inner encoder resolution	I32	ro	-	All	-2147483648 ~ 2147483647	-
		Encoder resolution for internal loop						
3002h 3055h	N/A	The objects in this section are not supported. Do not operate them.						
3056h	00h	Software state[12]	U16	ro	-	All	0 ~ 0xFFFF	-
		Software state table. The state corresponding to each bit is described as follows.						
		Bit	State Name	State Definition				
		0	Reserved	N/A				
		1	Reserved	N/A				
		2	Reserved	N/A				
		3	Homing state	0: Homing is not executed 1: Homing is in process				
		4	Position trigger function state	0: Position trigger function is not enabled 1: Position trigger function is enabled				
		5	Communication state of gantry control system	0: Communication for gantry control system is not executed 1: Communication for gantry control system is normal				
		6	Motor power state of gantry yaw axis	0: Motor for gantry yaw axis is unpowered 1: Motor for gantry yaw axis is powered				
		7	Alarm state of gantry yaw axis	0: No alarm is in gantry yaw axis 1: An alarm occurs in gantry yaw axis				
		8	Activated state of gantry control system	0: Gantry control system is not activated 1: Gantry control system is activated				
		9	Homing state of gantry yaw axis	0: Homing for gantry yaw axis is not completed 1: Homing for gantry yaw axis is completed				
		10	Near home sensor state of gantry yaw axis	0: Gantry yaw axis is not in the range of near home sensor 1: Gantry yaw axis is in the range of near home sensor				
		11	Regulation state of gantry yaw axis	0: Gantry yaw axis regulating is incompleted 1: Gantry yaw axis regulating is completed				
		12	In-position state of gantry yaw axis	0: Gantry yaw axis is not in-position 1: Gantry yaw axis is in-position				
		13	Ready state of gantry yaw axis	0: Drive for gantry yaw axis is not ready 1: Drive for gantry yaw axis is ready without triggering STO				
		14	Reserved	N/A				
15	Reserved	N/A						
3057h	00h	Application mode of gantry system	U16	rw	-	All	1, 2, 11	-
		Application mode setting of gantry control system. The applicable modes are as follows. Please refer to “E Series Servo Drive Gantry Control System User Manual” for detailed settings. 1: Activate gantry control system 2: Deactivate gantry control system 11: Execute yaw axis regulation						
3058h	00h	Yaw target position	I32	rw	Y	All	-2147483648 ~ 2147483647	inc
		Target position for gantry yaw axis						
3059h	00h	Yaw feedback position	I32	ro	Y	All	-2147483648 ~ 2147483647	inc
		Feedback position for gantry yaw axis						

Index	Sub-Index	Name	Data type	Access	PDO	Op Mode	Valid value	Unit	
305Ah	00h	Master feedback position	I32	ro	Y	All	-2147483648 ~ 2147483647	inc	
		Feedback position for gantry master axis							
305Bh	00h	Slave feedback position	I32	ro	Y	All	-2147483648 ~ 2147483647	inc	
		Feedback position for gantry slave axis							
3060h	00h	Use touch probe enable specific function	U16	rw	-	pp pv tq csp csv cst	0x0 ~ 0x3	-	
		Enable specific function with touch probe function.							
		Bit	Function	Definition					
		0	Error map	0: Do not use touch probe function to enable error map. 1: Use touch probe function to enable error map.					
		1	Position trigger function	(Before using this function, set Pt00E = t.1□□□.) 0: Do not use touch probe function to enable position trigger function. 1: Use touch probe function to enable position trigger function.					
		2~15	Reserved	N/A					
		For the details of error map and position trigger function, please refer to each servo drive user manual.							
3061h	00h	Enable position trigger function	U16	rw	-	All	0 ~ 1	-	
		Enable position trigger function. For the details of position trigger function, please refer to each servo drive user manual. 0: Disable position trigger function 1: Enable position trigger function							
3062h	00h	Overtravel stop mode selection	U16	rw	-	All	0 ~ 1	-	
		Parameter setup of overtravel stop 0: When overtravel happens, the motor stops accoring to the current setting of object 6085h (quick stop deceleration), and the original quick stop deceleration of the motion will not be affected. 1: When overtravel happens, the motor stops according to the current setting of object 6085h (quick stop deceleration), and the original quick stop deceleration of the motion will be modified.							
3063h	00h	Velocity analog input voltage	I16	ro	Y	All	-10000 ~ 10000	mV	
		Control signal's velocity analog input (V_REF) (applicable to E2 series servo drive) Formula: Object 3063h = Actual voltage - Object 3064h							
3064h	00h	Velocity analog input voltage offset	I16	rw	-	All	-10000 ~ 10000	mV	
		Velocity analog input's offset (applicable to E2 series servo drive)							
3065h	00h	Torque analog input voltage	I16	ro	Y	All	-10000 ~ 10000	mV	
		Control signal's torque analog input (T_REF) (applicable to E2 series servo drive) Formula: Object 3065h = Actual voltage - Object 3066h							
3066h	00h	Torque analog input voltage offset	I16	rw	-	All	-10000 ~ 10000	mV	
		Torque analog input's offset (applicable to E2 series servo drive)							
3067h	00h	Analog output 1 voltage	I16	rw	Y	All	-10000 ~ 10000	mV	
		Control signal's analog output 1 (AO1) When Pt006 = t.□□17 is set, users can control analog output 1 with this object.							
3068h	00h	Analog output 2 voltage	I16	rw	Y	All	-10000 ~ 10000	mV	
		Control signal's analog output 2 (AO2) When Pt006 = t.□□17 is set, users can control analog output 2 with this object.							
3069h	00h	Position trigger array value	I32	rw	Y	All	-2147483648 ~ 2147483647	inc	
		Position trigger array's value							
306Ah	00h	Position trigger array index	U16	rw	Y	All	0 ~ 255	-	
		Position trigger array's index value							

Index	Sub-Index	Name	Data type	Access	PDO	Op Mode	Valid value	Unit
306Bh	00h	Position trigger array control object	U16	rw	Y	All	0 ~ 65535	-
		Writing procedure of operating position trigger array Set 0x0001~0x0080 to select the writing procedure. The writing result will be displayed by 0x1000~0x2000.						
		Value	Definition					Category
		0x0001	Write the value of object 3069h to the “position array” corresponding to object 306Ah. (At this time, object 306Ah cannot exceed 255.)					Command
		0x0008	Set all the values in the “position array” to 0.					
		0x0010	Write the value of object 3069h to the “status array” corresponding to object 306Ah. (At this time, object 306Ah cannot exceed 7.)					
		0x0080	Set all the values in the “status array” to 0.					
0x1000	The writing succeeds.					Result		
0x2000	The writing fails. Refer to object 306Ch for the reason.							
306Ch	00h	Position trigger function error code	U16	ro	Y	All	0 ~ 65535	-
		The reasons that the writing of position trigger array or the enabling of position trigger function fails						
		Bit	Definition					
		※ The reasons that the writing of position trigger array fails						
		0	Fixed interval PT mode does not support the writing of position trigger array.					
		1	Wrong index value of array (object 306Ah)					
		2	Undefined command (object 306Bh)					
		3~7	Reserved					
		※ The reasons that the enabling of position trigger function fails						
		8	The encoder does not support position trigger function.					
		9	Homing is not executed.					
		10	The parameter setting of Pt00E or Pt230~Pt232 is wrong.					
		11	The current motor position exceeds the end position set by Pt232 (fixed interval PT mode Pt00E = t.□□1□).					
		12~15	Reserved					
306Dh	00h	Position trigger function status	I16	ro	Y	All	0 ~ 32767	-
		Status of position trigger function						
		Value	Definition					
		0	Position trigger function is not enabled.					
		3	Fixed interval position trigger function is executing (trigger direction: position decreasing).					
		4	Fixed interval position trigger function is executing (trigger direction: position increasing).					
		13	Random interval position trigger function is executing (trigger direction: index value decreasing).					
		14	Random interval position trigger function is executing (trigger direction: index value increasing).					
		20	Wait until it goes back to the first set trigger position (if repeat mode is enabled Pt012 = t.□□□1).					
99	Position trigger function is invalid (Pt00E = t.□□□0).							
306Eh	00h	Expected total number of position trigger	U16	ro	Y	All	0 ~ 65535	-
		Expected total number of position trigger						
306Fh	00h	Triggered number of position trigger	U16	ro	Y	All	0 ~ 65535	-
		Triggered number of position trigger						
3070h	00h	Remaining number of position trigger	U16	ro	Y	All	0 ~ 65535	-
		Remaining number of position trigger						

Index	Sub-Index	Name	Data type	Access	PDO	Op Mode	Valid value	Unit
3072h	00h	Auto focus control status	U16	ro	-	pp csp	0 ~ 32767	-
		Status of auto focus control						
		Value	Definition					
		0	Auto focus control function is not enabled.					
		1	Auto focus control function is initialized.					
		3	Auto focus control function is enabled.					
3073h	00h	Auto focus control error	U16	ro	-	pp csp	0 ~ 0xFFFF	-
		Error status of auto focus control. The status corresponding to each bit is described as follows.						
		Bit	Definition					
		0	Position of auto focus control exceeds the protection threshold of Pt2A3.					
		1	Deviation of auto focus control exceeds the protection threshold of Pt2A7.					
		2	Overtravel (any overtravel signal is detected during auto focus control)					
		3~15	Reserved					
3074h	00h	Enable auto focus control function	U16	rw	-	pp csp	0 ~ 1	-
		Enable auto focus control function. For the details of auto focus control function, please refer to "E Series Servo Drive Auto Focus Control Function User Manual." 0: Disable auto focus control function 1: Enable auto focus control function						
3075h	00h	Auto focus control feedback	F32	ro	-	pp csp	-3.40282e+38 ~ 3.40282e+38	mV
		Feedback of auto focus control						
3076h	00h	Auto focus control deviation	F32	ro	-	pp csp	-3.40282e+38 ~ 3.40282e+38	mV
		Deviation of auto focus control						
3077h	00h	Auto focus control position command	I32	ro	-	pp csp	-2147483648 ~ 2147483647	inc
		Position command of auto focus control						
3080h	00h	Gantry control: index	U16	rw	-	All	0x2000 ~ 0x4FFF	-
		The index value of the operation object for gantry slave axis parameter. Example: If this object is set to 0x2100, it indicates that index 2100h of gantry slave axis parameter is designated.						
3081h	00h	Gantry control: subindex	U16	rw	-	All	0	-
		The subindex value of the operation object for gantry slave axis parameter. The current version only supports the object with subindex value being 0.						
3082h	00h	Gantry control: data type of selected object	I16	ro	-	All	-3 ~ 8	-
		The data type of the gantry slave axis parameter designated by object 3080h. Different data type has different input / output register, the corresponding register is described as follows:						
		Value	Definition	Corresponding Input / Output Register				
		1	The data type of the designated object is BOOL.	3085h / 3086h (DINT)				
		2	The data type of the designated object is I8.					
		3	The data type of the designated object is I16.					
		4	The data type of the designated object is I32.					
		5	The data type of the designated object is U8.					
		6	The data type of the designated object is U16.					
		7	The data type of the designated object is U32.					
		8	The data type of the designated object is F32.	3087h / 3088h (REAL)				
		-1	The index value cannot be operated.	N/A				
		-2	The designated index object does not exist.					
		-3	The designated subindex object does not exist.					
Note: When object 3084h = -1, this object is not applicable.								

Index	Sub-Index	Name	Data type	Access	PDO	Op Mode	Valid value	Unit
3083h	00h	Gantry control: command	U16	rw	-	All	0 ~ 3	-
		The operation command of gantry slave axis parameter. The function of each command is described as follows:						
		Value	Definition	Description				
		0	Idle / Reset state	Idle / Reset state.				
		1	Writing command	The command will be triggered (positive edge) when this object is switched from 0 to 1. When the command is triggered, the value of the input register will be written to the designated object (3080h). Note: If the command is given during data processing (object 3084h is 1), it will be invalid.				
		2	Single reading command	The command will be triggered (positive edge) when this object is switched from 0 to 2. When the command is triggered, the value of the designated object (3080h) will be put into the corresponding output register. Note: If the command is given during data processing (object 3084h is 1), it will be invalid.				
3	Continuous reading command	The values of the designated object (3080h) will be continuously put into the corresponding output register. Note: Continuous reading command is not periodically updated.						
3084h	00h	Gantry control: status	I16	ro	-	All	-6 ~ 2	-
		The operation status of gantry slave axis parameter. The definition is as follows:						
		Value	Definition					
		0	Not in operation.					
		1	Data is being processed.					
		2	Data processing succeeds.					
		-1	The operation function of gantry slave axis parameter cannot be operated. Check if the firmware versions of master axis and slave axis are the same and the gantry control system is activated.					
		-2	The designated object (3080h) cannot be operated.					
		-3	The value of the input register exceeds the upper limit of the designated object (3080h)'s data type.					
		-4	The writing command is executed to read-only object.					
		-5	The unsupported operation command is used in object 3083h.					
-6	Data processing timeout.							
3085h	00h	Gantry control: input register of DINT	I32	rw	-	All	-2147483648 ~ 2147483647	-
		Input register for data type being BOOL, I8, I16, I32, U8, U16 or U32						
3086h	00h	Gantry control: output register of DINT	I32	ro	-	All	-2147483648 ~ 2147483647	-
		Output register for data type being BOOL, I8, I16, I32, U8, U16 or U32						
3087h	00h	Gantry control: input register of REAL	F32	rw	-	All	-3.40282e+38 ~ 3.40282e+38	-
		Input register for data type being F32						
3088h	00h	Gantry control: output register of REAL	F32	ro	-	All	-3.40282e+38 ~ 3.40282e+38	-
		Output register for data type being F32						
3090h	00h	Force control error code	U16	ro	-	fc	0 ~ 0xFFFF	-
		Causes of force control alarm. For the countermeasures, please refer to “E Series Servo Drive Force Control Function User Manual.”						
		Bit	Description					
		0	Force deviation is too big.					
		1	Force sensor feedback is too big.					
		2	The process of soft landing exceeds the time limit.					
		3	The overtravel warning is triggered during force control.					
		4	It exceeds the range of travel distance protection during force control.					
		5	Force controller reaches the limit value for a long time during force control.					
		6~15	Reserved					

Index	Sub-Index	Name	Data type	Access	PDO	Op Mode	Valid value	Unit		
3091h	00h	Force control status	I16	ro	-	fc	0 ~ 32767	-		
		Status of force control function								
		Value	Definition							
		0	Force control function is not activated.							
		1	Mode switching is in progress.							
		2	Soft landing is in progress.							
		3	Force control function is in progress.							
4	Force control function is OFF.									
3092h	00h	Force error actual value	I32	ro	-	fc	-2147483648 ~ 2147483647	mN		
		Actual value of force control deviation								
3093h	00h	Force feedback actual value	I32	ro	-	fc	-2147483648 ~ 2147483647	mN		
		Actual value of force control feedback								
3100h 3104h	N/A	This section is about alarm state table, and it is not supported yet. Use object 4095h / 603Fh (error code) to check the contents.								
3110h	00h	Drive warning events 1	U16	ro	-	All	0 ~ 0xFFFF	-		
		Warning state table 1. The warning corresponding to each bit is described as follows. It is recommended to replace this object with the object 4096h (warning code).								
		Bit	Waning No.	Warning Name						
		0	AL.900	Position deviation overflow						
		1	AL.901	<Not supported>						
		2	AL.910	Overload						
		3	AL.911	<Not supported>						
		4	AL.912	<Not supported>						
		5	AL.920	<Not supported>						
		6	AL.921	<Not supported>						
		7	AL.923	Internal fan stop						
		8	AL.930	Encoder battery malfunction						
		9	AL.941	Change of parameters and functions with save and restart requirement						
		10	AL.971	Undervoltage						
		11	AL.9A0	Overtravel detected when servo ON (P-OT or N-OT signal is received.)						
		12	AL.9A1	P-OT signal is received.						
		13	AL.9A2	N-OT signal is received.						
		14	AL.9AA	<Not supported>						
		15	AL.9Ab	<Not supported>						
		When the value of the bit is 1, the warning occurs.								
3111h	00h	Drive warning events 2	U16	ro	-	All	0 ~ 0xFFFF	-		
		Warning state table 2. The warning corresponding to each bit is described as follows. It is recommended to replace this object with the object 4096h (warning code).								
		Bit	Waning No.	Warning Name						
		0	AL.9F0	Servo voltage too big						
		1	AL.943	Fieldbus synchronous cycle time warning						
		2	AL.944	System warning						
		3	AL.945	Torque limit warning						
		4	AL.946	Encoder communication warning						
		5	AL.947	Multi-motion malfunction warning						
		6	AL.924	I ² T						
		When the value of the bit is 1, the warning occurs.								
		3120h	00h	Host controller's operation warning events	U32	ro	-	All	0 ~ 0xFFFFFFFF	-
				The overview of the causes that make the drive trigger the warning AL.980. The cause corresponding to each bit is described as follows.						

Index	Sub-Index	Name	Data type	Access	PDO	Op Mode	Valid value	Unit																												
		<table><tr><th>Bit</th><th>Cause</th><th>Countermeasure</th></tr><tr><td>0</td><td>The host controller modifies 6040h (Controlword) when Access is Thunder.</td><td>In disabled state, switch Access to Controller in Thunder before performing the operation of 6040h (Controlword).</td></tr><tr><td>1 ~ 3</td><td>Reserved</td><td>Reserved</td></tr><tr><td>4</td><td>The buffered set-points of pp mode are full, so the new set-point is discarded.</td><td>Wait until the execution of the first set-point is completed and the execution of the second set-point begins before entering the next set-point.</td></tr><tr><td>5 ~ 11</td><td>Reserved</td><td>Reserved</td></tr><tr><td>12</td><td>607B:01h (Min position range limit) is more than 0.</td><td>Set the value of 607B:01h between -2147483648 ~ 0.</td></tr><tr><td>13</td><td>607B:02h (Max position range limit) is less than 0.</td><td>Set the value of 607B:02h between 0 ~ 2147483647.</td></tr><tr><td>14</td><td>The range of 607Bh exceeds the allowable value 0x7FFFFFFF.</td><td>The value of 607B:02h ~ 607B:01h cannot exceed 0x7FFFFFFF.</td></tr><tr><td>15 ~ 31</td><td>Reserved</td><td>Reserved</td></tr></table>	Bit	Cause	Countermeasure	0	The host controller modifies 6040h (Controlword) when Access is Thunder.	In disabled state, switch Access to Controller in Thunder before performing the operation of 6040h (Controlword).	1 ~ 3	Reserved	Reserved	4	The buffered set-points of pp mode are full, so the new set-point is discarded.	Wait until the execution of the first set-point is completed and the execution of the second set-point begins before entering the next set-point.	5 ~ 11	Reserved	Reserved	12	607B:01h (Min position range limit) is more than 0.	Set the value of 607B:01h between -2147483648 ~ 0.	13	607B:02h (Max position range limit) is less than 0.	Set the value of 607B:02h between 0 ~ 2147483647.	14	The range of 607Bh exceeds the allowable value 0x7FFFFFFF.	The value of 607B:02h ~ 607B:01h cannot exceed 0x7FFFFFFF.	15 ~ 31	Reserved	Reserved							
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		1 ~ 3	Reserved	Reserved																																
		4	The buffered set-points of pp mode are full, so the new set-point is discarded.	Wait until the execution of the first set-point is completed and the execution of the second set-point begins before entering the next set-point.																																
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		12	607B:01h (Min position range limit) is more than 0.	Set the value of 607B:01h between -2147483648 ~ 0.																																
		13	607B:02h (Max position range limit) is less than 0.	Set the value of 607B:02h between 0 ~ 2147483647.																																
		14	The range of 607Bh exceeds the allowable value 0x7FFFFFFF.	The value of 607B:02h ~ 607B:01h cannot exceed 0x7FFFFFFF.																																
		15 ~ 31	Reserved	Reserved																																
When the value of the bit is 1, the warning occurs.																																				
3200h	00h	Absolute encoder initialization	I32	rw	Y	All	0 ~ 1	-																												
		Initialize absolute encoder. When it is set to 1, the multi-turn data of motor will be cleared. Keep servo off during the execution. The object will set the value according to the execution state:																																		
		<table><tr><th>Value</th><th>Definition</th></tr><tr><td>0</td><td>Not in operation.</td></tr><tr><td>1</td><td>Send the command of clearing multi-turn data.</td></tr><tr><td>2</td><td>The command of clearing multi-turn data is being executed.</td></tr><tr><td>4</td><td>The command of clearing multi-turn data is successfully executed.</td></tr><tr><td>16</td><td>Do not clear multi-turn data when the motor is enabled. Please disable the motor before issuing the command again.</td></tr><tr><td>32</td><td>Fail to execute the command of clearing multi-turn data.</td></tr></table>	Value	Definition	0	Not in operation.	1	Send the command of clearing multi-turn data.	2	The command of clearing multi-turn data is being executed.	4	The command of clearing multi-turn data is successfully executed.	16	Do not clear multi-turn data when the motor is enabled. Please disable the motor before issuing the command again.	32	Fail to execute the command of clearing multi-turn data.																				
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		16	Do not clear multi-turn data when the motor is enabled. Please disable the motor before issuing the command again.																																	
		32	Fail to execute the command of clearing multi-turn data.																																	
3201h	00h	General object i1	I32	rw	Y	All	-2147483648 ~ 2147483647	-																												
		Self-defined object with data type of DINT (1)																																		
3202h	00h	General object i2	I32	rw	Y	All	-2147483648 ~ 2147483647	-																												
		Self-defined object with data type of DINT (2)																																		
3203h	00h	General object i3	I32	rw	Y	All	-2147483648 ~ 2147483647	-																												
		Self-defined object with data type of DINT (3)																																		
3204h	00h	General object i4	I32	rw	Y	All	-2147483648 ~ 2147483647	-																												
		Self-defined object with data type of DINT (4)																																		
3205h	00h	General object i5	I32	rw	Y	All	-2147483648 ~ 2147483647	-																												
		Self-defined object with data type of DINT (5)																																		
3206h	00h	General object i6	I32	rw	Y	All	-2147483648 ~ 2147483647	-																												
		Self-defined object with data type of DINT (6)																																		
3207h	00h	General object i7	I32	rw	Y	All	-2147483648 ~ 2147483647	-																												
		Self-defined object with data type of DINT (7)																																		
3208h	00h	General object i8	I32	rw	Y	All	-2147483648 ~ 2147483647	-																												
		Self-defined object with data type of DINT (8)																																		
3209h	00h	General object i9	I32	rw	Y	All	-2147483648 ~ 2147483647	-																												
		Self-defined object with data type of DINT (9)																																		
3210h	00h	General object f0	F32	rw	Y	All	-3.40282e+38 ~ 3.40282e+38	-																												
		Self-defined object with data type of REAL (0)																																		
3211h	00h	General object f1	F32	rw	Y	All	-3.40282e+38 ~ 3.40282e+38	-																												
		Self-defined object with data type of REAL (1)																																		
3212h	00h	General object f2	F32	rw	Y	All	-3.40282e+38 ~ 3.40282e+38	-																												
		Self-defined object with data type of REAL (2)																																		

Index	Sub-Index	Name	Data type	Access	PDO	Op Mode	Valid value	Unit										
3213h	00h	General object f3	F32	rw	Y	All	-3.40282e+38 ~ 3.40282e+38	-										
		Self-defined object with data type of REAL (3)																
3214h	00h	General object f4	F32	rw	Y	All	-3.40282e+38 ~ 3.40282e+38	-										
		Self-defined object with data type of REAL (4)																
3215h	00h	Reset drive	I16	rw	Y	All	-1 ~ 2	-										
		Reset the drive.																
		<table><tr><th>Value</th><th>Definition</th></tr><tr><td>0</td><td>Not in operation.</td></tr><tr><td>1</td><td>Reset the drive. After it is done, the object will be automatically set to 0.</td></tr><tr><td>2</td><td>Reset the drives in gantry group mode. After it is done, the object will be automatically set to 0.</td></tr><tr><td>-1</td><td>Fail to reset. Check the following statuses: (1) The communication between the gantry axes is normal. (2) The firmware versions of the gantry axes are the same.</td></tr></table>							Value	Definition	0	Not in operation.	1	Reset the drive. After it is done, the object will be automatically set to 0.	2	Reset the drives in gantry group mode. After it is done, the object will be automatically set to 0.	-1	Fail to reset. Check the following statuses: (1) The communication between the gantry axes is normal. (2) The firmware versions of the gantry axes are the same.
		Value	Definition															
		0	Not in operation.															
		1	Reset the drive. After it is done, the object will be automatically set to 0.															
2	Reset the drives in gantry group mode. After it is done, the object will be automatically set to 0.																	
-1	Fail to reset. Check the following statuses: (1) The communication between the gantry axes is normal. (2) The firmware versions of the gantry axes are the same.																	
Note: Disconnection may occurs after this function is executed. Users need to request for communication reconnection from the controller.																		
3216h	00h	Send parameter to flash	-	rw	-	All	0 ~ 1	-										
		Save parameters to drive. When it is set to 1, the current drive parameters will be saved. After it is done, the object will be automatically set to 0.																
3217h	00h	Mastership setting for Fieldbus servo drive	I16	rw	Y	All	0 ~ 1	-										
		Mastership setting for Fieldbus servo drive 0: For Thunder 1: For host controller Note: (1) For slave axis in gantry mode, the object will be forced to be 0. (2) In enabled state, the object cannot be modified.																
4XXXh	00h	The 4000h series objects are from servo Ut parameters. Users can read more information of servo drive from this series of objects. Please refer to the chapter “List of panel monitoring parameters” in each servo drive user manual. The mapping relationship between servo Ut parameter numbers and object indexes is as follows: Object index = 4000h + servo Ut parameter number Example: Servo drive’s panel monitoring parameter Ut095 is “Alarm code”, and its corresponding object is 4095h.																

3.3.1 Absolute encoder initialization

When using a rotary absolute encoder, it is necessary to clear multi-turn data at the first start up after installing the battery. There are two types of data in a rotary absolute encoder, single-turn data and multi-turn data. The single-turn data shows the position of the motor's rotation within a single turn. The multi-turn data counts the number of the turns, and the backup is stored by the battery.

The position information of the drive is based on the following formulas, where M is multi-turn data and S is single-turn data.

6063h (position actual internal value) = M x encoder resolution + S

6064h (position actual value) = 6063h x electronic gear + 607Ch (home offset)

Keep servo off until the procedure of clearing data is finished. After that, power cycle the drive.

■ The procedure of clearing multi-turn data via EtherCAT

Step 1. Disable the motor.

Step 2. Set 3200h to 1.

Step 3. Wait until 3200h changes to 4 (the command is successfully executed).

Step 4. Reset the drive (set 3215h to 1).

■ Definition of object 3200h

Table 3.3.1.1

Value	Definition
0	Not in operation.
1	Send the command of clearing multi-turn data.
2	The command of clearing multi-turn data is being executed.
4	The command of clearing multi-turn data is successfully executed.
16	Do not clear multi-turn data when the motor is enabled. Please disable the motor before issuing the command again.
32	Fail to execute the command of clearing multi-turn data.

3.3.2 Host controller's operation warning

When users incorrectly set the value of the fieldbus object or set the value at an inappropriate time, the drive will pop up host controller's operation warning (AL.980) to remind users. When the warning is triggered, users can check the cause by viewing object 3120h (Host controller's operation warning events).

■ Host controller's operation warning events (3120h)

Table 3.3.2.1

Bit	Cause	Countermeasure
0	The host controller modifies 6040h (Controlword) when Access is Thunder.	In disabled state, switch Access to Controller in Thunder before performing the operation of 6040h (Controlword).
1 ~ 3	Reserved	Reserved
4	The buffered set-points of pp mode are full, so the new set-point is discarded.	Wait until the execution of the first set-point is completed and the execution of the second set-point begins before entering the next set-point.
5 ~ 11	Reserved	Reserved
12	607B:01h (Min position range limit) is more than 0.	Set the value of 607B:01h between -2147483648 ~ 0.
13	607B:02h (Max position range limit) is less than 0.	Set the value of 607B:02h between 0 ~ 2147483647.
14	The range of 607Bh exceeds the allowable value 0x7FFFFFFF.	The value of 607B:02h ~ 607B:01h cannot exceed 0x7FFFFFFF.
15 ~ 31	Reserved	Reserved

Note:

If users do not want to display the warning AL.980, set Pt0A1 = t.□□□1 to disable the trigger of the warning.

3.4 Object dictionary list

Table 3.4.1

Index	Sub-Index	Name	Data type	Access	PDO	Op Mode	Valid value	Unit
1000h	00h	Device type	U32	ro	-	All	0x00020192	-
1001h	00h	Error register	U8	ro	-	All	0x0 ~ 0xFF	-
1010h	-	Store parameters	-	-	-		-	-
	00h	Number of entries	U8	ro	-	All	1	-
	01h	Save all parameters	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
1011h	-	Restore default parameter	-	-	-		-	-
	00h	Number of entries	U8	ro	-	All	1	-
	01h	Restore all default parameters	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
1018h	-	Identity object	-	-	-		-	-
	00h	Number of entries	U8	ro	-	All	4	-
	01h	Vendor ID	U32	ro	-	All	0xAAAA	-
	02h	Product code	U32	ro	-	All	0x05	-
	03h	Revision number	U32	ro	-	All	0 ~ 4294967295	-
	04h	Serial number	U32	ro	-	All	0 ~ 4294967295	-
10F1h	-	Error settings	-	-	-		-	-
	00h	Number of entries	U8	ro	-	All	1	-
	02h	Sync error counter limit	U16	rw	-	All	0 ~ 15	-
1600h	-	1 st RxPDO mapping	-	-	-	-	-	-
	00h	Number of entries	U8	rw	-	All	0 ~ 10	-
	01h	Mapping entry 1	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	02h	Mapping entry 2	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	03h	Mapping entry 3	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	04h	Mapping entry 4	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	05h	Mapping entry 5	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	06h	Mapping entry 6	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	07h	Mapping entry 7	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	08h	Mapping entry 8	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	09h	Mapping entry 9	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	0Ah	Mapping entry 10	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
1601h	-	2 nd RxPDO mapping	-	-	-	-	-	-
	00h	Number of entries	U8	rw	-	All	0 ~ 10	-
	01h	Mapping entry 1	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	02h	Mapping entry 2	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	03h	Mapping entry 3	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	04h	Mapping entry 4	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	05h	Mapping entry 5	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	06h	Mapping entry 6	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	07h	Mapping entry 7	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	08h	Mapping entry 8	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	09h	Mapping entry 9	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	0Ah	Mapping entry 10	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-

Index	Sub-Index	Name	Data type	Access	PDO	Op Mode	Valid value	Unit
1602h	-	3 rd RxPDO mapping	-	-	-	-	-	-
	00h	Number of entries	U8	rw	-	All	0 ~ 10	-
	01h	Mapping entry 1	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	02h	Mapping entry 2	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	03h	Mapping entry 3	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	04h	Mapping entry 4	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	05h	Mapping entry 5	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	06h	Mapping entry 6	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	07h	Mapping entry 7	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	08h	Mapping entry 8	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	09h	Mapping entry 9	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	0Ah	Mapping entry 10	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
1603h	-	4 th RxPDO mapping	-	-	-	-	-	-
	00h	Number of entries	U8	rw	-	All	0 ~ 10	-
	01h	Mapping entry 1	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	02h	Mapping entry 2	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	03h	Mapping entry 3	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	04h	Mapping entry 4	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	05h	Mapping entry 5	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	06h	Mapping entry 6	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	07h	Mapping entry 7	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	08h	Mapping entry 8	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	09h	Mapping entry 9	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	0Ah	Mapping entry 10	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
1A00h	-	1 st TxPDO mapping	-	-	-	-	-	-
	00h	Number of entries	U8	rw	-	All	0 ~ 10	-
	01h	Mapping entry 1	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	02h	Mapping entry 2	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	03h	Mapping entry 3	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	04h	Mapping entry 4	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	05h	Mapping entry 5	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	06h	Mapping entry 6	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	07h	Mapping entry 7	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	08h	Mapping entry 8	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	09h	Mapping entry 9	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	0Ah	Mapping entry 10	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
1A01h	-	2 nd TxPDO mapping	-	-	-	-	-	-
	00h	Number of entries	U8	rw	-	All	0 ~ 10	-
	01h	Mapping entry 1	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	02h	Mapping entry 2	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	03h	Mapping entry 3	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	04h	Mapping entry 4	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	05h	Mapping entry 5	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	06h	Mapping entry 6	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	07h	Mapping entry 7	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	08h	Mapping entry 8	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-

Index	Sub-Index	Name	Data type	Access	PDO	Op Mode	Valid value	Unit
	09h	Mapping entry 9	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	0Ah	Mapping entry 10	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
1A02h	-	3 rd TxPDO mapping	-	-	-	-	-	-
	00h	Number of entries	U8	rw	-	All	0 ~ 10	-
	01h	Mapping entry 1	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	02h	Mapping entry 2	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	03h	Mapping entry 3	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	04h	Mapping entry 4	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	05h	Mapping entry 5	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	06h	Mapping entry 6	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	07h	Mapping entry 7	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	08h	Mapping entry 8	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	09h	Mapping entry 9	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	0Ah	Mapping entry 10	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
1A03h	-	4 th TxPDO mapping	-	-	-	-	-	-
	00h	Number of entries	U8	rw	-	All	0 ~ 10	-
	01h	Mapping entry 1	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	02h	Mapping entry 2	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	03h	Mapping entry 3	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	04h	Mapping entry 4	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	05h	Mapping entry 5	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	06h	Mapping entry 6	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	07h	Mapping entry 7	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	08h	Mapping entry 8	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	09h	Mapping entry 9	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
	0Ah	Mapping entry 10	U32	rw	-	All	0x0 ~ 0xFFFFFFFF	-
1C00h	-	Sync manager communication type	-	-	-	-	-	-
	00h	Number of entries	U8	ro	-	All	4	-
	01h	Communication type sync manager 0	U8	ro	-	All	1	-
	02h	Communication type sync manager 1	U8	ro	-	All	2	-
	03h	Communication type sync manager 2	U8	ro	-	All	3	-
	04h	Communication type sync manager 3	U8	ro	-	All	4	-
1C12h	-	Sync manager 2 PDO assignment	-	-	-	-	-	-
	00h	Number of assigned PDOs	U8	rw	-	All	0 ~ 1	-
	01h	Index of assigned RxPDO 1	U16	rw	-	All	0x1600 ~ 0x1603	-
1C13h	-	Sync manager 3 PDO assignment	-	-	-	-	-	-
	00h	Number of assigned PDOs	U8	rw	-	All	0 ~ 1	-
	01h	Index of assigned TxPDO 1	U16	rw	-	All	0x1A00 ~ 0x1A03	-
1C32h	-	Sync manager 2 synchronization	-	-	-	-	-	-
	00h	Number of synchronization parameters	U8	ro	-	All	12	-
	01h	Synchronization type	U16	ro	-	All	0 ~ 2	-
	02h	Cycle time	U32	ro	-	All	250000 ~ 4000000	ns
	04h	Synchronization types supported	U16	ro	-	All	5	-
	05h	Minimum cycle time	U32	ro	-	All	187500	ns
	06h	Calc and copy time	U32	ro	-	All	31250	ns
	09h	Delay time	U32	ro	-	All	31250	ns

Index	Sub-Index	Name	Data type	Access	PDO	Op Mode	Valid value	Unit
	0Ch	Cycle time too small	U16	to	-	All	0	-
1C33h	-	Sync manager 3 synchronization	-	-	-	-	-	-
	00h	Number of synchronization parameters	U8	ro	-	All	10	-
	01h	Synchronization type	U16	ro	-	All	0 ~ 2	-
	02h	Cycle time	U32	ro	-	All	250000 ~ 4000000	ns
	04h	Synchronization types supported	U16	ro	-	All	5	-
	05h	Minimum cycle time	U32	ro	-	All	187500	ns
	06h	Calc and copy time	U32	ro	-	All	31250	ns
	09h	Delay time	U32	ro	-	All	-	ns
	0Ch	Cycle time too small	U16	ro	-	All	0	-
2XXXh	00h	Pt parameters, refer to section 3.3 for details.						
3000h	00h	Motor type	U16	ro	-	All	0 ~ 2	-
3001h	00h	Inner encoder resolution	I32	ro	-	All	-2147483648 ~ 2147483647	-
3056h	00h	Software state[12]	U16	ro	-	All	0 ~ 0xFFFF	-
3057h	00h	Application mode of gantry system	U16	rw	-	All	1, 2, 11	-
3058h	00h	Yaw target position	I32	rw	Y	All	-2147483648 ~ 2147483647	inc
3059h	00h	Yaw feedback position	I32	ro	Y	All	-2147483648 ~ 2147483647	inc
305Ah	00h	Master feedback position	I32	ro	Y	All	-2147483648 ~ 2147483647	inc
305Bh	00h	Slave feedback position	I32	ro	Y	All	-2147483648 ~ 2147483647	inc
3060h	00h	Use touch probe enable specific function	U16	rw	-	pp pv tq csp csv cst	0x0 ~ 0x3	-
3061h	00h	Enable position trigger function	U16	rw	-	All	0 ~ 1	-
3062h	00h	Overtravel stop mode selection	U16	rw	-	All	0 ~ 1	-
3063h	00h	Velocity analog input voltage	I16	ro	Y	All	-10000 ~ 10000	mV
3064h	00h	Velocity analog input voltage offset	I16	rw	-	All	-10000 ~ 10000	mV
3065h	00h	Torque analog input voltage	I16	ro	Y	All	-10000 ~ 10000	mV
3066h	00h	Torque analog input voltage offset	I16	rw	-	All	-10000 ~ 10000	mV
3067h	00h	Analog output 1 voltage	I16	rw	Y	All	-10000 ~ 10000	mV
3068h	00h	Analog output 2 voltage	I16	rw	Y	All	-10000 ~ 10000	mV
3069h	00h	Position trigger array value	I32	rw	Y	All	-2147483648 ~ 2147483647	inc
306Ah	00h	Position trigger array index	U16	rw	Y	All	0 ~ 255	-
306Bh	00h	Position trigger array control object	U16	rw	Y	All	0 ~ 65535	-
306Ch	00h	Position trigger function error code	U16	ro	Y	All	0 ~ 65535	-
306Dh	00h	Position trigger function status	I16	ro	Y	All	0 ~ 32767	-
306Eh	00h	Expected total number of position trigger	U16	ro	Y	All	0 ~ 65535	-
306Fh	00h	Triggered number of position trigger	U16	ro	Y	All	0 ~ 65535	-
3070h	00h	Remaining number of position trigger	U16	ro	Y	All	0 ~ 65535	-
3072h	00h	Auto focus control status	U16	ro	-	pp csp	0 ~ 0x32767	-
3073h	00h	Auto focus control error	U16	ro	-	pp csp	0 ~ 0xFFFF	-
3074h	00h	Enable auto focus control function	U16	rw	-	pp csp	0~1	-
3075h	00h	Auto focus control feedback	F32	ro	-	pp csp	-3.40282e+38 ~ 3.40282e+38	mV
3076h	00h	Auto focus control deviation	F32	ro	-	pp csp	-3.40282e+38 ~ 3.40282e+38	mV

Index	Sub-Index	Name	Data type	Access	PDO	Op Mode	Valid value	Unit
3077h	00h	Auto focus control position command	I32	ro	-	pp csp	-2147483648 ~ 2147483647	inc
3080h	00h	Gantry control: index	U16	rw	-	All	0x2000 ~ 0x4FFF	-
3081h	00h	Gantry control: subindex	U16	rw	-	All	0	-
3082h	00h	Gantry control: data type of selected object	I16	ro	-	All	-3 ~ 8	-
3083h	00h	Gantry control: command	U16	rw	-	All	0 ~ 3	-
3084h	00h	Gantry control: status	I16	ro	-	All	-6 ~ 2	-
3085h	00h	Gantry control: input register of DINT	I32	rw	-	All	-2147483648 ~ 2147483647	-
3086h	00h	Gantry control: output register of DINT	I32	ro	-	All	-2147483648 ~ 2147483647	-
3087h	00h	Gantry control: input register of REAL	F32	rw	-	All	-3.40282e+38 ~ 3.40282e+38	-
3088h	00h	Gantry control: output register of REAL	F32	ro	-	All	-3.40282e+38 ~ 3.40282e+38	-
3090h	00h	Force control error code	U16	ro	-	fc	0 ~ 0xFFFF	-
3091h	00h	Force control status	I16	ro	-	fc	0 ~ 32767	-
3092h	00h	Force error actual value	I32	ro	-	fc	-2147483648 ~ 2147483647	mN
3093h	00h	Force feedback actual value	I32	ro	-	fc	-2147483648 ~ 2147483647	mN
3110h	00h	Drive warning events 1	U16	ro	-	All	0 ~ 0xFFFF	-
3111h	00h	Drive warning events 2	U16	ro	-	All	0 ~ 0xFFFF	-
3120h	00h	Host controller's operation warning events	U32	ro	-	All	0 ~ 0xFFFFFFFF	-
3200h	00h	Absolute encoder initialization	I32	rw	Y	All	0 ~ 1	-
3201h	00h	General object i1	I32	rw	Y	All	-2147483648 ~ 2147483647	-
3202h	00h	General object i2	I32	rw	Y	All	-2147483648 ~ 2147483647	-
3203h	00h	General object i3	I32	rw	Y	All	-2147483648 ~ 2147483647	-
3204h	00h	General object i4	I32	rw	Y	All	-2147483648 ~ 2147483647	-
3205h	00h	General object i5	I32	rw	Y	All	-2147483648 ~ 2147483647	-
3206h	00h	General object i6	I32	rw	Y	All	-2147483648 ~ 2147483647	-
3207h	00h	General object i7	I32	rw	Y	All	-2147483648 ~ 2147483647	-
3208h	00h	General object i8	I32	rw	Y	All	-2147483648 ~ 2147483647	-
3209h	00h	General object i9	I32	rw	Y	All	-2147483648 ~ 2147483647	-
3210h	00h	General object f0	F32	rw	Y	All	-3.40282e+38 ~ 3.40282e+38	-
3211h	00h	General object f1	F32	rw	Y	All	-3.40282e+38 ~ 3.40282e+38	-
3212h	00h	General object f2	F32	rw	Y	All	-3.40282e+38 ~ 3.40282e+38	-
3213h	00h	General object f3	F32	rw	Y	All	-3.40282e+38 ~ 3.40282e+38	-
3214h	00h	General object f4	F32	rw	Y	All	-3.40282e+38 ~ 3.40282e+38	-
3215h	00h	Reset drive	I16	rw	Y	All	-1 ~ 2	-
3216h	00h	Send parameter to flash	-	rw	-	All	0 ~ 1	-
3217h	00h	Mastership setting for Fieldbus servo drive	I16	rw	Y	All	0 ~ 1	-
4XXXh	00h	Ut parameters, refer to section 3.3 for details.						
603Fh	00h	Error code	U16	ro	Y	All	0x0 ~ 0xFFFF	-
6040h	00h	Controlword	U16	rw	Y	All	0x0 ~ 0xFFFF	-
6041h	00h	Statusword	U16	ro	Y	All	0x0 ~ 0xFFFF	-
605Ah	00h	Quick stop option code	I16	rw	-	All	2	-
605Bh	00h	Shutdown option code	I16	rw	-	All	0	-
605Ch	00h	Disable operation code	I16	rw	-	All	0	-

Index	Sub-Index	Name	Data type	Access	PDO	Op Mode	Valid value	Unit
605Dh	00h	Halt option code	I16	rw	-	pp	1, 2	-
						pv tq hm	2	
605Eh	00h	Fault reaction option code	I16	rw	-	All	0 ~ 2	-
6060h	00h	Modes of operation	I8	rw	Y	All	-2 ~ 10	-
6061h	00h	Modes of operation display	I8	ro	Y	All	-2 ~ 10	-
6062h	00h	Position demand value	I32	ro	Y	pp hm csp	-2147483648 ~ 2147483647	inc
6063h	00h	Position actual internal value	I32	ro	Y	All	-2147483648 ~ 2147483647	count
6064h	00h	Position actual value	I32	ro	Y	All	-2147483648 ~ 2147483647	inc
6065h	00h	Following error window	U32	rw	Y	pp csp	0 ~ 4294967295	inc
6066h	00h	Following error time out	U16	rw	Y	pp csp	0 ~ 65535	ms
6067h	00h	Position window	U32	rw	Y	pp	0 ~ 4294967295	inc
6068h	00h	Position window time	U16	rw	Y	pp	0 ~ 65535	ms
606Bh	00h	Velocity demand value	I32	ro	Y	pv csv	-2147483648 ~ 2147483647	inc/s
606Ch	00h	Velocity actual value	I32	ro	Y	All	-2147483648 ~ 2147483647	inc/s
606Dh	00h	Velocity window	U16	rw	Y	pv	0 ~ 65535	inc/s
606Eh	00h	Velocity window time	U16	rw	Y	pv	0 ~ 65535	ms
6071h	00h	Target torque	I16	rw	Y	tq cst	-32768 ~ 32767	0.1%
6072h	00h	Max torque	U16	rw	Y	All	0 ~ 65535	0.1%
6074h	00h	Torque demand	I16	ro	Y	All	-32768 ~ 32767	0.1%
6075h	00h	Motor rated current	U32	ro	-	All	0 ~ 4294967295	mA
6076h	00h	Motor rated torque	U32	ro	-	All	0 ~ 4294967295	mNm
6077h	00h	Torque actual value	I16	ro	Y	All	-32768 ~ 32767	0.1%
607Ah	00h	Target position	I32	rw	Y	pp csp	-2147483648 ~ 2147483647	inc
607Bh	00h	Position range limit	U8	ro	-	All	2	-
	01h	Min position range limit	I32	rw	Y	All	-2147483648 ~ 0	inc
	02h	Max position range limit	I32	rw	Y	All	0 ~ 2147483647	inc
607Ch	00h	Home offset	I32	rw	Y	All	-2147483648 ~ 2147483647	inc
607Dh	-	Software position limit (Not support)	-	-	-	-	-	-
607Fh	00h	Max profile velocity	U32	rw	Y	pp pv hm	0 ~ 4294967295	inc/s
6081h	00h	Profile velocity	U32	rw	Y	pp	0 ~ 4294967295	inc/s
6083h	00h	Profile acceleration	U32	rw	Y	pp pv	0 ~ 4294967295	inc/s ²
6084h	00h	Profile deceleration	U32	rw	Y	pp pv	0 ~ 4294967295	inc/s ²
6085h	00h	Quick stop deceleration	U32	rw	Y	pp pv hm csp csv	0 ~ 4294967295	inc/s ²
6087h	00h	Torque slope	U32	rw	Y	tq	0 ~ 4294967295	0.1%/s
6098h	00h	Homing method	I8	rw	Y	hm	-128 ~ 127	-

Index	Sub-Index	Name	Data type	Access	PDO	Op Mode	Valid value	Unit
6099h	-	Homing speeds	-	-	-	-	-	-
	00h	Number of entries	U8	ro	-		2	-
	01h	Speed during search for switch	U32	rw	Y	hm	0 ~ 4294967295	inc/s
	02h	Speed during search for zero	U32	rw	Y		0 ~ 4294967295	inc/s
609Ah	00h	Homing acceleration	U32	rw	Y	hm	0 ~ 4294967295	inc/s ²
60B1h	00h	Velocity offset	I32	rw	Y	csv	-2147483648 ~ 2147483647	inc/s
60B2h	00h	Torque offset	I16	rw	Y	cst	-32768 ~ 32767	0.1%
60B8h	00h	Touch probe function	U16	rw	Y	All	0 ~ 65535	-
60B9h	00h	Touch probe status	U16	ro	Y	All	0 ~ 65535	-
60BAh	00h	Touch probe 1 positive edge	I32	ro	Y	All	-2147483648 ~ 2147483647	inc
60BBh	00h	Touch probe 1 negative edge	I32	ro	Y	All	-2147483648 ~ 2147483647	inc
60BCh	00h	Touch probe 2 positive edge	I32	ro	Y	All	-2147483648 ~ 2147483647	inc
60C2h	-	Interpolation time period	-	-	-	-	-	-
	00h	Number of entries	U8	ro	-	csp csv cst	2	-
	01h	Interpolation time period value	U8	rw	-		0 ~ 255	-
	02h	Interpolation time index	I8	rw	-		-128 ~ 63	-
60C5h	00h	Max acceleration	U32	rw	Y	pp hm pv	0 ~ 4294967295	inc/s ²
60C6h	00h	Max deceleration	U32	rw	Y	pp hm pv	0 ~ 4294967295	inc/s ²
60E0h	00h	Positive torque limit value	U16	rw	Y	All	0 ~ 65535	0.1%
60E1h	00h	Negative torque limit value	U16	rw	Y	All	0 ~ 65535	0.1%
60F2h	00h	Position option code	U16	rw	Y	pp	0x0 ~ 0x00C0	-
60F4h	00h	Following error actual value	I32	ro	Y	pp hm csp	-2147483648 ~ 2147483647	inc
60FCh	00h	Position demand internal value	I32	ro	Y	pp hm csp	-2147483648 ~ 2147483647	count
60FDh	00h	Digital inputs	U32	ro	Y	All	0x0 ~ 0xFFFFFFFF	-
60FEh	-	Digital outputs	-	-	-	-	-	-
	00h	Number of entries	U8	ro	-	All	2	-
	01h	Physical outputs	U32	rw	Y		0x0 ~ 0xFFFFFFFF	-
	02h	Bit mask	U32	rw	Y		0x0 ~ 0xFFFFFFFF	-
60FFh	00h	Target velocity	I32	rw	Y	pv csv	-2147483648 ~ 2147483647	inc/s
6502h	00h	Supported drive modes	U32	ro	-	All	0x0 ~ 0xFFFFFFFF	-