HSD7 Series AC Servo Drive
EtherCAT User Manual

HNC Electric Limited

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1、Preface

1.1 Getting Started guide

To describe operation of motor independent action in PP mode（Profile Position Mode）

1） Connection preparation

a） Please connect maste and slave, slave and motor.

b） The EtherCAT communication needs to record the ESI file of EtherCAT slave staion (ask for it from our company).

c） The main station is to generate ENI with the configuration file according to the ESI file provided by our company, and then constitute the EtherCAT network.

d） Set Station Alias，Configured Station Alias (0004h) of SII is 0.

e） Power on and check if there's alarm.

2） Communication setup

a) According to ENI file, the master station performs communication initialization。As an example of setting, the following Settings are required under DC mode.

（DC mode、2ms cycle、the time to lock the data=100us）

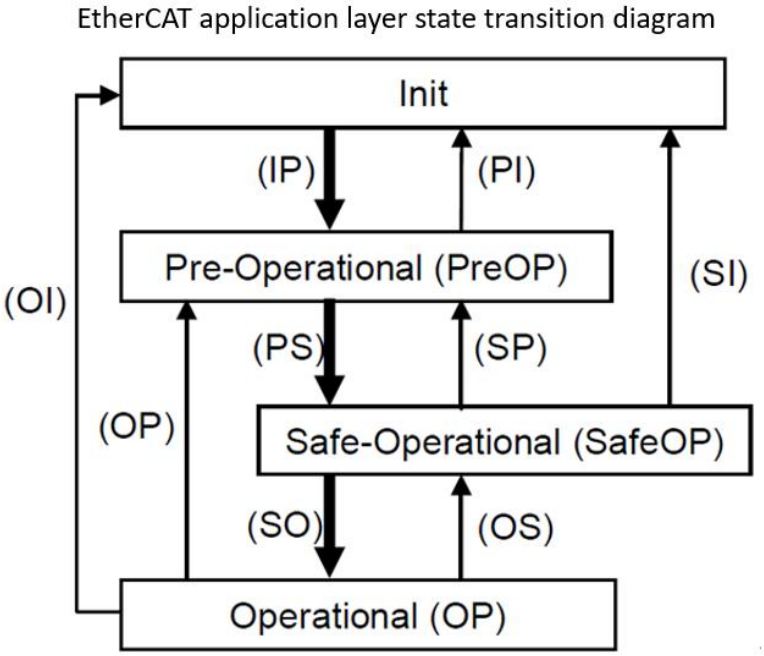
1C32h-01h = 2(DC)、1C32h-02h = 2000000(ns)

1C33h-01h = 2(DC)、1C33h-03h = 100000(ns)

b) Execute the ESC register setting, and the ESM state is transformed from Init to PreOP

c) Confirm the ESM status into PreOP, execute ESC register setting (DC, PDO, use SM etc.), and convert the ESM state from PreOP to SafeOP.

d) After confirming that the ESM state enters the SafeOP, transformed the ESM state from SafeOP to OP.



3） Object setting

Under the control of PP, the setting example of absolute positioning action shown below is described as follows:

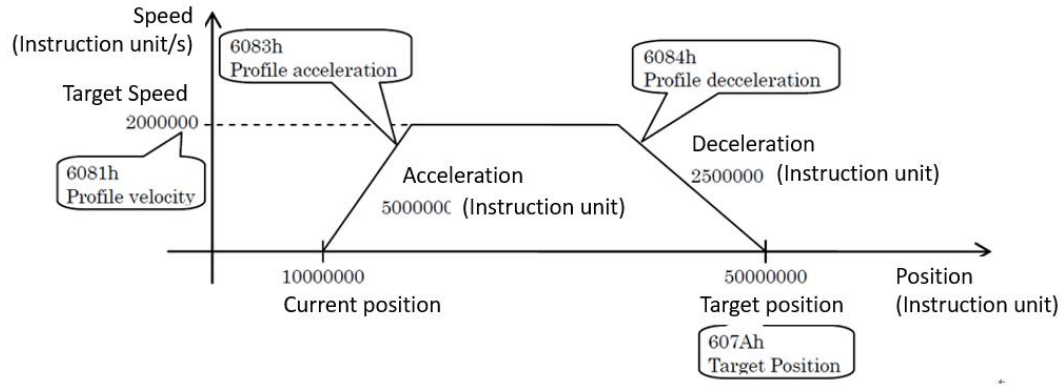
a) Set control mode（6060h:Modes of operation = 1）。

b) Set the target positon（607Ah:Target Position = 5000000 instruction unit）。

c) Set the target speed（6081h:Profile Speed = 200000 instruction unit/s）。

d) Set acceleration（6083h:Profile Speed = 5000000 instruction unit/s/s）。

e) Set decceleration（6084h:Profile Speed = 2500000 instruction unit/s/s）。



4） Motor action

The EtherCAT communication is the so-called PDS(Power Drive Systems) state, which represents the state of the servo Drive.PDS can be changed through object 6040h(Controlword) and can be referenced by 6041h(Statusword).It is necessary to send the instructions to the next state only after the state has been converted through 6041h(Statusword).

a) The PDS state is transformed from Switch on disabled to Ready to Switch on.

Set 6040h=0006h (2: Shutdown), and confirm that 6041h is changed from xx40h to xx21h.

b) The state of PDS is switched from Switch on disabled to Switch on.

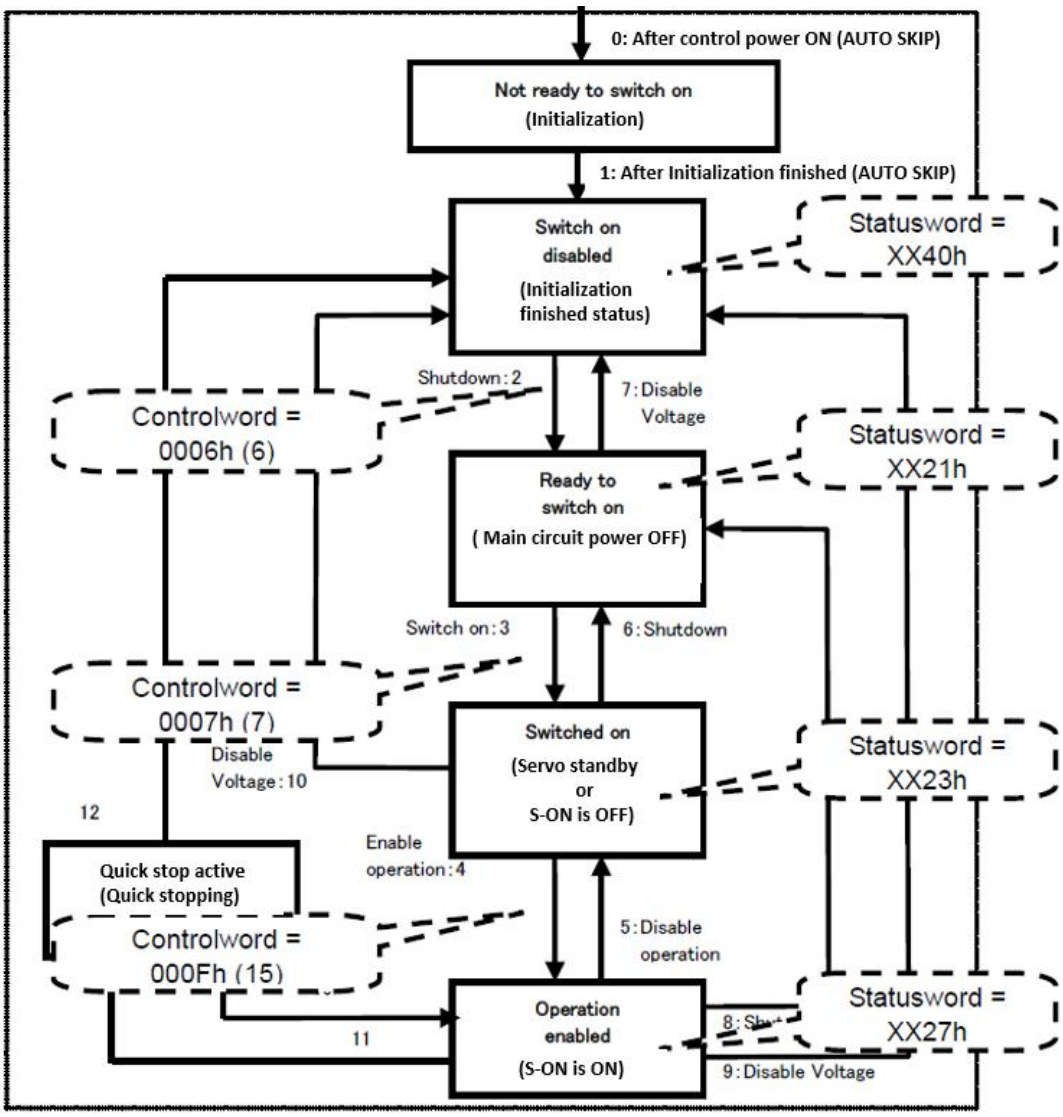
Set 6040h=0007h (3: Switch on), and confirm that 6041h changed from xx21h to xx23h.

c) The state of PDS is converted from Switch on disabled to operation enabled.

Set 6040h=000Fh (4: Enable operation), and confirm that 6041h is changed from xx23h to xx27h, and the servo enables ON.

d) Because of the start of PP movement, change bit4(new set point) of 6040h from 0 to 1, bit5(change set immediately), bit6(abs/rel), and bit9(change on set-point) keep as 0, please set 6040h=001Fh.

e) The servo on is closed by switching the PDS state from Operation enabled to Switched on.Set 6040h=0007h(5: Disable operation), and confirm that 6041h is changed from xx27h to xx23h.



5） If the motor does not move.

If the servo does not enable ON, please confirm the PDS state within the drive.

If the servo ON enabled, but the motor does not move, then the object setting may be wrong or omitted, please confirm the set value of the object.

If the alarm is sent, please remove the alarm first.

2、System overview

2.1 EtherCAT overview

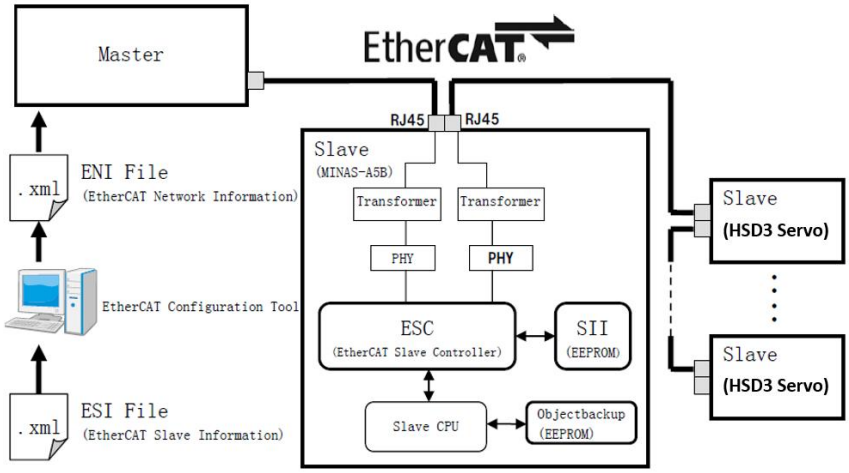
The so-called EtherCAT is the abbreviation of Ethernet for Control Automation Technology. Adopt real-time Ethernet open network communication between master and slave stations developed by Beckhoff Automation GmbH, and managed by ETG.

2.2 System constitute (Master* slave)

EtherCAT's connection system is linear network system between the master station and multiple slave staions

The number of slave station nodes that can be connected depends on the master station processing or communication cycle, the number of bytes transferred, and so on.Please refer to the matching master station specification for confirmation.

The master station is based on the ESI file provided by the company to generate the ENI file and use ENI to form the EtherCAT network.



EtherCAT Slave Information (ESI):

The company provides documents in XML format that record the definition of information from the slave station (manufacturer's information, product information, Profile, object, process data, availability cycle, SM setting, etc.).

EtherCAT Network Information (ENI):

The document on the side of the master station contains information that identifies the slave station information and the information of initialize each slave station.

Slave Information Interface (SII):

ESC connected the EEPROM of record SII data. In this EEPROM (SII), the setted initialization information, the specification value set by the application communication of slave station (the data size value of the Mailbox), the mapping of process data, and so on.

(Note) : The cable length between nods is within 100m.

2.3 Specification overview

<table>
<tr><th>Item</th><th>Specification</th></tr>
<tr><td>The physical layer</td><td>100BASE-TX (IEEE802.3)</td></tr>
<tr><td>Baud rate</td><td>100[Mbps] (Full duplex)</td></tr>
<tr><td>The topology</td><td>LINE</td></tr>
<tr><td>Connection cable</td><td>Twisted CAT5e</td></tr>
<tr><td>Cable length</td><td>Node: Max 100m.</td></tr>
<tr><td>Conneted axis numble</td><td>Max: 65535</td></tr>
<tr><td>Communication interface</td><td>2ports (RJ45)</td></tr>
<tr><td>EtherCAT Indicatiors (LED)</td><td>[RUN] One of the eight digital tubes.
[ERR] No corresponding
[L/A IN] One of the eight digital tubes.
[L/A OUT] One of the eight digital tubes.</td></tr>
<tr><td>Station Alias (ID)</td><td>0 ~ 65535</td></tr>
<tr><td>Explicit Device ID</td><td>Corresponding</td></tr>
<tr><td>Device Profile</td><td>CoE (CANopen over EtherCAT)</td></tr>
<tr><td>SyncManager</td><td>4</td></tr>
<tr><td>FMMU</td><td>3</td></tr>
<tr><td>Operation mode</td><td>
<table>
<tr><td></td><td colspan="2">Modes of operation</td></tr>
<tr><td rowspan="4">Position</td><td>pp</td><td>Profile position mode</td></tr>
<tr><td>csp</td><td>Cyclic synchronous position mode</td></tr>
<tr><td>ip</td><td>Interpolate position mode</td></tr>
<tr><td>hm</td><td>Homing mode</td></tr>
<tr><td rowspan="2">Speed</td><td>pv</td><td>Profile speed mode</td></tr>
<tr><td>csv</td><td>Cyclic synchronous speed mode</td></tr>
<tr><td rowspan="2">Torque</td><td>tq</td><td>Torque profile mode</td></tr>
<tr><td>cst</td><td>Cyclic synchronous torque mode</td></tr>
</table>
</td></tr>
<tr><td>ouch Probe</td><td>2ch Positive edge/Negative edge</td></tr>
<tr><td>Synchronous mode</td><td>DC
SM2
FreeRUN</td></tr>
<tr><td>Cycle Time(DC、SM2)</td><td>100，200，500，1000，2000，4000 [us]</td></tr>
<tr><td>Communication object</td><td>SDO，PDO</td></tr>
<tr><td>SDO information</td><td>SDO Request，SDO Response，SDO information，Diagnostic information，Complete Access</td></tr>
<tr><td>Free PDO Mapping</td><td>Corresponding</td></tr>
<tr><td>Maximum PDO distribution number</td><td>RxPDO: 4 [Table] TxPDO: 4 [Table]</td></tr>
<tr><td>Maximum PDO data length</td><td>RxPDO: 32 [byte] TxPDO: 32 [byte]</td></tr>
<tr><td>Diagnosis Object</td><td>Only corresponding diagnosis message</td></tr>
<tr><td>Command Object</td><td>No corresponding</td></tr>
<tr><td>Shift time</td><td>The 100us moment is just corresponding Input(response)</td></tr>
<tr><td>CSP position command compensation when communication is abnormal.</td><td>No corresponding</td></tr>
<tr><td>Object monitoring</td><td>Corresponding</td></tr>
</table>

3、EtherCAT communication specifications

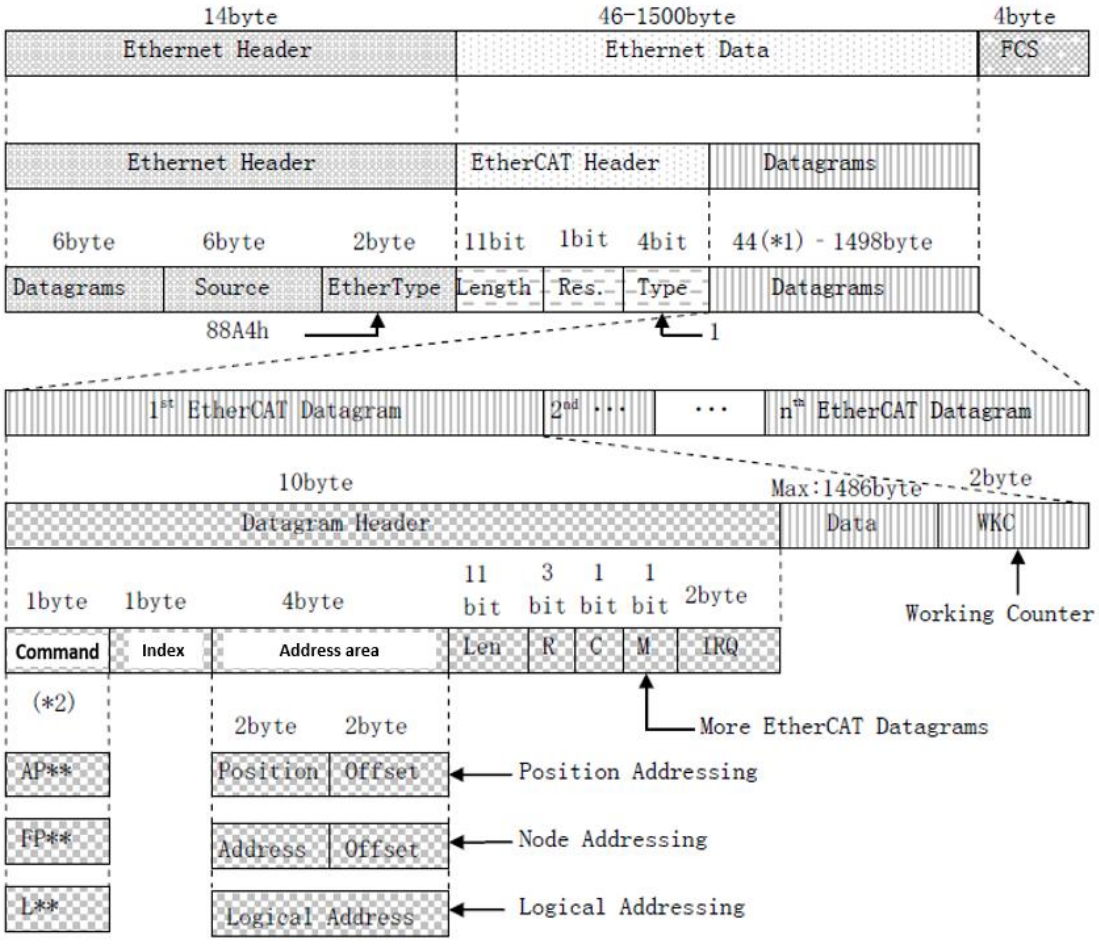
3.1 EtherCAT frame structure

EtherCAT is an industrial communication protocol based on Ethernet that can be controlled in real time.

Only the IEEE 802.3 Ethernet specification is expanded, and no changes are made to the basic structure. Therefore, data in the standard Ethernet frame can be forwarded. Since the EtherType of the Ethernet Header is [88A4h], the subsequent Ethernet Data is treated as an EtherCAT frame. An EtherCAT frame is composed of an EtherCAT frame header and one or more EtherCAT submessages, and is further subdivided into EtherCAT submessages. Only the EtherCAT frames with Type=1 of the EtherCAT header are processed according to the ESC.

*1) Ethernet packet is shorter than 64byte, add 1-32byte。（Ethernet Header + Ethernet Data + FCS）

Ethernet/EtherCAT frame form



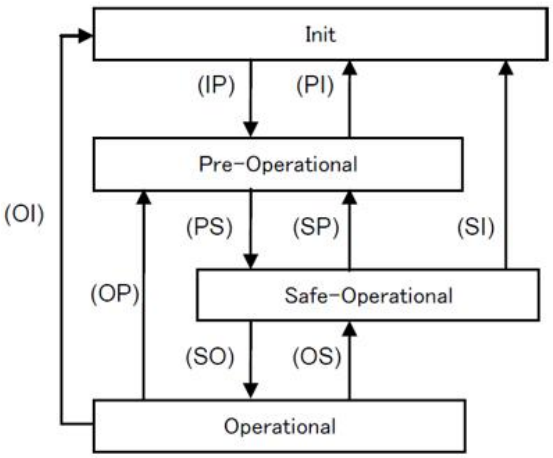
*2) Cmd

Addressing mode	Cmd	Abbreviation	Name	Description
-	00h	NOP	No operation	No operation
Position Addressing	01h	APRD	Auto increment physical read	Each slave station increments Address and receives a frame with an Address value of 0. Perform the requested read action.
	02h	APWR	Auto increment physical write	Each slave station increments Address and receives a frame with an Address value of 0. Perform the requested write action.
	03h	APRW	Auto increment physical read write	Each slave station increments Address and receives a frame with an Address value of 0. Perform the required read & write actions.
Node Addressing	04h	FPRD	Configured address physical read	Each slave station has the same value of Address and Station Address. Perform the requested read action.
	05h	FPWR	Configured address physical read	Each slave station has the same Address value and Station Address. Perform the requested write action.
	06h	FPRW	Configured address physical read write	Each slave station has the same value of Address and Station Address. Perform the required read & write actions.
-	07h	BRD	Broadcast read	All slaves perform the requested read action
	08h	BWR	Broadcast write	All slaves perform the requested write action
	09h	BRW	Broadcast read write	All slaves perform the required read & write actions
Logical Addressing	0Ah	LRD	Logical read	Each slave station executes the requested read action when the Address value matches the logical memory specified by the FMMU request.
	0Bh	LWR	Logical write	Each slave station performs the requested write operation when the Address value matches the logical memory specified by the FMMU request.
	0Ch	LRW	Logical read write	Each slave station performs the requested read & write operation when the Address value matches the logical memory specified by the FMMU request.
Position Addressing	0Dh	ARWM	Positional physical read/multiple write	Each slave station increments the Address, and the slave station whose Address value receives 0 completes the required read action, and the other slaves perform the write action.
Node Addressing	0Eh	FRMW	Configured address physical read /multiple write	The slave Address and Station Address values are compared, the consistent slave performs the requested read action, and the other slaves execute the write action.
-	0Fh ~ FFh	-	(Reserved)	

3.2 ESM (EtherCAT State Machine) state machine

The conversion diagram of the state machine (ESM) of the EtherCAT application layer is as follows:

EtherCAT application layer state transition diagram



※ The "IP" "SP" and so on are the abbreviation of state transition in this diagram.

(IP): Init→Pre-Operational

(PS): Pre-Operational→Safe-Operational

.....

ESM state	Actions acquired in each state	Communication action			
		SDO Send and receive	PDO (S to M)	PDO (M to S)	
Init	In the initialization of the communication module, SDO transceivers and PDOs cannot be sent or received.	--	--	--	
Pre-Operational (PreOP)	SDO can send and receive actions	Yes	--	--	
Safe-Operational (SafeOP)	In addition to SDO transceiving, the status of the signaling (slave to master) via PDO can be	Yes	Yes	--	
Operational (OP)	SDO Transceiver, PDO Transceiver All Possible Status	Yes	Yes	Yes	

Access from the master station to the ESC register is irrelevant to the above table.

When the ESM state transitions from the OP to other ESM states, before completion of the conversion, if the instruction update is stopped or the SYNC0, SM2 events are stopped, there is a possibility of sending a communication abnormality.

The relationship between each PDS status and ESM status is shown in the following table:

ESM state / PDS state	Init	PreOP	PreOP	OP
Not ready to switch on	Yes	No	No	No
Switch on disabled	Yes	Yes	Yes	Yes
Ready to switch on	No	Yes	Yes	Yes
Switched on	No	Yes	Yes	Yes
Operation enabled	No	Yes	Yes	Yes
Fault reaction active	Yes	Yes	Yes	Yes
Fault	Yes	Yes	Yes	Yes

3.3 ESC address space

HNC-E holds 8 Kbytes of physical address space. The first 4K (0000h-0FFFh) is used as a register space, and the other 4Kbyte is a process data used as a RAM area. The registers are as follows:

ESC Register Byte Address	Length (byte)	Description	Initial value
ESC Information			
0000h	1	Type	04h
0001h	1	Revision	02h
0002h~0003h	2	Build	0040h
0004h	1	FMMUs supported	03h
0005h	1	SyncManagers supported	04h
0006h	1	RAM size	08h
0007h	1	Port Descriptor	0Fh
0008h-0009h	2	ESC Features supported	0184h
Station Address			
0010h-0011h	2	Configured Station Address	-
0012h-0013h	2	Configured Station Alias	-
:			
Data Link Layer			
:			
0100h-0102h	4	ESC DL Control	
:			
0110h-0111h	2	ESC DL Status	
Application Layer			
0120h-0121h	2	AL Control	
0130h-0131h	2	AL Status	
0134h-0135h	2	AL Status Code	
:			
PDI			
0140h	1	PDI Control	
0141h	1	ESC Configuration	
0150h	1	PDI Configuration	
0151h	1	SYNC/LATCH PDI Configuration	
0152h-0153h	2	Extended PDI Configuration	
:			
Watchdogs			
0400h-0401h	2	Watchdogs Divider	
0410h-0411h	2	Watchdogs Time PDI	
0420h-0421h	2	Watchdogs Time Process Data	
0440h-0441h	2	Watchdogs Status Process Data	
0442h	1	Watchdogs Counter Process Data	
0443h	1	Watchdogs Counter PDI	
:			
FMMU			
0600h-063Fh	3x16	FMMU[2:0]	
+0h-3h	4	Logical Start Address	

+4h-5h	2	Length	
+6h	1	Logical Start bit	
+7h	1	Logical Stop bit	
+8h-9h	2	Physical Start Address	
+Ah	1	Physical Start bit	
+Bh	1	Type	
+Ch	1	Activate	
+Dh-Fh	3	Reserved	
:			
Distributed Clocks (DC) – SYNC Out Unit			
0981h	1	Activation	
:			
0984h	1	Activation Status	
098Eh	1	SYNC0 Status	
098Fh	1	SYNC1 Status	
0990h-0997h	8	Start Time Cyclic Operation	
:			
09A0h-09A3h	4	SYNC0 Cycle Time	
09A4h-09A7h	4	SYNC1 Cycle Time	

3.4 SII(Slave Information Interface)EEPROM

The HSD7-E loads 16Kbit EEPROM for storing EtherCAT slave information (ESI). The following table shows the configuration of the EEPROM. ESI uses word addresses.

SII EEPROM Word Address	+0h	+1h	+2h	+3h	+4h	+5h	+6h	+7h
0000h	EtherCAT Slave Controller Configuration Area							
0008h	Vendor ID		Product Code		Revision Number		Serial Number	
0010h	Hardware Delays				Bootstrap Mailbox Config			
0018h	Mailbox Sync Man Config					Reserved		
0020h : 0030h	Reserved							
0038h	Reserved						Size	Version
0040h :	Additional Information							
	Category Strings							
	Category Generals							
	Category FMMU							
	Category SyncManager							
	Category TxPDO/RxPDO for each PDO							

In the ESC register configuration area (EEPROM word address 0000h-0007h), the Configured Station Alias is automatically read by the ESC after the power is turned on and written in the ESC register. When the changed value of the SII EEPROM is reflected in the ESC register, turn on the power again.

SII EEPROM Byte Address	Name	Description	ESC Register Word Address	Data type	Initial value
0000h	PDI Control	Initial value of PDI control register	0140h 0141h	Unsigned16	0E8Dh
0001h	PDI Configuration	Initial value of PDI configuration register	0150h 0151h	Unsigned16	CC84h
0002h	Pulse Length of Sync	The initial value of the pulse width of the SYNC signal	0982h 0983h	Unsigned16	0064h
0003h	Extended PDI Config	Expand the initial value of the PDI configuration register	0152h 0153h	Unsigned16	0000h
0004h	Configured Station Alias	Station Alias (ID) initial value	0012h 0013h	Unsigned16	0000h
0005h	Reserved	Reserved	——	Unsigned16	8000h
0006h	Reserved	Reserved		Unsigned16	——
0007h	Chechsum	Verification of ESC register configuration area	——	——	——
0008h 0009h	Vendor ID	Manufacturer ID	——	Unsigned32	0088h
000Ah 000Bh	Product Code	Product code	——	Unsigned32	
000Ch 000Dh	Revision Number	version number	——	Unsigned32	
000Eh 000Fh	Serial Number	serial number	——	Unsigned32	
0010h	Execution Delay	Execution delay	——	Unsigned16	0000h
0010h	Port0 Delay	Port 0 delay	——	I16	0000h
0011h	Port0 Delay	Port 1 delay	——	I16	0000h
0013h	Reserved	Reserved	——	BYTE[2]	——
0014h	Reserved	Reserved	——	Unsigned16	0000h
0015h	Reserved	Reserved	——	Unsigned16	0000h
0016h	Reserved	Reserved	——	Unsigned16	0000h
0017h	Reserved	Reserved	——	Unsigned16	0000h
0018h	Standard Receive box Offset	Standard Status Receive Mailbox Offset (Master to slave)	——	Unsigned16	1000h
0019h	Standard Receive box Size	The size of the standard status receive mailbox (Master to slave)	——	Unsigned16	0100h
001Ah	Standard Send box Offset	The standard state sends the offset of the Mailbox (slave to master)	——	Unsigned16	1200h
001Bh	Standard Send box Size	The standard status of the size of the mailbox (slave to master)	——	Unsigned16	0100h
001Ch	Box Protocol	Supported Mailbox protocols	——	Unsigned16	0004h

001Dh ~003Dh	Reserved	Reserved	——	BYTE[66]	——
003Eh	Size	EEPROM size (this servo driver loads 16Kbit EEPROM)	——	Unsigned16	000Fh
003Fh	Version	version	——	Unsigned16	0001h

3.5 Communication synchronization mode

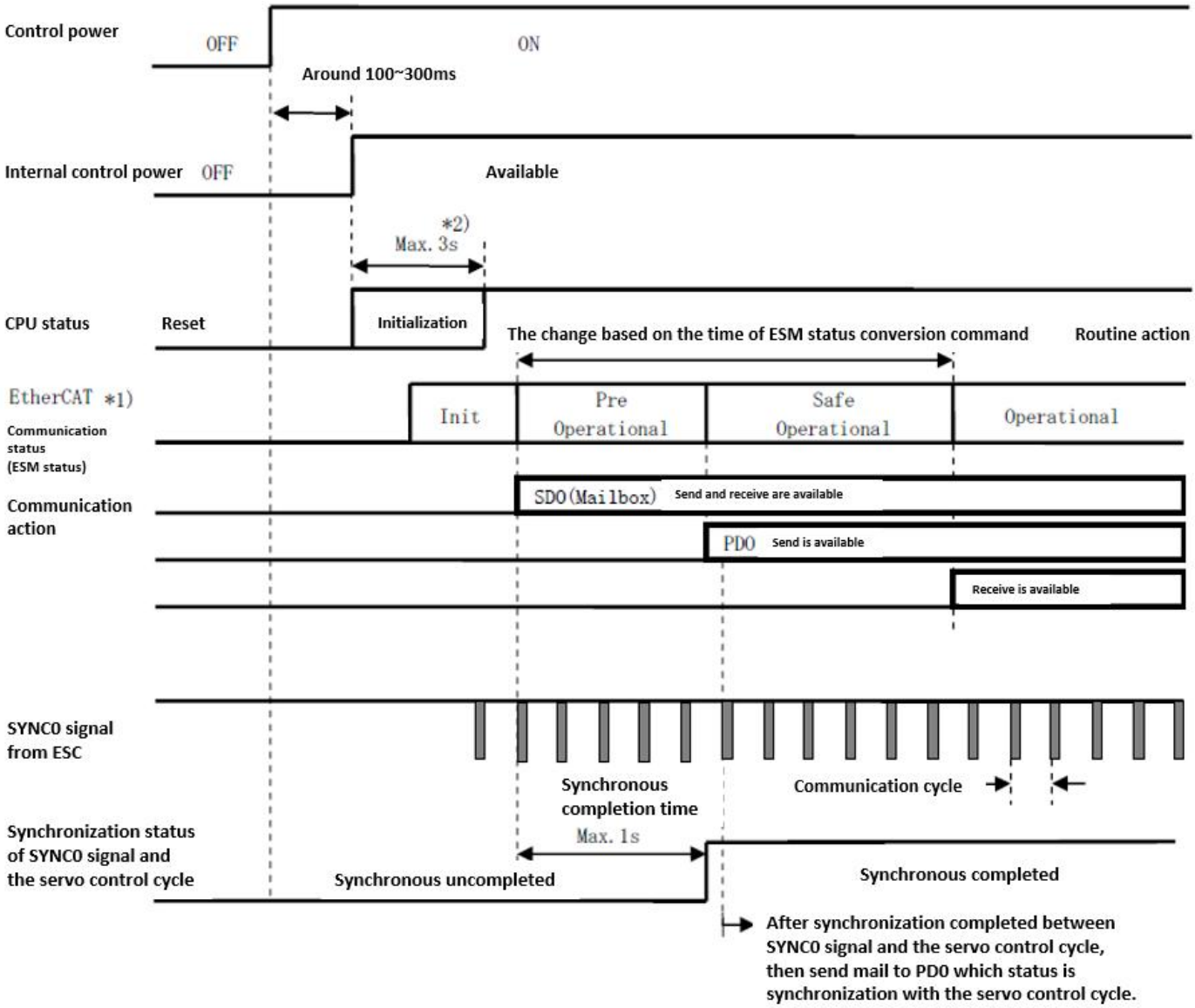
The E*-**A30 series can support the following synchronization modes.

Synchronous mode	Content	Synchronization method	Feature
FreeRun	asynchronous	asynchronous	Simple processing Under real time
SM2	SM2 Synchronization of events	RxPDO receive event synchronization	No transmission delay compensation, poor accuracy Need to guarantee the transfer time in the upper computer (Dedicated hardware, etc.)
DC	SYNC0 Synchronization of events	Based on the time of the first axis Synchronize time information from other slaves	High precision Need to perform time compensation processing at the master station

3.5.1 DC synchronization

This servo driver has a 32 bit DC (Distributed Clock). The synchronization of EtherCAT communication is based on this DC. Synchronization is based on DC slaves that share the same reference clock (System Time). The local cycle of the slave starts at the SYNC0 event. Because the processing of the slave starts at SYNC0, it is always synchronized with the SYNC0 event. The master station needs to perform transmission delay compensation when the communication is initialized, as well as regular offset compensation.

The figure below shows the synchronization completion from the control power input to the SYNC0 event and the processing of the slave.

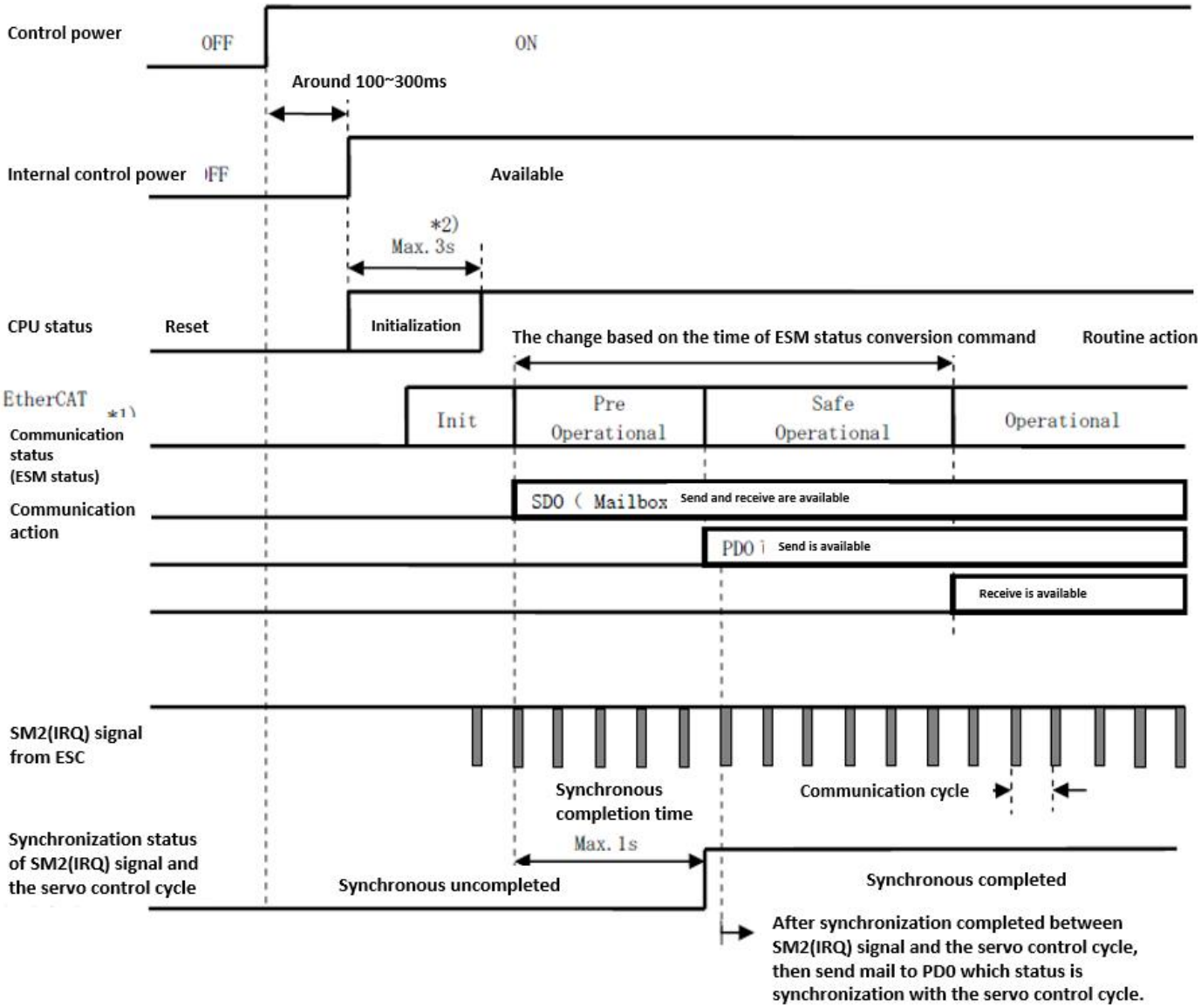

Control power
OFF
ON
Around 100~300ms
Internal control power
OFF
Available
*2)
Max. 3s
CPU status
Reset
Initialization
The change based on the time of ESM status conversion command
Routine action
EtherCAT *1)
Communication status (ESM status)
Init
Pre Operational
Safe Operational
Operational
Communication action
SDO(Mailbox)
Send and receive are available
PDO
Send is available
Receive is available
SYNC0 signal from ESC
Synchronous completion time
Max. 1s
Communication cycle
Synchronization status of SYNC0 signal and the servo control cycle
Synchronous uncompleted
Synchronous completed
After synchronization completed between SYNC0 signal and the servo control cycle, then send mail to PD0 which status is synchronization with the servo control cycle.

3.5.2 SM synchronization

The local cycle of the slave starts with the SM2 event. Since the processing of the slave starts with the SM2 event cycle, it is always synchronized with the SM2 event.

(Note): Because the SM2 event occurs when the PDO reception is completed, it must be ensured that the master station periodically transmits. If the sending event fluctuates too much, it can cause the synchronization to fail or an alarm occurs. If this happens, use DC synchronization.

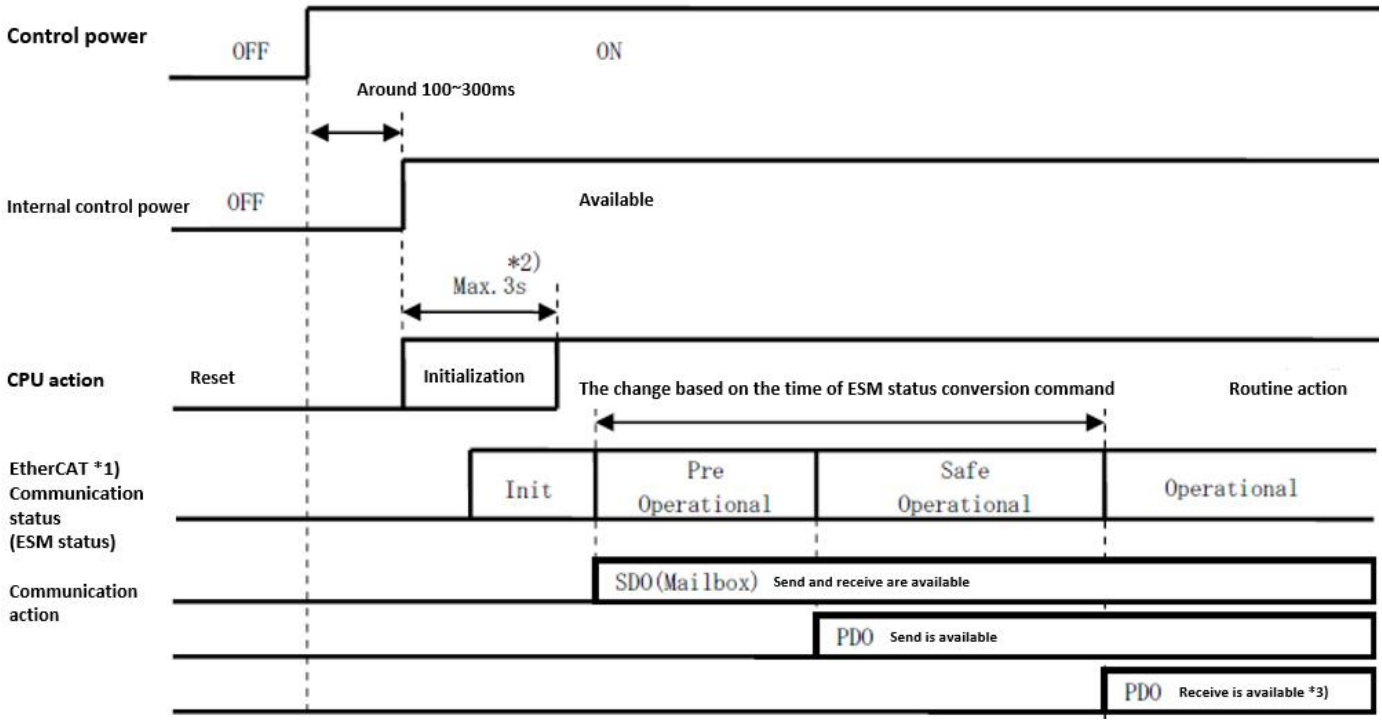
The figure below shows the synchronization completion from the control power input to the SM2 event and the processing of the slaves.



3.5.3 FreeRUN asynchronous

The FreeRUN mode starts with the disconnection of the slave's local timer. The local cycle is independent of the communication cycle or the master cycle and is asynchronous.

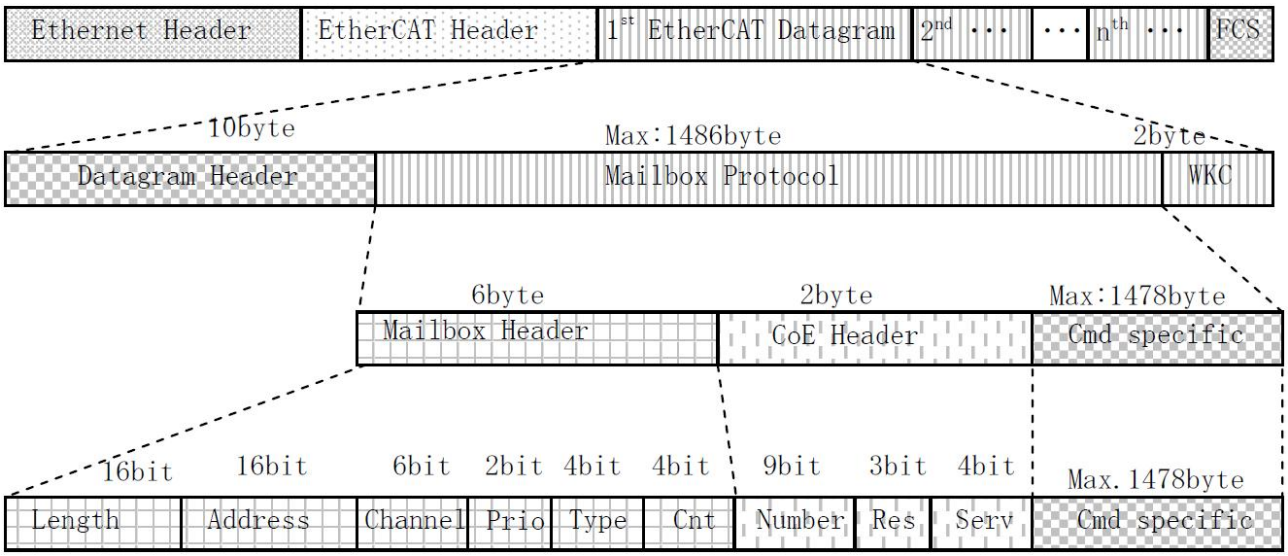
The figure below shows the process when controlling the power input.



3.6 SDO

SDO data exchange uses Mailbox communication. The master station reads and writes data in the records in the object dictionary, and can perform object setting and various status monitoring of slave stations.

1） Mailbox data structure



Note: Please refer to the ETG specifications (ETG1000-5 and ETG1000-6) for details.

2） Mailbox time out

This servo drive performs the following timeout settings in MailBox communication

- Mailbox request timeout: 100ms
- Mailbox response timeout: 10s

3.6.1 Information when an exception occurs

1） Abort message

If the SDO data exchange process fails, the slave returns the error code of the Abort message.

Error code F3 F2 F1 F0	Description
05 03 00 00_h	Toggle bit not alternated
05 04 00 01_h	Client / server command specifier not valid or unknown
06 01 00 00_h	Unsupported access to an object
06 01 00 01_h	Attempt to read a write only object
06 01 00 02_h	Attempt to write a read only object
06 02 00 00_h	Object does not exist in the object dictionary
06 04 00 41_h	Object cannot be mapped to the PDO
06 04 00 42_h	The number and length of the objects to be mapped would exceed PDO length
06 04 00 47_h	General internal incompatibility in the device
06 07 00 10_h	Data type does not match, length of service parameter does not match
06 07 00 12_h	Data type does not match, length of service parameter too high
06 07 00 13_h	Data type does not match, length of service parameter too low
06 09 00 11_h	Sub-index does not exist
06 04 00 43_h	General parameter incompatibility
06 06 00 00_h	Access failed due to an hardware error *1)
06 09 00 30_h	Value range of parameter exceeded
06 09 00 31_h	Value of parameter written too high
06 09 00 32_h	Value of parameter written too low
06 09 00 36_h	Maximum value is less than minimum value
08 00 00 20_h	Data cannot be transferred or stored to the application *1)
08 00 00 21_h	Data cannot be transferred or stored to the application because of local control
08 00 00 22_h	Data cannot be transferred or stored to the application because of the present device state *3)
08 00 00 23_h	No Object Dictionary is present *2)

2） Emergency message

The emergency message is transmitted from the slave station to the master station in response to the Mailbox communication when an abnormal alarm is sent in the servo driver.

Validity/invalidity of emergency message sending can be set to 10F3 (Diagnosis history) - 05h (Flags): bit0. It is enabled by default.

Index	SubIndex	Name	Unit	Range	Type	Access	PDO	OP-mode
10F3h	--	Diagnosis history	--	--	--	--	--	--
		The alarm history reading and the setting of Emergency message invalidation are executed.						
	05h	Flags	--	0 - 65535	U16	Following table	No	ALL

Bit 0	RW	0: Emergency message invalid 1: Emergency message effective
Bit4-1	R	Not supported, fixed to 0011b
Bit5	R	1: Clear the alarm history (10F3h-03h=0 write) is completed.
Bit15-6		Reserved

Emergency message consists of 8 bytes of data, as shown in the following table:

Byte	0	1	2	3	4	5	6	7
content	Error code (OD: 603Fh) (L) (H)		Error register (OD: 1001h)	Error Field				

- Error code

Index	Sub Index	Name	Unit	Range	Type	Access	PDO	OP-mode
603Fh	00h	Error code	--	0-65535	U16	RO	TxPDO	ALL
		Indicates the servo driver's current alarm. FA**h ** indicates the main alarm number (00h - FFh) Example: FA10h : 10h Err10.0 Servo Drive Overcurrent Occurs FA03h : 03h Err03.0 Servo motor overload occurred Note: The b axis of the multi-axis servo driver is displayed as Fb**h						

- Error register

Index	Sub Index	Name	Unit	Range	Type	Access	PDO	OP-mode
1001h	00h	Error register	--	0-255	U8	RO	NO	ALL

Indicates the type of current alarm of the servo driver. 00h is the alarm when the alarm does not occur.

bit	content
0-3	(Not supported)
4	AL status code The defined alarm occurs (EtherCAT communication related alarms)
5	(Not supported)
6	(Reserved)
7	AL status code No defined alarm occurred (EtherCAT communication unrelated alarm)

- Error Field

The auxiliary number of the alarm returns Data[0] and 00h returns Data[1-4].

Example: A141 (instruction overspeed) occurs when single-axis servo or dual-axis A-axis occurs

Byte	0	1	2	3	4	5	6	7
content	Error code		Error register	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]
value	FA14h		80h	01h	00h	00h	00h	00h

F_ _ _Main alarm number

Sub alarm number

Example: When b141 (command overspeed) is sent on the biaxial b-axis

Byte	0	1	2	3	4	5	6	7
content	Error code		Error register	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]
value	Fb14h		80h	01h	00h	00h	00h	00h

F_ _ _Main alarm number

Sub alarm number

When the abnormal state is cleared in the servo driver

Byte	0	1	2	3	4	5	6	7
content	Error code		Error register	Data[0]	Data[1]	Data[2]	Data[3]	Data[4]
value	0000h		00h	00h	00h	00h	00h	00h

3.7 PDO

For EtherCAT real-time data transfer, it executs through PDO data exchange

The PDO has the RxPDO transfer from the master station to slave station and the TxPDO transfer from the slave station to master station.

	Sender	Receiver
RxPDO	Master	Slave
TxPDO	Slave	Master

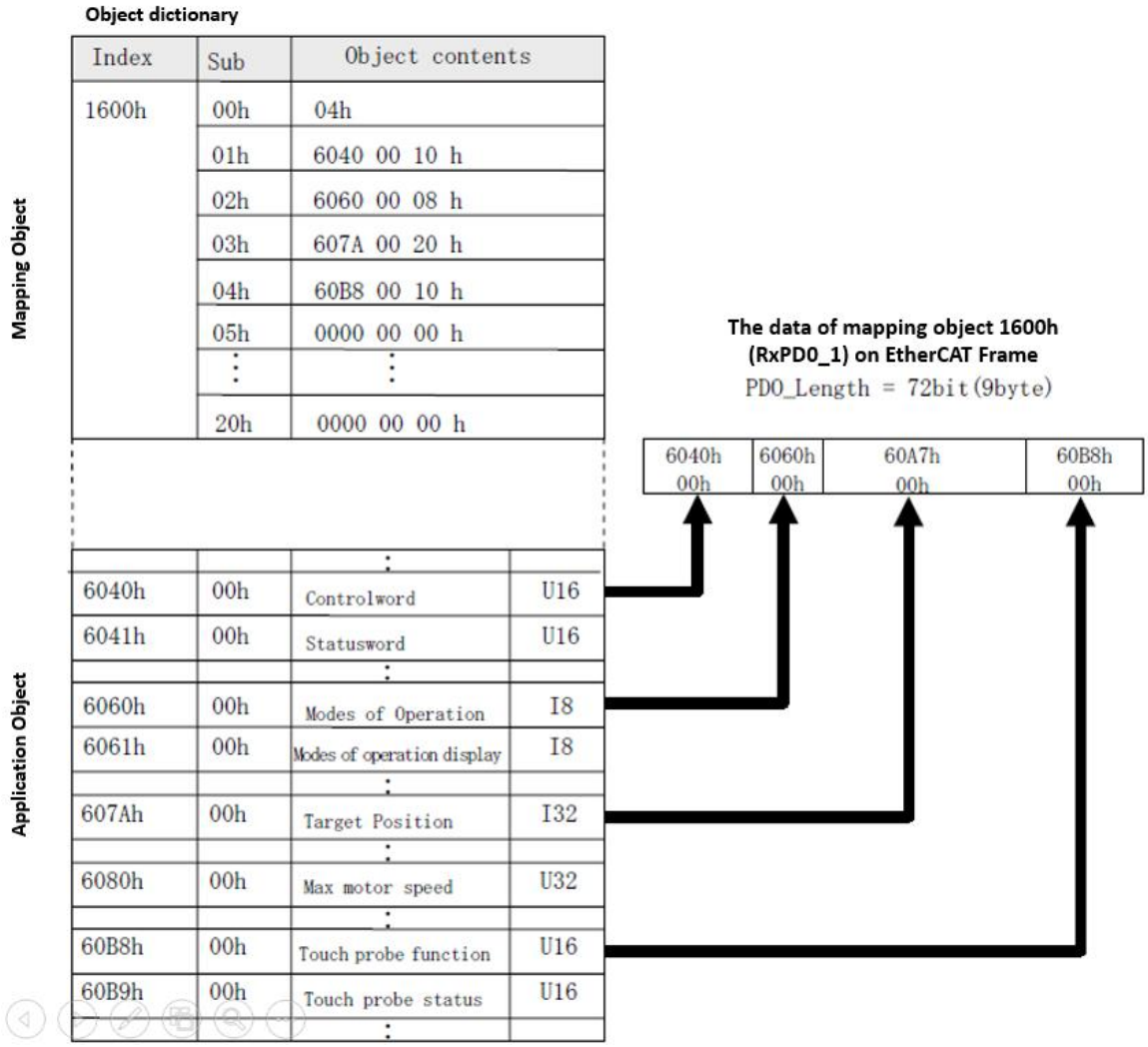
3.7.1 PDO mapping object

The PDO mapping refers to the mapping of the application objects from the object dictionary to the PDO.

RxPDO can use 1600h - 1603h and TxPDO to define PDO mapping objects using 1A00h - 1A03h.

The maximum number of application objects that a mapping object can define for RxPDO/TxPDO is 32bytes.

Example: an example of allocating application objects 6040h, 6060h, 60B8h to mapping object 1600h (RxPDO_1).



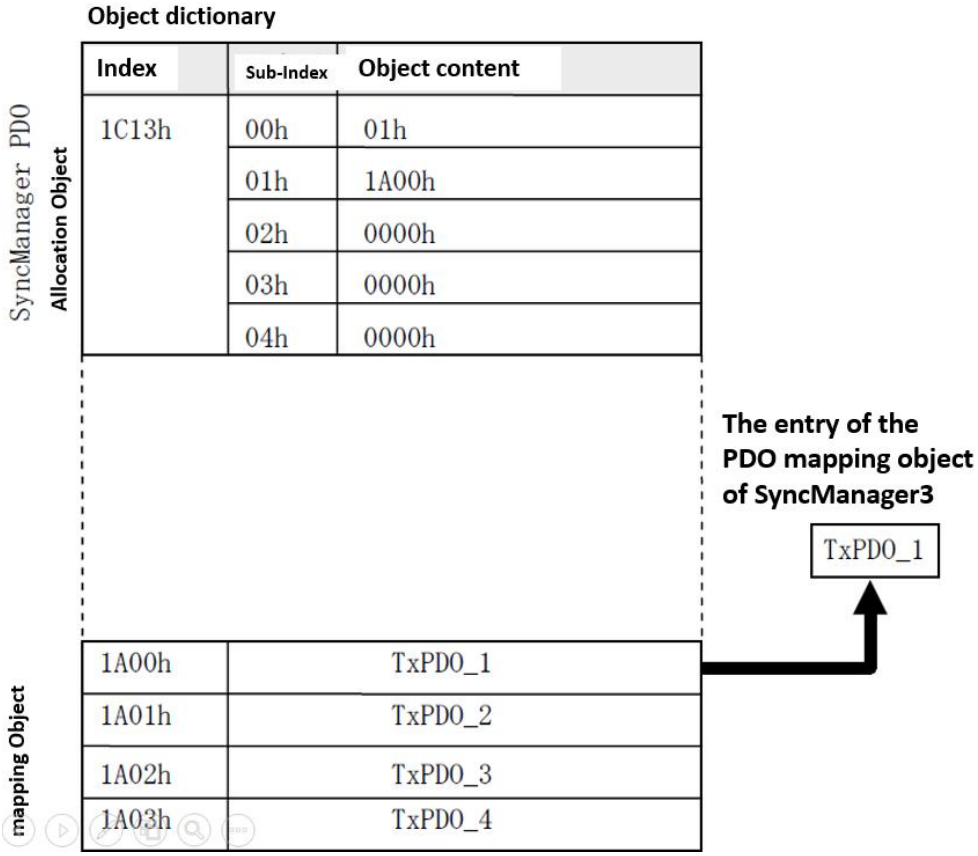
3.7.2 PDO allocation object

Because of the PDO data exchange, you must assign the PDO mapping table to SyncManager. Allocate objetc for the SyncManager PDO record the relationship between the table and SyncManager for mapping.

This servo product's SyncManager PDO allocation object can use RxPDO (SyncManager2) 1C12h, TxPDO (SyncManager3) 1C13h.

The maximum number of application objects that can be defined by an allocation object by RxPDO/TxPDO is 4 Table.Usually, because the mapping object is sufficient, the default does not need to be changed.

Example: an example of allocating mapping object 1A00h, 6060h, 60B8h to mapping object 1600h (RxPDO_1).

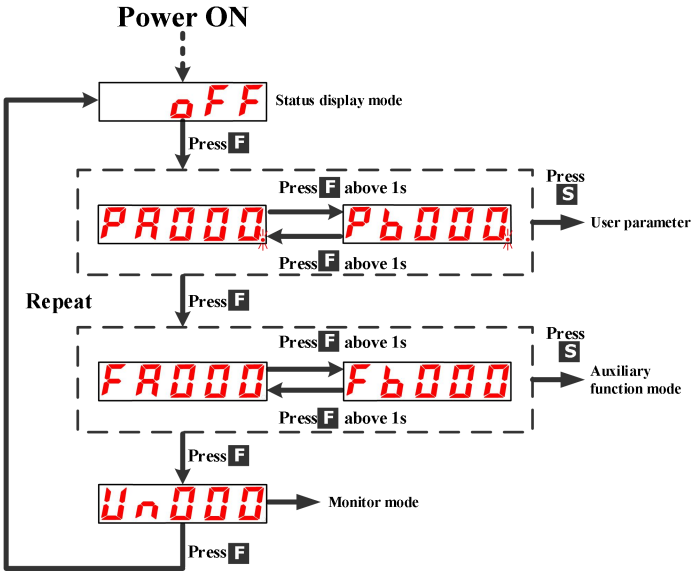


3.8 Front panel structure & Node Address setting

The front panel is used to switch between A and B axis display & operations, Parameters settings, Jog operation and other status display etc.

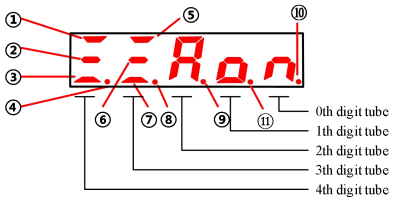
3.8.1 Basic mode selection & operation

The servo drive basic mode switch, operation, status display, parameters setting, operation command operation are executed by pressing the front panel. The basic mode include status display mode, parameter setting mode, monitoring mode along with auxiliary function mode. By pressing F key, each mode will be switched by the following chart.



3.8.2 Status display mode & EtherCAT Indicators

1）The data display of each bit.



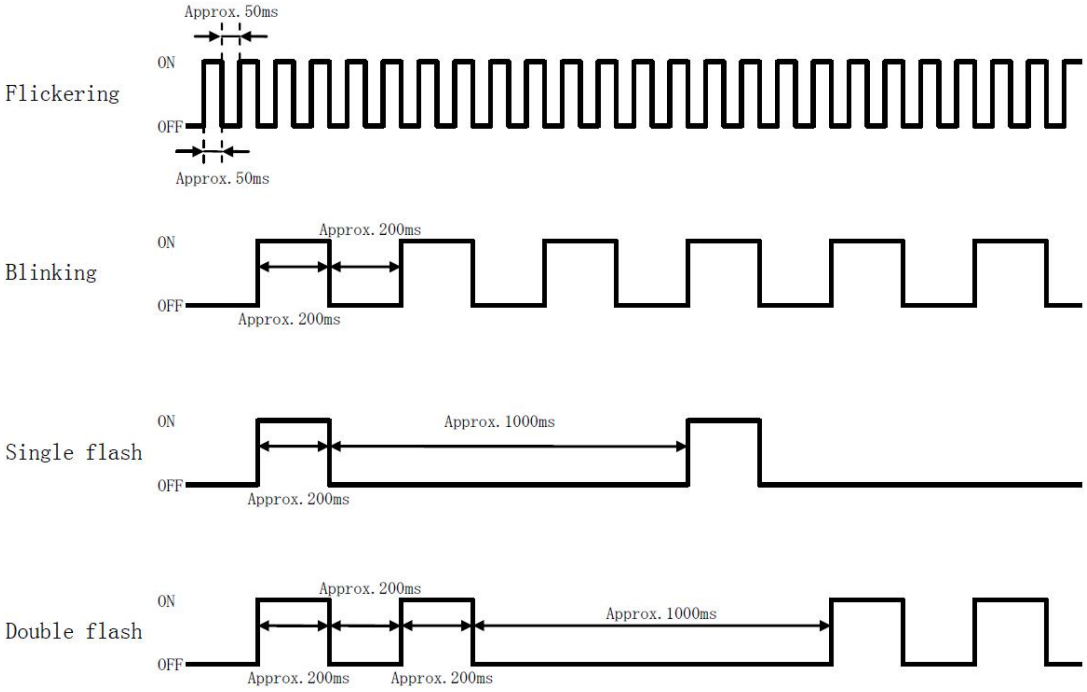
This servo drive provides 4 EtherCAT indicatiors through 7 display tubes. Please refer to the right drawing:
①(L/A IN)、⑤(L/A OUT)、
⑩(A axis RUN)、⑪(b axis RUN)。

Item	Speed ,Torque control mode		Position control mode	
	Bit data	Display content	Bit data	Display content
①	L/A IN	Physical layer connection status & operation status from the input port	L/A IN	Physical layer connection status & operation status from the input port
②	A Axis Same speed （/V-CMP）	When the difference between motor speed & command speed is lower than the defined value, it lights on. Define value parameter：PA503 （factory set value is 10rpm）	A axis Orientation complete （/COIN）	When the bias between actual motor position is smaller than the position command, it lights on. Define value parameter：PA500 （factory set value is 10 pulses）
③	A Axis Motor torque output	The motor output torque reaches 10% of the rated torque.	A axis Motor torque output	The motor output torque reaches 10% of the rated torque.
④	A axis CW/CCW prohibited	When the servo is under the position limit status: If the light is on, it means CCW is prohibited. The light off, it means CW is prohibited. Blinking means CW/CCW both prohibited.	A axis CW/CCW prohibited	When the servo is under the position limit status: If the light is on, it means CCW is prohibited. The light off, it means CW is prohibited. Blinking means CW/CCW both prohibited.
⑤	L/A IN	Physical layer connection status & operation status from the output port	L/A IN	Physical layer connection status & operation status from the output port
⑥	B axis Same speed （/V-CMP）	When the difference between motor speed & command speed is lower than the defined value, it lights on. Define value parameter：Pb503 （Factory set value is 10rpm）	B axis Orientation completed （/COIN））	When the bias between actual motor position is smaller than the position command, it lights on. Define value parameter：PA500 （factory set value is 10 pulse）
⑦	B axis Motor torque output	The motor output torque reaches 10% of the rated torque.	B axis Motor torque output	The motor output torque reaches 10% of the rated torque.
⑧	B axis CW/CCW prohibited	When the servo is under the position limit status: If the light is on, it means CCW is prohibited. The light off, it means CW is prohibited. Blinking means CW/CCW both	B axis CW/CCW prohibited	When the servo is under the position limit status: If the light is on, it means CCW is prohibited. The light off, it means CW is prohibited. Blinking means CW/CCW both

		prohibited.		prohibited.
⑨	Main power supply ready	The light is on if the main power supply is normal. The light is off if the main power is being cut off.	Main power supply ready	The light is on if the main power supply is normal. The light is off if the main power is being cut off.
⑩	A axis RUN Indicator	ESM status	A Axis RUN Indicator	ESM status
⑪	B axis RUN Indicator	ESM status	B axis RUN Indicator	ESM status

2）EtherCAT Indicators

As LED status, ON & OFF have the following 4 modes:



a) RUN operation

RUN Indicator indicates the ESM status

LED status	Descriptions
OFF	ESM：initialized state
Blinking	ESM：Pre-Operational status
Single flash	ESM：Safe-Operational status
ON	ESM：Operational status

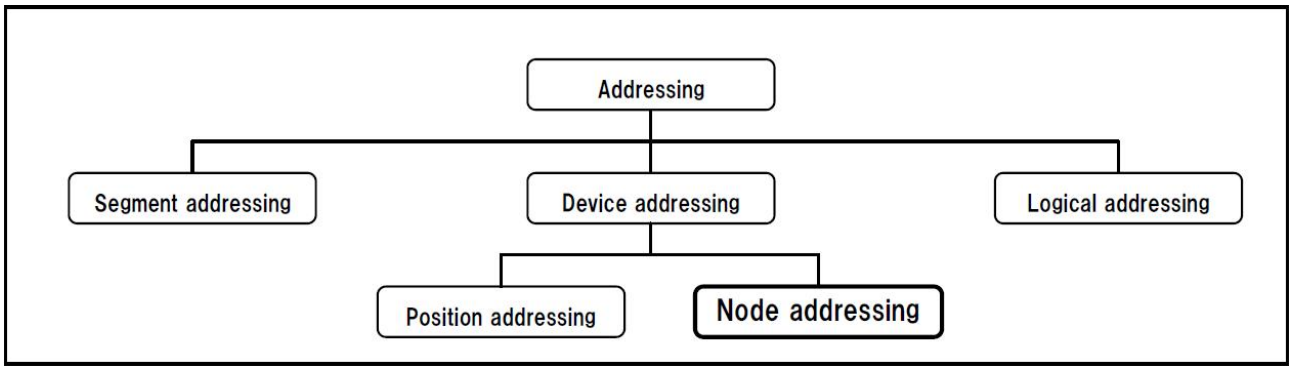
b) L/A IN & L/A OUT

L/A IN & L/A OUT indicate the connection status and operation conditions of each physical port.

LED status	Descriptions
OFF	Unable to connect
Blinking	Connected and with data receving and sending
ON	Connected but no data transfering

3.8.3 Node addressing (Station alias setting)

The specified addressing mode of EtherCAT:



This chapter will have introduction of Node addressing. There are 3 ways to differentiate the servo drive according to the setting methods and read methods, the main station fixed the ID of slave station .

1） Read SII value through “Configured Station Alias”

The method of reading SII 0004h value through 0012h（Configured Station Alias on ESC register.

2） Read parameter PA013 values through “Configured Station Alias”

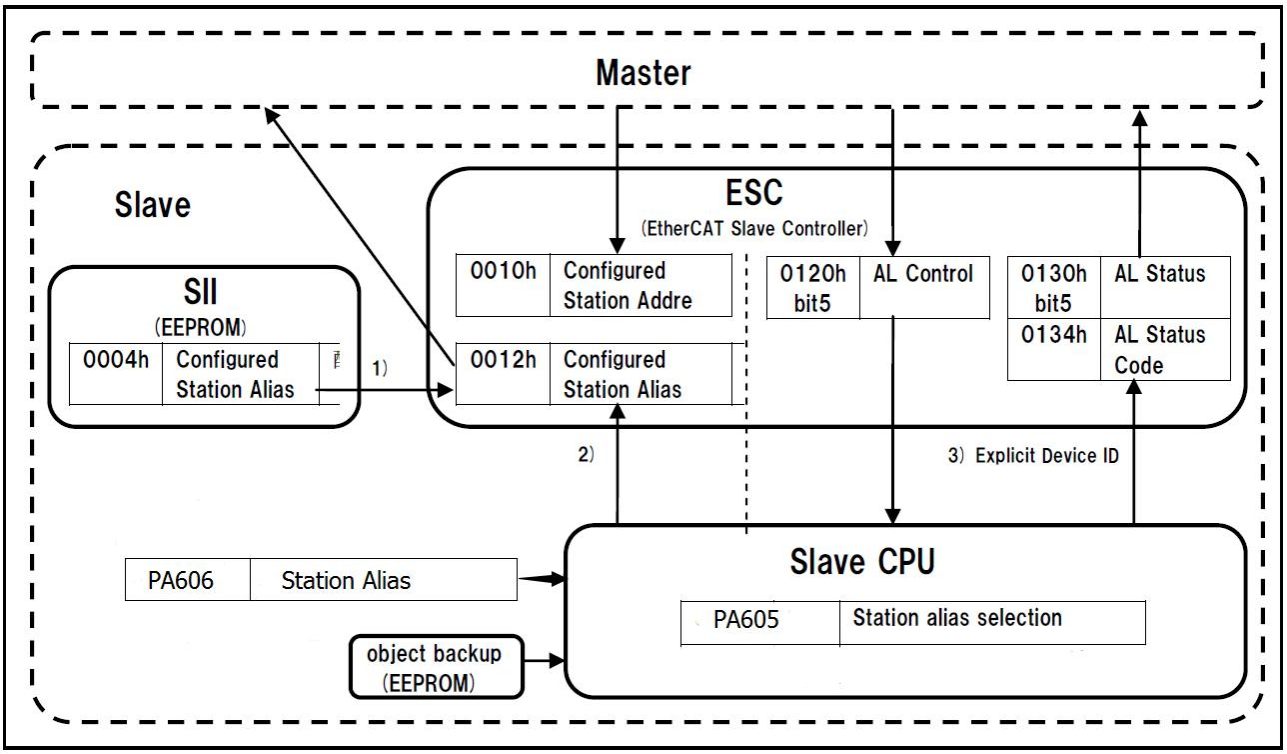
The method of reading parameter PA013 values through 0012h（Configured Station Alias） on ESC register 从 ESC

3） Read PA013 values through “AL Status Code”

The method of reading P6606 set value through application level status code (0134h).

Main station reads the set value of ESC register Configured Station Alias(0012h), and then set to Configured Station Address(0010h)。

Based on the above, set the FPRD command addresses while use mailbox settings.



1） Read Configured Station Alias through SII value

The servo drive reads PA014 value through backup EEPROM when its powered on, if the value is 1,set the 0004h (Configured Station Alias) value of SII into 0012h of ESC register. Please read this value from the main station.

2） Read Configured Station Alias through PA013 value

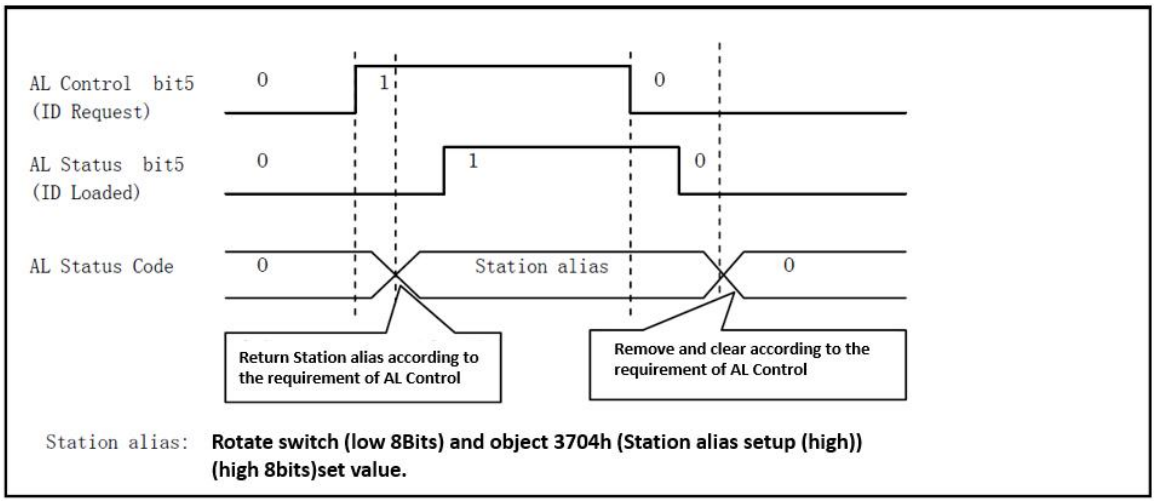
The servo drive reads PA014 value through backup EEPROM when its powered on, if the value is 0, set PA013 value to

0012h (Configured Station Alias) of ESC register. Please read this value from the main station.

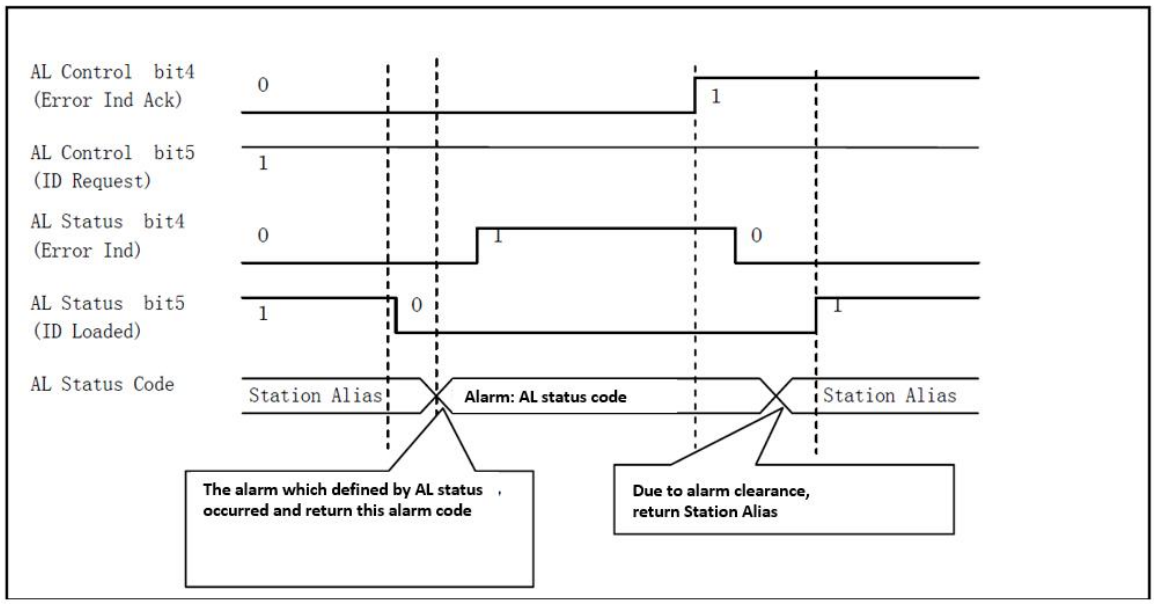
PA number	Name	Range	Unit	Default	Power restart	Remarks
PA014	EtherCAT Station alias selection	0 ~ 1	——	0000	Y	This parameter is invalid for b axis
	0：use the value of PA013 as the EtherCAT Station alias. 1：use the SII zone(0004h) value as the EtherCAT Station alias.					
PA013	EtherCAT Station alias	0000 ~ FFFF	——	0001	Y	This parameter is invalid for b axis

3） Read “AL Status Code” through PA013 value:

a) The bit5(ID Request) of “AL Control(0120h) “ is 1
b) Return to “AL Status Code(0134h)” based on parameters PA013 & PA014.
c) The bit5(ID login) of “AL Status (0130h)” return to 1.
d) The bit5(ID request)of “AL Control (0120h)” return to 0.
e) The bit5(ID login) of “AL Status (0130h)” return to 0.
f) AL Status Code(0134h) is being cleared.



In addition, during the return process of Station Alias, if allarm(defined by AL Status Code) occurs, then it return to the related AL Status Code. It will return back to Stations Alias if the alarm is cleared.



4、General specification for objects

4.1 Object structure

Object dictionary table for CoE (CANopen over EtherCAT) by CiA402 protocol

Specified object dictionary of CiA402		Object dictionary of ES-**A30		
Index	content	Index	content	reference
0000h-0FFFh	Data type zone	0000h-0FFFh	Data type zone	
1000h-1FFFh	CoE communication zone	1000h-1FFFh	CoE communication zone	
2000h-5FFFh	Defined by the manufacturer	2000h-2FFFh	Reserved	
		3000h-3FFFh	Servo parameter zone	
		4000h-5FFFh	Reserved	
6000h-9FFFh	Profile zone	6000h-6FFFh	Servo drive Profile zone	
		7000h-9FFFh	Reserved	
A000h-FFFFh	Reserved	A000h-FFFFh	Reserved	

Specified object dictionary of CiA402		Object dictionary of ED-**A30		
Index	content	Index	content	refernece
0000h-0FFFh	Data type zone	0000h-0FFFh	Data type zone	
1000h-1FFFh	CoE communication zone	1000h-1FFFh	CoE communication zone	
2000h-5FFFh	Defined by the manufacturer	2000h-2FFFh	Reserved	
		3000h-37FFh	Servo A axis parameter zone	
		3800h-3FFFh	Servo b axis parameter zone	
		4000h-5FFFh	Reserved	
6000h-9FFFh	Profile zone	6000h-67FFh	Servo A axis Profile zone	
		6800h-6FFFh	Servo b axis Profile zone	
		7000h-9FFFh	Reserved	
A000h-FFFFh	Reserved	A000h-FFFFh	Reserved	

5、CoE communication zone(1000h-1FFFh)

5.1 Object overview table

Index	Sub-Index	Name
1000h	00h	Device type
1001h	00h	Error register
1008h	00h	Manufacturer device name
1009h	00h	Manufacturer hardware version
100Ah	00h	Manufacturer software version
1018h	--	Identity object
	00h	Number of entries
	01h	Vender ID
	02h	Product code
	03h	Revision Number
	04h	Serial Number
10F1h	--	Error settings
	00h	Number of entries
	01h	Error Reaction
	02h	Sync Error Counter Limit
10F3h	--	Diagnosis History
	00h	Number of entries
	01h	Maximum messages
	02h	Newest message
	03h	Newest acknowledged message
	04h	New message available
	05h	Flags
	06h	Diagnosis message 1
	:	:
	13h	Diagnosis message 14
1600h / 1610h	--	Receive PDO mapping 1
	00h	Number of entries
	01h	1st receive PDO mapped
	:	:
	20h	32nd receive PDO mapped
1601h / 1611h	--	Receive PDO mapping 1
	00h	Number of entries
	01h	1st receive PDO mapped
	:	:
	20h	32nd receive PDO mapped
1602h / 1612h	--	Receive PDO mapping 1
	00h	Number of entries
	01h	1st receive PDO mapped
	:	:
	20h	32nd receive PDO mapped

Index	Sub-Index	Name
1603h / 1613h	--	Receive PDO mapping 1
	00h	Number of entries
	01h	1st receive PDO mapped
	:	:
	20h	32nd receive PDO mapped
1A00h / 1A10h	--	Transmit PDO mapping 1
	00h	Number of entries
	01h	1st transmit PDO mapped
	:	:
	20h	32nd transmit PDO mapped
1A01h / 1A11h	--	Transmit PDO mapping 1
	00h	Number of entries
	01h	1st transmit PDO mapped
	:	:
	20h	32nd transmit PDO mapped
1A02h / 1A12h	--	Transmit PDO mapping 1
	00h	Number of entries
	01h	1st transmit PDO mapped
	:	:
	20h	32nd transmit PDO mapped
1A03h / 1A13h	--	Transmit PDO mapping 1
	00h	Number of entries
	01h	1st transmit PDO mapped
	:	:
	20h	32nd transmit PDO mapped
1C00h	--	Sync manager type
	00h	Number of entries
	01h	Sync manager 0(Mailbox Out)
	02h	Sync manager 1(Mailbox In)
	03h	Sync manager 2(RxPDO)
	04h	Sync manager 3(TxPDO)

Index	Sub-Index	Name
1C12h	--	Sync manager channel 2
	00h	Number of entries
	01h	Mapping OD index of RxPDO1
	02h	Mapping OD index of RxPDO2
	03h	Mapping OD index of RxPDO3
	04h	Mapping OD index of RxPDO4
1C13h	--	Sync manager channel 3
	00h	Number of entries
	01h	Mapping OD index of TxPDO1
	02h	Mapping OD index of TxPDO2
	03h	Mapping OD index of TxPDO3
	04h	Mapping OD index of TxPDO4
1C32h	--	Sync manager channel 2
	00h	Number of entries
	01h	Sync mode
	02h	Cycle Time
	03h	Shift Time
	04h	Sync mode supported
	05h	Minimum cycle time
	06h	Calc and copy time
	08h	Get cycle time
	09h	Delay time
	0Ah	Sync0 cycle time
	0Bh	SM-Event misse
	0Ch	Cycle time too small
	0Dh	Shift time too short
	20h	Sync error

Index	Sub-Index	Name
1C33h	--	Sync manager channel 3
	00h	Number of entries
	01h	Sync mode
	02h	Cycle Time
	03h	Shift Time
	04h	Sync mode supported
	05h	Minimum cycle time
	06h	Calc and copy time
	08h	Get cycle time
	09h	Delay time
	0Ah	Sync0 cycle time
	0Bh	SM-Event misse
	0Ch	Cycle time too small
	0Dh	Shift time too short
	20h	Sync error

5.2 Device information

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name</th><th>Unit</th><th>Range</th><th>Type</th><th>Access</th><th>PDO</th><th>OP-mode</th></tr>
<tr><td rowspan="2">1000h</td><td rowspan="2">00h</td><td>Device type</td><td>--</td><td>00020192h</td><td>U32</td><td>RO</td><td>No</td><td>ALL</td></tr>
<tr><td colspan="8">Indicate the device type
If the device is servo drive, the fixed value is 00020192h。</td></tr>
<tr><td rowspan="2">1001h</td><td rowspan="2">00h</td><td>Wrong register</td><td>--</td><td>0 - 255</td><td>U8</td><td>RO</td><td>No</td><td>ALL</td></tr>
<tr><td colspan="8">Indicate the alarm type of the device, if there is no alarm, it’s 0000h。
<table>
<tr><th>bit</th><th>Content</th></tr>
<tr><td>0-3</td><td>(Not supported)</td></tr>
<tr><td>4</td><td>AL status code :definition of alarm occurs（EtherCAT communication related alarms）</td></tr>
<tr><td>5</td><td>(Not supported)</td></tr>
<tr><td>6</td><td>(Reserved)</td></tr>
<tr><td>7</td><td>AL status code: definition of alarms not occured（EtherCAT communication unrelated alarm）</td></tr>
</table></td></tr>
<tr><td rowspan="2">1008h</td><td rowspan="2">00h</td><td>Device name</td><td>--</td><td>--</td><td>VS</td><td>RO</td><td>No</td><td>ALL</td></tr>
<tr><td colspan="8">Use 16 characters to describe the name，if there are less than 16, use space/blank(20h) to fulful.
<table>
<tr><td>byte</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td><td>..</td><td>15</td></tr>
<tr><td>character</td><td>i</td><td>3</td><td>D</td><td>S (W)</td><td>-</td><td></td><td></td><td>A</td><td>3</td><td>0</td><td colspan="3">(space)</td></tr>
</table></td></tr>
<tr><td rowspan="2">1009h</td><td rowspan="2">00h</td><td>Device hardware version</td><td>--</td><td>--</td><td>VS</td><td>RO</td><td>No</td><td>ALL</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td rowspan="2">100Ah</td><td rowspan="2">00h</td><td>Device software version</td><td>--</td><td>--</td><td>VS</td><td>RO</td><td>No</td><td>ALL</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td rowspan="10">1018h</td><td rowspan="2">--</td><td>Identity onject</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td colspan="8">Indicate the device information</td></tr>
<tr><td rowspan="2">00h</td><td>Numer of entries</td><td>--</td><td>0 - 255</td><td>U8</td><td>RO</td><td>No</td><td>ALL</td></tr>
<tr><td colspan="8">The default number is the Subindex value，fixed value is 04h</td></tr>
<tr><td rowspan="2">01h</td><td>Vendor ID</td><td>--</td><td>00000088</td><td>U32</td><td>RO</td><td>No</td><td>ALL</td></tr>
<tr><td colspan="8">Indicate the EtherCAT Vendor ID</td></tr>
<tr><td rowspan="2">02h</td><td>Product code</td><td>--</td><td>0 - 4294967295</td><td>U32</td><td>RO</td><td>No</td><td>ALL</td></tr>
<tr><td colspan="8">Indicate product code
Single axis 0x00010000 Multi axis 0x00020000</td></tr>
<tr><td rowspan="2">03h</td><td>Revision number</td><td>--</td><td>0 - 4294967295</td><td>U32</td><td>RO</td><td>No</td><td>ALL</td></tr>
<tr><td colspan="8"></td></tr>
<tr><td rowspan="2">04h</td><td>Serial number</td><td>--</td><td>0 - 4294967295</td><td>U32</td><td>RO</td><td>No</td><td>ALL</td></tr>
<tr><td colspan="8"></td></tr>
</table>

5.3 SM communication type (1C00h)

The SM action mode is set through 1C00h object, as for servo drive, this value is fixed.

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
1C00h	--	SM communication type	--	--	--	--	--	--
		Set SM action mode						
	00h	Numer of entries	--	0 - 255	U8	RO	No	ALL
		Indicate Subindex numbers，fixed value is 04h						
	01h	Communication type SM0	--	0 - 4	U8	RO	No	ALL
		Set SM0 usage: 0：not used 1：mail receiving (master station->slave station) 2：mail sending (slave station->master station) 3：RxPDO(master station->slave station) 4：TxPDO(slave station->master station) SM0 uses Mailbox to receive mail，so the fixed value is 1.						
	02h	Communication type SM1	--	0 - 4	U8	RO	No	ALL
		Set SM1 usage: 0：not used 1：mail receiving (master station->slave station) 2：mail sending (slave station->master station) 3：RxPDO(master station->slave station) 4：TxPDO(slave station->master station) SM0 uses Mailbox to receive mail，so the fixed value is 2.						
	03h	Communication type SM2	--	0 - 4	U8	RO	No	ALL
		Set SM2 usage: 0：not used 1：mail receiving (master station->slave station) 2：mail sending (slave station->master station) 3：RxPDO(master station->slave station) 4：TxPDO(slave station->master station) SM2 uses Process data output (RxPDO), so the fixed value is 3.						
	04h	Communication type SM3	--	0 - 4	U8	RO	No	ALL
		Set SM3 usage: 0：not used 1：mail receiving (master station->slave station) 2：mail sending (slave station->master station) 3：RxPDO(master station->slave station) 4：TxPDO(slave station->master station) SM3 uses Process data in(TxPDO), so the fixed value is 4						

5.4 PDO mapping

5.4.1 PDO allocating object

PDO mapping allocation table: SM sets the objects through 1C12-1C13h

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
1C12h	--	SM2	--	--	--	--	--	--
		Set the entrance of PDO mapping object on SM2 SM2 used as Process data output(RxPDO) This object can be changed only when ESM status is PreOP Note) if Subindex00h value is not 0, 01h-04h cant be changed.						
	00h	Numer of entries	--	0 - 4	U8	RW	No	ALL
		Indicate the number of allocated objects						
	01h	Mapping OD index of RxPDO1	--	1600h – 1603h 1610h – 1613h	U16	RW	No	ALL
		Appoint the PDO mapping object.						
	02h	Mapping OD index of RxPDO2	--	1600h – 1603h 1610h – 1613h	U16	RW	No	ALL
		Appoint the PDO mapping object.						
	03h	Mapping OD index of RxPDO3	--	1600h – 1603h 1610h – 1613h	U16	RW	No	ALL
		Appoint the PDO mapping object.						
	04h	Mapping OD index of RxPDO4	--	1600h – 1603h 1610h – 1613h	U16	RW	No	ALL
		Appoint the PDO mapping object.						
1C13h	--	SM3	--	--	--	--	--	--
		Set the entrance of PDO mapping object on SM3. SM3 used as Process data output(TxPDO). This object can be changed only when ESM status is PreOP Noted: if Subindex00h value is not 0，01h-04h cant be changed.						
	00h	Numer of entries	--	0 - 4	U8	RW	No	ALL
		Indicate the number of allocated objects						
	01h	Mapping OD index of RxPDO1	--	1600h – 1603h 1610h – 1613h	U16	RW	No	ALL
		Appoint the PDO mapping object.						
	02h	Mapping OD index of RxPDO2	--	1600h – 1603h 1610h – 1613h	U16	RW	No	ALL
		Appoint the PDO mapping object.						
	03h	Mapping OD index of RxPDO3	--	1600h – 1603h 1610h – 1613h	U16	RW	No	ALL
		Appoint the PDO mapping object.						
	04h	Mapping OD index of RxPDO4	--	1600h – 1603h 1610h – 1613h	U16	RW	No	ALL
		Appoint the PDO mapping object.						

Note: subindex01-04h of 1C12h and 1C13h can be changed only when the ESM status is PreOP and Subindex00h=0. The other state is return to Abort Code (0601 0003h).After setting the change, set the Subindex number of Subindex00h ,

reflect the PDO allocation object setting by converting ESM status to SafeOP.

5.4.2 PDO mapping object

PDO mapping object table : RxPDO uses 1600h~1603h(multi axis drive b axis uses 1610h~1613h)、 TxPDO uses 1A00h-1A03h(multi axis drive b axis uses 1A10h~1A13h)

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name</th><th>Unit</th><th>Range</th><th>Type</th><th>Access</th><th>PDO</th><th>OP-mode</th></tr>
<tr><td rowspan="14">1600h
/
1610h</td><td rowspan="2">--</td><td>RxPDO mapping 1</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td colspan="8">Indicate RxPDO object
The value of this object can only be changed when ESM status is PreOP
Note: if Subindex00h value is not 0，then 01h-20h cant be changed</td></tr>
<tr><td rowspan="2">00h</td><td>Numer of entries</td><td>--</td><td>0 - 32</td><td>U8</td><td>RW</td><td>No</td><td>ALL</td></tr>
<tr><td colspan="8">Indicate the number of allocations of this object</td></tr>
<tr><td rowspan="2">01h</td><td>1st receive PDO mapped</td><td>--</td><td>0 - 4294967295</td><td>U32</td><td>RW</td><td>No</td><td>ALL</td></tr>
<tr><td colspan="8">Set the first mapping object
<table><tr><td>bit31 ： bit16</td><td>bit15 ： bit8</td><td>bit07 ： bit00</td></tr><tr><td>Index</td><td>SubIndex</td><td>Bit length</td></tr></table></td></tr>
<tr><td rowspan="2">02h</td><td>2nd receive PDO mapped</td><td>--</td><td>0 - 4294967295</td><td>U32</td><td>RW</td><td>No</td><td>ALL</td></tr>
<tr><td colspan="8">Set the first mapping object, method is same as Subindex01.</td></tr>
<tr><td rowspan="2">03h</td><td>3rd receive PDO mapped</td><td>--</td><td>0 - 4294967295</td><td>U32</td><td>RW</td><td>No</td><td>ALL</td></tr>
<tr><td colspan="8">Set the 2nd mapping object, method is same as Subindex01.</td></tr>
<tr><td>：</td><td colspan="8">：</td></tr>
<tr><td rowspan="2">20h</td><td>32nd receive PDO mapped</td><td>--</td><td>0 - 4294967295</td><td>U32</td><td>RW</td><td>No</td><td>ALL</td></tr>
<tr><td colspan="8">Set the 32nd mapping object, method is same as Subindex01.</td></tr>
<tr><td rowspan="2">1601h
/
1611h</td><td rowspan="2">--</td><td>RxPDO mapping 2</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td colspan="8">Subindex & other specs are the same as 1600h</td></tr>
<tr><td rowspan="2">1602h
/
1612h</td><td rowspan="2">--</td><td>RxPDO mapping 3</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td colspan="8">Subindex & other specs are the same as 1600h</td></tr>
<tr><td rowspan="2">1603h
/
1613h</td><td rowspan="2">--</td><td>RxPDO mapping 4</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td colspan="8">Subindex & other specs are the same as 1600h</td></tr>
</table>

Note: please don’t map the same object

The subindex01-04h of 1600h -- 1610h(multi-axis drive b 1610h~1613h) can be changed only when the ESM state is PreOP and Subindex00h=0. The other state is to return to Abort Code (0601 0003h).After setting the change, set the Subindex number of Subindex 00h , reflect the PDO allocation object setting by converting ESM status to SafeOP.

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name</th><th>Unit</th><th>Range</th><th>Type</th><th>Access</th><th>PDO</th><th>OP-mode</th></tr>
<tr><td rowspan="12">1A00h
/
1A10h</td><td rowspan="2">--</td><td>TxPDO mapping 1</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td colspan="8">Indicate TxPDO object
The value of this object can only be changed when ESM status is PreOP
Note: if Subindex00h value is not 0，then 01h-20h cant be changed</td></tr>
<tr><td rowspan="2">00h</td><td>Numer of entries</td><td>--</td><td>0 - 32</td><td>U8</td><td>RW</td><td>No</td><td>ALL</td></tr>
<tr><td colspan="8">Indicate the number of allocations of this object</td></tr>
<tr><td rowspan="2">01h</td><td>1st transmit PDO mapped</td><td>--</td><td>0 - 4294967295</td><td>U32</td><td>RW</td><td>No</td><td>ALL</td></tr>
<tr><td colspan="8">Set the first mapping object
<table><tr><td>bit31 ： bit16</td><td>bit15 ： bit8</td><td>bit07 ： bit00</td></tr><tr><td>Index</td><td>SubIndex</td><td>Bit length</td></tr></table></td></tr>
<tr><td rowspan="2">02h</td><td>2nd transmit PDO mapped</td><td>--</td><td>0 - 4294967295</td><td>U32</td><td>RW</td><td>No</td><td>ALL</td></tr>
<tr><td colspan="8">Set the first mapping object, the method is the same as Subindex01.</td></tr>
<tr><td rowspan="2">03h</td><td>3rd transmit PDO mapped</td><td>--</td><td>0 - 4294967295</td><td>U32</td><td>RW</td><td>No</td><td>ALL</td></tr>
<tr><td colspan="8">Set the second mapping object, the method is the same as Subindex01.</td></tr>
<tr><td>：</td><td colspan="8">：</td></tr>
<tr><td rowspan="2">20h</td><td>32nd transmit PDO mapped</td><td>--</td><td>0 - 4294967295</td><td>U32</td><td>RW</td><td>No</td><td>ALL</td></tr>
<tr><td colspan="8">Set the 32nd apping object, the method is the same as Subindex01.</td></tr>
<tr><td rowspan="2">1A01h
/
1A11h</td><td rowspan="2">--</td><td>TxPDO mapping 2</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td colspan="8">Subindex & other specs are the same as 1600h</td></tr>
<tr><td rowspan="2">1A02h
/
1A12h</td><td rowspan="2">--</td><td>TxPDO mapping 3</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td colspan="8">Subindex & other specs are the same as 1600h</td></tr>
<tr><td rowspan="2">1A03h
/
1A13h</td><td rowspan="2">--</td><td>TxPDO mapping 4</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td colspan="8">Subindex & other specs are the same as 1600h</td></tr>
</table>

Note: please don’t map the same object

The subindex01-04h of 1A00h - 1A10h (multi-axis drive b axis 1A10h~1A613h) can be changed only when the ESM state is PreOP and Subindex00h=0. The other state is to return to Abort Code (0601 0003h). After setting the changes, set the Subindex number of Subindex00h, reflect the PDO allocation object setting by converting ESM status to SafeOP.

5.4.3 Default PDO mapping

- PDO mapping 1

  Postion control (Touch probe)

	Index	Sub-Index	Size (bit)	Name	Factory default
RxPDO (1600h)	6040h	00h	16	Controlword	60400010h
	6060h	00h	8	Modes of operation	60600008h
	607Ah	00h	32	Target Position	607A0020h
	60B8h	00h	16	Touch probe function	60B80010h
TxPDO (1A00h)	603Fh	00h	16	Error code	603F0010h
	6041h	00h	16	Statusword	60410010h
	6061h	00h	8	Modes of operation display	60610008h
	6064h	00h	32	Position actual value	60640020h
	60B9h	00h	16	Touch probe status	60B90010h
	60BAh	00h	32	Touch probe pos1 pos value	60BA0020h
	60F4h	00h	32	Following error actual value	60F40020h
	60FDh	00h	32	Digital inputs	60FD0020h

- PDO mapping 2

  Position mode、speed mode、torque mode (Touch probe)

	Index	Sub-Index	Size (bit)	Name	Factory default
RxPDO (1601h)	6040h	00h	16	Controlword	60400010h
	6060h	00h	8	Modes of operation	60600008h
	6071h	00h	16	Target Torque	60710010h
	607Ah	00h	32	Target Position	607A0020h
	6080h	00h	32	Max motor speed	60800020h
	60B8h	00h	16	Touch probe function	60B80010h
	60FFh	00h	32	Target Velocity	60FF0020h
TxPDO (1A01h)	603Fh	00h	16	Error code	603F0010h
	6041h	00h	16	Statusword	60410010h
	6061h	00h	8	Modes of operation display	60610008h
	6064h	00h	32	Position actual value	60640020h
	606Ch	00h	32	Velocity actual value	606C0020h
	6077h	00h	16	Torque actual value	60770010h
	60B9h	00h	16	Touch probe status	60B90010h
	60BAh	00h	32	Touch probe pos1 pos value	60BA0020h
	60FDh	00h	32	Digital inputs	60FD0020h

- The PDO mapping 3

  Position mode, speed mode (use of Touch probe, torque limitation)

	Index	Sub-Index	Size (bit)	Name	Factory default
RxPDO (1602h)	6040h	00h	16	Controlword	60400010h
	6060h	00h	8	Modes of operation	60600008h
	6072h	00h	16	Max torque	60720010h
	607Ah	00h	32	Target Position	607A0020h
	60B8h	00h	16	Touch probe function	60B80010h
	60FFh	00h	32	Target Velocity	60FF0020h
TxPDO (1A02h)	603Fh	00h	16	Error code	603F0010h
	6041h	00h	16	Statusword	60410010h
	6061h	00h	8	Modes of operation display	60610008h
	6064h	00h	32	Position actual value	60640020h
	606Ch	00h	32	Velocity actual value	606C0020h
	6077h	00h	16	Torque actual value	60770010h
	60B9h	00h	16	Touch probe status	60B90010h
	60BAh	00h	32	Touch probe pos1 pos value	60BA0020h
	60FDh	00h	32	Digital inputs	60FD0020h

- The PDO mapping 4

  Position mode, speed mode, torque mode (use of Touch probe, torque limitation)

	Index	Sub-Index	Size (bit)	Name	Factory default
RxPDO (1603h)	6040h	00h	16	Controlword	60400010h
	6060h	00h	8	Modes of operation	60600008h
	6071h	00h	16	Target Torque	60710010h
	6072h	00h	16	Max torque	60720010h
	607Ah	00h	32	Target Position	607A0020h
	6080h	00h	32	Max motor speed	60800020h
	60B8h	00h	16	Touch probe function	60B80010h
	60FFh	00h	32	Target Velocity	60FF0020h
TxPDO (1A03h)	603Fh	00h	16	Error code	603F0010h
	6041h	00h	16	Statusword	60410010h
	6061h	00h	8	Modes of operation display	60610008h
	6064h	00h	32	Position actual value	60640020h
	606Ch	00h	32	Velocity actual value	606C0020h
	6077h	00h	16	Torque actual value	60770010h
	60B9h	00h	16	Touch probe status	60B90010h
	60BAh	00h	32	Touch probe pos1 pos value	60BA0020h
	60FDh	00h	32	Digital inputs	60FD0020h

5.4.4 PDO mapping setup steps

In order to increase the Profile speed to 1600h(RxPDO mapping 1), the setting steps of PDO mapping are described.

Before the change

Index	Set Value	Object content	
1600h-01h	60400010h	6040h-00h	Controlword
1600h-02h	60600008h	6060h-00h	Modes of operation
1600h-03h	607A0020h	607Ah-00h	Target Position
1600h-04h	60B80010h	60B8h-00h	Touch probe function

After the change

Index	Set Value	Object content		
1600h-01h	60400010h	6040h-00h	Controlword	
1600h-02h	60600008h	6060h-00h	Modes of operation	
1600h-03h	607A0020h	607Ah-00h	Target Position	
1600h-04h	60B80010h	60B8h-00h	Touch probe function	
1600h-05h	60810020h	6081h-00h	Profile velocity	← Increase

<Setting method> When using SDO information setting

1) Switch the ESM status from Iniit to PreOP.
2) The value of 1600h-00h is modified by SDO to 0.
3) The value of 1600h-05h modified by SDO is 60810020h.
4) The value of 1600h-00h is modified by SDO.
5) Switch the ESM status from PreOP to SafeOP. TxPDO is effective.
6) Switch the ESM status from SafeOP to OP and RxPDO is effective.
7) If the power is turned off again, 2 - 4 need to be set.

5.5 SM2/3 synchronization(1C32、1C33h)

SM2 is executed by setting 1C32h, and SM3 is executed by setting 1C33h.

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name</th><th>Unit</th><th>Range</th><th>Type</th><th>Access</th><th>PDO</th><th>OP-mode</th></tr>
<tr><td rowspan="11">1C32h</td><td>--</td><td>SM2 synchronization</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td><td>--</td></tr>
<tr><td></td><td colspan="8"></td></tr>
<tr><td rowspan="2">00h</td><td>Numer of entries</td><td>--</td><td>0 - 255</td><td>U8</td><td>RW</td><td>No</td><td>ALL</td></tr>
<tr><td colspan="8">Represents the number of objects allocated to this object.</td></tr>
<tr><td rowspan="2">01h</td><td>Sync mode</td><td>--</td><td>0 – 65535</td><td>U16</td><td>RW</td><td>No</td><td>ALL</td></tr>
<tr><td colspan="8">Set the synchronous mode for SM2.
<table>
<tr><td>00h:FreeRun(not synchronized)</td><td>01h: SM2(synchronized with sm2 event)</td></tr>
<tr><td>02h:DCSYNC0(synchronized with sync0)</td><td>03h:</td></tr>
</table>
According to the combination of the settings of ESC register 0981h (DC-Activation) (table below), the set value of this object is automatically set when switching from PreOP to SafeOP.
<table>
<tr><td>ESC register 0981h Setting state</td><td>1C32h-01h setting value</td><td></td><td>The value of 1c32h-01h changed when the PreOP->SafeOP is switched.</td></tr>
<tr><td rowspan="3">DC effective ON</td><td>00h: FreeRun</td><td rowspan="6">-></td><td>02h: DC SYNC0</td></tr>
<tr><td>01h: SM2</td><td>02h: DC SYNC0</td></tr>
<tr><td>02h: DC SYNC0</td><td>02h: DC SYNC0</td></tr>
<tr><td rowspan="3">DC effective OFF</td><td>00h: FreeRun</td><td>00h: FreeRun</td></tr>
<tr><td>01h: SM2</td><td>01h: SM2</td></tr>
<tr><td>02h: DC SYNC0</td><td>00h: FreeRun</td></tr>
</table></td></tr>
<tr><td rowspan="2">02h</td><td>Cycle time</td><td>ns</td><td>0 - 4294967295</td><td>U32</td><td>RO</td><td>No</td><td>ALL</td></tr>
<tr><td colspan="8">Set the period of the SM
<table>
<tr><td>Sync mode(1C32h-01h)</td><td>function</td></tr>
<tr><td>00h: FreeRun</td><td>Set the interval of events according to local time</td></tr>
<tr><td>01h: SM2</td><td>Set the minimum time interval for SM2 Event</td></tr>
<tr><td>02h: DC SYNC0</td><td>Sync0 Cycle Time (ESC register: 09A0h) is set</td></tr>
</table>
Please set the integer multiples of 100,000 (100us)</td></tr>
<tr><td rowspan="2">03h</td><td>Shift time</td><td>ns</td><td>0 - 4294967295</td><td>U32</td><td>RO</td><td>No</td><td>ALL</td></tr>
<tr><td colspan="8">Not supported</td></tr>
<tr><td rowspan="2">04h</td><td>Sync modes support</td><td>--</td><td>0 - 65535</td><td>U16</td><td>RO</td><td>No</td><td>ALL</td></tr>
<tr><td colspan="8">Set the supported synchronization type
BIT0：FreeRun mode support 0: not supported 1: support this servo drive is set to 1
BIT1：SM synchronous mode support 0: not supported 1: support this servo drive is set to 1.
BIT4-2：DC synchronous mode supports this servo drive to be set to 011b.
000b：not supported
001b：DC sync0 Event support
010b：DC sync1 Event support
011b：DC sync0/sync1 Event support
BIT6-5：output offset supports this servo drive to be set to 00b.</td></tr>
</table>

		00b： not supported 01b： local time offset support. BI15-7：Reserved						
1C32h	05h	Min cycle time	ns	0 - 4294967295	U32	RO	No	ALL
		From SM2 Event, SYNC0 Event to ESC reading, write the minimum value. This servo is fixed to 20000.						
	06h	Calc and copy time	ns	0 - 4294967295	U32	RO	No	ALL
		Elapsed time from SM2 Event, SYNC0 Event to PWM signal generation. This servo is fixed to 100000.						
	08h	Get cycle time	ns	0 - 4294967295	U32	RO	No	ALL
	09h	Delay time	ns	0 - 4294967295	U32	RO	No	ALL
		From PWM signal to power transistor output time, this servo is fixed to 0.						
	0Ah	Sync0 cycle time	ns	0 - 4294967295	U32	RO	No	ALL
		The value of ESC register 09A0h is set when DC SYNC0 (1C32h-01h = 02h). It is set to 0 when other than DC SYNC0.						
	0Bh	Cycletime too small	--	0 - 65535	U16	RO	No	ALL
		Not supported						
	0Ch	SM-event missed	--	0 - 65535	U16	RO	No	ALL
		Not supported						
	0Dh	Shifttime too small	--	0 - 65535	U16	RO	No	ALL
		Not supported						
	0Eh	RxPDO toggle fail	--	0 - 65535	U16	RO	No	ALL
		Not supported						
	20h	Sync error		0 - 1	bool	RO	No	ALL
		Not supported						

Note: this table only provides reference value, not to ensure content.

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
1C33h	--	SM3 synchronization	--	--	--	--	--	--
	00h	Numer of entries	--	0 - 255	U8	RW	No	ALL
		Represents the number of objects allocated to this object.						
	01h	Sync mode	--	0 – 65535	U16	RW	No	ALL

Set the synchronous mode for SM2.

00h:FreeRun(not synchronized)	01h: not supported
02h:DCSYNC0(synchronized with sync0)	22h: SM2((synchronized with SM2)

According to the combination of the settings of ESC register 0981h (DC-Activation) (table below), the set value of this object is automatically set when switching from PreOP to SafeOP.

ESC register 0981h Setting state	1C33h-01h setting value		The value of 1C33h-01h changed when the PreOP->SafeOP is switched.
DC effective ON	00h: FreeRun	->	02h: DC SYNC0
	22h: SM2		02h: DC SYNC0
	02h: DC SYNC0		02h: DC SYNC0

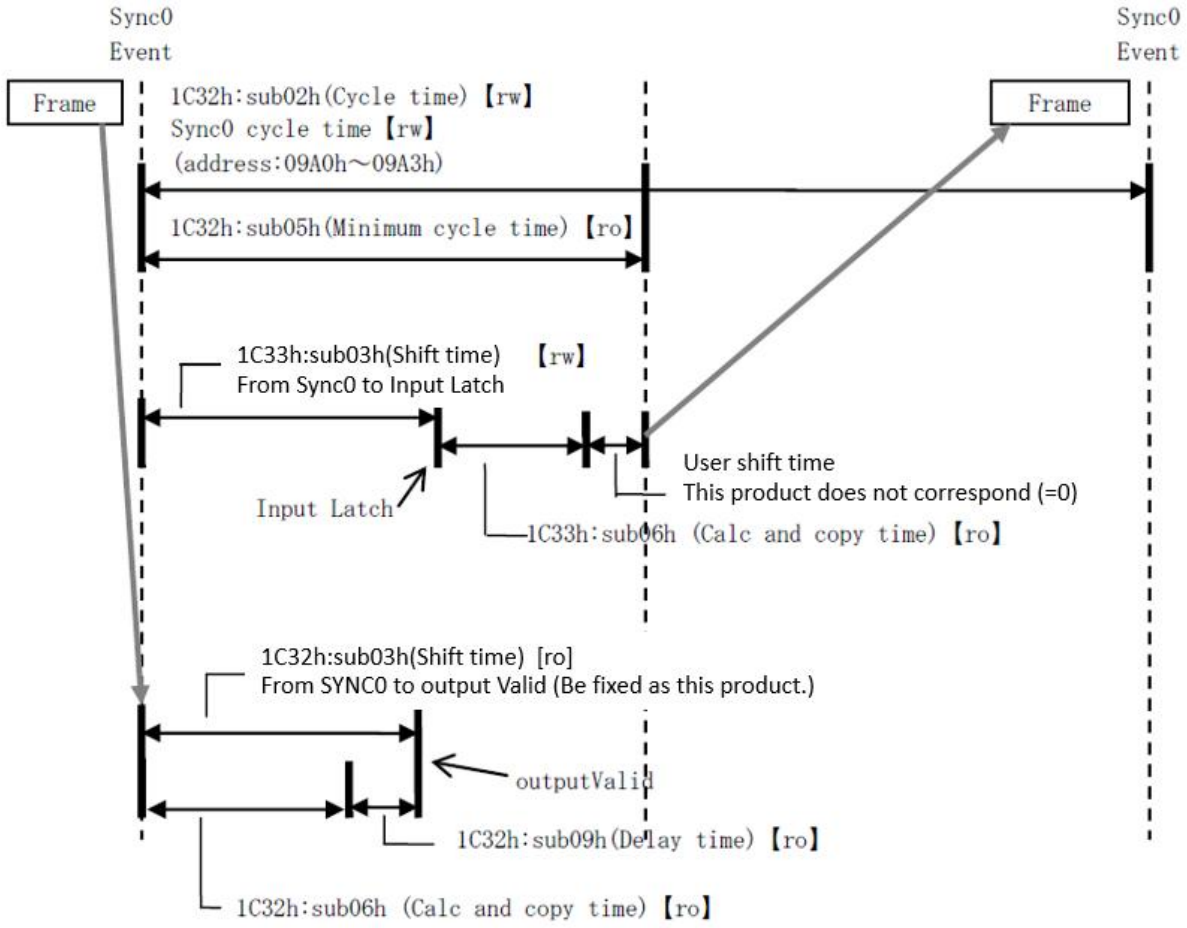
		DC effective OFF	00h: FreeRun		00h: FreeRun			
			22h: SM2		22h: SM2			
			02h: DC SYNC0		00h: FreeRun			
	02h	Cycle time	ns	0 - 4294967295	U32	RO	No	ALL
		Set the period of the SM. The same value as 1C32h-02h is set.						
	03h	Shift time	ns	0 - 4294967295	U32	RW	No	ALL
		Set the time to write the RxPDO value from the Sync0 and Sync0 events to the ESC from the station CPU. Usually set to 0.						
	04h	Sync modes support	--	0 - 65535	U16	RO	No	ALL
		Set the supported synchronization type BIT0：FreeRun mode support 0: not supported 1: support this servo drive is set to 1 BIT1：SM synchronous mode support 0: not supported 1: support this servo drive is set to 1. BIT4-2：DC synchronous mode supports this servo drive to be set to 011b. 000b：not supported 001b：DC sync0 Event support 010b：DC sync1 Event support 011b：DC sync0/sync1 Event support BIT6-5：output offset supports this servo drive to be set to 00b. 00b： not supported 01b： local time offset support. BI15-7：Reserved						
	05h	Min cycle time	ns	0 - 4294967295	U32	RO	No	ALL
		From SM2 Event, SYNC0 Event to ESC reading, write the minimum value. This servo is fixed to 20000.						
	06h	Calc and copy time	ns	0 - 4294967295	U32	RO	No	ALL
		Elapsed time from SM2 Event, SYNC0 Event to PWM signal generation. This servo is fixed to 100000.						
	08h	Get cycle time	ns	0 - 4294967295	U32	RO	No	ALL
	09h	Delay time	ns	0 - 4294967295	U32	RO	No	ALL
		From PWM signal to power transistor output time, this servo is fixed to 0.						
	0Ah	Sync0 cycle time	ns	0 - 4294967295	U32	RO	No	ALL
		The value of ESC register 09A0h is set when DC SYNC0 (1C32h-01h = 02h). It is set to 0 when other than DC SYNC0.						
	0Bh	Cycletime too small	--	0 - 65535	U16	RO	No	ALL
		Not supported						
	0Ch	SM-event missed	--	0 - 65535	U16	RO	No	ALL
		Not supported						
	0Dh	Shifttime too small	--	0 - 65535	U16	RO	No	ALL
		Not supported						
	0Eh	RxPDO toggle fail	--	0 - 65535	U16	RO	No	ALL
		Not supported						
	20h	Sync error		0 - 1	bool	RO	No	ALL
		Not supported						

Note: this table only provides reference value, not to ensure content.

5.5.1 DC (SYNC0 Event synchronization)

Synchronization method	feature
Based on the time of the first axis Synchronize time information from other slaves	High precision It is necessary to compensate at the main station side.

The specifications of DC synchronous mode in this servo driver are as follows:



SM2/3 setting in DC sync mode:

Index	Sub-Index	Access	Name	Value
1C32h	00h	RO	Numer of entries	20h
	01h	RW	Sync mode	02h
	02h	RW	Cycle time	100us: 100000 200us: 200000 500us: 500000 1ms: 1000000 2ms: 2000000 4ms: 4000000
	03h	RO	Shift time	Not supported
	04h	RO	Sync modes supported	00100b
	05h	RO	Min cycle time	17000
	06h	RO	Calc and copy time	100000
	09h	RO	Delay time	0
	0Ah	RO	Sync0 cycle time	The value of ESC register 09A0h
	0Bh	RO	Cycle time too small	Not supported
	0Ch	RO	SM-event missed	Not supported
	0Dh	RO	Shift time too short	Not supported
	20h	RO	Sync error	Not supported

Note: this table only provides reference value, not to ensure content.

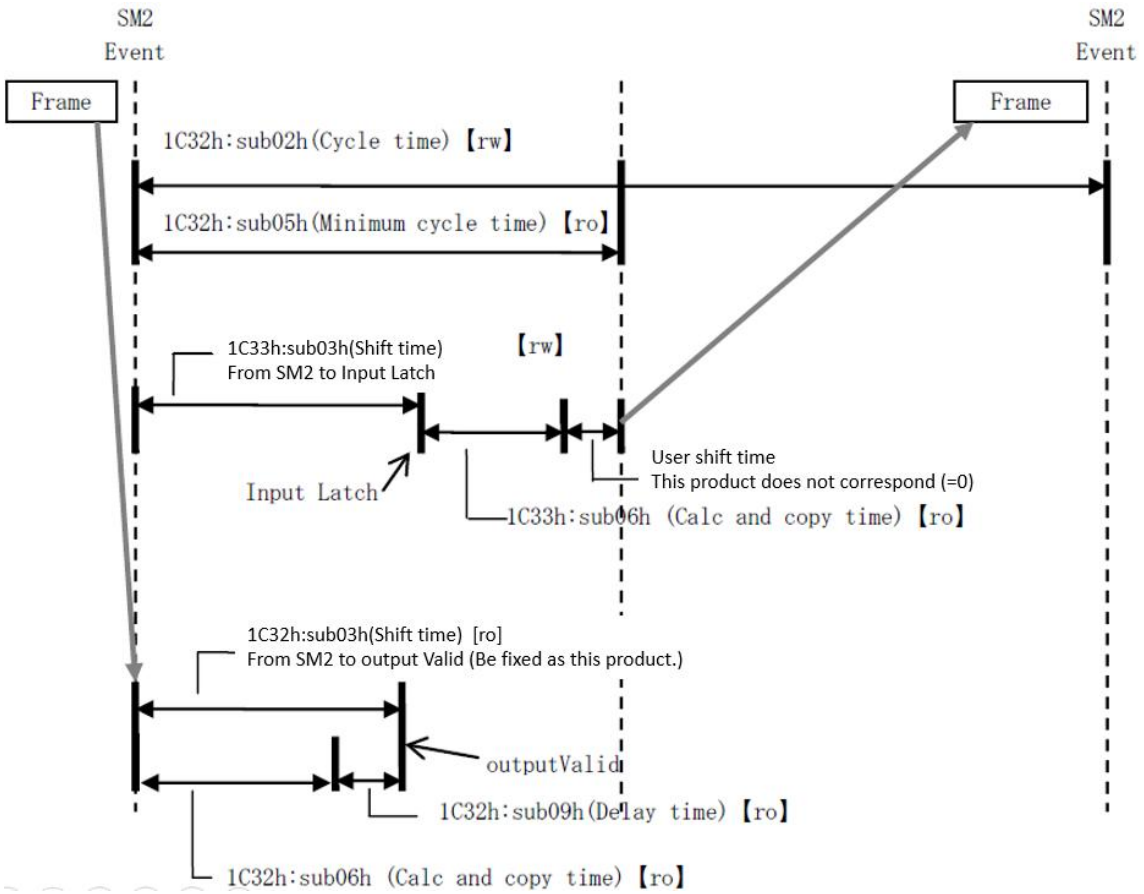
Index	Sub-Index	Access	Name	Value
1C33h	00h	RO	Numer of entries	The same setting as 1C32h: 00h.
	01h	RW	Sync mode	02h
	02h	RW	Cycle time	The same setting as 1C32h: 02h.
	03h	RO	Shift time	0
	04h	RO	Sync modes supported	bit4-2: DC synchronous type supported 001b：DC SYNC0 Event supported bit6-5: Input offset supported 00b：not supported
	05h	RO	Min cycle time	The same setting as 1C32h: 05h.
	06h	RO	Calc and copy time	100000
	09h	RO	Delay time	The same setting as 1C32h: 09h.
	0Ah	RO	Sync0 cycle time	The same setting as 1C32h: 0Ah.
	0Bh	RO	Cycle time too small	Not supported
	0Ch	RO	SM-event missed	Not supported
	0Dh	RO	Shift time too short	Not supported
	20h	RO	Sync error	Not supported

Note: this table only provides reference value, not to ensure content.

5.5.2 SM2(SM2 Event synchronization)

Synchronization method	feature
Synchronize with RxPDO's incoming time	No transmission delay compensation, poor precision The transfer time must be ensured on the upper side (dedicated hardware, etc.).

The specifications of SM2 mode in this servo driver are as follows:



SM2/3 setting in SM2 sync mode:

Index	Sub-Index	Access	Name	Value
1C32h	00h	RO	Numer of entries	20h
	01h	RW	Sync mode	01h
	02h	RW	Cycle time	100us: 100000 200us: 200000 500us: 500000 1ms: 1000000 2ms: 2000000 4ms: 4000000
	03h	RO	Shift time	Not supported
	04h	RO	Sync modes supported	00010b
	05h	RO	Min cycle time	17000
	06h	RO	Calc and copy time	100000
	09h	RO	Delay time	0
	0Ah	RO	Sync0 cycle time	The value of ESC register 09A0h
	0Bh	RO	Cycle time too small	Not supported
	0Ch	RO	SM-event missed	Not supported
	0Dh	RO	Shift time too short	Not supported
	20h	RO	Sync error	Not supported

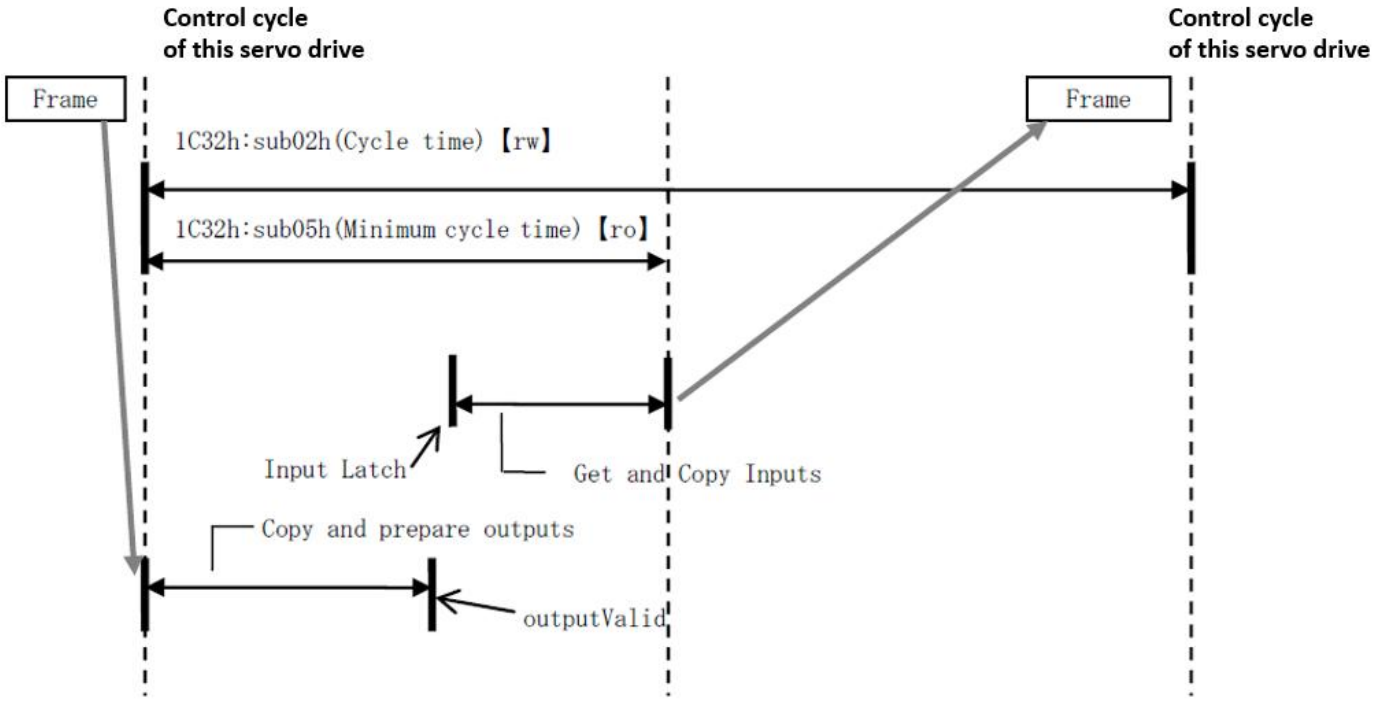
Index	Sub-Index	Access	Name	Value
1C33h	00h	RO	Numer of entries	The same setting as 1C32h: 00h.
	01h	RW	Sync mode	22h
	02h	RW	Cycle time	The same setting as 1C32h: 02h.
	03h	RO	Shift time	0
	04h	RO	Sync modes supported	The same setting as 1C32h: 04h.
	05h	RO	Min cycle time	The same setting as 1C32h: 05h.
	06h	RO	Calc and copy time	100000
	09h	RO	Delay time	The same setting as 1C32h: 09h.
	0Ah	RO	Sync0 cycle time	The same setting as 1C32h: 0Ah.
	0Bh	RO	Cycle time too small	Not supported
	0Ch	RO	SM-event missed	Not supported
	0Dh	RO	Shift time too short	Not supported
	20h	RO	Sync error	Not supported

Note: this table only provides reference value, not to ensure content.

5.5.3 Free Run(nonsynchronous)

Synchronization method	feature
Nonsynchronous	Simple processing Lack of real time

The specifications of FreeRun mode in this servo driver are as follows:



SM2/3 setting in FreeRun mode:

Index	Sub-Index	Access	Name	Value
1C32h	00h	RO	Numer of entries	20h
	01h	RW	Sync mode	00h
	02h	RW	Cycle time	100us: 100000 200us: 200000 500us: 500000 1ms: 1000000 2ms: 2000000 4ms: 4000000
	03h	RO	Shift time	Not supported
	04h	RO	Sync modes supported	00001b
	05h	RO	Min cycle time	17000
	06h	RO	Calc and copy time	Not supported
	09h	RO	Delay time	0
	0Ah	RO	Sync0 cycle time	Not supported
	0Bh	RO	Cycle time too small	Not supported
	0Ch	RO	SM-event missed	Not supported
	0Dh	RO	Shift time too short	Not supported
	20h	RO	Sync error	Not supported

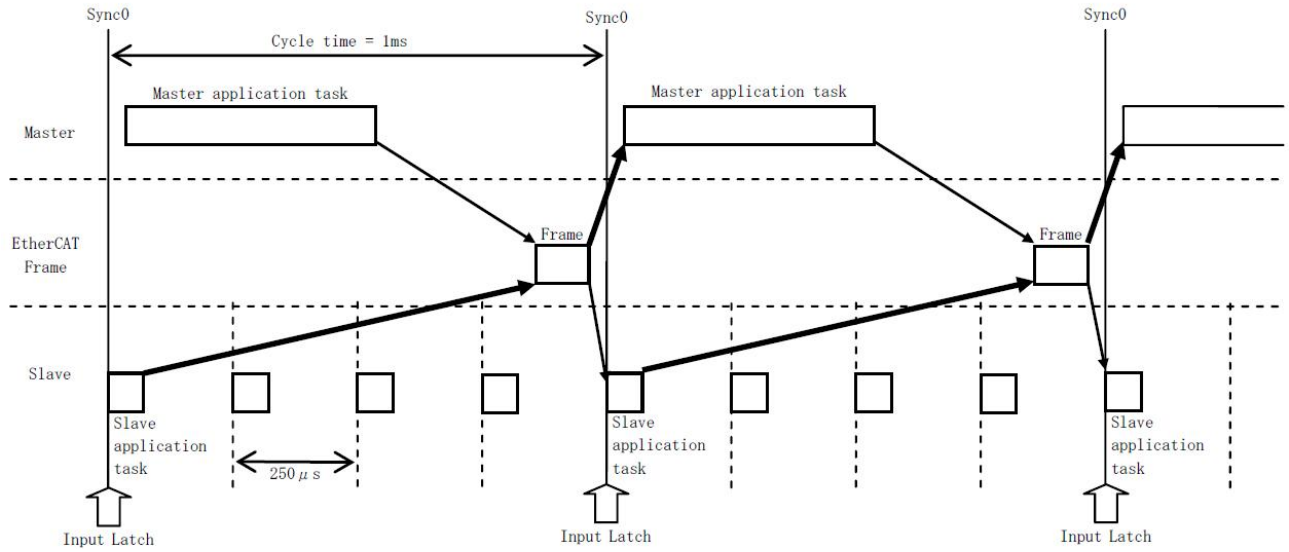
Index	Sub-Index	Access	Name	Value
1C33h	00h	RO	Numer of entries	The same setting as 1C32h: 00h.
	01h	RW	Sync mode	00h
	02h	RW	Cycle time	The same setting as 1C32h: 02h.
	03h	RO	Shift time	Not supported
	04h	RO	Sync modes supported	The same setting as 1C32h: 04h.
	05h	RO	Min cycle time	The same setting as 1C32h: 05h.
	06h	RO	Calc and copy time	The same setting as 1C32h: 06h.
	09h	RO	Delay time	The same setting as 1C32h: 09h.
	0Ah	RO	Sync0 cycle time	The same setting as 1C32h: 0Ah.
	0Bh	RO	Cycle time too small	Not supported
	0Ch	RO	SM-event missed	Not supported
	0Dh	RO	Shift time too short	Not supported
	20h	RO	Sync error	Not supported

Note: this table only provides reference value, not to ensure content.

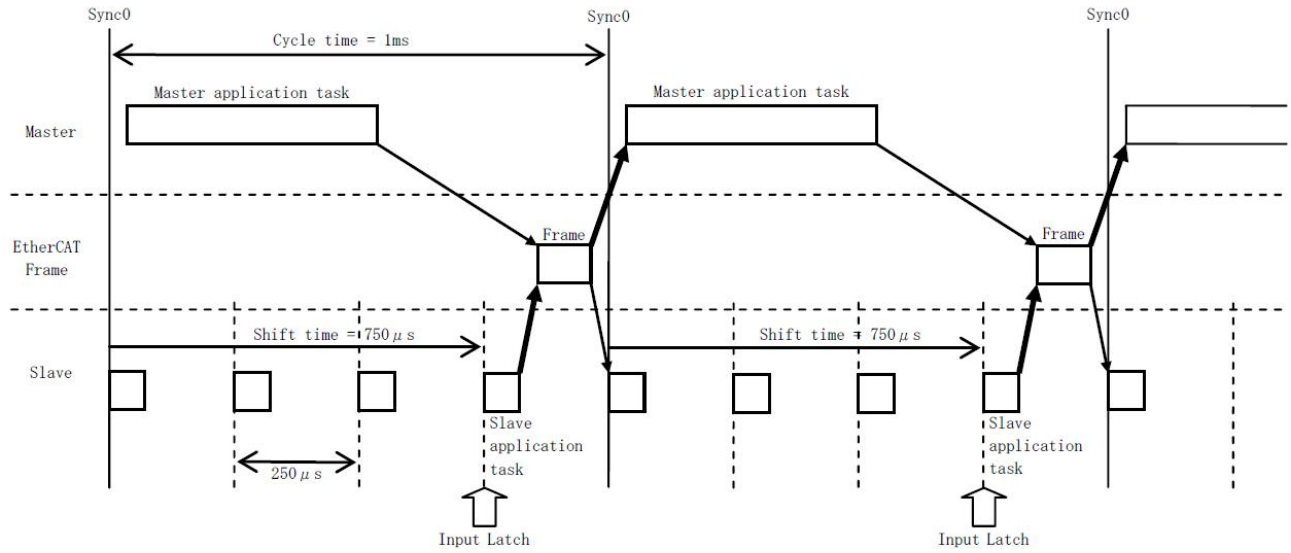
5.5.4 Input shift time

In order to provide the master station with the latest slave information, it corresponds to Input shift time. Setting 1C33h-03h to adjust the time of the Input Latch can be set as much as possible before the TxPDO frame is sent. Especially when the communication period (Cycle time) becomes longer, it is more effective.

〈DC Cycle Time = 1ms、Input shift time = 0μs〉



〈DC Cycle Time = 1ms、Input shift time = 750μs〉

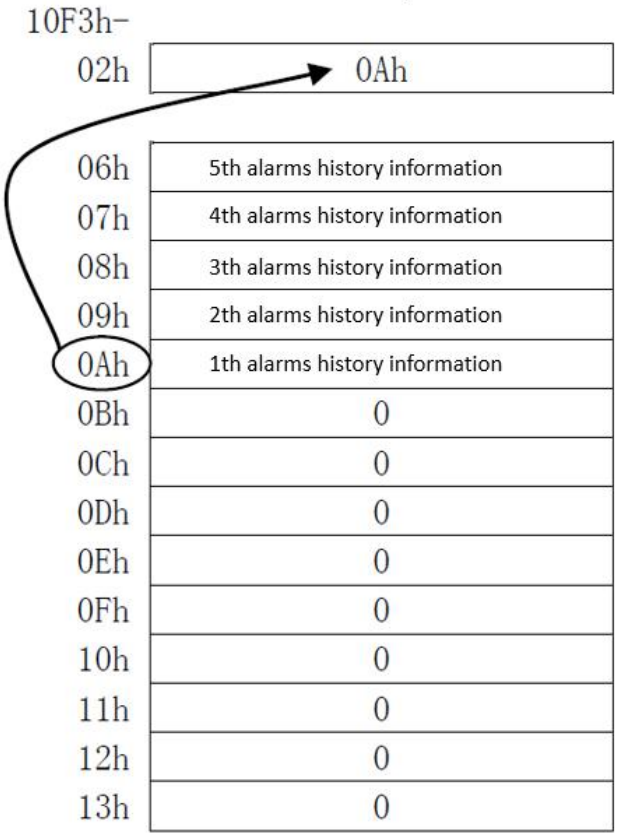


5.6 Diagnosis history (Alarm resume reading function 10F3h)

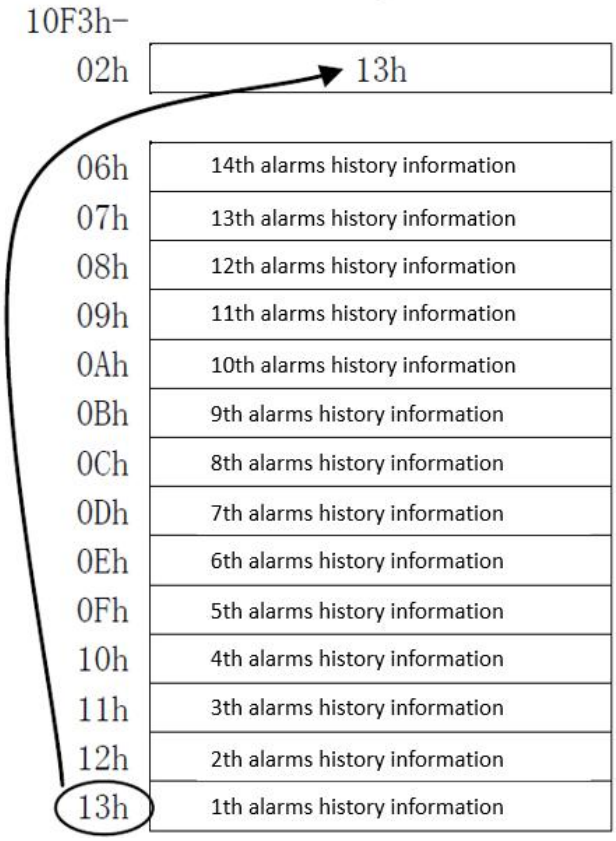
We use object 10F3h (Diagnosis History) to read 14 alarm records.

The alarm record can be placed in the order of the most recent 14 alerts in order of 10F3h-06h (Diagnosis message 1) to 10F3h-13h (Diagnosis message 14). The latest alarm is placed in the Subindex confirmed by 10F3h-02h (Newest message).

<5 alarms history situation>



<14 alarms history situation>



Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
10F3h	--	Diagnosis history	--	--	--	--	--	--
		Execute alarm record read, as well as the Emergency message effective set is invalid.						
	00h	Numer of entries	--	0 - 255	U8	RO	No	ALL
		The number of objects assigned to this object is fixed at 13H.						
	01h	Max message	--	0 – 255	U8	RO	No	ALL
		This servo drive stores the maximum number of alarm information, which is fixed to 0Eh(14 times).						
	02h	Newest message	--	0 – 255	U8	RO	No	ALL
		Represents the Subindex of the latest alarm information store. When the alarm record is cleared, it is 0.						
	03h	Newest acknowledge message	--	0 – 255	U8	RW	No	ALL
		When reading: Return 0. At the time of writing: The set value 00h means to clear all Diagnosis messages,other values return SDO abort.						
	04h	New messages available	--	0 - 1	bool	RO	No	ALL
		Not supported, fixed to 0.						

	05h	Flags	--	0 - 65535	U16	The following table	No	ALL

Bit 0	RW	0: Emergency message invalid 1: Emergency message effective
Bit4-1	R	Not supported, fixed to 0011b
Bit5	R	1: The clearance of the alarm record (10f3h-03h =0 write) is completed.
Bit15-6		Reserved

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
10F3h	06h	Diagnosis message 1	--	--	OS	RO	No	ALL

Said alarm record

eg	00	E8	10	FF	02	00	00	00	00	00	00	00	00	00	00	0
use	(L) (H) (fixed)		(L) (H) Error code		(L) (H) (fixed)		(L) (H) Text ID		(L) (fixed)							(H)
	Diag code				Flags		Text ID		Time stamp							

Diag code Identifying information diagnostic code, Error code is the return object 603F set value.

Flags Fixed at 0002h

Text ID The alarm code returns the defined Text ID. High 8-bit main alarm number, low 8-bit auxiliary alarm number.

Time stamp The time when the exception occurred.

:	:						
13h	Diagnosis message 14	--	--	OS	RO	No	ALL
	Said alarm record，Content is the same as Subindex06h.						

6、Drive Profile Range(6000h-6FFFh)

6.1 Overview

Index	Sub Index	Name
6007	00	Abort connection option code
603F	00	error_code
6040	00	Contro lword
6041	00	Status word
605A	00	quick_stop_option_code
605B	00	shutdown_option_code
605C	00	disable_operation_option_code
605D	00	stop_option_code

Index	Sub Index	Name
608F	--	position_encoder_revolution
	00	number_of_entries
	01	encoder_increments
	02	motor_ revolutions
6091	--	gear_ratio
	00	number_of_entries
	01	motor_ revolutions
	02	shaft_ revolutions

605E	00	fault_reaction_option_code
6060	00	modes_of_operation
6061	00	modes_of_operation_display
6062	00	position_demand_value
6063	00	position_actual_value*
6064	00	position_actual_value
6065	00	following_error_window
6066	00	following_error_time_out
6067	00	position_window
6068	00	position_window_time
6069	00	speed_sensor_actual_value
606B	00	speed_demand_value
606C	00	speed_actual_value
606D	00	speed_window
606E	00	speed_window_time
606F	00	speed_threshold
6070	00	speed_threshold_time
607A	00	target_position
607B	--	position_range_limit
	00	number_of_entries
	01	min_position_range_limit
	02	max_position_range_limit
607C	00	home_offset
6081	00	profile_speed
6082	00	end_speed
6083	00	profile_acceleration
6084	00	profile_deceleration
6085	00	quick_stop_deceleration
6086	00	motion_profile_type
6087	00	torque_slope
6088	00	torque _profile_type
6092	--	feed_constant
	00	number_of_entries
	01	feed
	02	shaft_ revolutions
6098	00	homing_method
6099	--	homing_speeds
	00	number_of_entries
	01	speed_during_search_for_switch
	02	speed_during_search_for_zero
609A	00	homing_acceleration
60B1	00	speed_offset
60B2	00	torque_offset
60B8	00	touch_probe_function
60B9	00	touch_probe_status
60BA	00	touch_probe_pos1_pos_value
60BB	00	touch_probe_pos1_neg_value
60BC	00	touch_probe_pos2_pos_value
60BD	00	touch_probe_pos2_neg_value
60C0	00	interpolation_sub_mode_select
60C1	--	interpolation_data_record
	00	number_of_entries
	01	X1
60C2	--	interpolation_time_period
	00	number_of_entries
	01	interpolation_time_units
	02	interpolatio_time_index
60C5	00	max_acceleration
60C6	00	max_deceleration

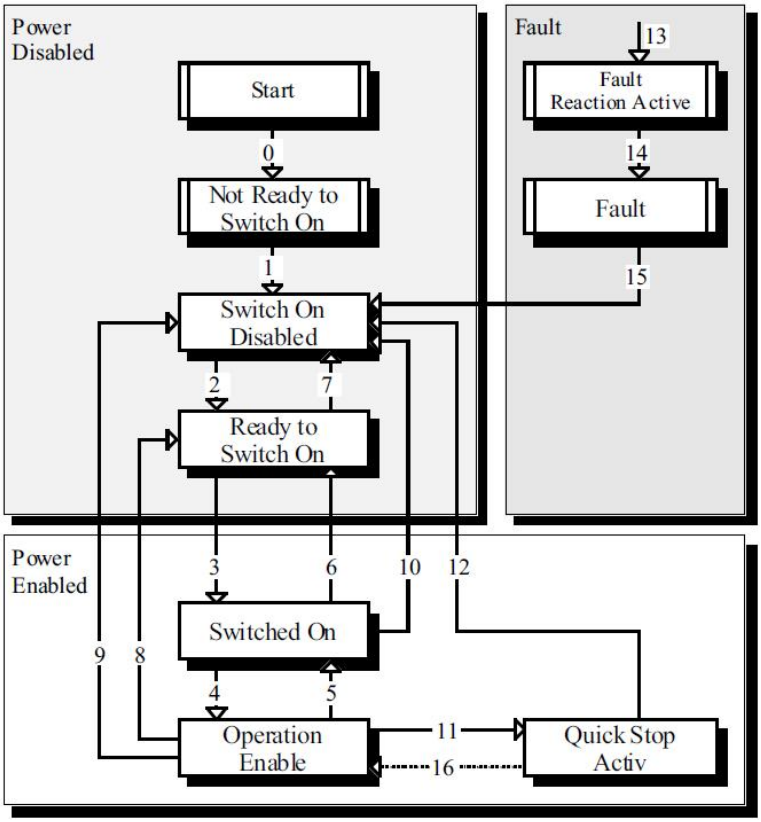
Index	Sub Index	Name
60E3	--	supported_homing_method
	00	number_of_entries
	01	1st supported_homing_method
	..	
	20	32nd supported_homing_method
60F4	00	following_error_actual_value
60FA	00	control_effort
60FC	00	position_demand_value*
60FD	00	digital_inputs
60FE	--	digital_ouputs
	00	number_of_entries
	01	physical_ouputs
	02	bit_mask
60FF	00	target_speed
6502	00	supported_drive_modes
6504	00	drive_manufacturer
6505	00	drive_catalog_address

PS：In double shaft set，b axis profile address need to shift 0x800。

6.2 PDS Specification(Control state machine)

6.2.1 Equipment control state state machine

Master station through controlword to control the drive， through read drive's statusword to learn the drive current status 。



As shown above，state machine could be divided into three parts："Power Disabled""Power Enabled"and"Fault"。All state after the alarm turn into"Fault"。And after power on, the drive initialized，and turn into SWITCH_ON_DISABLED state。On the condition， could be communicated with， and could seeting the drive （e.g， set the drive's operating mode to"PP"mode）。At this point，the power remains disabled，and motor is under-excitaiton。After through state transmit2、3、4， enter OPERATION ENABLE。 At this point， the power enabled， drive control the motor in line with the configuration operating mode。In consequence, verify the drive parameter configurated in right way and relevant input value as 0 before this condition。State transmit 9 complete the power disabled 。Once the drive alarm，the drive state enter FAULT。

6.3 Control word (6040h)

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
6040h	00h	controlword		0 - 65535	U16	rw	RxPDO	ALL

Setting PDS(control state machine)state transition and servo drive command instruction

Bit specification：

15	14	13	12	11	10	9	8	7		6	5	4	3	2	1	
r						oms	h	fr		oms			eo	qs	ev	

r	reserved	eo	enable operation
oms	operation mode specific	qs	quick stop
h	halt	ev	enable voltage
fr	fault reset	so	switch on

Bit0 ~ 3 and Bit7：

State machine transmission with the 5 bit formed the relevant command instruction trigger.

Command	Bit of the *controlword*					Transitions
	Fault reset	Enable operation	Quick stop	Enable voltage	Switch on	
Shutdown	0	X	1	1	0	2,6,8
Switch on	0	0	1	1	1	3*
Switch on	0	1	1	1	1	3**
Disable voltage	0	X	X	0	X	7,9,10,12
Quick stop	0	X	0	1	X	7,10,11
Disable operation	0	0	1	1	1	5
Enable operation	0	1	1	1	1	4,16
Fault reset	↑	X	X	X	X	15

PS: In the table the bit could be neglect with “X”;

Bit4、5、6、9：

The 4 bits in different modes, different definition。

opm	bit9	bit6	bit5	Bit4
pp	change on set_point	abs/rel	change set immediatly	new set point
pv	Reserved	Reserved	Reserved	Reserved
tq	Reserved	Reserved	Reserved	Reserved
hm	Reserved	Reserved	Reserved	start homeing
ip	Reserved	Reserved	Reserved	enable ip mode
csp	Reserved	Reserved	Reserved	Reserved
csv	Reserved	Reserved	Reserved	Reserved
cst	Reserved	Reserved	Reserved	Reserved

Other bit：all is reserved bit。

6.4 Status word (6041h)

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
6041h	00h	statusword		0 - 65535	U16	ro	TxPDO	ALL

Indicate servo drive state。

Bit specification：

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
r		oms		ila	oms	rm	r	w	sod	qs	ve	f	oe	se	rso

r	reserved	qs	quick stop
oms	operation mode specific	ve	voltage enable
ila	internal limit active	f	fault
rm	remote	oe	operation enabled
w	warning	se	switched on
sod	switch on disabled	rso	ready to switch on

Bit0 ~ 3 、Bit5 和 Bit6：

These bits group indicate drive in the PDS state。

State word	PDS state	
xxxx xxxx x0xx 0000 b	Not ready to switch on	Initialization incomplete state
xxxx xxxx x1xx 0000 b	Switch on disabled	Initialization complete state
xxxx xxxx x01x 0001 b	Ready to switch on	Main power OFF state
xxxx xxxx x01x 0011 b	Switched on	Servo on enabled OFF/servo in ready state
xxxx xxxx x01x 0111 b	Operation enabled	Servo on enabled ON
xxxx xxxx x00x 0111 b	Quick stop active	Stop
xxxx xxxx x0xx 1111 b	Fault reaction active	Error judgement
xxxx xxxx x0xx 1000 b	Fault	Error state

Bit4： Voltage enabled

When the bit display 1，indicate power enabled。

Bit5： Quick stop

when the bit display 0，indicate the drive stop according to the setting（605A **h**：quick_stop_option_code）。

Bit7： Warning

When the bit display 1,indicate the drive detect alarm。

Bit10、12、13：

These three bits in different control mode, different implicatin.

opm	bit13	Bit12	Bit10
pp	following error	set-point acknowledge	target reached
pv	max slippage error	speed	target reached
tq	Reserved	Reserved	target reached
hm	homing error	homing attained	target reached
ip	Reserved	Reserved	target reached
csp	Reserved	Reserved	Reserved
csv	Reserved	Reserved	Reserved
cst	Reserved	Reserved	Reserved

Bit11： Internal limit active

When the bit display 1，indicate inner torque exceed set value。

Other bit：

All is reserved bit。

6.5 control mode setting

6.5.1 Supported drive modes (6502h)

The supported drive modes could be confirmed on 6502h(Modes of operation)。

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
6502h	00h	supported drive modes	--	0 - 4294967295	U32	ro	TxPDO	ALL

Supported drive modes 0 nonsupport 1 support 。

Bit indication：

31-16	15-10	9	8	7	6	5	4	3	2	1	0
ms	r	cst	csv	csp	ip	hm	r	tq	pv	vl	pp
0	0	1	1	1	1	1	0	1	1	0	1

ms Manufacturer specific r reserved

6.5.2 Modes of operation (6060h)

Drive modes setting by 6060h to proceed。

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
6060h	00h	modes of operation	--	-128 - 127	U8	rw	RxPDO	ALL

Drive modes setting:0 nonsupport，1 support

Bit indication：

value	0	1	3	4	6	7	8	9	10	Other value
abbr	Nop	pp	pv	tq	hm	ip	csp	csv	cst	nonsupport

6.5.3 Modes of operation display (6061h)

Drive inner modes confirmed by 6061h to proceed

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
6061h	00h	modes of operation display	--	-128 - 127	U8	ro	TxPDO	ALL

Drive modes setting,0 nonsupport，1 support。

Bit indication：

value	0	1	3	4	6	7	8	9	10	Other vakue
abbr	nop	pp	pv	tq	hm	ip	csp	csv	cst	nonsupport

6.6 Position control functions (csp/ip/pp/hm)

6.6.1 Position controlgeneral functions

1）postion frame

(TBD)

2）associated objects(instruction)

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode			
								pp	csp	ip	hm
6040h	00h	Controlword	--	0 - 65535	U16	rw	RPDO	Y	Y	Y	Y
6072h	00h	max torque	0.1%	0 - 65535	U16	rw	RPDO	Y	Y	Y	Y
607Ah	00h	target position	Instruction unit	-2147483648 – 2147483647	I32	rw	RPDO	Y	Y	-	-
607Dh	--	soft position limit	--	--	--	--	--	Y	Y	Y	-
	00h	number_of_entries	--	2	U8	ro	No				
	01h	min position limit	Instruction unit	-2147483648 – 2147483647	I32	rw	RPDO				
	02h	max position limit	Instruction unit	-2147483648 – 2147483647	I32	rw	RPDO				
607Fh	00h	max profile speed	Instruction unit	0 - 4294967295	U32	rw	RPDO	Y	-	Y	Y
6080h	00h	max motor speed	rpm	0 - 4294967295	U32	rw	RPDO	Y	Y	Y	Y
6081h	00h	profile speed	Instruction unit	0 - 4294967295	U32	rw	RPDO	Y	-	-	-
6082h	00h	end speed	Instruction unit	0 - 4294967295	U32	rw	RPDO	Y	-	-	-
6083h	00h	profile acceleration	Instruction unit	0 - 4294967295	U32	rw	RPDO	Y	-	-	-
6084h	00h	profile deceleration	Instruction unit /s^2	0 - 4294967295	U32	rw	RPDO	Y	-	-	-
60B1h	00h	speed offset	Instruction unit /s	-2147483648 – 2147483647	I32	rw	RPDO	Y	Y	Y	Y
60B2h	00h	torque offset	0.1%	-32768 – 32767	I16	rw	RPDO	Y	Y	Y	Y
60C5h	00h	max acceleration	Instruction unit /s^2	0 - 4294967295	U32	rw	RPDO	Y	-	-	-
60C6h	00h	max deceleration	Instruction unit /s^2	0 - 4294967295	U32	rw	RPDO	Y	-	-	-

3）associated objects(monitor)

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode			
								pp	csp	ip	hm
6041h	00h	statusword	--	0 - 65535	U16	ro	TPDO	Y	Y	Y	Y
6062h	00h	position demand value	Instruction unit	-2147483648 – 2147483647	I32	ro	TPDO	Y	Y	Y	Y
6063h	00h	position actual internal value	pulse	-2147483648 – 2147483647	I32	ro	TPDO	Y	Y	Y	Y
6064h	00h	position actual value	Instruction unit	-2147483648 – 2147483647	I32	ro	TPDO	Y	Y	Y	Y
6065h	00h	following error window	Instruction unit	0 - 4294967295	U32	rw	RPDO	Y	Y	-	-
6066h	00h	following error time out	1ms	0 - 65535	U16	rw	RPDO	Y	Y	-	-
6067h	00h	position window	Instruction unit	0 - 4294967295	U32	rw	RPDO	Y	Y	-	-
6068h	00h	position window time	1ms	0 - 65535	U16	rw	RPDO	Y	Y	-	-
6069h	00h	speed sensor actual value	--	-2147483648 – 2147483647	I32	ro	TPDO	Y	Y	Y	Y
606Ch	00h	speed actual value	Instruction unit /s	-2147483648 – 2147483647	I32	ro	TPDO	Y	Y	Y	Y
6074h	00h	torque demand	0.1%	-32768 – 32767	I16	ro	TPDO	Y	Y	Y	Y
6076h	00h	motor rate torque	mN.m	0 - 4294967295	U32	ro	TPDO	Y	Y	Y	Y
6077h	00h	Torque actual value	0.1%	-32768 – 32767	I16	ro	TPDO	Y	Y	Y	Y
60F4h	00h	following error actual value	Instruction unit	-2147483648 – 2147483647	I32	ro	TPDO	Y	Y	Y	Y
60FAh	00h	control effort	Instruction unit /s	-2147483648 – 2147483647	I32	ro	TPDO	Y	Y	Y	Y
60FCh	00h	position demand internal value	pulse	-2147483648 – 2147483647	I32	ro	TPDO	Y	Y	Y	Y

6.6.2 Position control mode (PP)

Specified object position、object speed and speed-up and speed down，drive position instruction generated modes

1）PP position mode associated object (instruction)

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
6040h	00h	controlword	--	0 - 65535	U16	rw	RPDO	
60F2h	00h	positioning option code	0.1%	0 - 32767	U16	rw	RPDO	

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
6040h	00h	controlword	--	0 - 65535	U16	rw	RPDO	

Setting drive other to PDS(control state machine)state transfer

Bit indication：

15…10	9	8	7	6	5	4	3	2	1	0

r	oms	h	fr	oms			eo	qs	ev	so
	change on set-point			absolute/ relative	change set immediately	new set-point				

r	reserved	eo	enable operation
oms	operation mode specific	qs	quick stop
h	halt	ev	enable voltage
fr	fault reset	so	switch on

bit9，6-4(oms)：

bit	Name	Value	Specific
4	new set-point	0 -> 1	Positioning enable，setting value update trigger。
5	change set immediately	0	Current positioning finished，proceed to next positioning。
		1	Interrupt current positioning， promptly proceed to next positioning。
6	absolute/relative	0	target position(607Ah)as absolute position to process
		1	target position(607Ah)as relative position to process
9	change on set-point		Nonsupport

2）PP position modes associated object(monitor)

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
6041h	00h	statusword	--	0 - 65535	U16	ro	TPDO	

Drive state。

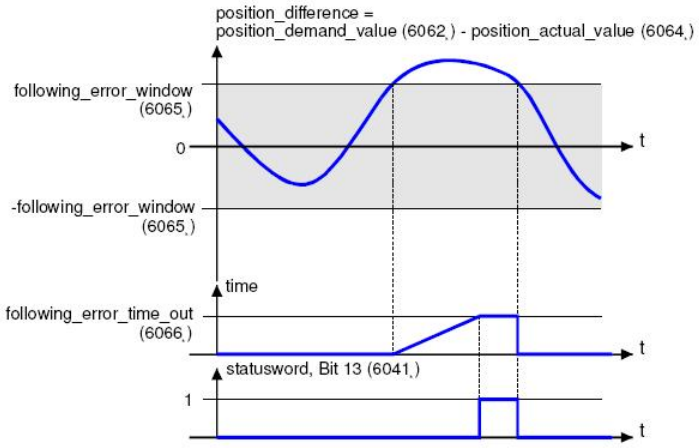
Bit indication：

15-14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
r	oms		ila	oms	rm	r	w	sod	qs	ve	f	oe	se	rso
	following error	set-point acknowledge		target reached										

r	reserved	qs	quick stop
oms	operation mode specific	ve	voltage enable
ila	internal limit active	f	fault
rm	remote	oe	operation enabled
w	warning	se	switched on
sod	switch on disabled	rso	ready to switch on

bit13-12，10(oms)：

bit	Name	Value	Specific
10	target reached	0	halt=0：positioning unfinished；halt=1：shaft decelerating；
		1	halt=0：positioning finished；halt=1：shaft stopped；
12	set-point acknowledge	0	The data buffer used to positioning is empty.
		1	The data buffer used to positioning is full.
13	following error		Refer to the illustration below



Following error –features

Other position control in common associated object，refer to 6-6-1。

3）PP positioning modes

* move 1（basic set-point）

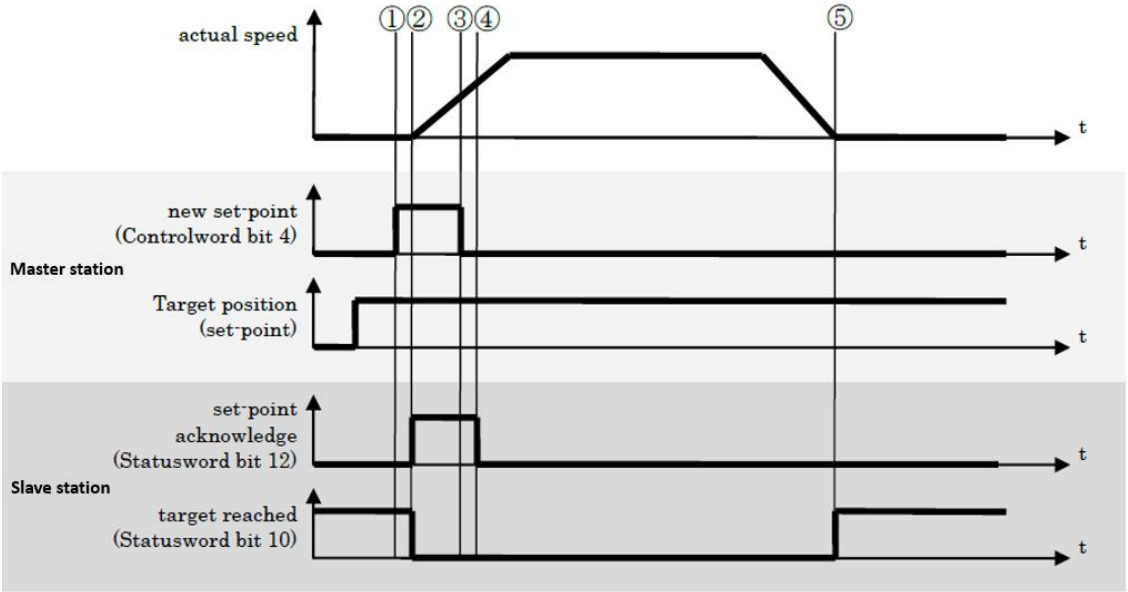
①master station setting target position(607Ah), make controlword(6040h)bit4(new set-point)from 0 to 1。

②slave station controlword(6040h)bit4(new set-point)rising adge， target position(607Ah)as target position begin to position。At this point change statusword (6041h)的 bit12(set-point acknowledge)from 0 to 1。

③ After master station confirm statusword (6041h) 的 bit12(set-point acknowledge)rising edge ,set controlword(6040h)bit4(new set-point) to 0。

④controlword(6040h)bit4(new set-point)as 0，statusword (6041h)的 bit12(set-point acknowledge)as 0。

⑤When slave station reached tarfet position，make statusword (6041h)的 bit10(target reached)as 1。



*move 2（no buffering move data modification：single set-point）

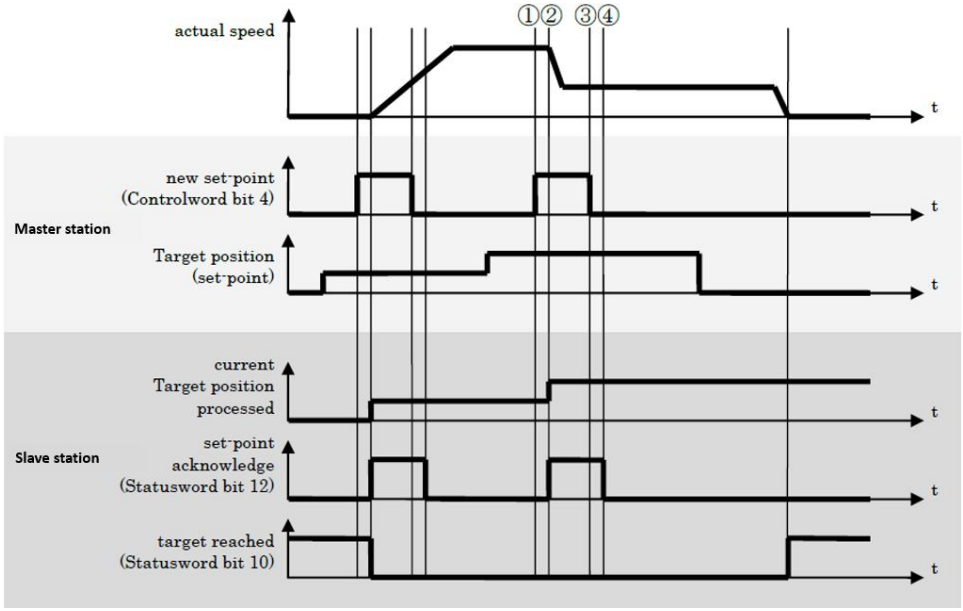
Master station controlword(6040h)bit5(change set immediately)as 1， modified positioning data ， slave station will interrupt current positioning move，proceed to next positioning move。

① master station confirm statusword (6041h)bit12(set-point acknowledge)as 0 ， after setting new target position(607Ah)or profile speed(6081h)，make controlword(6040h)bit4(new set-point)from 0 to 1。

②slave station confirm controlword(6040h)bit4(new set-point)rising edge， target position(607Ah)as target position update promptly。At this point change statusword (6041h)bit12(set-point acknowledge)from 0 to 1。

③ After master station confirm statusword (6041h)bit12(set-point acknowledge)rising edge ， set controlword(6040h)bit4(new set-point) to 0。

④controlword(6040h)bit4(new set-point)as 0，statusword (6041h)bit12(set-point acknowledge)as 0。



* move 3（data modification in buffering moves：set of set-point）

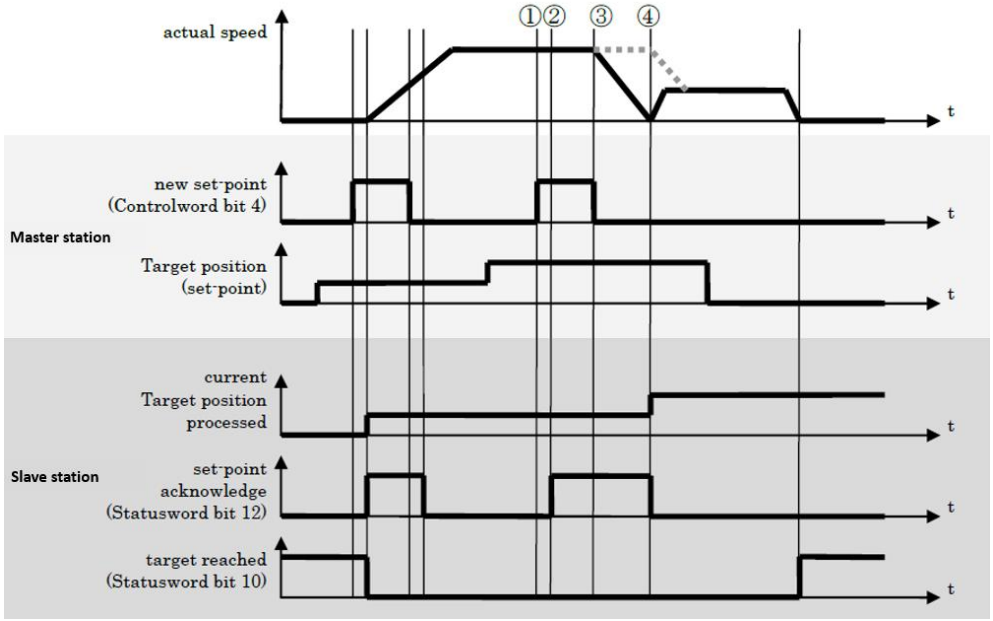
Master station controlword(6040h)bit5(change set immediately)as o，modified positioning data, slave station start to next positioning move before finished current positioning move。

① master station confirm statusword (6041h)bit12(set-point acknowledge)as 0， after setting new target position(607Ah) or profile speed(6081h)，make controlword(6040h)bit4(new set-point)from 0 to 1。

②slave station confirm controlword(6040h)bit4(new set-point)rising edge ， target position(607Ah)as new target position to buffer。At this point statusword (6041h)bit12(set-point acknowledge)from 0 to 1。

③ After master station confirm statusword (6041h)bit12(set-point acknowledge)rising edge ， setting controlword(6040h)bit4(new set-point) as 0。

④slave station confirm controlword(6040h)bit4(new set-point)as 0，and confirm the running positioning move finished ，after use new target position start to positioning ，make statusword (6041h)bit12(set-point acknowledge)as 0。



6.6.3 Cyclic position control mode(CSP)

1）CSP position mode associated object(instruction)

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
6040h	00h	controlword	--	0 - 65535	U16	rw	RPDO	
60B0h	00h	positioning offset	Instruction unit	-2147483648 – 2147483647	I32	rw	RPDO	

Other position mode relative associated object，refer to6-6-1。

Other move relative associated object，refer to 6-9。

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
6040h	00h	controlword	--	0 - 65535	U16	rw	RPDO	

Setting drive control other to PDS(control state machine)state transfer。

Bit instruction：

15…10	9	8	7	6	5	4	3	2	1	0
r	oms	h	fr	oms			eo	qs	ev	So
	r			r	r	r				

r	reserved	eo	enable operation
oms	operation mode specific	qs	quick stop
h	halt	ev	enable voltage
fr	fault reset	so	switch on

2）PP position mode associated object(monitor)

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
6041h	00h	statusword	--	0 - 65535	U16	ro	TPDO	

Other position control relative associated object，refer to6-6-1。

Other move relative associated object，refer to 6-9。

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
6041h	00h	statusword	--	0 - 65535	U16	ro	TPDO	

Drive state。

Bit indication：

15-14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
r	oms		ila	oms	rm	r	w	sod	qs	ve	f	oe	se	rso
	following error	drive follows command value		r										

r	reserved	qs	quick stop
oms	operation mode specific	ve	voltage enable
ila	internal limit active	f	fault
rm	remote	oe	operation enabled
w	warning	se	switched on
sod	switch on disabled	rso	ready to switch on

bit13-12，10(oms)：

bit	Name	Value	Specific
10	r		unused
12	drive follows command value	0	The move will be not performed by target position
		1	The move will be performed by target position
13	following error		Refer to 6-6-2

3）CSP position mode move

At the mod,the motion will running through master station instead of slave station。

Target position is equal to target position(607Ah)and position offset(60B0h)，as absolute position 。

interpolation time period(60C2h)， indicate to update the period of target position(607Ah)and position offset(60B0h).The value to be set as same period with cycle time(1C32h-02h)

6.6.4 Interpolation position control mode (IP)

(TBD)

6.6.5 Origin reset control mode (HM)

The method to reset origin，fixed move speed，at inner drive to generate the position order perform origin reset mode.

1）hm mode associated object(order)

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
6040h	00h	Controlword	--	0 - 65535	U16	rw	RPDO	
6098h	00h	homing method	--	-128 – 127	I8	rw	RPDO	
6099h	--	homing speeds	--	--	--	--	--	
	00h	number of entries	--	2	U8	ro	No	
	01h	switch speed	Instruction unit/S	0 - 4294967295	U32	rw	RPDO	
	02h	zero speed	Instruction unit/S	0 - 4294967295	U32	rw	RPDO	
609Ah	00h	homing acceleration	Instruction unit/S^2	0 - 4294967295	U32	rw	RPDO	

Other position relative associated object，refer to6-6-1。

Other move relative associated object，refer to 6-9。

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
6040h	00h	Controlword	--	0 - 65535	U16	rw	RPDO	

Setting drive other to PDS(control state machine)state transfer。

Bit indication：

15…10	9	8	7	6	5	4	3	2	1	0
r	oms	h	fr	oms			eo	qs	ev	so
	R			r	r	start home				

r	reserved	eo	enable operation
oms	operation mode specific	qs	quick stop
h	halt	ev	enable voltage
fr	fault reset	so	switch on

bit9，6-4(oms)：

bit	Name	Value	Specific
4	start home	0 -> 1	Start origin reset
5	r	--	unused
6	r	--	unused
9	r	--	unused

2）hm mode associated object(monitor)

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
6041h	00h	statusword	--	0 - 65535	U16	ro	TPDO	

Other position control relative associated object，refer to 6-6-1。

Other move relative associated object，refer to 6-9。

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
6041h	00h	statusword	--	0 - 65535	U16	ro	TPDO	

Drive state。

Bit indication：

15-14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
r	oms		ila	oms	rm	r	w	sod	qs	ve	f	oe	se	rso
	home error	home attained		target reached										

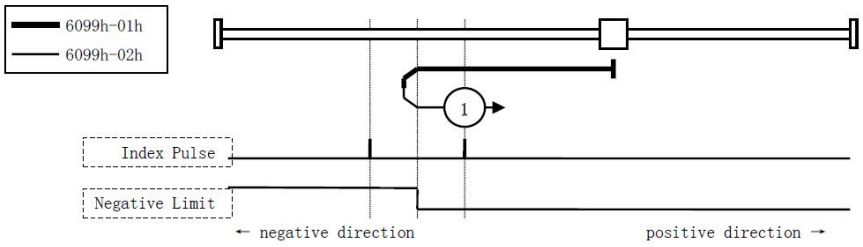
r	reserved	qs	quick stop
oms	operation mode specific	ve	voltage enable
ila	internal limit active	f	fault
rm	remote	oe	operation enabled
w	warning	se	switched on
sod	switch on disabled	rso	ready to switch on

bit13-12，10(oms)：

bit	Name	Value	Specific
10	target reached	0	In action
		1	Stop state
12	home attained	0	Origin reset move unfinished
		1	Origin reset move finished
13	home error	0	Origin reset normal
		1	Origin reset abnormal

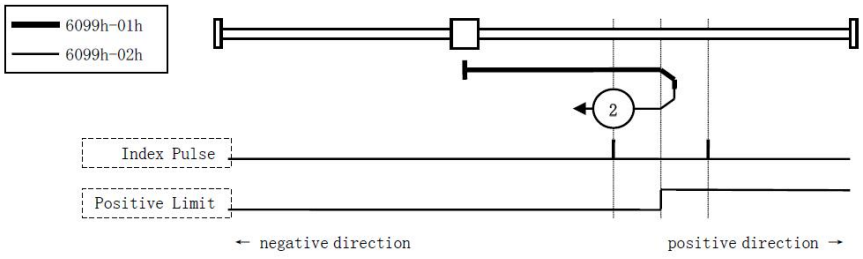
3）hm　move in different modes

Method 1:



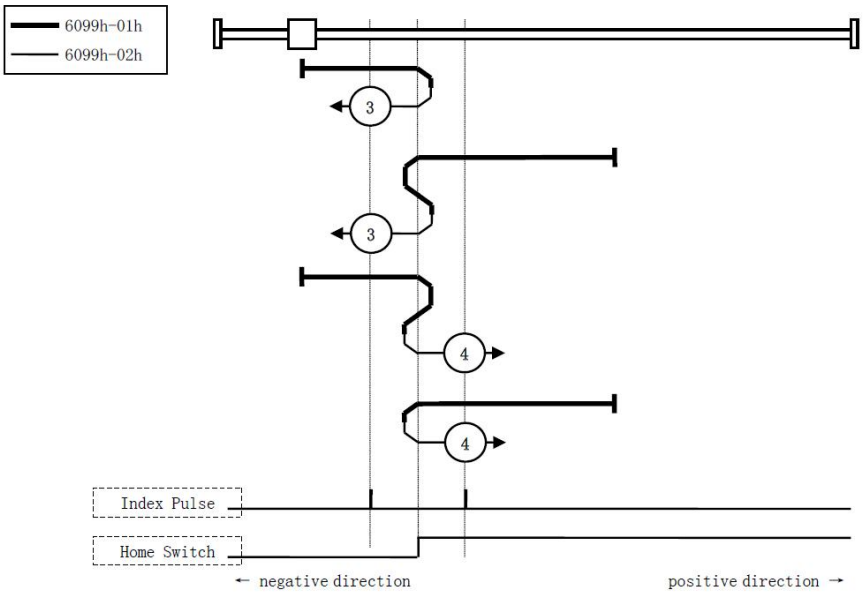
Homing on negative limit switch and index pulse

Method 2:



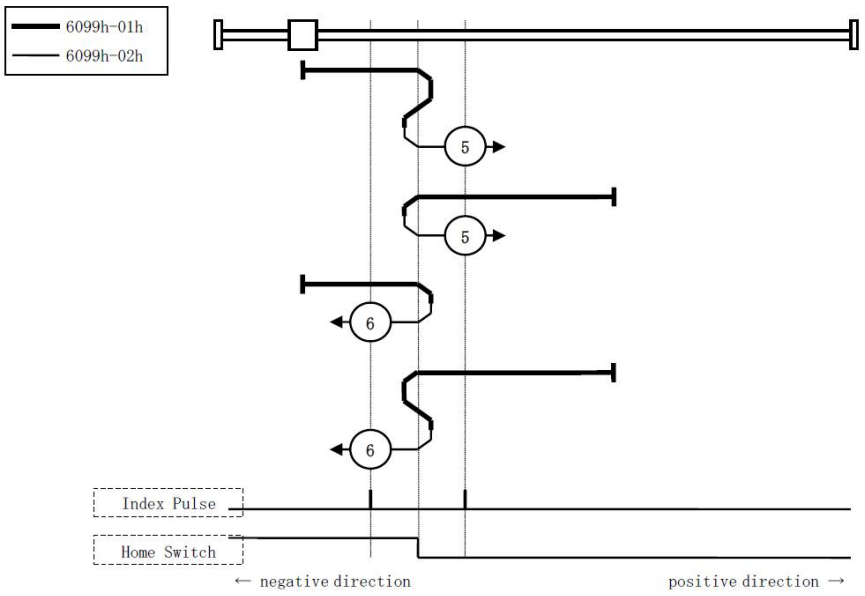
Homing on positive limit switch and index pulse

Method 3-4:



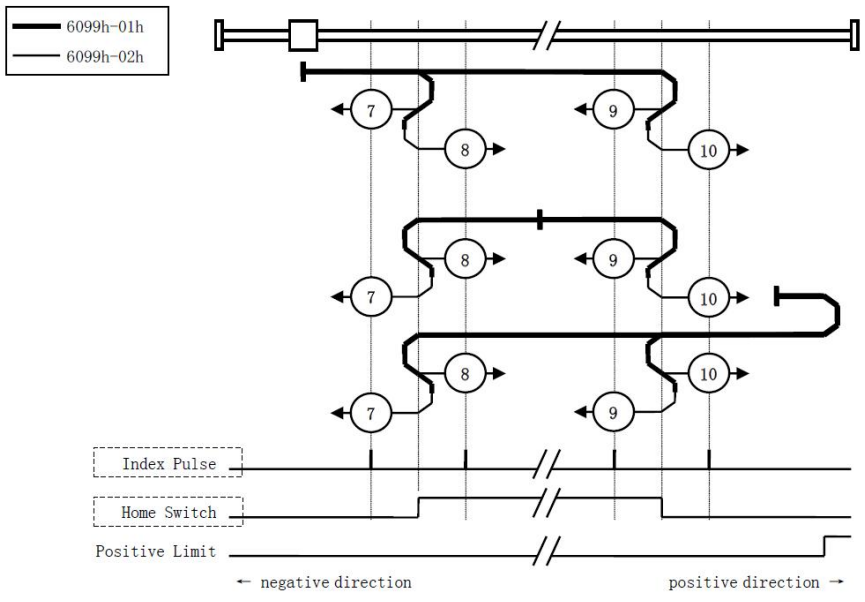
Homing on positive home switch and index pulse

Method 5-6:



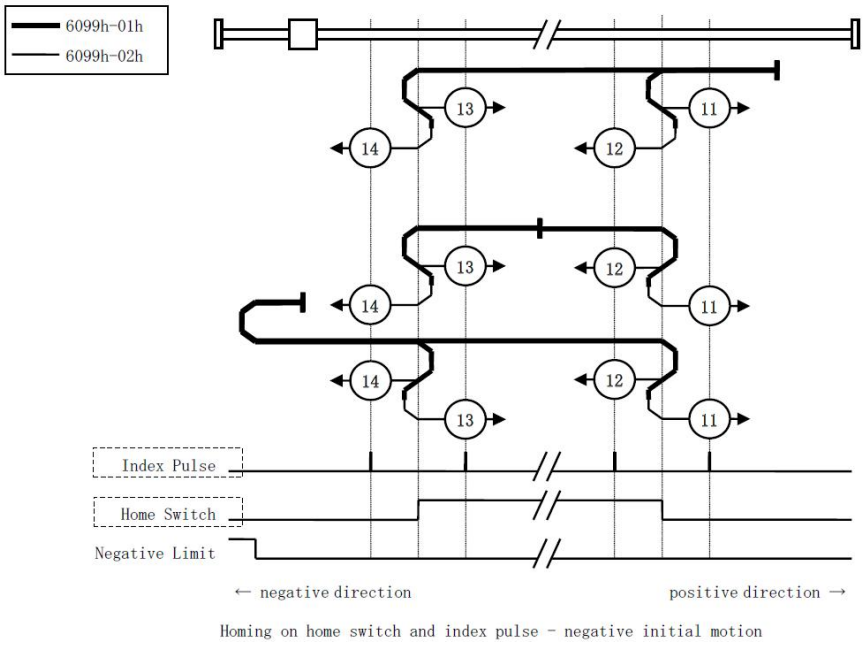
Homing on negative home switch and index pulse

Method 7-10:



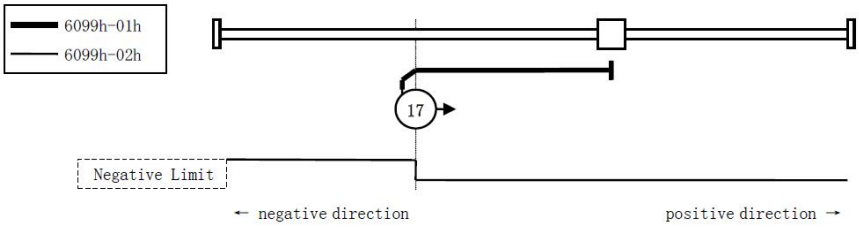
Homing on home switch and index pulse - positive initial motion

Method 11-14:



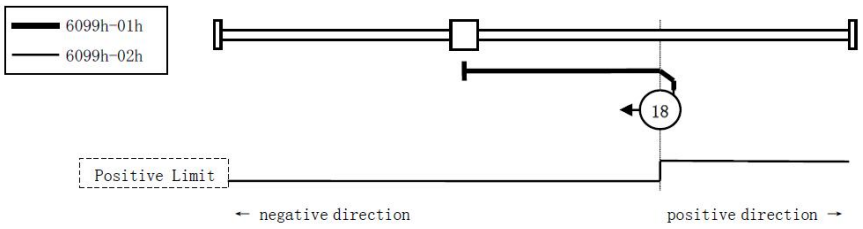
Homing on home switch and index pulse - negative initial motion

Method 17:



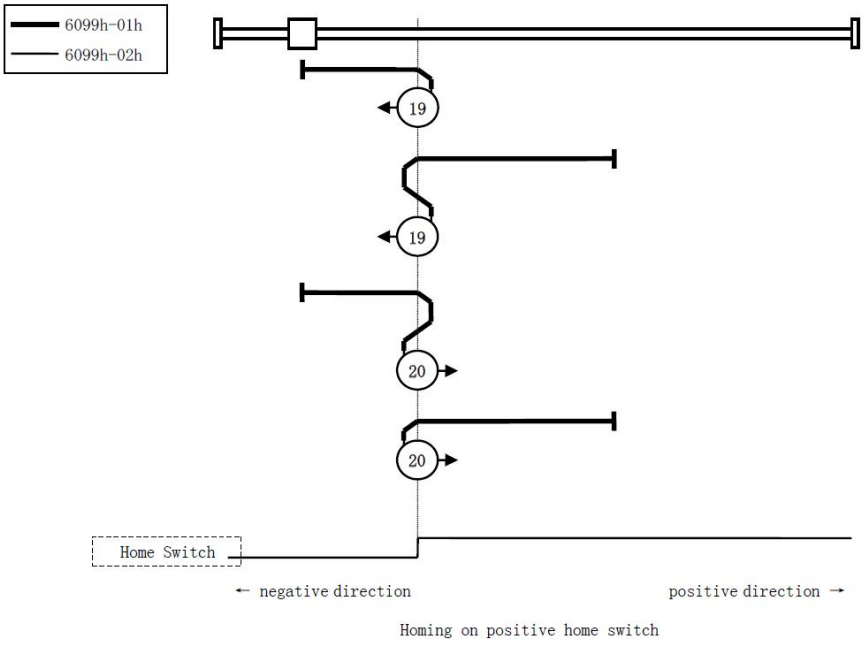
Homing on negative limit switch

Method 18:



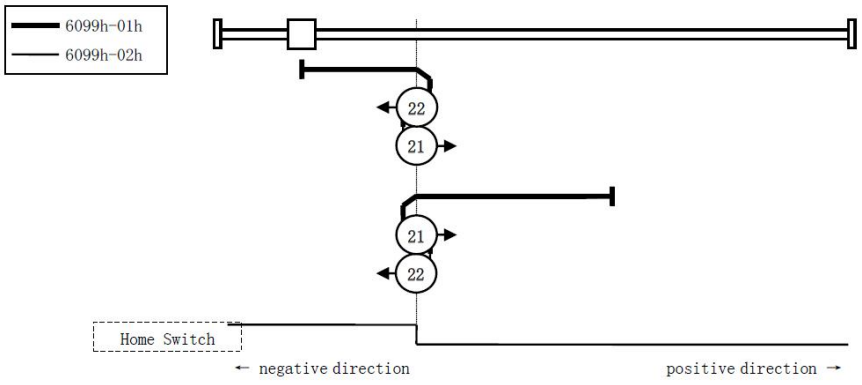
Homing on positive limit switch

Method 19-20:



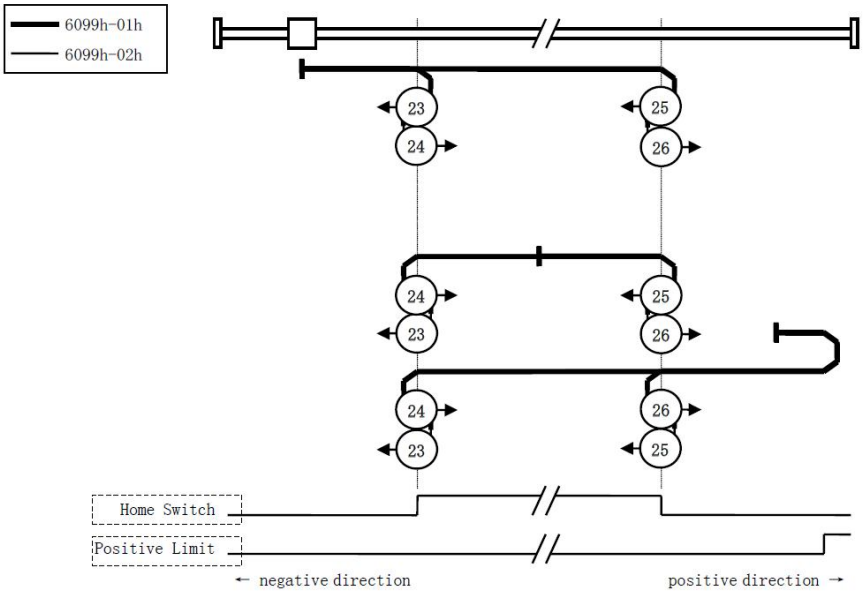
Homing on positive home switch

Method 21-22:



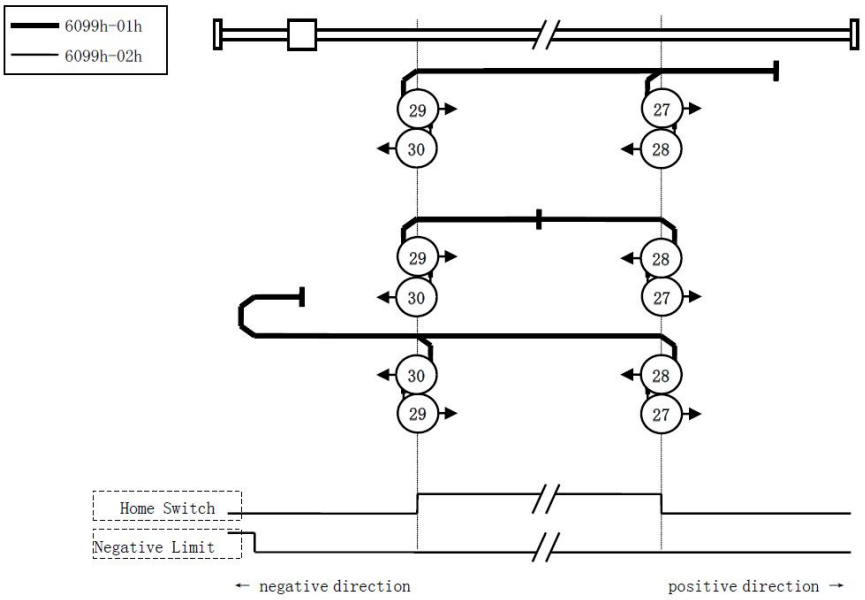
Homing on negative home switch and index pulse

Method 23-26:



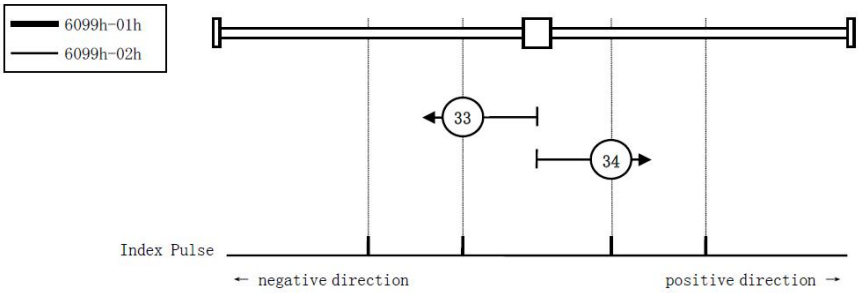
Homing on home switch and index pulse - positive initial motion

Method 27-30:



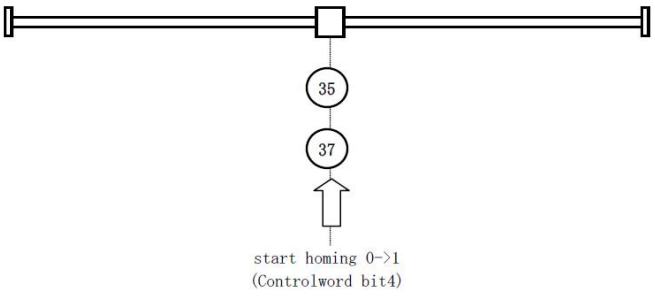
Homing on home switch and index pulse - negative initial motion

Method 33-34:



Homing on index pulse

Method 35:



6.7 Speed control function (csv/pv)

6.7.1 Speed control general function

1）Speed control block diagram

(TBD)

2）Associated objects (command)

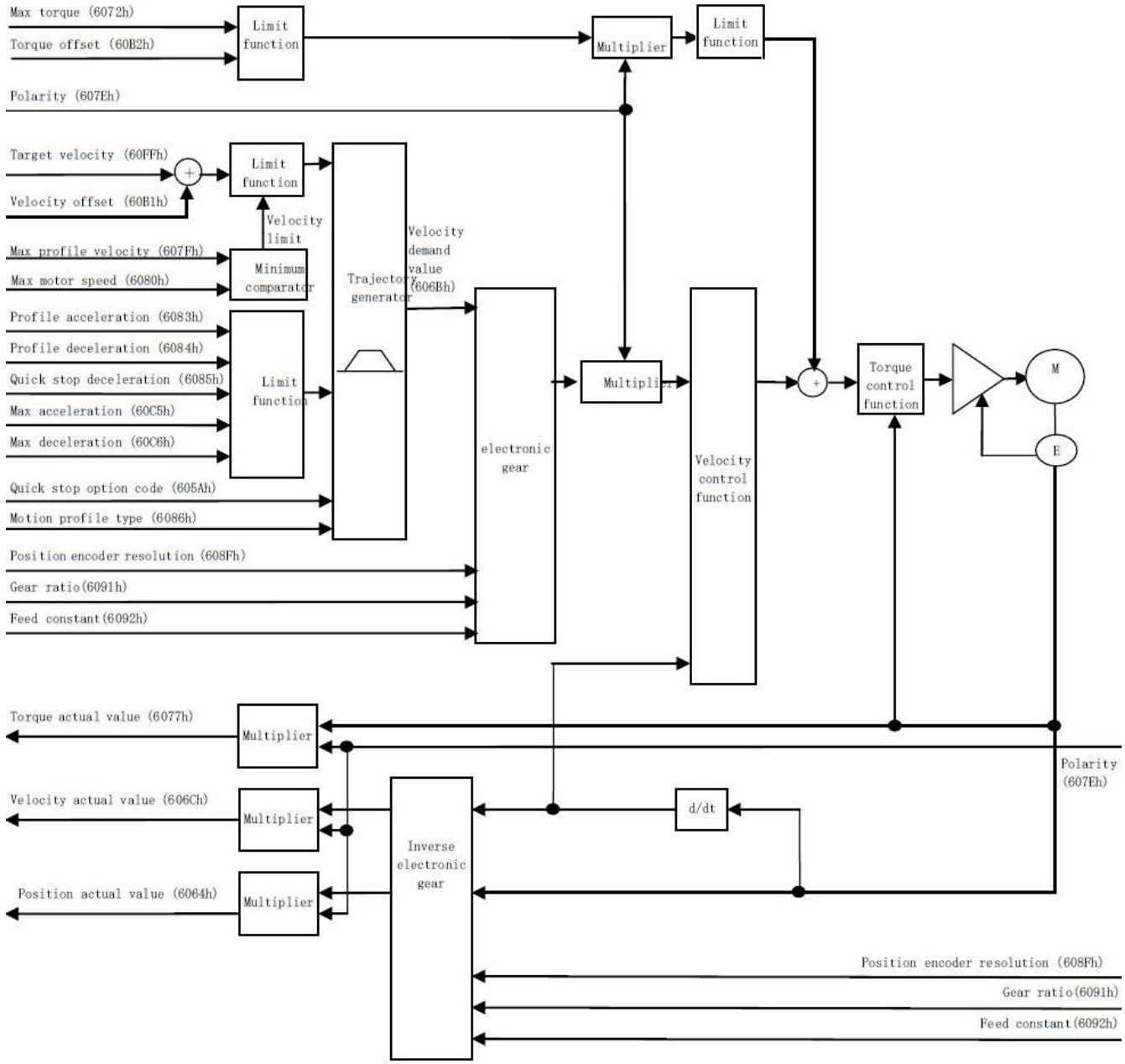
Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode			
								pv	csv		
6040h	00h	controlword	--	0 - 65535	U16	rw	RPDO	Y	Y		
6072h	00h	max torque	0.1%	0 - 65535	U16	rw	RPDO	Y	Y		
6080h	00h	max motor speed	rpm	0 - 4294967295	U32	rw	RPDO	Y	Y		
60B1h	00h	speed offset	Command Unit/s	-2147483648 – 2147483647	I32	rw	RPDO	Y	Y		
60B2h	00h	torque offset	0.1%	-32768 – 32767	I16	rw	RPDO	Y	Y		
60FFh	00h	target speed	Command Unit /s	-2147483648 – 2147483647	I32	rw	RPDO	Y	Y		

3）Associated objects (monitor)

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode			
								pv	csv		
6041h	00h	statusword	--	0 - 65535	U16	ro	TPDO	Y	Y		
6063h	00h	position actual internal value	pulse	-2147483648 – 2147483647	I32	ro	TPDO	Y	Y		
6064h	00h	position actual value	Command Unit	-2147483648 – 2147483647	I32	ro	TPDO	Y	Y		
6069h	00h	speed sensor actual value	--	-2147483648 – 2147483647	I32	ro	TPDO	Y	Y		
606Bh	00h	elocity demand value	Command Unit /s	-2147483648 – 2147483647	I32	ro	TPDO	Y	Y		
606Ch	00h	speed actual value	Command Unit /s	-2147483648 – 2147483647	I32	ro	TPDO	Y	Y		
6074h	00h	torque demand	0.1%	-32768 – 32767	I16	ro	TPDO	Y	Y		
6076h	00h	motor rate torque	mN.m	0 - 4294967295	U32	ro	TPDO	Y	Y		
6077h	00h	Torque actual value	0.1%	-32768 – 32767	I16	ro	TPDO	Y	Y		

6.7.2 Profile Speed control mode (pv)

Assign speed、Acceleration and deceleration, etcSpeed control mode that generates speed command action inside the servo driver.



Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
6040h	00h	controlword	--	0 - 65535	U16	rw	RPDO	

Set the control command for the servo driver of PDS (control state machine) state transition.

Bit Instructions：

15…10	9	8	7	6	5	4	3	2	1	0
r	oms	h	fr	oms			eo	qs	ev	so
	r			r	r	start home				

r	reserved	eo	enable operation
oms	operation mode specific	qs	quick stop
h	halt	ev	enable voltage
fr	fault reset	so	switch on

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
6041h	00h	statusword	--	0 - 65535	U16	ro	TPDO	

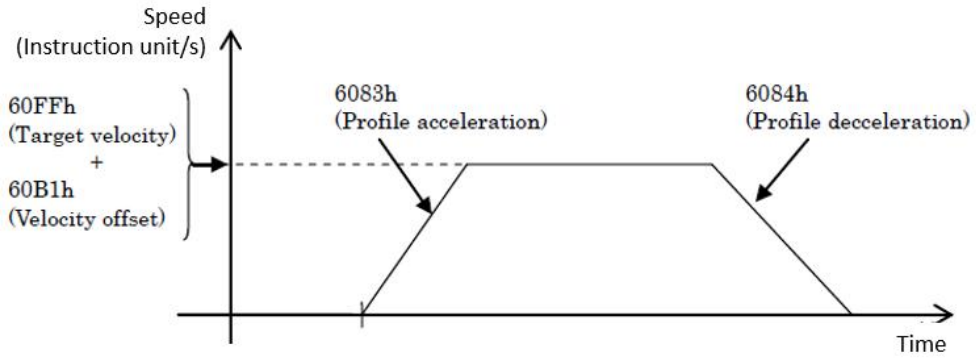
Indicates the status of the servo driver.

Bit Instructions：

15-14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
r	oms		ila	oms	rm	r	w	sod	qs	ve	f	oe	se	rso
	max slip-age error	speed		target reached										

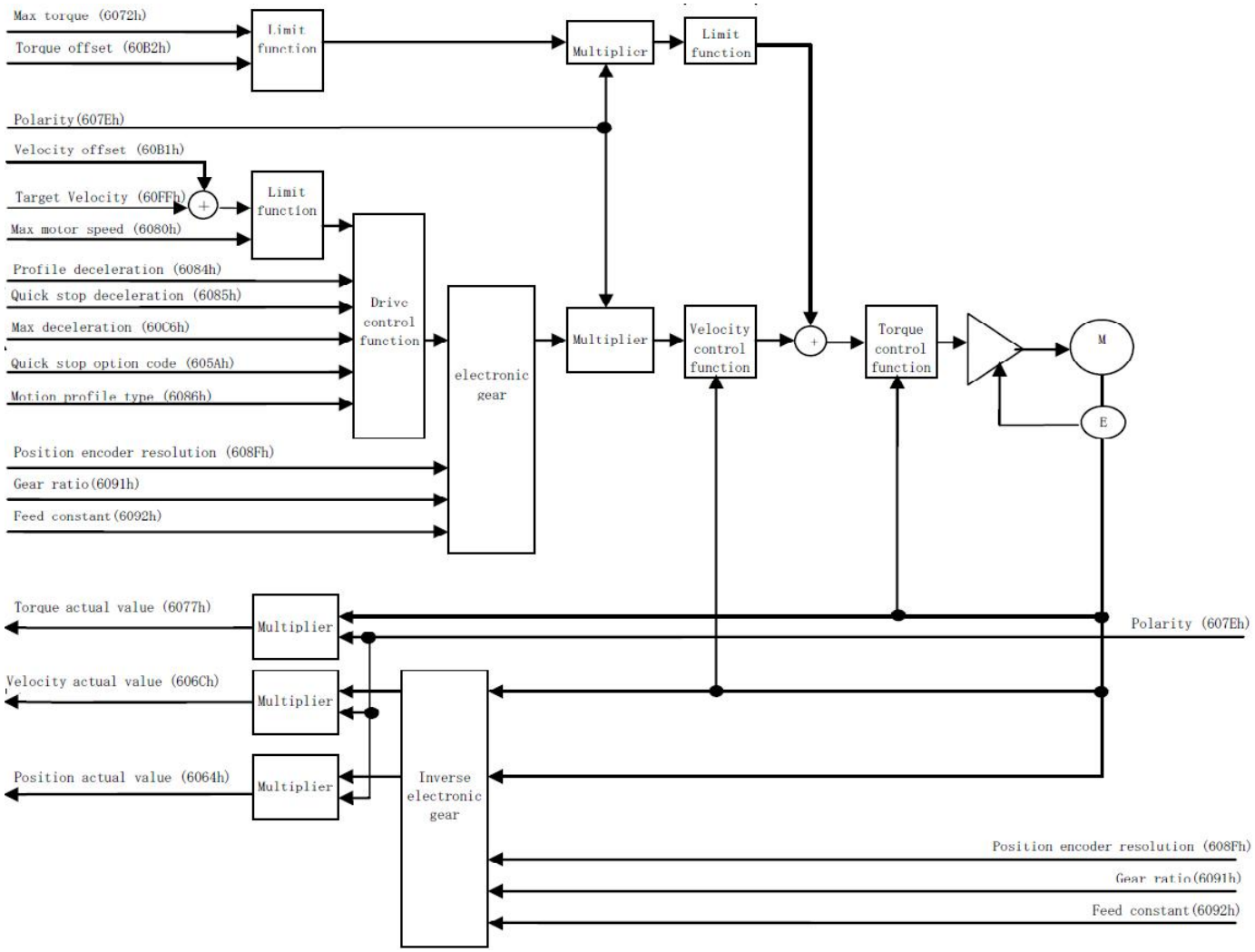
r	reserved	qs	quick stop
oms	operation mode specific	ve	voltage enable
ila	internal limit active	f	fault
rm	remote	oe	operation enabled
w	warning	se	switched on
sod	switch on disabled	rso	ready to switch on

Pv control mode action:



6.7.3 Cycle Speed control Mode(csv)

According to the master station to generate the command speed, the command speed is updated according to the interpolation cycle, and the speed control mode of the operation is performed. Please use DC or SM2 synchronous mode.



Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
6040h	00h	controlword	--	0 - 65535	U16	rw	RPDO	

Set the control command for the servo driver of PDS (control state machine) state transition.

Bit Instructions：

15…10	9	8	7	6	5	4	3	2	1	0
r	oms	h	fr	oms			eo	qs	ev	so
	r			r	r	start home				

r	reserved	eo	enable operation
oms	operation mode specific	qs	quick stop
h	halt	ev	enable voltage
fr	fault reset	so	switch on

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
6041h	00h	statusword	--	0 - 65535	U16	ro	TPDO	

Indicates the status of the servo driver.

Bit Instructions：

15-14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
r	oms		ila	oms	rm	r	w	sod	qs	ve	f	oe	se	rso
	r	drive follows command value		r										

r	reserved	qs	quick stop
oms	operation mode specific	ve	voltage enable
ila	internal limit active	f	fault
rm	remote	oe	operation enabled
w	warning	se	switched on
sod	switch on disabled	rso	ready to switch on

bit13-12，10(oms)：

bit	Name	Value	Specific
10	r	--	Reserved
12	drive follows command value	0	Not Perform this action based on the target speed
		1	Perform this action based on the target speed
13	r	--	Reserved

Csv Control mode action:

Cycle Speed control mode, the trajectory generation is not in the slave station but is made by the master station.

Target speed is the added value of 60FFh (target speed) and 60B1h (speed offset).

Interpolation time period (60C2h), represents the period of updating two targets of target position (607Ah) and position offset (60B0h). This value is set to the same period as cycle time (1C32h-02h).

6.8 Torque control function (pt/cst)

6.8.1 Torque control general function

1）Torque control block diagram

(TBD)

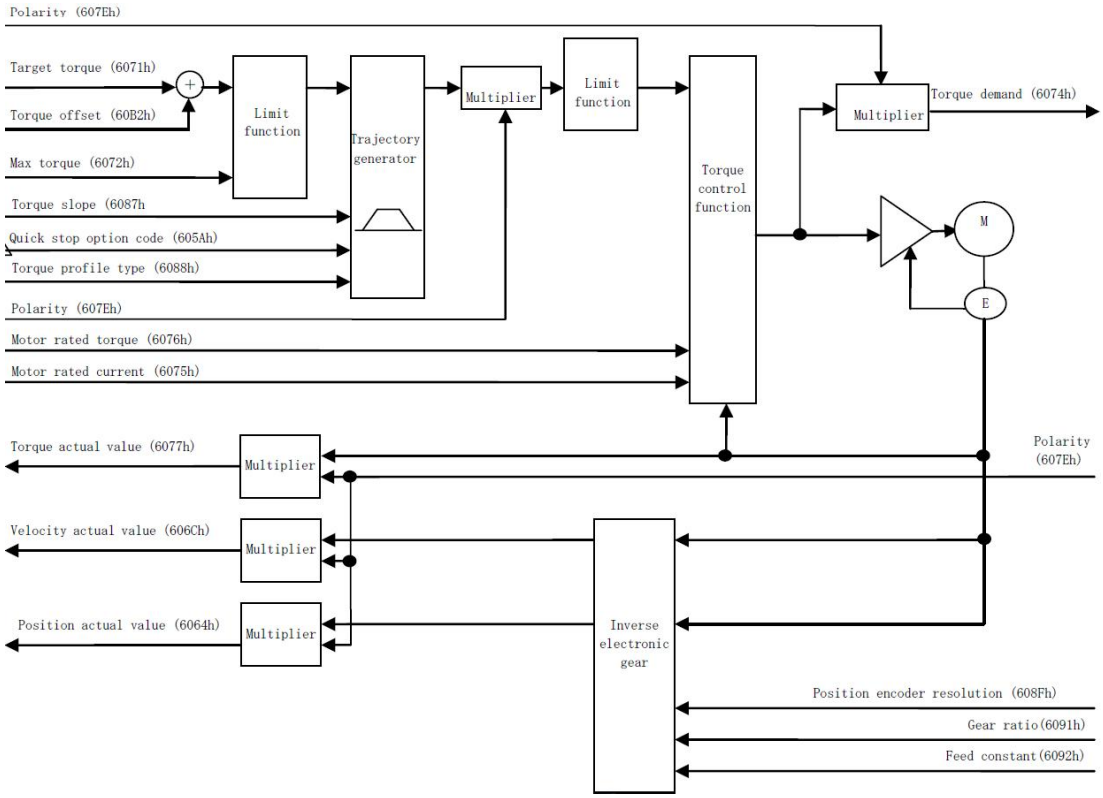
2）Associated objects (Command)

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode			
								pt	cst		
6040h	00h	controlword	--	0 - 65535	U16	rw	RPDO	Y	Y		
6071h	00h	target torque	0.1%	-32768 – 32767	I16	rw	RPDO	Y	Y		
6072h	00h	max torque	0.1%	0 - 65535	U16	rw	RPDO	Y	Y		
6080h	00h	max motor speed	rpm	0 - 4294967295	U32	rw	RPDO	Y	Y		
6087h	00h	torque slope	0.1%/s	0 - 4294967295	U32	rw	RPDO	Y	Y		
60B2h	00h	torque offset	0.1%	-32768 – 32767	I16	rw	RPDO	Y	Y		

3）Associated objects (Monitor)

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode			
								pv	csv		
6041h	00h	statusword	--	0 - 65535	U16	ro	TPDO	Y	Y		
6063h	00h	position actual internal value	pulse	-2147483648 – 2147483647	I32	ro	TPDO	Y	Y		
6064h	00h	position actual value	Command Unit	-2147483648 – 2147483647	I32	ro	TPDO	Y	Y		
6069h	00h	speed sensor actual value	--	-2147483648 – 2147483647	I32	ro	TPDO	Y	Y		
606Ch	00h	speed actual value	Command Unit /s	-2147483648 – 2147483647	I32	ro	TPDO	Y	Y		
6074h	00h	torque demand	0.1%	-32768 – 32767	I16	ro	TPDO	Y	Y		
6075h	00h	motor rate current	mA	0 - 4294967295	U32	ro	No	Y	Y		
6076h	00h	motor rate torque	mN.m	0 - 4294967295	U32	ro	No	Y	Y		
6077h	00h	torque actual value	0.1%	-32768 – 32767	I16	ro	TPDO	Y	Y		
6078h	00h	current actual value	0.1%	-32768 – 32767	I16	ro	TPDO	Y	Y		
6079h	00h	DClink circuit voltage	mV	0 - 4294967295	U32	ro	TPDO	Y	Y		

6.8.2 Profile Torque Control Mode (tq)



Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
6040h	00h	controlword	--	0 - 65535	U16	rw	RPDO	

Set the control command for the servo driver of PDS (control state machine) state transition.

Bit Instructions:

15…10	9	8	7	6	5	4	3	2	1	0
r	oms	h	fr	oms			eo	qs	ev	so
	r			r	r	start home				

r	reserved	eo	enable operation
oms	operation mode specific	qs	quick stop
h	halt	ev	enable voltage
fr	fault reset	so	switch on

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
6041h	00h	Status word	--	0 - 65535	U16	ro	TPDO	

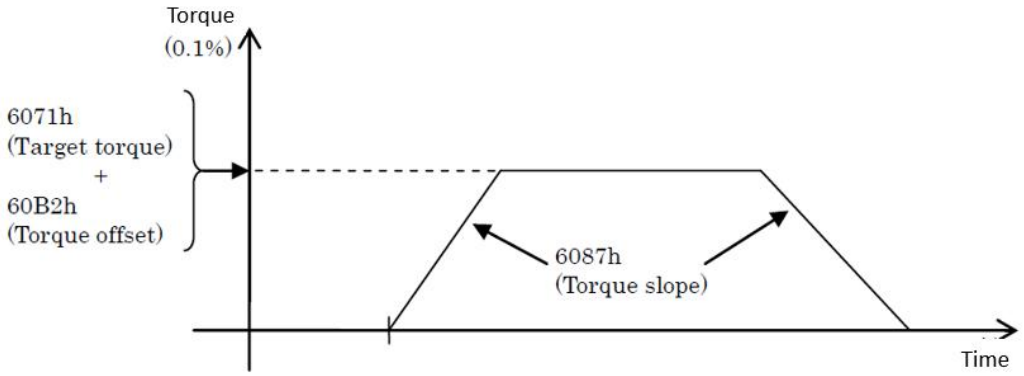
Indicates the status of the servo driver.

Bit Instructions:

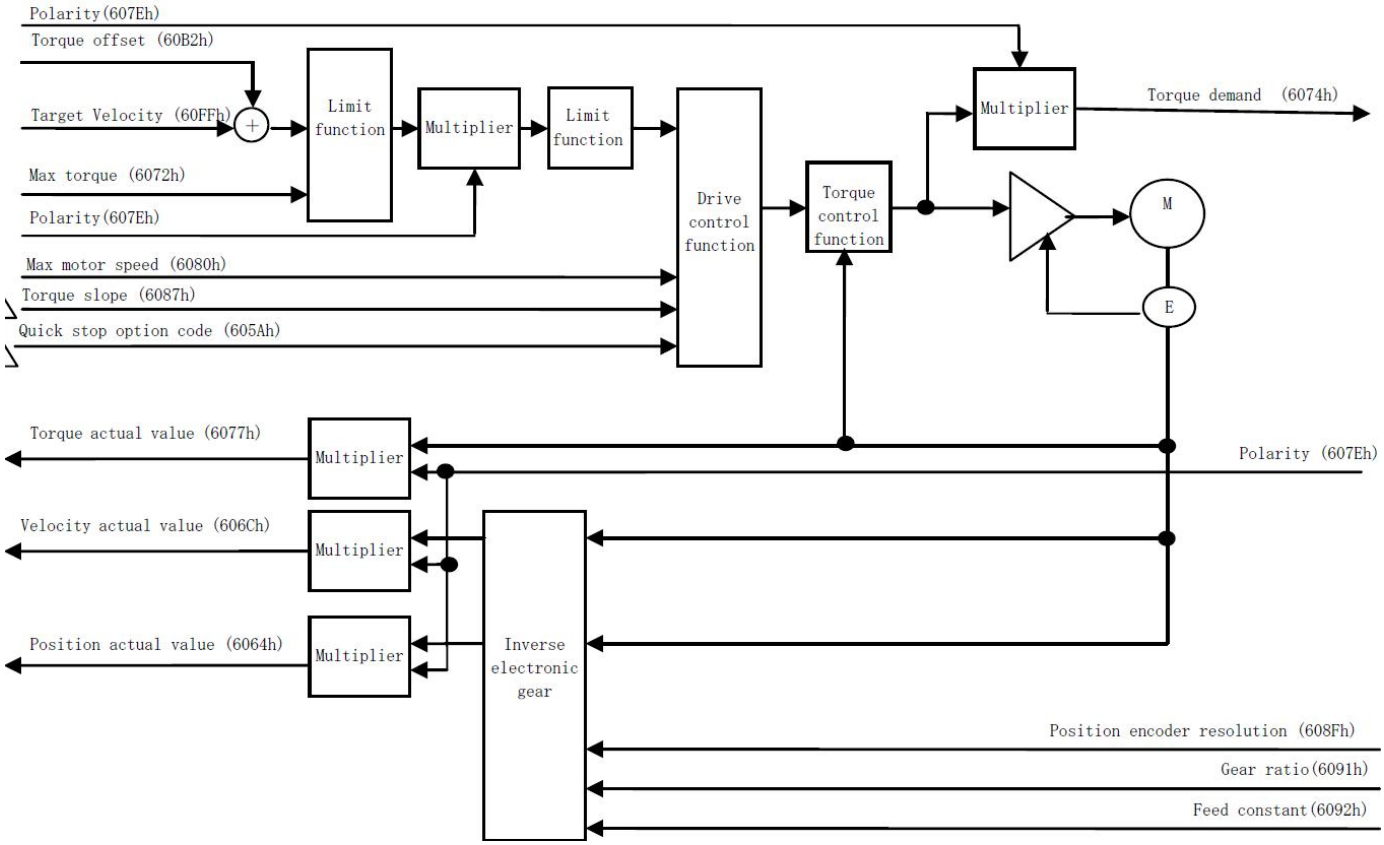
15-14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
r	oms		ila	oms	rm	r	w	sod	qs	ve	f	oe	se	rso
	r	r		r										

r	reserved	qs	quick stop
oms	operation mode specific	ve	voltage enable
ila	internal limit active	f	fault
rm	remote	oe	operation enabled
w	warning	se	switched on
sod	switch on disabled	rso	ready to switch on

Tq control mode action：



6.8.3 Cycle Torque control mode (csq)



Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
6040h	00h	controlword	--	0 - 65535	U16	rw	RPDO	

Set the control command for the servo driver of PDS (control state machine) state transition.

Bit Instructions:

15…10	9	8	7	6	5	4	3	2	1	0
r	oms	h	fr	oms			eo	qs	ev	so
	r			r	r	start home				

r	reserved	eo	enable operation
oms	operation mode specific	qs	quick stop
h	halt	ev	enable voltage
fr	fault reset	so	switch on

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
6041h	00h	statusword	--	0 - 65535	U16	ro	TPDO	

Indicates the status of the servo driver.

Bit Instructions

15-14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
r	oms		ila	oms	rm	r	w	sod	qs	ve	f	oe	se	rso
	r	drive follows command value		r										

r	reserved	qs	quick stop
oms	operation mode specific	ve	voltage enable
ila	internal limit active	f	fault
rm	remote	oe	operation enabled
w	warning	se	switched on
sod	switch on disabled	rso	ready to switch on

bit13-12，10(oms)：

bit	Name	Value	Specific
10	r	--	Reserved
12	drive follows command value	0	Not Perform this action based on the target speed
		1	Perform this action based on the target speed
13	r	--	Reserved

Cst control mode action:

Cycle torque control mode, the trajectory generation is not in the slave station, but by the master station planning.

The target speed is the additive value of 6071h (target torque) and 60B2h (torque offset).

Interpolation time period (60C2h), represents the period of updating two targets of target position (607Ah) and position offset (60B0h). This value is set to the same period as cycle time (1C32h-02h).

6.9 Mode common function

6.9.1 Touch probe function

This function selects the clamp trigger signal from the external input (EXT1/EXT2) or Z-phase, locking the feedback device.

If the trigger signal uses an external input (EXT1/EXT2), assign the input port to EXT1, EXT2 via parameters Pn511.1 and Pn511.2 respectively..

Clamp trigger use external input (EXT1/EXT2) to send the Acquired error， please make sure the speed as low as possible which nearby clamp trigger input signal.

If,

1）touch Functional composition

(TBD)

2）Touch probe Associated objects

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode			
60B8h	00h	touch probe func	--	0 - 65535	U16	rw	RPDO				
60B9h	00h	touch probe status	--	0 - 65535	U16	ro	TPDO				
60BAh	00h	touch probe pos1(+)	Command Unit	-2147483648 – 2147483647	I32	ro	TPDO				
60BBh	00h	touch probe pos1(-)	Command Unit	-2147483648 – 2147483647	I32	ro	TPDO				
60BCh	00h	touch probe pos2(+)	Command Unit	-2147483648 – 2147483647	I32	ro	TPDO				
60BDh	00h	touch probe pos2(-)	Command Unit	-2147483648 – 2147483647	I32	ro	TPDO				

3）Touch probe function(60B8h)

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
60B8h	00h	touch probe func	--	0 - 65535	U16	rw	RPDO	ALL
		Perform the set of touch probe function.						

Bit Instructions：

bit	Value	Specific	
0	0	Switch off touch probe 1	Touch probe 1 Run/Stop
	1	Enable touch probe 1	
1	0	Trigger first event	Touch probe 1 Time mode select
	1	continuous	
2	0	Trigger with touch probe 1 input	Touch probe 1 Trigger selection (external input/Z pulse)
	1	Trigger with zero impulse single postion encoder	
3	--	reserved	Reserved
4	0	Switch off sampling at positive edge of touch probe 1	Touch probe 1 Rising edge selection
	1	Enable sampling at positive edge of touch probe 1	
5	0	Switch off sampling at negative edge of touch probe 1	Touch probe 1 Falling edge selection
	1	Enable sampling at negative edge of touch probe 1	
6-7	--	Not surpport	Reserved
8	0	Switch off touch probe 2	Touch probe 2 Run/Stop
	1	Enable touch probe 2	
9	0	Trigger first event	Touch probe2 Time mode select
	1	continuous	
10	0	Trigger with touch probe 2 input	Touch probe 2 Trigger selection (external input/Z pulse)
	1	Trigger with zero impulse single postion encoder	
11	--	reserved	Reserved
12	0	Switch off sampling at positive edge of touch probe 2	Touch probe 2 Rising edge selection
	1	Enable sampling at positive edge of touch probe 2	
13	0	Switch off sampling at negative edge of touch probe 2	Touch probe 2

	1	Enable sampling at negative edge of touch probe 2	Falling edge selection
14-15	--	Not surpport	Reserved

4）Touch probe status(60B9h)

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
60B9h	00h	touch probe status	--	0 - 65535	U16	ro	TPDO	ALL
		Perform the set of touch probe function.						

Bit Instructions：

bit	Value	Specific	
0	0	Touch probe 1 is switch off	Touch probe 1Stop
	1	Touch probe 1 is enable	Touch probe 1Run
1	0	Touch probe 1 no positive edge value stored	Rising edge Touch probe 1 not completed
	1	Touch probe 1 positive edge value stored	Rising edge Touch probe 1 completed
2	0	Touch probe 1 no negative edge value stored	Falling edge Touch probe 1 not completed
	1	Touch probe 1 negative edge value stored	Falling edge Touch probe 1 completed
3-5	--	reserved	Reserved
6-7	--	Not surpport	Reserved
8	0	Touch probe 2 is switch off	Touch probe 2Stop
	1	Touch probe 2 is enable	Touch probe 2Run
9	0	Touch probe 2 no positive edge value stored	Rising edge Touch probe 2 not completed
	1	Touch probe 2 positive edge value stored	Rising edge Touch probe 2 completed
10	0	Touch probe 2 no negative edge value stored	Falling edge Touch probe 2 not completed
	1	Touch probe 2 negative edge value stored	Falling edge Touch probe 2 completed
11-13	--	reserved	Reserved
14-15	--	Not surpport	Reserved

5）Touch probe position 1/2 positive value (60BAh-60BDh)

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
60BAh	00h	touch probe pos1 value+	Command unit	2147483648 – 2147483647	I32	ro	TPDO	ALL
		Represents the position of the rising edge of touch probe 1						
60BBh	00h	touch probe pos1 value+	Command unit	2147483648 – 2147483647	I32	ro	TPDO	ALL
		Represents the position of the falling edge of touch probe 1						
60BCh	00h	touch probe pos2 value+	Command unit	Command unit	I32	ro	TPDO	ALL

		Represents the position of the rising edge of touch probe 2						
60BDh	00h	touch probe pos2 value-	Command unit	2147483648 – 2147483647	I32	ro	TPDO	ALL
		Represents the position of the falling edge of touch probe 2						

6）Start of touch probe action

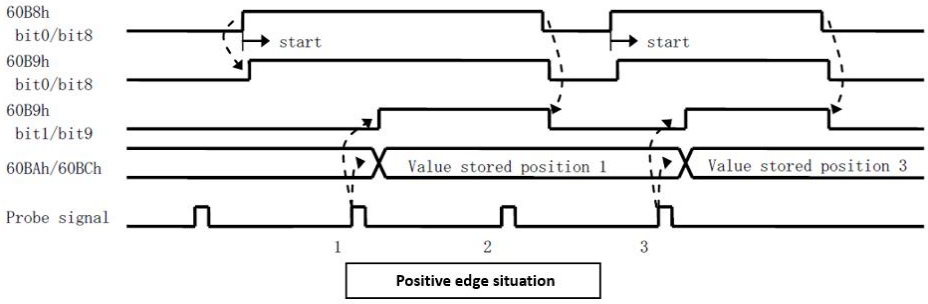
Bit 0/8 of touch probe function (60B8h) is 0->1, and various setting conditions (60B8h: bit1-7/bit9-15) are acquired, and touch probe operation is started..

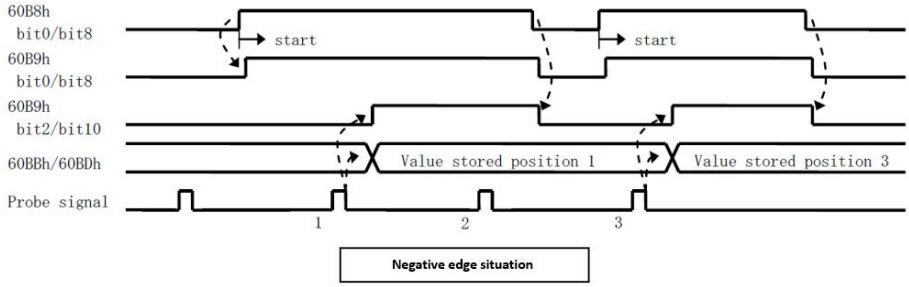
Changes to various setting conditions are valid. Please reset bit0/8 to 0 and then again to 1.

7）touch probe Event mode

<Trigger first event mode> (60B8h:bit1/9 = 0)

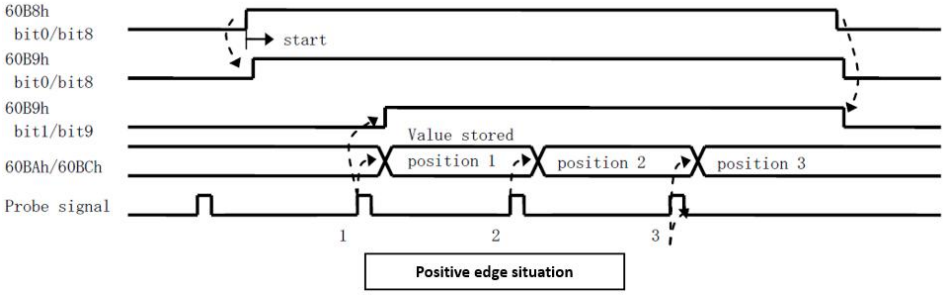
After starting, the position is only clamped on the first trigger signal. In order to get the position again, you need to start the touch probe again.

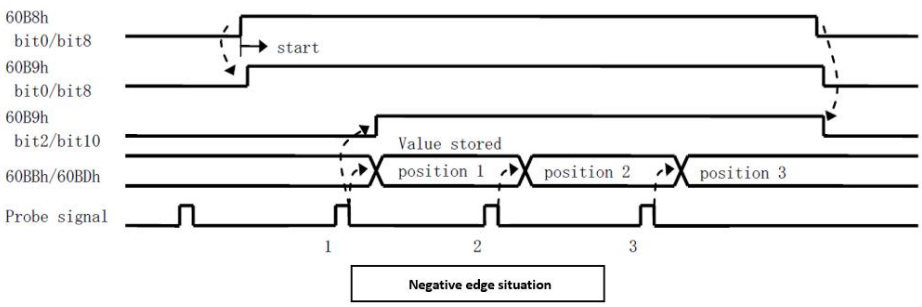




<continuous mode> (60B8h:bit1/9 = 1)

After start-up, the position of the embedment occurs each time a trigger signal occurs. The acquired value is saved to the next probe signal.





6.9.2 Digital inputs/Digital outputs

Bits of Digital inputs / Digital outputs are assigned by servo parameters Pn509-514 (OD: 3509h-3514h) and indicate the input states of /POT, /NOT, /HM-REF, EXT1, EXT2, and IN1-IN8.

1) Digital inputs

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
60FDh	00h	Digital inputs	--	0 - 4294967295	U32	ro	TPDO	ALL

Indicates the input status of the external input

bit	31	30	29	28	27	26	25	24
Func	Reserved							
bit	23	22	21	20	19	18	17	16
Func	IN8	IN7	IN6	IN5	IN4	IN3	IN2	IN1
bit	15	14	13	12	11	10	9	8
Func	Reserved							
bit	7	6	5	4	3	2	1	0
Func	Reserved					/HM-REF	/POT	/NOT

2) Digital outputs

Index	Sub-Index	Name	Unit	Range	Type	Access	PDO	OP-mode
60FEh	--	Digital outputs	--	--	--	--	--	--

Indicates the input status of the external input

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

00h	numbers of entries	--	2	U8	ro	No	All
	Indicates the number of 60FEh Sub-indexes						
00h	Physical outputs	--	0 - 4294967295	U32	rw	RPDO	All
	Operate the output of the external output signal						
00h	bit mask	--	0 - 4294967295	U32	rw	RPDO	All
	Set the mask of the external output signal						

7、List of object dictionaries

Index	Sub index	Name	Unit	Range	Data Type	Access	PDO	
1000	00	device_type	-	0 - 4294967295	U32	ro	No	
1001	00	error_register	-	0 - 255	U8	ro	No	
1008	00	manufacturer_device_name	-	-	VS	ro	No	
1009	00	manufacturer_hardware_version	-	-	VS	ro	No	
100A	00	manufacturer_software_version	-	-	VS	ro	No	
1018	--	Identity object	-	-				
	00h	Number of entries	-	0 - 255	U8	ro	No	
	01h	Vender ID	-	00000088	U32	ro	No	
	02h	Product code	-	0 - 4294967295	U32	ro	No	
	03h	Revision Number	-	0 - 4294967295	U32	ro	No	
	04h	Serial Number	-	0 - 4294967295	U32	ro	No	
10F1	--	Error settings	-	0 - 255	-	-	-	-
	00h	Number of entries	-			ro	No	
	01h	Error Reaction	-			ro	No	
	02h	Sync Error Counter Limit	-			ro	No	
10F3	--	Diagnosis History	-	-	-	-	-	-
	00h	Number of entries	-	0 - 255	U8	ro	No	
	01h	Maximum messages	-	0 - 255	U8	ro	No	
	02h	Newest message	-	0 - 255	U8	ro	No	
	03h	Newest acknowledged message	-	0 - 255	U8	rw	No	
	04h	New message available	-	0 - 1	Bool	ro	No	
	05h	Flags	-	0 - 65535	U16	rw	No	
	06h	Diagnosis message 1	-	-	OS	ro	No	
	:	:	-	-				
	13h	Diagnosis message 14	-	-	OS	ro	No	
1600	--	Receive PDO mapping 1	-	-	-	-	-	
	00h	Number of entries	-	0 - 255	U8	rw	No	
	01h	1st receive PDO mapped	-	0 - 4294967295	U32	rw	No	
	:	:						
	20h	32nd receive PDO mapped	-	0 - 4294967295	U32	rw	No	
1601	--	Receive PDO mapping 2	-	-	-	-	-	
	00h	Number of entries	-	0 - 255	U8	rw	No	
	01h	1st receive PDO mapped	-	0 - 4294967295	U32	rw	No	
	:	:						
	20h	32nd receive PDO mapped	-	0 - 4294967295	U32	rw	No	
1602	--	Receive PDO mapping 3	-	-	-	-	-	
	00h	Number of entries	-	0 - 255	U8	rw	No	
	01h	1st receive PDO mapped	-	0 - 4294967295	U32	rw	No	
	:	:						
	20h	32nd receive PDO mapped	-	0 - 4294967295	U32	rw	No	

Index	Sub index	Name	Unit	Range	Data Type	Access	PDO	
1603	--	Receive PDO mapping 4	-	-	-	-	-	
	00h	Number of entries	-	0 - 255	U8	rw	No	
	01h	1st receive PDO mapped	-	0 - 4294967295	U32	rw	No	
	:	:						
	20h	32nd receive PDO mapped	-	0 - 4294967295	U32	rw	No	
1610 (b Axis)	--	Receive PDO mapping 1	-	-	-	-	-	
	00h	Number of entries	-	0 - 255	U8	rw	No	
	01h	1st receive PDO mapped	-	0 - 4294967295	U32	rw	No	
	:	:						
	20h	32nd receive PDO mapped	-	0 - 4294967295	U32	rw	No	
1611 (b Axis)	--	Receive PDO mapping 2	-	-	-	-	-	
	00h	Number of entries	-	0 - 255	U8	rw	No	
	01h	1st receive PDO mapped	-	0 - 4294967295	U32	rw	No	
	:	:						
	20h	32nd receive PDO mapped		0 - 4294967295	U32	rw	No	
1612 (b Axis)	--	Receive PDO mapping 3	-	-	-	-	-	
	00h	Number of entries	-	0 - 255	U8	rw	No	
	01h	1st receive PDO mapped	-	0 - 4294967295	U32	rw	No	
	:	:						
	20h	32nd receive PDO mapped	-	0 - 4294967295	U32	rw	No	
1613 (b Axis)	--	Receive PDO mapping 4	-	-	-	-	-	
	00h	Number of entries	-	0 - 255	U8	rw	No	
	01h	1st receive PDO mapped	-	0 - 4294967295	U32	rw	No	
	:	:						
	20h	32nd receive PDO mapped		0 - 4294967295	U32	rw	No	
1A00	--	Transmit PDO mapping 1	-	-	-	-	-	
	00h	Number of entries	-	0 - 255	U8	rw	No	
	01h	1st transmit PDO mapped	-	0 - 4294967295	U32	rw	No	
	:	:						
	20h	32nd transmit PDO mapped		0 - 4294967295	U32	rw	No	
1A01	--	Transmit PDO mapping 2	-	-	-	-	-	
	00h	Number of entries	-	0 - 255	U8	rw	No	
	01h	1st transmit PDO mapped	-	0 - 4294967295	U32	rw	No	
	:	:						
	20h	32nd transmit PDO mapped	-	0 - 4294967295	U32	rw	No	
1A02	--	Transmit PDO mapping 3	-	-	-	-	-	
	00h	Number of entries	-	0 - 255	U8	rw	No	
	01h	1st transmit PDO mapped	-	0 - 4294967295	U32	rw	No	
	:	:						
	20h	32nd transmit PDO mapped	-	0 - 4294967295	U32	rw	No	

Index	Sub index	Name	Unit	Range	Data Type	Access	PDO	
1A03	--	Transmit PDO mapping 4	-	-	-	-	-	
	00h	Number of entries	-	0 - 255	U8	rw	No	
	01h	1st transmit PDO mapped	-	0 - 4294967295	U32	rw	No	
	:	:						
	20h	32nd transmit PDO mapped	-	0 - 4294967295	U32	rw	No	
1A10 (b Axis)	--	Transmit PDO mapping 1	-	-	-	-	-	
	00h	Number of entries	-	0 - 255	U8	rw	No	
	01h	1st transmit PDO mapped	-	0 - 4294967295	U32	rw	No	
	:	:						
	20h	32nd transmit PDO mapped	-	0 - 4294967295	U32	rw	No	
1A11 (b Axis)	--	Transmit PDO mapping 2	-	-	-	-	-	
	00h	Number of entries	-	0 - 255	U8	rw	No	
	01h	1st transmit PDO mapped	-	0 - 4294967295	U32	rw	No	
	:	:						
	20h	32nd transmit PDO mapped	-	0 - 4294967295	U32	rw	No	
1A12 (b Axis)	--	Transmit PDO mapping 3	-	-	-	-	-	
	00h	Number of entries	-	0 - 255	U8	rw	No	
	01h	1st transmit PDO mapped	-	0 - 4294967295	U32	rw	No	
	:	:						
	20h	32nd transmit PDO mapped	-	0 - 4294967295	U32	rw	No	
1A13 (b Axis)	--	Transmit PDO mapping 4	-	-	-	-	-	
	00h	Number of entries	-	0 - 255	U8	rw	No	
	01h	1st transmit PDO mapped		0 - 4294967295	U32	rw	No	
	:	:						
	20h	32nd transmit PDO mapped	-	0 - 4294967295	U32	rw	No	
1C00	--	Sync manager type		-	-	-	-	
	00h	Number of entries	-	0 - 255	U8	ro	No	
	01h	Sync manager 0(Mailbox Out)	-	0 - 4	U8	ro	No	
	02h	Sync manager 1(Mailbox In)	-	0 - 4	U8	ro	No	
	03h	Sync manager 2(RxPDO)	-	0 - 4	U8	ro	No	
	04h	Sync manager 3(TxPDO)	-	0 - 4	U8	ro	No	
1C12	--	Sync manager channel 2	-	-	-	-	-	
	00h	Number of entries	-	0 - 4	U8	rw	No	
	01h	Mapping OD index of RxPDO1	-	1600-1603(A Axis) 1610-1613(b Axis)	U16	rw	No	
	02h	Mapping OD index of RxPDO2	-		U16	rw	No	
	03h	Mapping OD index of RxPDO3	-		U16	rw	No	
	04h	Mapping OD index of RxPDO4	-		U16	rw	No	

Index	Sub index	Name	Unit	Range	Data Type	Access	PDO	
1C13	--	Sync manager channel 3	-	-	-	-	-	
	00h	Number of entries	-	0 - 4	U8	rw	No	
	01h	Mapping OD index of TxPDO1	-	1A00-1A03(A Axis) 1A10-1A13(b Axis)	U16	rw	No	
	02h	Mapping OD index of TxPDO2	-		U16	rw	No	
	03h	Mapping OD index of TxPDO3	-		U16	rw	No	
	04h	Mapping OD index of TxPDO4	-		U16	rw	No	
1C32	--	Sync manager channel 2	-	-	-	-	-	
	00h	Number of entries	-	0 - 255	U8	ro	No	
	01h	Sync mode	-	0 - 65535	U16	rw	No	
	02h	Cycle Time	ns	0 - 4294967295	U32	rw	No	
	03h	Shift Time	ns	0 - 4294967295	U32	ro	No	
	04h	Sync mode supported	-	0 - 65535	U16	ro	No	
	05h	Minimum cycle time	ns	0 - 4294967295	U32	ro	No	
	06h	Calc and copy time	ns	0 - 4294967295	U32	ro	No	
	08h	Get cycle time	ns	0 - 4294967295	U32	ro	No	
	09h	Delay time	ns	0 - 4294967295	U32	ro	No	
	0Ah	Sync0 cycle time	ns	0 - 4294967295	U32	ro	No	
	0Bh	SM-Event missed	-	0 - 65535	U16	ro	No	
	0Ch	Cycle time too small	-	0 - 65535	U16	ro	No	
	0Dh	Shift time too short	-	0 - 65535	U16	ro	No	
	20h	Sync error	-	0 - 1	Bool	ro	No	
1C33	--	Sync manager channel 3	-	-	-	-	-	
	00h	Number of entries	-	0 - 255	U8	ro	No	
	01h	Sync mode	-	0 - 65535	U16	rw	No	
	02h	Cycle Time	ns	0 - 4294967295	U32	ro	No	
	03h	Shift Time	ns	0 - 4294967295	U32	rw	No	
	04h	Sync mode supported	-	0 - 65535	U16	ro	No	
	05h	Minimum cycle time	ns	0 - 4294967295	U32	ro	No	
	06h	Calc and copy time	ns	0 - 4294967295	U32	ro	No	
	08h	Get cycle time	ns	0 - 4294967295	U32	ro	No	
	09h	Delay time	ns	0 - 4294967295	U32	ro	No	
	0Ah	Sync0 cycle time	ns	0 - 4294967295	U32	ro	No	
	0Bh	SM-Event misse	-	0 - 65535	U16	ro	No	
	0Ch	Cycle time too small	-	0 - 65535	U16	ro	No	
	0Dh	Shift time too short	-	0 - 65535	U16	ro	No	
	20h	Sync error	-	0 - 1	Bool	ro	No	

Index	Sub index	Name	Unit	Range	Data Type	Access	PDO	
3000	00	PA000	-	-	U16	rw	No	
3001	00	PA001	-	-	U16	rw	No	
3002	00	PA002	-	-	U16	rw	No	
3003	00	PA003	-	-	U16	rw	No	
3004	00	PA004	-	-	U16	rw	No	
3100	00	PA100	0.1Hz	1 - 20000	U16	rw	No	
3101	00	PA101	0.01ms	1 - 40000	U16	rw	No	
3102	00	PA102	0.1/s	1 - 20000	U16	rw	No	
3103	00	PA103	1%	0 - 20000	U16	rw	No	
3104	00	PA104	0.1Hz	1 - 20000	U16	rw	No	
3105	00	PA105	0.01ms	1 - 40000	U16	rw	No	
3106	00	PA106	0.1/s	1 - 20000	U16	rw	No	
:								
3618	00	PA618	User Pulse	-1073741824 - 1073741823	I32	rw	No	
3800	00	PA000	-	-	U16	rw	No	
3801	00	PA001	-	-	U16	rw	No	
3802	00	PA002	-	-	U16	rw	No	
3803	00	PA003	-	-	U16	rw	No	
3804	00	PA004	-	-	U16	rw	No	
3900	00	PA100	0.1Hz	1 - 20000	U16	rw	No	
3901	00	PA101	0.01ms	1 - 40000	U16	rw	No	
3902	00	PA102	0.1/s	1 - 20000	U16	rw	No	
3903	00	PA103	1%	0 - 20000	U16	rw	No	
3904	00	PA104	0.1Hz	1 - 20000	U16	rw	No	
3905	00	PA105	0.01ms	1 - 40000	U16	rw	No	
3906	00	PA106	0.1/s	1 - 20000	U16	rw	No	
:								
3E18	00	PA618	User Pulse	-1073741824 - 1073741823	I32	rw	No	

Index	Sub index	Name	Unit	Range	Data Type	Access	PDO	
6007	00	abort_connection_option_code	-	0 - 3	I16	rw	No	
603F	00	error_code	-	0 - 65535	U16	ro	Tx	
6040	00	controlword	-	0 - 65535	U16	rw	Rx	
6041	00	statusword	-	0 - 65535	U16	ro	Tx	
605A	00	quick_stop_option_code	-	0 - 7	I16	rw	No	
605B	00	shutdown_option_code	-	0 - 1	I16	rw	No	
605C	00	disable_operation_option_code	-	0 - 1	I16	rw	No	
605D	00	stop_option_code	-	0 - 3	I16	rw	No	
605E	00	fault_reaction_option_code	-	0 - 2	U16	rw	No	
6060	00	modes_of_operation	-	0 - 127	I8	rw	Rx	
6061	00	modes_of_operation_display	-	0 - 127	I8	ro	Tx	
6062	00	position_demand_value	user pulse	-2147483648 - 2147483647	I32	ro	Tx	
6063	00	position_actual_value*	pulse	-2147483648 - 2147483647	I32	ro	Tx	
6064	00	position_actual_value	user pulse	-2147483648 - 2147483647	I32	ro	Tx	
6065	00	following_error_window	user pulse	0 - 4294967295	U32	rw	Rx	
6066	00	following_error_time_out	1ms	0 - 65535	U16	rw	Rx	
6067	00	position_window	user pulse	0 - 4294967295	U32	rw	Rx	
6068	00	position_window_time	1ms	0 - 65535	U16	rw	Rx	
6069	00	speed_sensor_actual_value	-	-2147483648 - 2147483647	U16	ro	Tx	
606B	00	speed_demand_value	user pulse/s	-2147483648 - 2147483647	I32	ro	Tx	
606C	00	speed_actual_value	user pulse/s	-2147483648 - 2147483647	I32	ro	Tx	
606D	00	speed_window	user pulse/s	0 - 65535	U16	rw	Rx	
606E	00	speed_window_time	1ms	0 - 65535	U16	rw	Rx	
606F	00	speed_threshold	user pulse/s	0 - 65535	U16	rw	Rx	
6070	00	speed_threshold_time	1ms	0 - 65535	U16	rw	Rx	
6071	00	target_torque	0.1%	-32768 - 32767	I16	rw	Rx	
6072	00	max_torque	0.1%	0 - 65535	U16	rw	Rx	
6073	00	max_current	0.1%	0 - 65535	U16	ro	No	
6074	00	torque_demand	0.1%	-32768 - 32767	I16	ro	Tx	
6075	00	motor_rated_current	mA	0 - 4294967295	U32	ro	Tx	
6076	00	motor_rated_torque	mN.m	0 - 4294967295	U32	ro	Tx	
607A	00	target_position	user pulse	-2147483648 - 2147483647	I32	rw	Rx	

Index	Sub index	Name	Unit	Range	Data Type	Access	PDO	
607B		position_range_limit	--	--	--	--	--	
	00	number_of_entries	--	2	I8	rw	No	
	01	min_position_range_limit	user pulse	-2147483648 - 2147483647	I32	rw	No	
	02	max_position_range_limit	user pulse	-2147483648 - 2147483647	I32	rw	No	
607C	00	home_offset	user pulse	-2147483648 - 2147483647	I32	rw	Rx	
6080	00	max_motor_speed	rpm	0 - 4294967295	U32	rw	Rx	
6081	00	profile_speed	user pulse/s	0 - 4294967295	U32	rw	Rx	
6082	00	end_speed	user pulse/s	0 - 4294967295	U32	rw	Rx	
6083	00	profile_acceleration	user pulse/s^2	0 - 4294967295	U32	rw	Rx	
6084	00	profile_deceleration	user pulse/s^2	0 - 4294967295	U32	rw	Rx	
6085	00	quick_stop_deceleration	user pulse/s^2	0 - 4294967295	U32	rw	Rx	
6086	00	motion_profile_type	--	-32768 - 32767	I16	rw	Rx	
608F	--	Position encoder resolution	--	--	--	--	--	
	00	Number of entries	--	2	U8	ro	No	
	01	Position encoder increments	pulse	1 - 4294967295	U32	rw	No	
	02	Position encoder revolutions	r(Motor)	1 - 4294967295	U32	rw	No	
6091	--	Gear ratio	--	--	--	--	--	
	00	Number of entries	--	2	U8	ro	No	
	01	Motor revolutions	r(Motor)	1 - 4294967295	U32	rw	No	
	02	Shaft revolutions	r(Axis)	1 - 4294967295	U32	rw	No	
6092	--	Feed constant	--	--	--	--	--	
	00	number_of_entries	--	2	U8	ro	No	
	01	feed	user pulse	1 - 4294967295	U32	rw	No	
	02	Shaft revolutions	r(Axis)	1 - 4294967295	U32	rw	No	
6098	00	homing_method	--	-128 - 127	I8	rw	Rx	
6099	--	homing_speeds	--	--	--	--	--	
	00	number_of_entries	--	2	U8	ro	No	
	01	speed_during_search_for_switch	user pulse/s	0 - 4294967295	U32	rw	Rx	
	02	speed_during_search_for_zero	user pulse/s	0 - 4294967295	U32	rw	Rx	
609A	00	homing_acceleration	user pulse/s^2	0 - 4294967295	U32	rw	Rx	

Index	Sub index	Name	Unit	Range	Data Type	Access	PDO	
60B1	00	speed_offset	user pulse/s	-2147483648 - 2147483647	I32	rw	Rx	
60B2	00	torque_offset	0.1%	-32768 - 32767	I16	rw	Rx	
60B8	00	Touch Probe Function	--	0 - 65535	U16	rw	Rx	
60B9	00	Touch Probe Status	--	0 - 65535	U16	ro	Tx	
60BA	00	Touch Probe Pos1 Pos Value	--	-2147483648 - 2147483647	I32	ro	Tx	
60BB	00	Touch Probe Pos1 Neg Value	--	-2147483648 - 2147483647	I32	ro	Tx	
60BC	00	Touch Probe Pos2 Pos Value	--	-2147483648 - 2147483647	I32	ro	Tx	
60BD	00	Touch Probe Pos2 Neg Value	--	-2147483648 - 2147483647	I32	ro	Tx	
60C0	00	Interpolation sub mode select	--	0	I16	rw	No	
60C1	--	Interpolation data record	--	--	--	--	--	
	00	number_of_entries	--	1	U8	ro	No	
	01	X1	user puls	-2147483648 - 2147483647	I32	rw	Rx	
60C2	--	--	--	--	--	--	--	
	00	number_of_entries	--	2	U8	ro	No	
	01	Interpolation time units		0 - 255	U8	rw	No	
	02	Interpolation time index		-128 - 63	I8	ro	No	
60FA	00	control_effort	user puls/s	-2147483648 - 2147483647	I32	ro	Tx	
60FC	00	position_demand_value*	pulse	-2147483648 - 2147483647	I32	ro	Tx	
60FF	00	target_speed	user puls/s	-2147483648 - 2147483647	I32	rw	Rx	
6502	00	Supported drive modes	--	0 - 4294967295	U32	rw	No	

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