使用說明書
P-SERVO EC 驅動器
閉迴路控制步進驅動器

高明鐵企業股份有限公司
GMT GLOBAL INC.

※為了安全使用本產品，使用前請務必閱讀該使用說明書。

誠摯感謝您本次購買P-SERVO EC。
本書內容為說明有關P-SERVO EC之規格與使用方法。
請務必熟讀本書內容後，再正確地使用P-SERVO EC。

本製品特徵

- 透過閉迴路控制附編碼器馬達，來改善步進馬達缺點，如失步、干擾、共振、噪音等。
- 能以最適合負載狀態之電流來驅動控制，故馬達發熱現象亦能大幅減輕。
- 能如AC 伺服驅動器般實現位置控制、速度控制。
- 位置控制與開迴路步進馬達不同是以編碼器解析度±1Pulse 進行控制，故停止精度也能得到提升。

商品保證

●購入本機一年之內，如由於非錯誤／不當操作原因而發生故障的話，限將本機以親送或寄送方式送回本公司，之後便可享免費維修服務。維修通常需要耗費若干工作天，還望各位諒解。

●由於操作不當或失誤導致故障發生，或是購入一年過後發生任何程度之故障時，則維修便須收取費用。此時亦如同上述所言，限將本機以親送或寄送方式寄回本公司維修。由於維修通常需要耗費若干工作天，故假如本機需用於極為重要之運作系統之中，為了保險起見懇請考慮購入預備用製品。

●以寄送方式將本機送到本公司維修時，如在運送過程中造成本機損壞，恕本公司無法對此類故障負責。故懇請各位在寄送之前確認本機包裝中填入充分緩衝材，並盡量使本機不要在運送過程中受到外部環境過大震動的影響（0.5G 以下）。

●以下服務項目沒有包含在本製品之販賣價格當中，故盼各位諒解。
(A) 與系統適性之檢討、判斷（設計時）
(B) 試運轉以及調整（與馬達間之合適調整需額外收費）
(C) 在本機所處現場之故障判定及維修

使用注意事項

●請遵守額定數值及在本書敘述之環境中使用本機。

●本公司製品之設計及製造目的，並非是為讓本機被使用於攸關性命之情況或環境中。因此如有特殊用途需購入本機時，請知會本公司業務人員並進行討論及確認。

●本公司不斷努力追求品質向上與顧客信任之提升，但使用本製品時也請務必要留心多重備用設計、火災延燒對策設計、誤動作防止設計等安全規畫，以避免系統設計時故障而發生人身意外、火災意外等社會性損害。

●為不斷改良特性，本製品今後可能會不事先預告而有規格上變更。

安全注意事項

為讓所有使用者都能安全使用 P-SERVO EC，在本書中表列出安全注意事項如下。
此處記載之注意事項內容與使用者人身安全息息相關，因此請務必遵守。

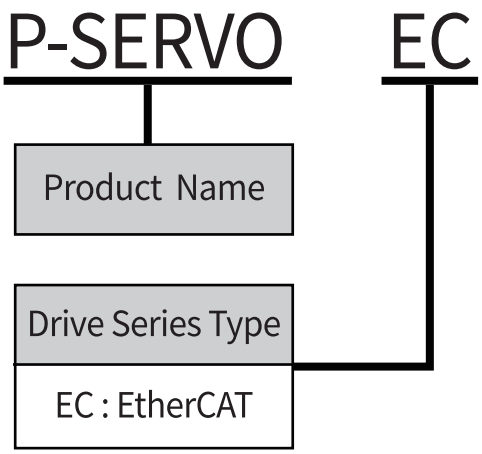
危險	以表示如發生失誤，會有危險狀況發生導致人死亡或重度傷病之可能性。
注意	以表示如發生失誤，會有危險狀況發生導致人受到中等程度的人身障礙或輕傷之可能性。 亦有可能產生物質上的損害。
禁止	以表示不得違反。
強制	以表示必定完成。

危險	●通電中請絕對勿用手觸摸端子部分及其內部，否則恐有觸電之虞。 ●請勿硬拉或是扭曲線纜，或是在線纜上擺放重物，否則恐有觸電、著火之虞。 ●請絕對勿用手觸碰模組可動部分，否則恐有被捲進回轉軸導致受傷之虞。 ●請絕對勿用手觸碰驅動器內部，否則恐有觸電之虞。 ●請務必將驅動器及馬達之接地端子接地。否則恐有觸電之虞。 ●移動、配線、維護、檢查等動作請確認斷電後面板上之顯示LED 燈燈號完全熄滅後再進行，否則恐有觸電之虞。 ●運轉中請絕對勿觸碰馬達回轉部分，否則恐有受傷之虞。
注意	●請勿在可能沾染水、油、藥品飛沫之場所，或是有腐蝕性氣體、可燃性氣體之場所使用本機。 ●請使用規定之電源電壓。否則恐有起火之虞。 ●驅動器、馬達、周邊機器本身溫度會上升因此請勿觸碰，否則恐有燒燙傷之虞。 ●配線請正確進行連接。 ●馬達與驅動器請依照指定組合搭配使用，否則恐有起火之虞。 ●通電中或是斷電後不久，驅動器之散熱片、馬達等可能仍處於高溫，因此請勿觸碰。否則恐有燒燙傷之虞。 ●請勿對機殼邊緣部位施加過大壓力，否則恐有受傷之虞。
禁止	●請勿在會受到陽光直射的場所使用本機，或是保管於此處。 ●請勿在周圍溫度濕度超過規定範圍的場所使用本機，或是保管於此處。 ●請勿在很多粉塵、塵埃等的場所使用本機，或是保管於此處。 ●請勿在會受到直接震動或衝擊的場所使用本機，或是保管於此處。 ●請勿將自行修理或改造本機內外部構造。
強制	●請於外部設置能即時停止動作之緊急停止回路。

目錄 Contents

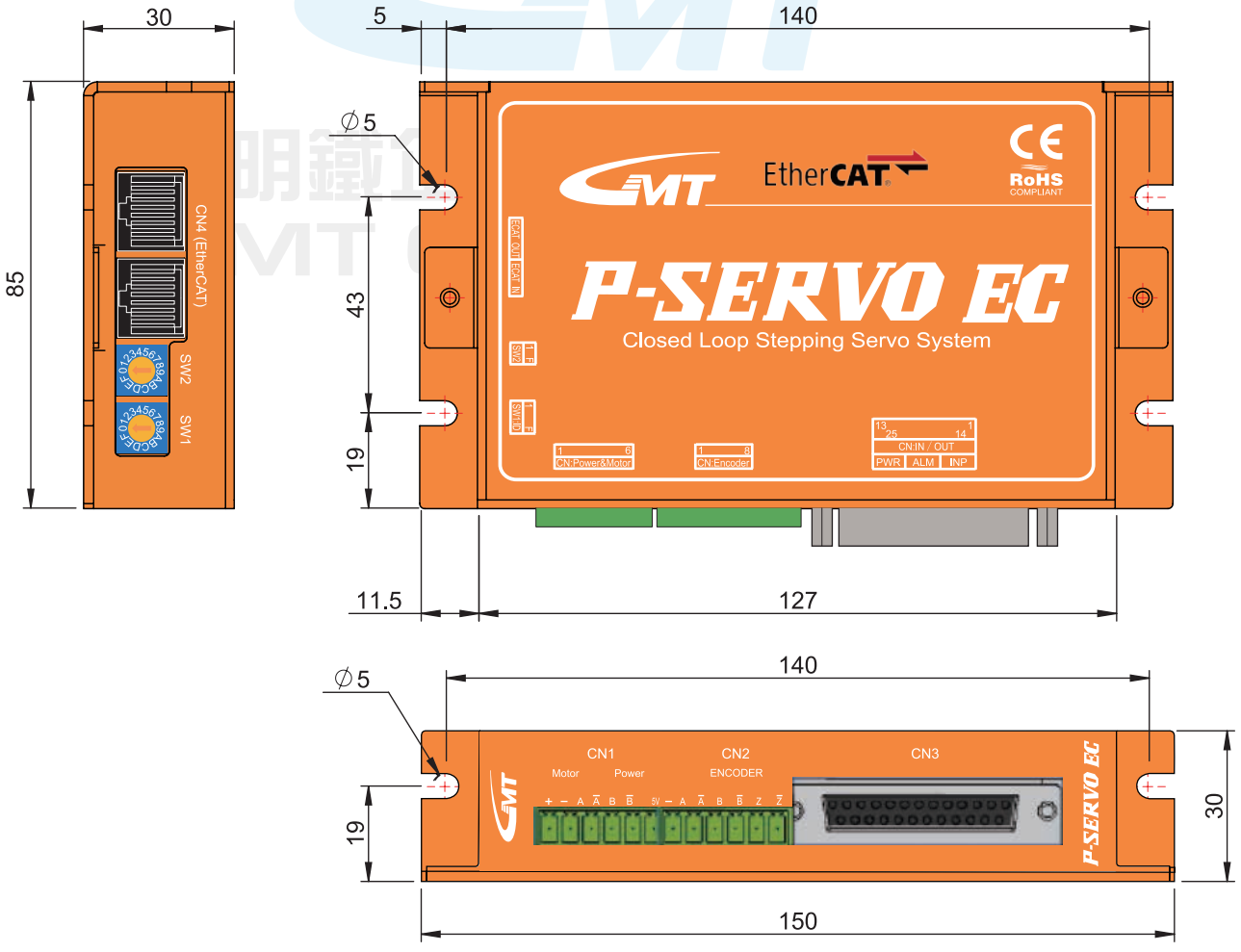
1. 產品規格

1.1. 產品名稱



1.2. 產品外型規格

單位:mm



1.3. EtherCAT規格

Type of Communication	EtherCAT
Physical Layer	Ethernet - 100BASE-TX
Connector	RJ45 (shielded) ECAT IN : EtherCAT Input ECAT OUT : EtherCAT Output
ECAT Device ID	Set Configured Station Alias by ECAT ID Switch : 0 ~ 256 Set Physical Address at Master : 1 ~ 65535
Topology	Line (Structured by Products only) Tree, Star (When use Junction products)
Support Protocol	CoE (CANopen application protocol over EtherCAT)
Control Profile	CiA 402 drive profile (IEC61800-7)
Supported Operation Mode	Cyclic Synchronous Position Mode Cyclic Synchronous Velocity Mode Profile Position Mode Profile Velocity Mode Homing Mode
Synchronization	Free Run, SM Event, DC SYNC Event (Minimum cycle time:250us)
Processing Data	Static PDO Mapping

1.4. 驅動器規格

名稱		P-SERVO EC	
輸入電壓/電流		24VDC±10% / Max 500mA (Except motor current)	
系統架構		Closed loop control	
馬達驅動電流		Max 3.1 Arms	
操作環境	溫度	使用：0~50°C	保存：-20~70°C
	濕度(非冷凝)	使用：35~85%	保存：10~90%
	震動抵抗	0.5g	
功能	轉速	0~3000rpm	
	定位解析度[ppr]	200 ~ 51,200 pulse	
	保護功能	過電流、過電壓、欠電壓、過速度、最大計數錯誤、過熱、迴路接線異常、定位錯誤、位置值溢位保護、記憶體錯誤、內部通訊錯誤	
	LED顯示	電源狀態、定位狀態、激磁狀態、警示燈、執行狀態	
輸入輸出訊號	輸入訊號	4個固定輸入訊號(LIMIT+、LIMIT-、ORG、EMG) 8個使用者自訂輸入訊號	
	輸出訊號	煞車 8個使用者自訂輸出訊號	

2. 產品安裝

接通電源前請務必進行以下作業。

2.1. 安裝注意事項

請確實參照後頭敘述接頭指定表進行配線。

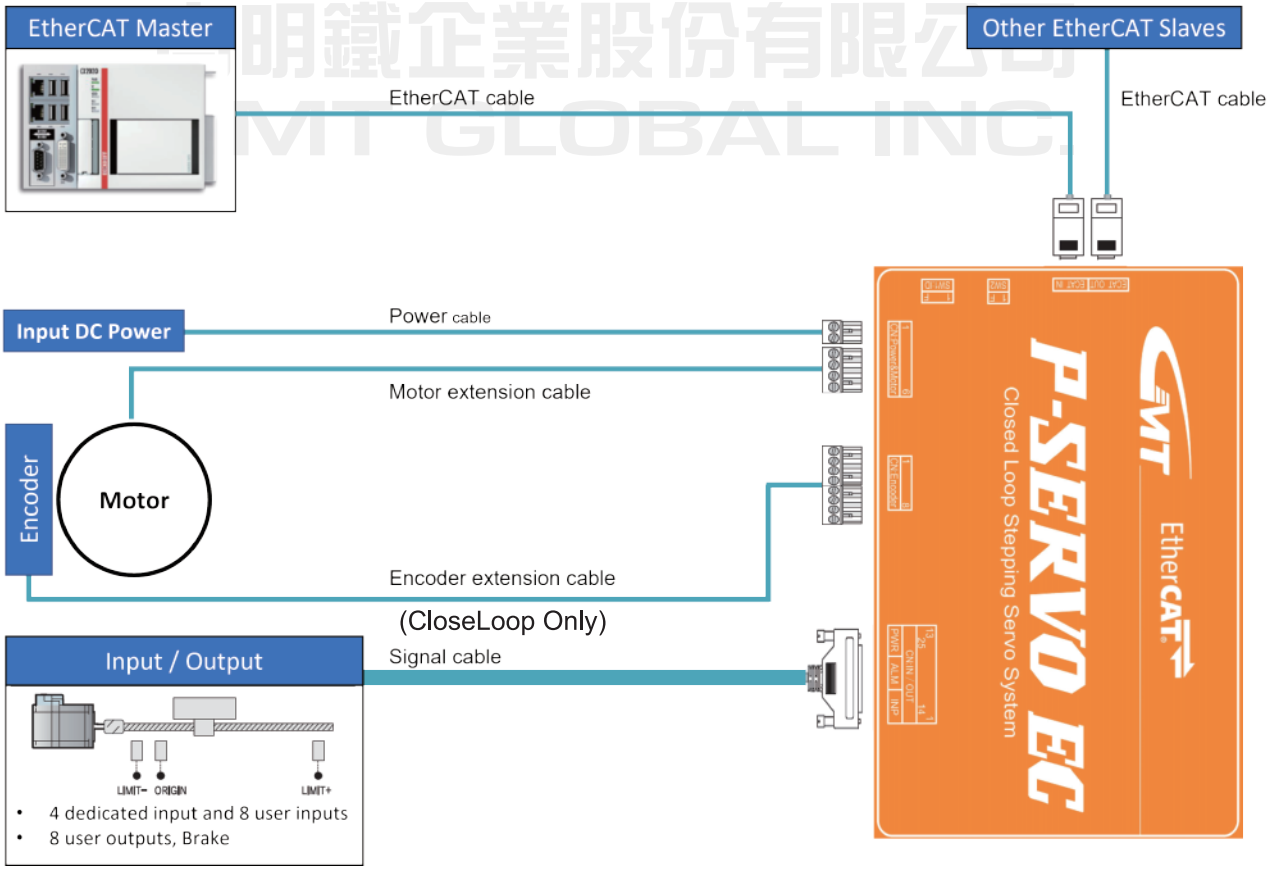
1. CN1：電源與馬達之配線
   請正確連接電源與馬達。
   尤其如將馬達輸出端子連接至電源可能會導致驅動器破損，請注意。
   請使用 AWG#20 以上線材。

2. CN2：編碼器之配線

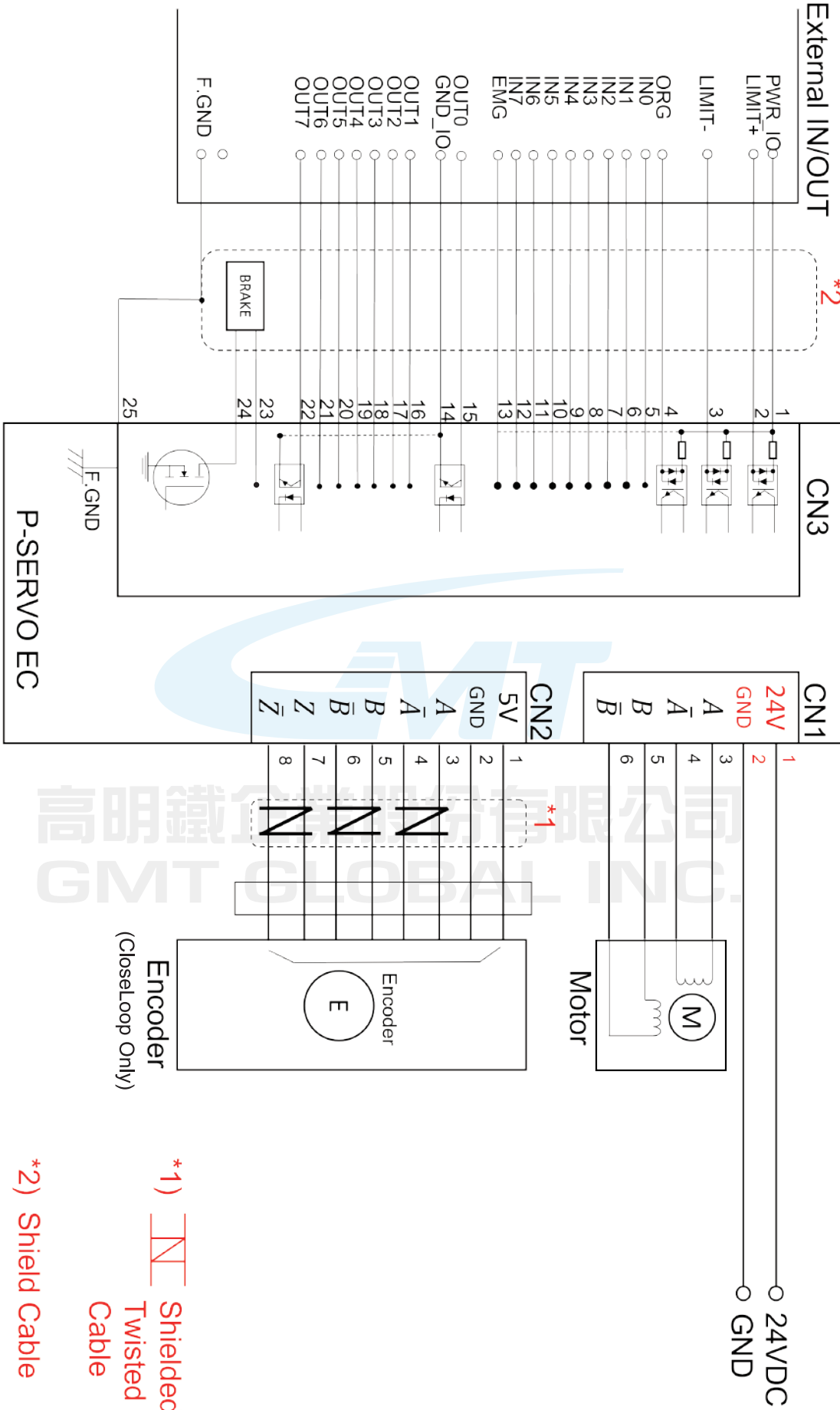
3. CN3：介面信號之配線
   請配線必要之數位輸入和數位輸出信號。
   本輸出／入皆以光耦合絕緣。
   絕緣用電源 (+24V) 請另行準備。

4. CN4：EtherCAT通訊之配線
   請使用 RJ45 接頭。

2.1. 系統方塊圖



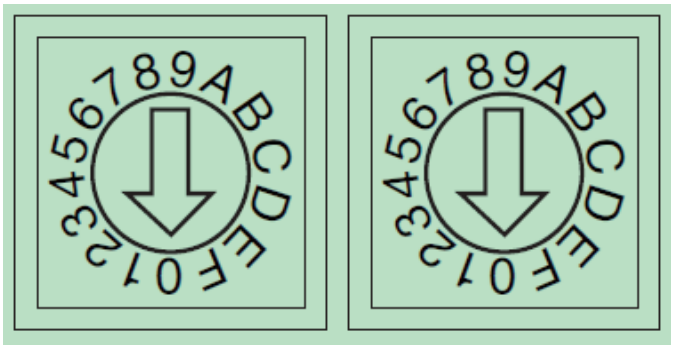
2.3. 外部線路方塊圖



2.4. 外觀與部件名稱

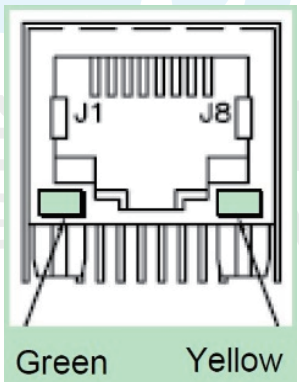
2.4.1. EtherCAT ID

利用二旋鈕變更EtherCAT ID，兩旋鈕分別為16進制高低位，可設定範圍為0x00~0xFF (0~255)。
ID數值設定僅有開機初始化時偵測，偵測完畢後旋轉無效，若需更改必須重新上電。



2.4.2. EtherCAT status LED

此二LED顯示 EtherCAT 封包傳輸當前狀態，詳見下方表格。

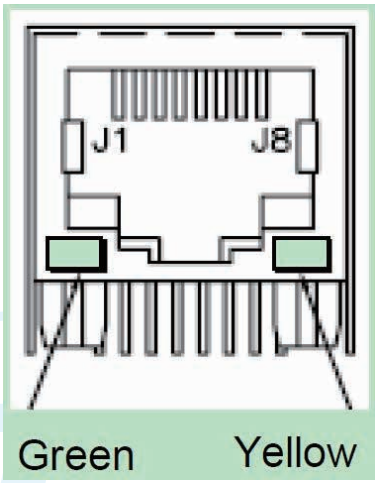


LEDs	LED status	Description
Green	Blinking	Activity
	OFF	No link
Yellow	ON	100/1000-Mbps
	OFF	10-Mbps

2.4.3. EtherCAT Communication Connector (CN4)

透過網路線連接 EtherCAT Master 至驅動器之 ECAT_IN，若有下一驅動器，則透過網路線連結 ECAT_OUT 至下一驅動器之 ECAT_IN。

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



2.4.4. IO Connector(CN3)

驅動器輸入輸出利用光耦合隔離保護，內部光耦合信號ON為導通;OFF為不導通。
信號電壓準位不額外顯示或計算。

Pin No.	Function	I/O
1	24VDC1	Input
2	LIMIT+	Input
3	LIMIT-	Input
4	ORGIN	Input
5	IN0	Input
6	IN1	Input
7	IN2	Input
8	IN3	Input
9	IN4	Input
10	IN5	Input
11	IN6	Input
12	IN7	Input
13	EMG	Input
14	24VDC1_GND	Input
15	OUT0	Output
16	OUT1	Output
17	OUT2	Output
18	OUT3	Output
19	OUT4	Output
20	OUT5	Output
21	OUT6	Output
22	OUT7	Output
23	Break+	Output
24	Break-	Output
25	F.GND	Input

- 輸入訊號：
  - 請準備輸入電路的電源為DC 24V ±10%(電流消耗約為5mA/Pin)

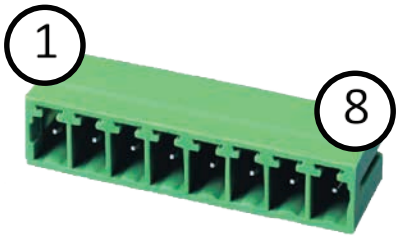
- 輸出訊號：
  - 請準備輸出電路的電源為DC 24V ±10%
  - 可與輸入電路的電源共用，請控制輸出電路的電源規格如下：

- 電源電壓必須低於30V

- 電源電流供給低於15mA

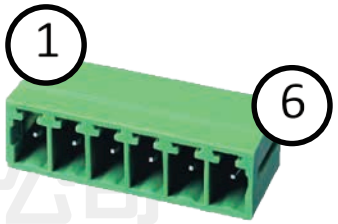
2.4.5. Encoder Connector(CN2)(CloseLoop Only)

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



2.4.6. Power&Motor Connector(CN1)

Pin No.	Function
1	24VDC
2	GND
3	A
4	/A
5	B
6	/B



2.5. 附錄

2.5.1. 接頭規格

Item	Header	Part No.	Manufacturer
CN1 Power&Motor	Male Female	ECH350R-6P EC350V-6P	DINKLE
CN2 (CloseLoop Only) Encoder	Male Female	ECH350R-8P EC350V-8P	DINKLE
CN3 Digital I/O	Male Female	WDBF-25CFPBDR-8.08	WISCONN

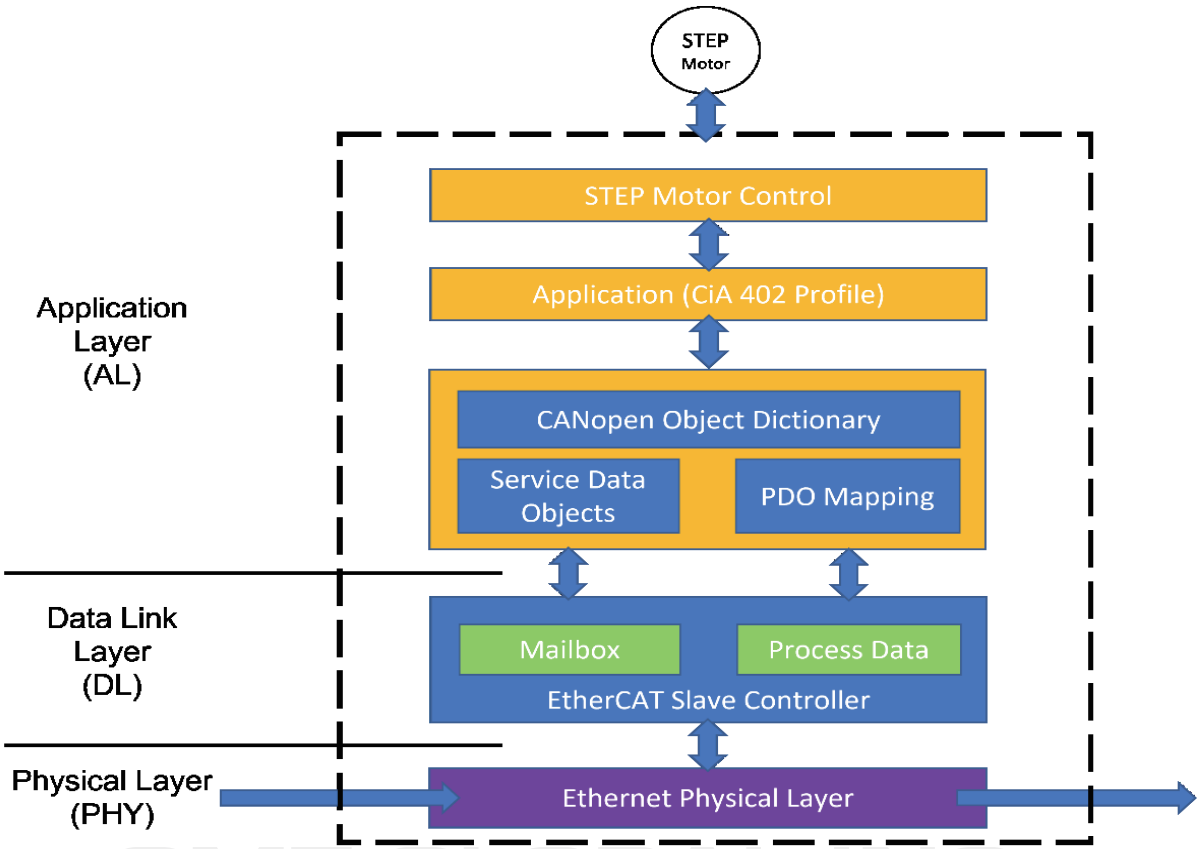
3. EtherCAT通訊協定

EtherCAT 相關名詞縮寫與定義解釋

縮寫	全名
C	Constant
CAN	Controller Area Network
CiA	CAN in Automation
CoE	CANopen over EtherCAT
DC	Distributed Clocks
EEPROM	Electrically-Erasable Programmable Read-Only Memory
ESC	EtherCAT Slave Controller
ESM	EtherCAT State Machine
ETG	EtherCAT Technology Group
EtherCAT	Ethernet for Control Automation Technology
FMMU	Fieldbus Memory Management Unit
FoE	File transfer over EtherCAT
INIT	Initial State
OD	Object Dictionary
PDI	Physical Device Internal Interface
PDO	Process Data Object
PDO mapping	Process Data Object mapping
SAVE	Save to flash memory
SDO	Service Data Object
STLD	Step Loss Detection
PREOP	Pre-Operational
RXPDO	Receive Process Data Object
TXPDO	Transmit Process Data Object
SM	Sync. Manager
RO	Read-Only
RW	Read & Write

3.1. CANopen over EtherCAT

P-SERVO EC 是具 EtherCAT 通訊協定之嵌入式驅動控制器，透過 EtherCAT 支持 CAN 應用通訊協定 CiA402(CANopen over EtherCAT,CoE)。
EtherCAT slave 結構如下圖所示：



3.1.1. 物件字典

Object Dictionary is dictionary of Objects what product has.

3.1.2. Mailbox Communication

Master and Slave commands and receives Service Data Object (SDO) at Mailbox communication (SDO Communication).
This communication method is the way of message transfer and master delivers command and slave responses.
SDO Communication used for setting or confirmation of objects at Object Dictionary.
This communication can be used under Pre-Operation, Safe-Operation, Operation status of controller.

3.1.3. Process Data Communication

Process Data Communication (PDO Communication) commands and receives Process Data Objects (PDO) with Master periodically.
Data that will be delivered and received is already defined at the initial stage of communication by PDO Mapping.
PDO communication is categorized as transmission PDO (following Tx PDO) delivers controller status information and Receipt PDO (following Rx PDO) delivers command from master.
This communication can be used under Operational status of controller and Tx PDO is only available for Safe-Operational.

3.1. PDO Mapping

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

3.2. PDO Mapping

Tx PDO Mapping information to be delivered to Master is to set at 1600h ~ 1601h Object and Rx PDO Mapping information to be received command from master is to set at 1A00h ~ 1A01h Object.
Object ID value, Low level Index value, length of data (bit unit) of data that will be delivered and received are recorded at Mapping Table.

RxPDO Mapping

PDO Map Object		Object Contents		
Index	Sub	Object	Sub	Size
0x1601	1	0x6040	0x00	0x10
0x1601	2	0x607A	0x00	0x20
0x1601	3	0x6081	0x00	0x20
0x1601	4	0x6060	0x00	0x08
0x1601	5	0x0000	0x00	0x00

Application Object List

Object	Sub	Name
0x6040	0x00	Control Word
0x6060	0x00	Mode of Operation
0x607A	0x00	Target Position
0x6081	0x00	Profile Velocity
0x0000	0x00	

RxPDO 1

Control Word	Target Position	Profile Velocity	Mode of Operation

3.2.1. PDO Assign

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

SyncManager
PDO Assign Object

Index	Sub	Object
0x1C12	1	0x1600
0x1C13	1	0x1A00

PDO Mapping Object

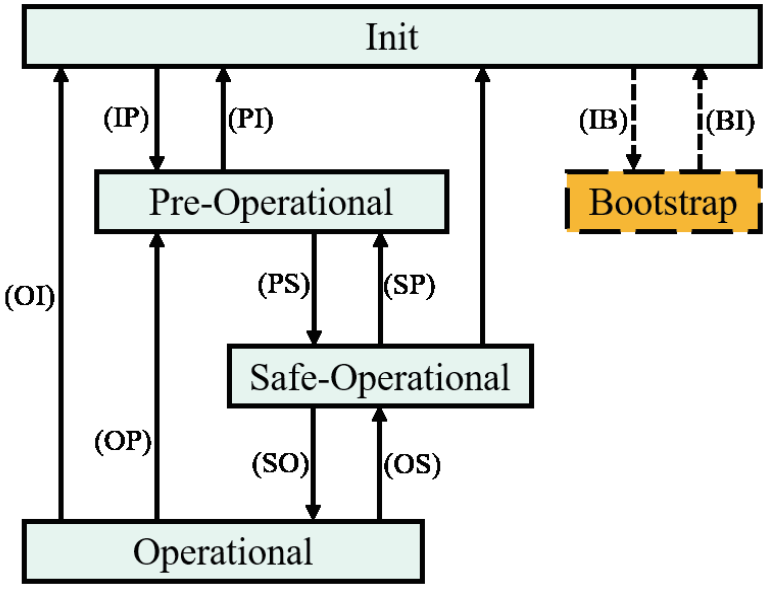
Object	Name
0x1600	Rx PDO Map0
0x1601	Rx PDO Map1
...	
0x1A00	Tx PDO Map0
0x1A01	Tx PDO Map1

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

1C13h is object to assign Tx PDO and can assign one object among Tx PDO Object 1A00h or 1A01h.

3.3. EtherCAT狀態機

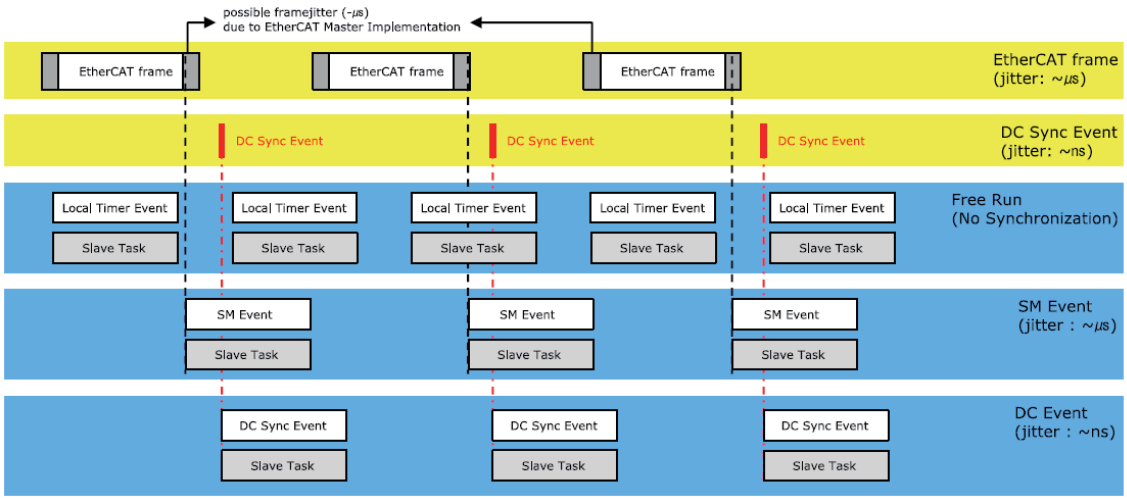
EtherCAT狀態機(EtherCAT State Machine, ESM)，與整個EtherCAT主站與從站之間系統運行協調息息相關，主要由主站發送請求切換狀態命令給從站，而從站接收命令後，根據當前應用層 (Application Layer, AL) 狀態，回覆主站當前狀態並依狀況切換狀態，此狀態命令皆使用固定定址法，避免交握時發生錯誤，狀態機架構圖如圖所示。



狀態	介紹
Init 初始化	此時主站僅能存取資料連結層(Data link Layer, DLL)相關資訊，用於搜尋網路拓樸時使用。
Bootstrap 引導程序階段	選用。此狀態為可更新從站內部firmware，允許FoE協定的通訊訪問。
Pre-Operational 預運行階段	主站此時可由非週期性的Mailbox通訊，與從端之FMMU進行初始化的動作，以利SM與從站建立程序資料物件映射。
Safe-Operational 安全運行階段	主站此時可由週期性的Mailbox通訊持續地進行數據更新，此時從站會確定同步模式是否被設定正確。
Operational 運行階段	主站此時可進行雙向週期通訊。

3.4. 同步模式

Synchronization modes provided from controller are as below.



3.4.1. Free Run

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

3.4.1. SM Event

Controller runs under synchronization with SM Event of EtherCAT communication.
SM Event is generated once controller receives EtherCAT Frame.
Once synchronization by SM Event, each one of controller has few us range of jitter.

3.4.1. DC Sync Event

Synchronized controller runs under Sync Interrupt is generated according to Distributed Clock (following DC).
DC is synchronized time shared between Master and Slave. With synchronized clock, interrupt is generated under accurate synchronization and controller executes commands under accurate timing.
In this case, each one of controller has few us range of jitter.

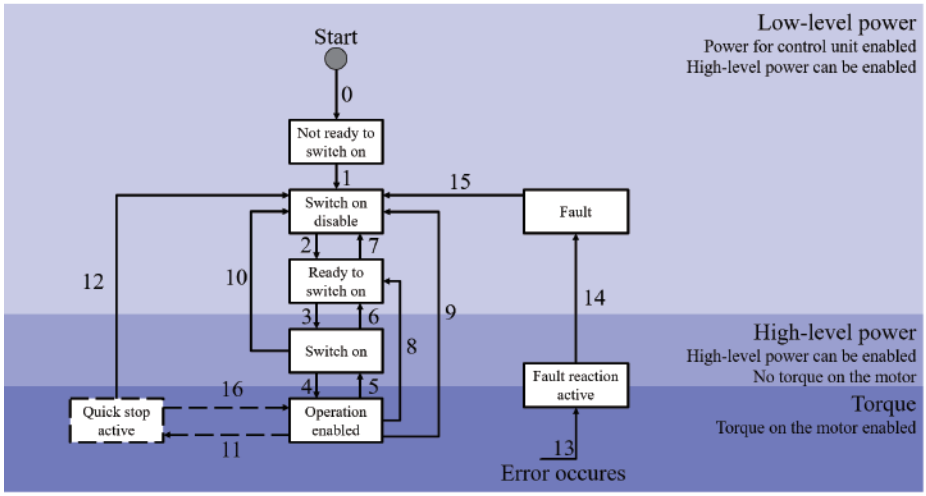
3.5. EtherCAT從端裝置資訊

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

4 . CiA 402驅動器配置文件

4.1. 驅動器狀態機控制

CiA402狀態機透過控制字元(Controlword:0x6040)下命令使狀態機切換當前狀態，讀取當前狀態機狀態可透過狀態字元(Statusword:0x6041)得知，而 CiA402 狀態機之示意圖如圖所示，各狀態介紹詳見表。



狀態	狀態描述
Not ready to switch on	驅動器初始化，並檢查驅動器有無錯誤，驅動級電源尚未準備完成，此時還無法設定驅動器參數。
Switch on disabled	驅動器沒有錯誤，驅動級電源尚未準備完成，此時已經可以設定驅動器參數。
Ready to switch on	驅動器已準備好開始伺服，此時驅動器參數可以設定。
Switch on	驅動級電源已準備完成，驅動器等待致能伺服，此時驅動器參數可以設定。
Operation enabled	驅動器正常運行，馬達已通電可以正常進行運動模式，此時驅動器參數必須為『可運行中更改』的項目才可以設定。
Quick stop active	快速停機致能，此時驅動器參數必須為『可運行中更改』的項目才可以設定。
Fault reaction active	偵測到驅動器發生故障，驅動器正在執行停機，此時驅動器參數必須為『可運行中更改』的項目才可以設定。

CiA402狀態機將電源分為三種狀態：Low-level power、High-level power以及Torque，三種狀態分別為驅動器已供電，但尚未供給馬達電源；驅動器與馬達驅動級皆有電源，但馬達尚未有扭矩能力；驅動器與馬達驅動級皆有電源，此時馬達已有扭矩能力。

Num.	CiA402狀態	Controlword:0x6040
0	Start => Not ready to switch on	None
1	Not ready to switch on => Switch on disable	None
2	Switch on disable => Ready to switch on	0x0006
3	Ready to switch on => Switch on	0x0007
4	Switch on => Operation enabled	0x000F
5	Operation enabled => Switch on	0x0007
6	Switch on => Ready to switch on	0x0006
7	Ready to switch on => Switch on disable	0x0000
8	Operation enabled => Ready to switch on	0x0006
9	Operation enabled => Switch on disable	0x0000
10	Switch on => Switch on disable	0x0000
11	Operation enabled => Quick stop active	0x0002
12	Quick stop active => Switch on disable	None
13	=> Fault reaction active	None
14	Fault reaction active => Fault	None
15	Fault => Switch on disable	0x0080
16	Quick stop active => Operation enabled	0x000F

4.2. 錯誤代碼Error Code

當錯誤發生時，狀態機切換至 ”Fault reaction active”，此時可透過讀取 Error code(0x603F)得知詳細的錯誤訊息，並參照如下表之解決方案初步進行錯誤排除。

Error Code		External Indication	Status	category	解決辦法	Description	警示燈號閃爍次數
Hex	Dec						
0x7501	29953	E_750x_H	ETHERCAT_INITIALIZATION_ERROR	EtherCAT internal error	返原廠維護	EtherCAT模塊init失敗	1
0x7502	29954		ETHERCAT_COMMUNICATION_ERROR			EtherCAT模塊周邊通訊失敗	
0xFF01	65281	E_FF0x_H	OVER_SPEED_ERROR	DRIVE Motion error	降低負載，降低操作速度	過速度，負載過大導致，或encoder接線接觸不良	2
0xFF02	65282		POSITION_TRACKING_ERROR			負載過大，無法跟上位置命令允許誤差區間	
0xFF03	65283		IN_POSITION_ERROR			in-position訊號異常	
0xFF11	65297	E_FF1x_H	MOTOR_ENCODER_CONNECTION_ERROR	DRIVE error	減輕負載或檢查接線是否異常或接觸不良	迴路錯誤	3
0xFF12	65298		DRIVE_OVERHEAT			過熱	
0xFF13	65299		DRIVE_PHASE_A_SHORT2SUPPLY			馬達異常或驅動級異常	
0xFF14	65300		DRIVE_PHASE_B_SHORT2SUPPLY			馬達異常或驅動級異常	
0xFF15	65301		DRIVE_PHASE_A_SHORT2GND			馬達異常或驅動級異常	
0xFF16	65302		DRIVE_PHASE_B_SHORT2GND			馬達異常或驅動級異常	
0xFF21	65313	E_FF2x_H	EMERGENCY_BUTTON_RESET_ERROR	EMERGENCY BTN reset error	緊急停止按鈕被觸發，請解除觸發狀態	緊急停止按鈕未被清除	4
0xFF31	65329	E_FF3x_H	INTERNAL_INIT_ERROR	DRIVE peripheral init	返原廠維護	內部通訊異常或IC損壞	5
0xFF41	65345	E_FF4x_H	HOMING_ERROR	Homing error	檢查極限開關之線路是否異常被觸發，或是檢測是否有雜物遮蔽導致誤觸發	復歸發生錯誤	6
0xFF42	65346		LIMIT_SWITCH_ERROR			極限開關狀態異常	
0xFF51	65361	E_FF5x_H	DATAFLASH_INITIALIZATION_ERROR	DATAFLASH error	返原廠維護	Dataflash初始化失敗	7
0xFF52	65362		DATAFLASH_READ_ERROR			Dataflash讀取失敗	
0xFF53	65363		DATAFLASH_WRITE_ERROR			Dataflash寫入失敗	

4.3. 操作模式Mode of operation

透過變更 Mode of operation(0x6060) 對驅動器進行模式切換，當前模式將會顯示在 Mode of operation display(0x6061)。
不同操作模式下，Controlword(0x6040) 與 Statusword(0x6041) 些許的bit將會有不同的定義，詳見後續小節介紹。

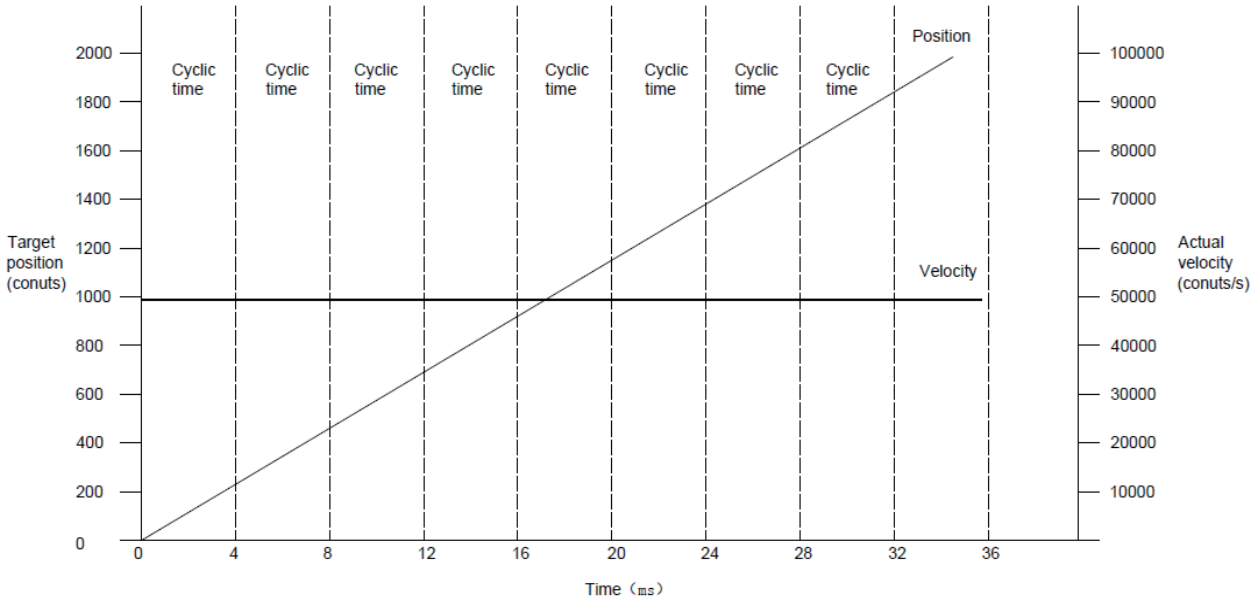
本驅動器支援之操作模式如下表所示:

Mode of operation	描述
1	Profile Position Mode(輪廓位置模式)
3	Profile Velocity Mode(輪廓速度模式)
6	Homing Mode(原點模式)
8	Cyclic Synchronous Position Mode(同步位置模式)
9	Cyclic Synchronous Velocity Mode(同步速度模式)

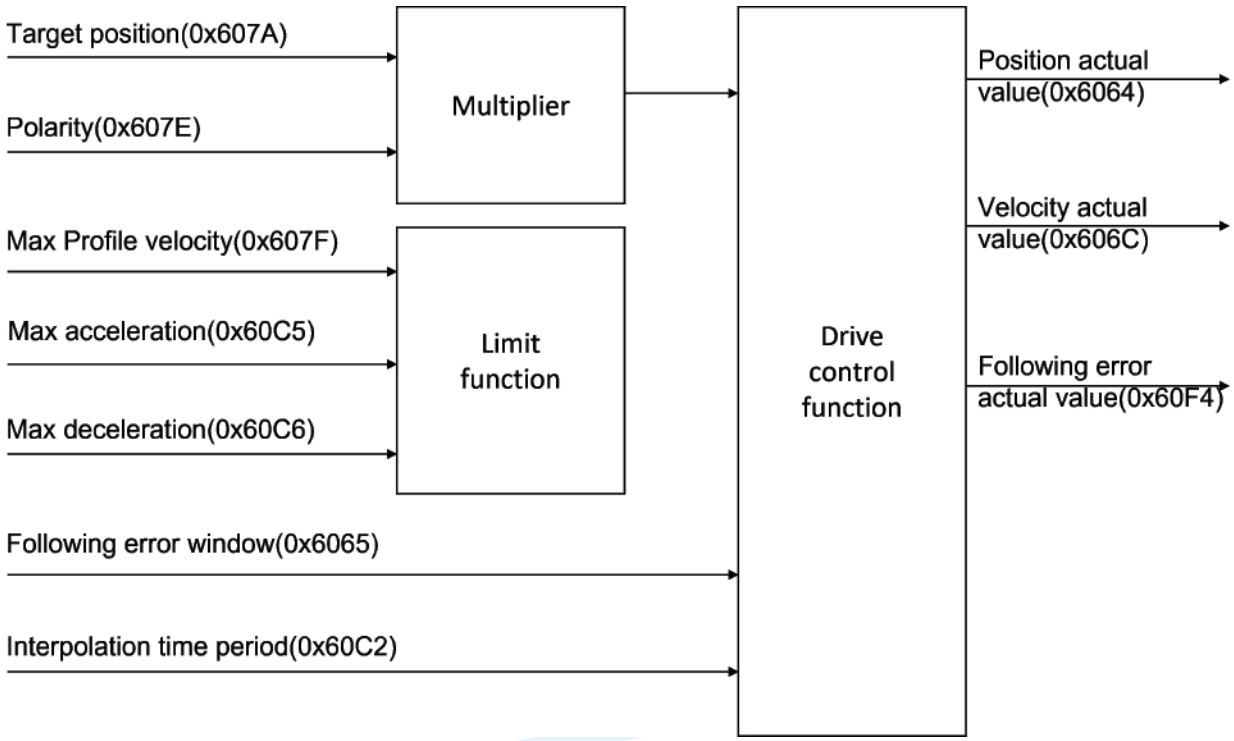
4.4. 同步位置模式Cyclic Synchronous Position Mode

4.4.1. 定義

Cyclic Synchronous Position mode(CSP Mode) assigns target position to controller by Master' s operation profile creation function through cyclic communication. Controller internally executes position / velocity control with receipt of target position in each cycle.
To use CSP Mode, Mode of operation (6060h) Cyclic Synchronous Position Mode needs to be set. Mode of operation display (6061h) is shown as Cyclic Synchronous Position Mode, Target position transmitted from master :
Object 607Ah: Target position is executed.



4.4.2. 相關物件



4.4.2. Control word and Status word

Control word under CSP Mode are as follows.

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

Status word under CSP Mode are as follows.

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

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

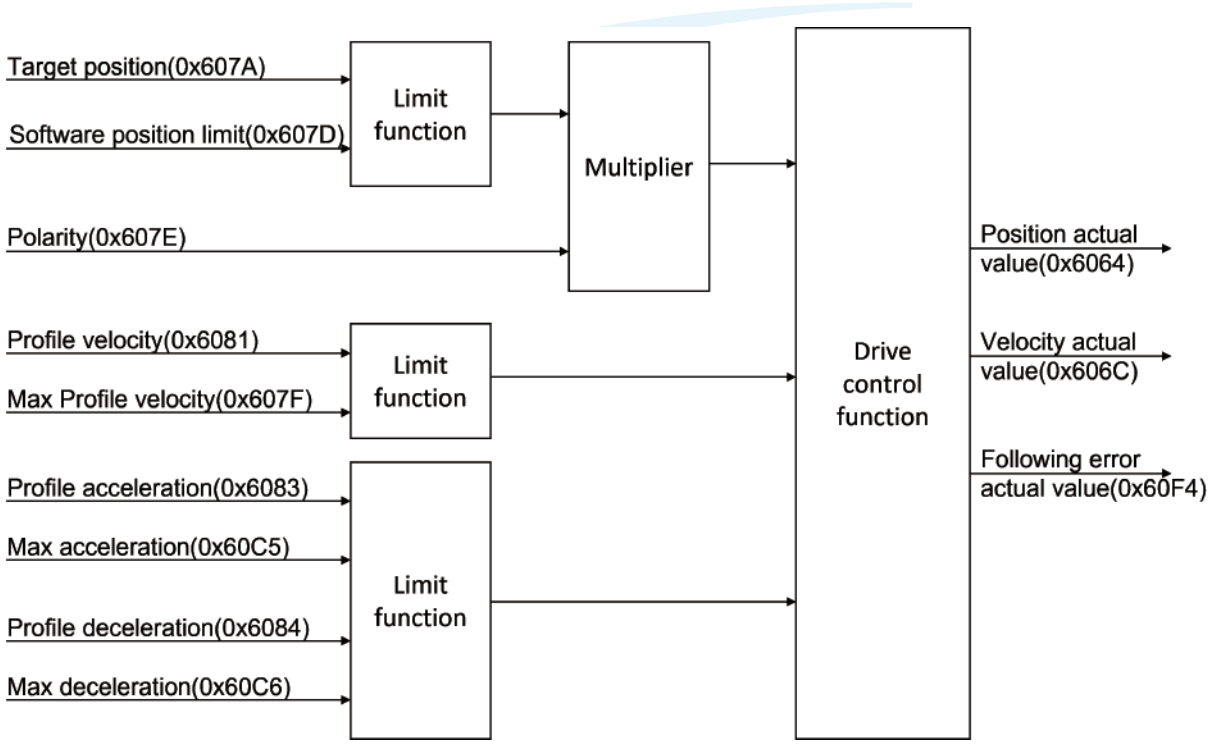
Bit	Value	Description
12	0	Target position value ignored.
	1	Target position value executed.
13	1	Following Error generated.

4.5 輪廓位置模式Profile Position Mode

4.5.1. 定義

Position control mode is to move to target position of Target position (607Ah) object with receipt of Control word (6040h) input.
It is general Point to point operation. To use position control mode, need to set Profile Position Mode at Mode of operation (6060h).
Mode of operation display (6061h) is shown as Profile Position Mode, ready to use position control command.

4.5.2. 相關物件



4.5.3. Control word and Status word

Control word under PP mode are as follows.

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

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

Bit	Value	Description
6	0 1	Target position (607Ah) is absolute position. Target position (607Ah) is relative position.
8	1	Position movement command canceled and stops according to set action at Halt option code (605Dh).

Status word under PP mode are as follows.

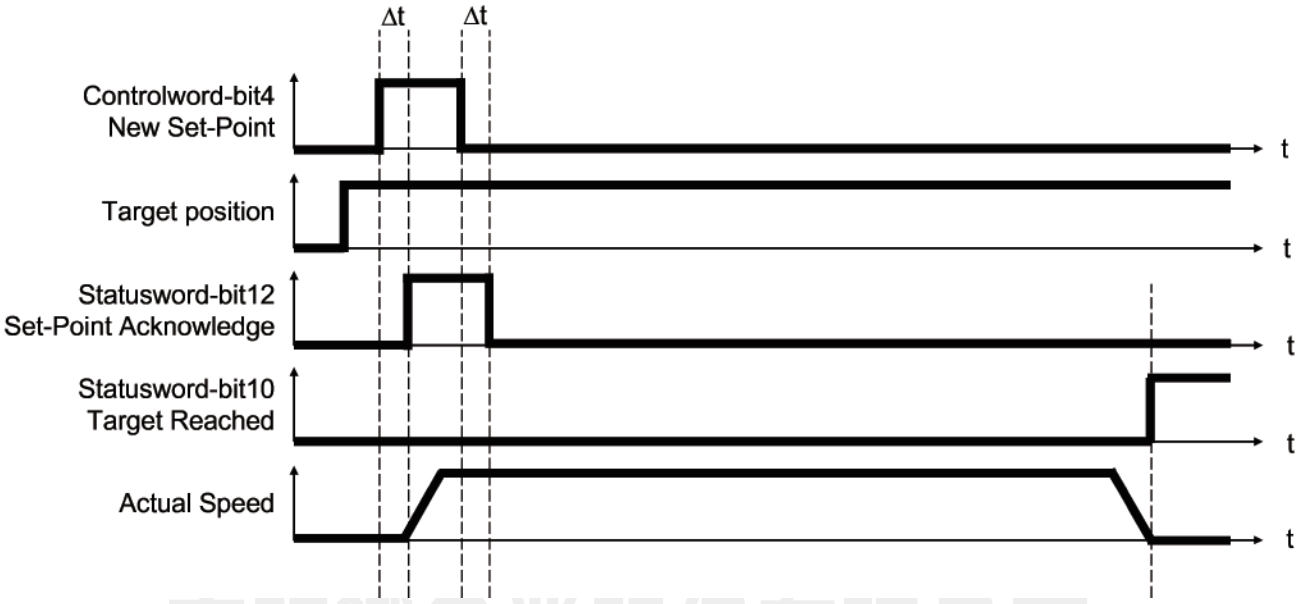
Bit	Name	Description
0	Ready to switch on	
1	Switched on	
2	Operation enabled	
3	Fault	
4	Voltage enabled	
5	Quick stop	
6	Switch on disabled	
7	Reserved	
8	Reserved	
9	Remote	
10	Target Reached	Reached at target position
11	Internal Limit Active	
12	Set-point Acknowledge	'New Set-Point' Response
13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

Bit	Value	Description
10	0	Control Word of Halt(Bit 8) = 0: Not reached at the target position. Control Word of Halt(Bit 8) = 1: Stop status of controller.
	1	Control Word of Halt(Bit 8) = 0: Reached at the target position. Control Word of Halt(Bit 8) = 1: Controller stops.
12	0	Control Word of New Set-Point(Bit 4) has reset and previous position movement com- mand processed. Able to input new position.
	1	Control word of New Set-Point(Bit 4) is already set or previous position movement com- mand is under processing.
13	1	Following Error generated.

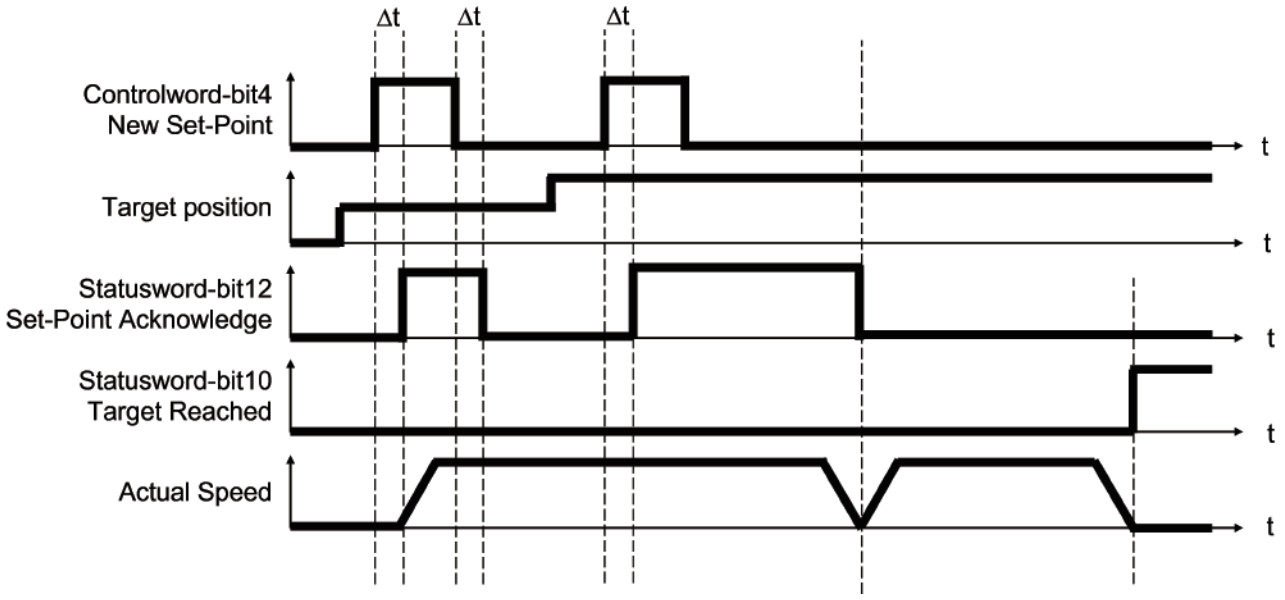
4.5.4. Position movement method

1. General Movement(New Set-Point)

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



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

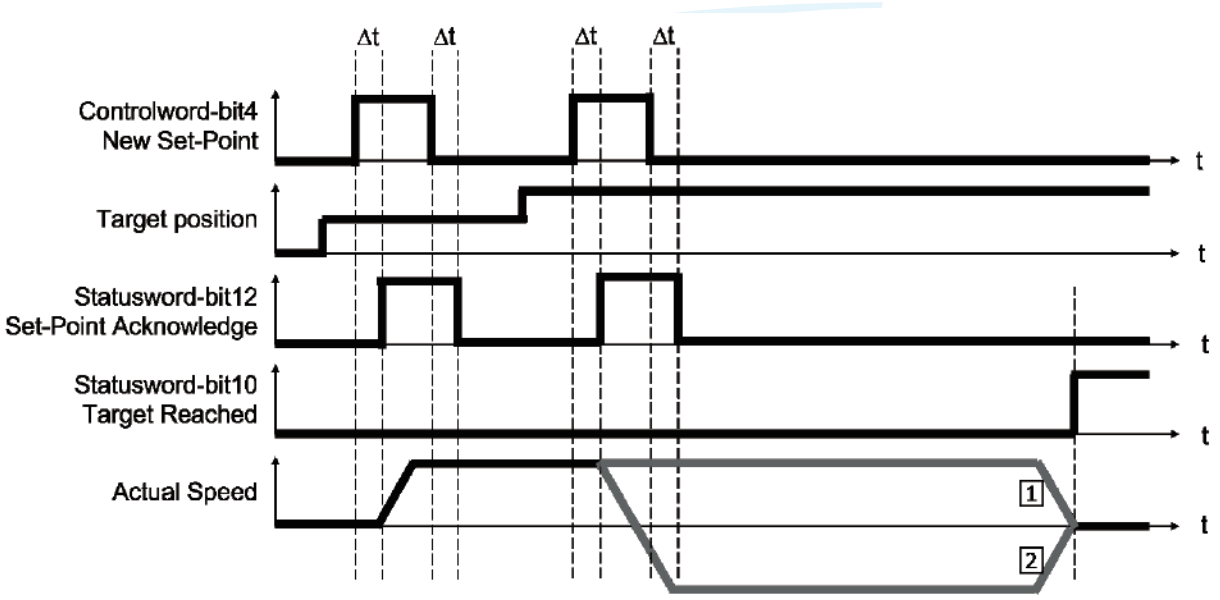


Once reaches at target position, Status word of Target Reached (Bit 10) goes to SET.
If it does not reach at target position due to error or status as below, Target Reached (Bit 10) can not be changed as SET.

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

2. Target position override

In case of using Control word of Change Set Immediately (Bit 5) under SET status during position movement command, able to cancel currently operating position movement command and immediately move to new target position. If a new target position movement command incoming when the last command is not finished yet, the new target position movement command will be executed immediately.



1. If new target position is sufficiently ahead of previous target position, it will move to new target position passing by previous target position.

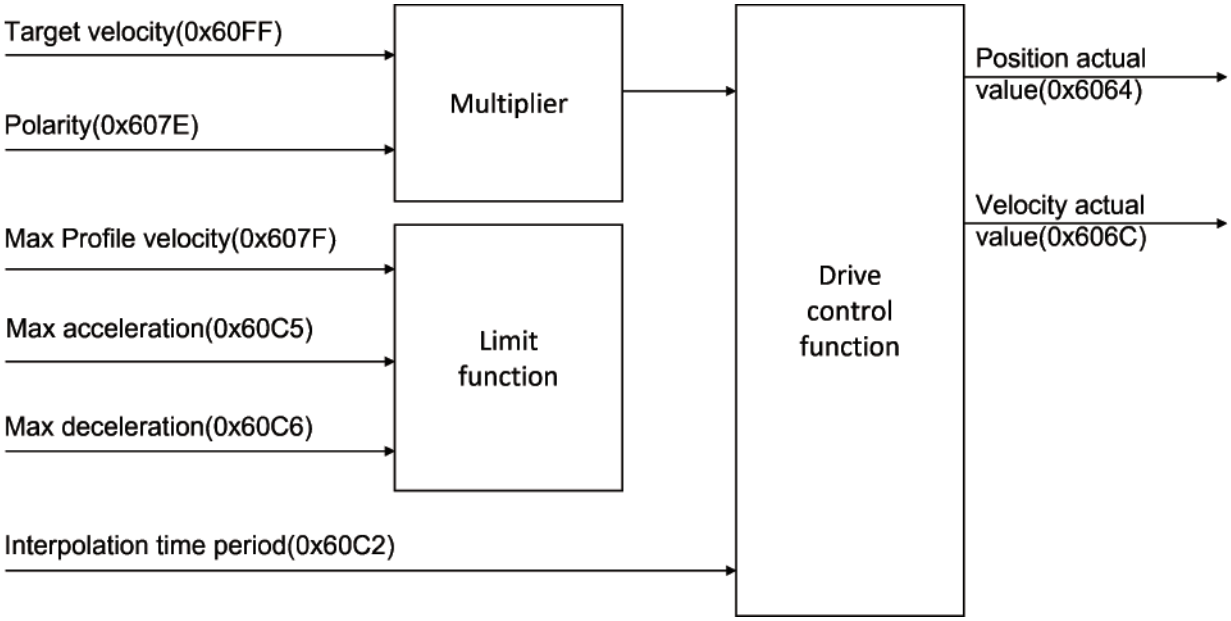
2. If new target position is behind of previous target position, it will be decelerated according to correspondent position and if need, it can stop and move to opposite direction. If there is no previous position movement command or already completed, command under Change Set Immediately (Bit 5) under SET status is same as general position movement command.

4.6. 同步速度模式Cyclic Synchronous Velocity Mode

4.6.1. 定義

Cyclic Synchronous Velocity mode(CSV Mode) assigns target velocity to controller by Master's operation profile creation function through cyclic communication. Controller internally executes position / velocity control with receipt of target velocity in each cycle. To use CSV Mode, Mode of operation (6060h) Cyclic Synchronous Position Mode needs to be set. Mode of operation display (6061h) is shown as Cyclic Synchronous Velocity Mode, Target velocity transmitted from master : Object 60FFh: Target velocity is executed.

4.6.2. 相關物件



4.6.3. Control word and Status word

Control word under CSP Mode are as follows.

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

Status word under PP mode are as follows.

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

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

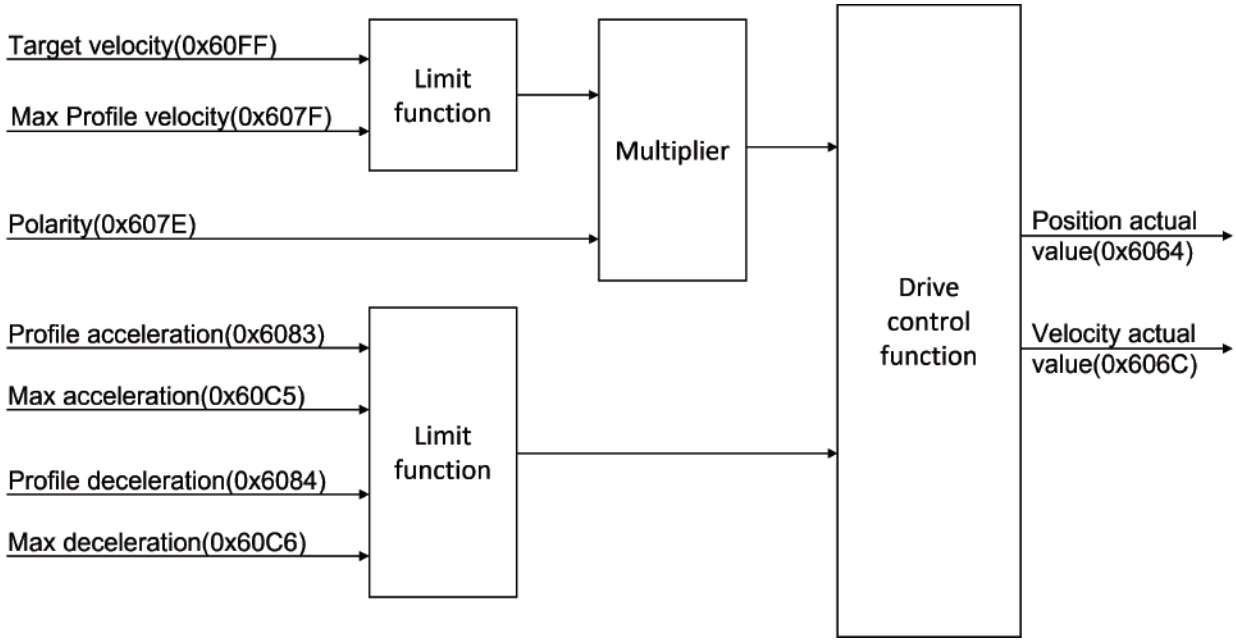
Bit	Value	Description
12	0	Target velocity value ignored.
	1	Target velocity value executed.

4.7. 輪廓速度模式Profile Velocity Mode

4.7.1. 定義

Profile Velocity control mode is a simple operation mode to control drive speed.
User only need to set Target velocity(60FFh), Profile acceleration(6083h) and Profile deceleration(6084h), then the drive will execute the velocity control command according to the settings.
To use velocity control mode, need to set Profile Velocity Mode at Mode of operation (6060h).
Mode of operation display (6061h) is shown as Profile Velocity Mode, ready to use velocity control command.

4.7.2. 相關物件



4.7.3. Control word and Status word

Control word under PV mode are as follows.

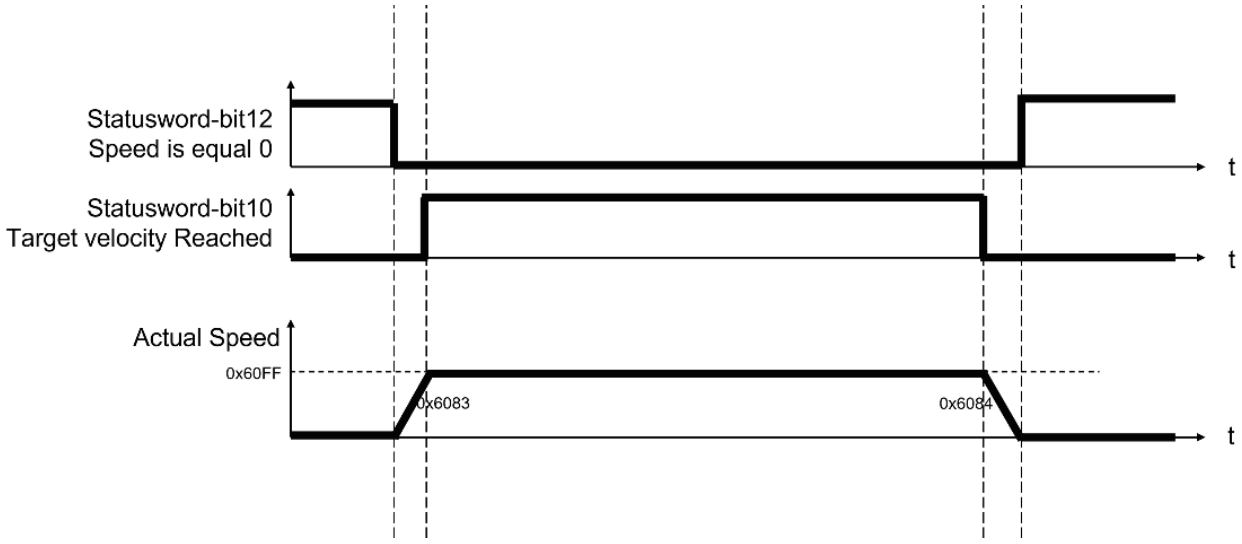
Bit	Name	Description
0	Switch On	
1	Enable Voltage	
2	Quick Stop	
3	Enable Operation	
4~6	Reserved	
7	Fault Reset	
8	Halt	Stop command
9 ～ 15	Reserved	

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

Status word under PV mode are as follows.

Bit	Name	Description
0	Ready to switch on	
1	Switched on	
2	Operation enabled	
3	Fault	
4	Voltage enabled	
5	Quick stop	
6	Switch on disabled	
7	Reserved	
8	Reserved	
9	Remote	
10	Target Reached	Reached at target velocity
11	Internal Limit Active	
12	Speed	Current velocity is equal 0
13	Reserved	
14	Reserved	
15	Reserved	

Bit	Value	Description
10	0	Control Word of Halt(Bit 8) = 0: Not reached at the target velocity. Control Word of Halt(Bit 8) = 1: Axis decelerates.
	1	Control Word of Halt(Bit 8) = 0: Reached at the target velocity. Control Word of Halt(Bit 8) = 1: Axis actual velocity is 0.
12	0	Speed is not equal 0.
	1	Speed is equal 0.

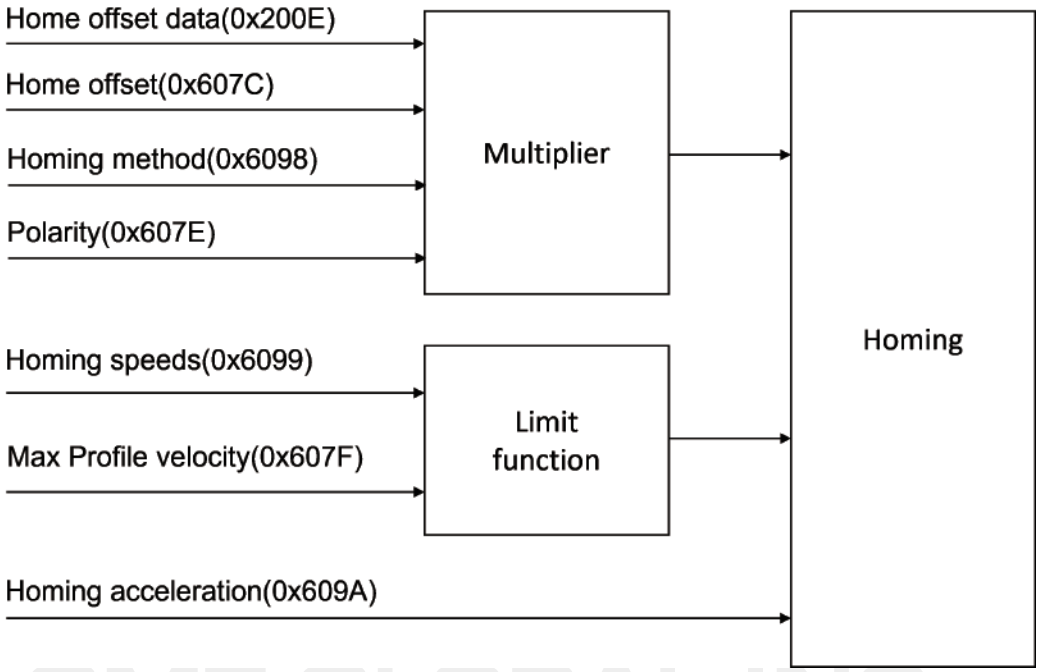


4.8. 原點模式Homing Mode

4.8.1. 定義

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

4.8.2. 相關物件



There are 4 kinds (Origin Switch, Positive Limit Switch, Negative Limit Switch, Index pulse of Encoder) switches to find out origin. And it can be differentiated by Homing Method (6098h).
If it is not Homing method by Limit Switch, once Limit Switch goes ON during origin searching, it will move to opposite direction against movement direction. During motion towards opposite direction, if opposite side of Limit Switch goes ON, origin search goes failure.
If Sensor origin and mechanical origin is different, able to set with using Home Offset (607Ch).
Once position of mechanical origin is set to Home Offset, Status word - bit 12: Home Attained is going to be ON and position objects will be initialized.
When Homing finished, current actual position will be assigned 0. User can set “Object 200Eh:Homing offset data” to a non-zero value, the next Homing finished current actual position will be assigned “Homing offset data.”

4.8.3. Control word and Status word

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

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

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

Status word at Homing Mode are as follows.

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

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

4.8.4. 原點探索方式

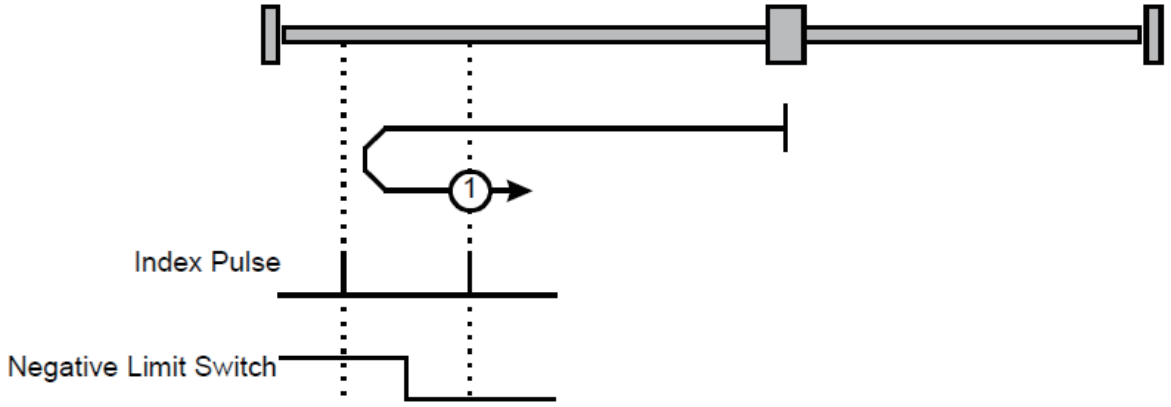
Homing method	Name
1	Homing on Negative Limit Switch and Index Pulse
2	Homing on Positive Limit Switch and Index Pulse
3	Homing on Positive Origin Switch and Index pulse(Negative direction)
4	Homing on Positive Origin Switch and Index pulse(Positive direction)
5	Homing on Negative Origin Switch and Index pulse(Positive direction)
6	Homing on Negative Origin Switch and Index pulse(Negative direction)
7	Homing on Origin Switch (Positive Direction, Positive Edge) and Index Pulse(Negative direction)
8	Homing on Origin Switch (Positive Direction, Positive Edge) and Index Pulse(Positive direction)
9	Homing on Origin Switch (Positive Direction, Negative Edge) and Index Pulse(Negative direction)
10	Homing on Origin Switch (Positive Direction, Negative Edge) and Index Pulse(Positive direction)
11	Homing on Origin Switch (Negative Direction, Positive Edge) and Index Pulse(Positive direction)
12	Homing on Origin Switch (Negative Direction, Positive Edge) and Index Pulse(Negative direction)
13	Homing on Origin Switch (Negative Direction, Negative Edge) and Index Pulse(Positive direction)
14	Homing on Origin Switch (Negative Direction, Negative Edge) and Index Pulse(Negative direction)
15,16	Reserved
17	Homing on Negative Limit Switch
18	Homing on Positive Limit Switch
19	Homing on Origin Switch(Positive Direction, Positive Edge and Negative Direction stop on Negative Edge)
20	Homing on Origin Switch(Positive Direction, Positive Edge and stop)
21	Homing on Origin Switch(Positive Direction, Negative Edge and stop)
22	Homing on Origin Switch(Positive Direction, Negative Edge and Negative Direction stop on Positive Edge)
23	Homing on Origin Switch(Positive Direction, Positive Edge and Negative Direction stop on Negative Edge)
24	Homing on Origin Switch(Positive Direction, Positive Edge and stop on Positive Edge with Positive Limit Protection)
25	Homing on Origin Switch(Positive Direction, Negative Edge and Negative Direction stop on Positive Edge)
26	Homing on Origin Switch(Positive Direction, Negative Edge and stop on Negative Edge with Positive Limit Protection)
27	Homing on Origin Switch(Negative Direction, Positive Edge and Positive Direction stop on Negative Edge)
28	Homing on Origin Switch(Negative Direction, Positive Edge and stop on Positive Edge with Negative Limit Protection)
29	Homing on Origin Switch(Negative Direction, Negative Edge and Positive Direction stop on Positive Edge)
30	Homing on Origin Switch(Negative Direction, Negative Edge and stop on Negative Edge with Negative Limit Protection)
31,32	Reserved
33	Homing Index Pulse (Negative Direction)
34	Homing Index Pulse (Positive Direction)
35,36	Reserved
37	Set the current position origin and reset current position
38~127	Reserved
-1~-128	Reserved

Note：Homeing method included “Index Pulse”，support only for CloseLoop type Driver.

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

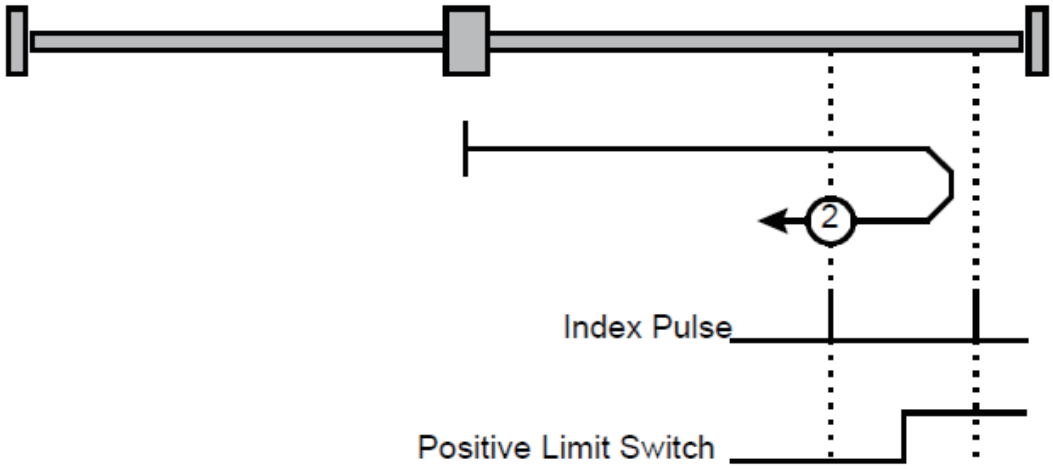
• Method 1: Homing on negative limit switch and index pulse

Using this method as shown in figure, the initial direction of movement shall be leftward if the negative limit switch is inactive (here: low). The home position shall be at the first index pulse to the right of the position where the negative limit switch becomes inactive.



• Method 2: Homing on positive limit switch and index pulse

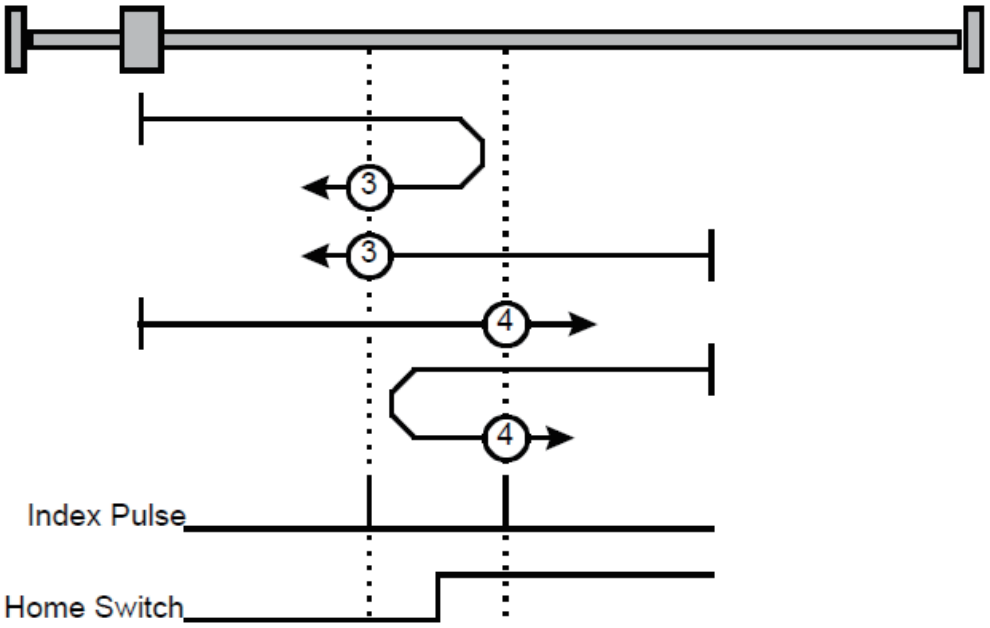
Using this method as shown in figure, the initial direction of movement shall be rightward if the positive limit switch is inactive (here: low). The position of home shall be at the first index pulse to the left of the position where the positive limit switch becomes inactive.



• Method 3 and 4: Homing on positive home switch and index pulse

Using these methods as shown in figure, the initial direction of movement shall be dependent on the state of the home switch. The home position shall be at the index pulse to either to the left or the right of the point where the home switch changes state.

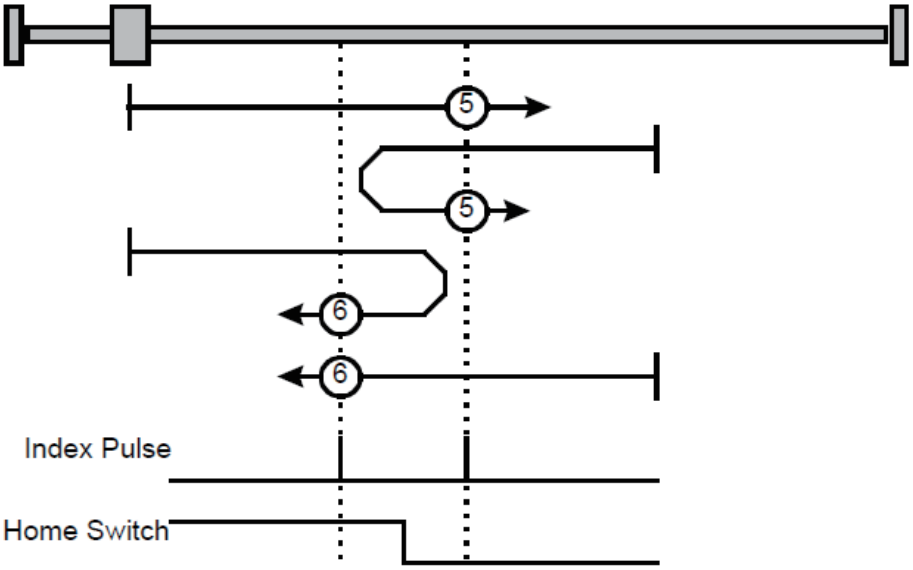
If the initial position is situated so that the direction of movement shall reverse during homing, the point at which the reversal takes place is anywhere after a change of state of the home switch.



• Method 5 and 6: Homing on negative home switch and index pulse

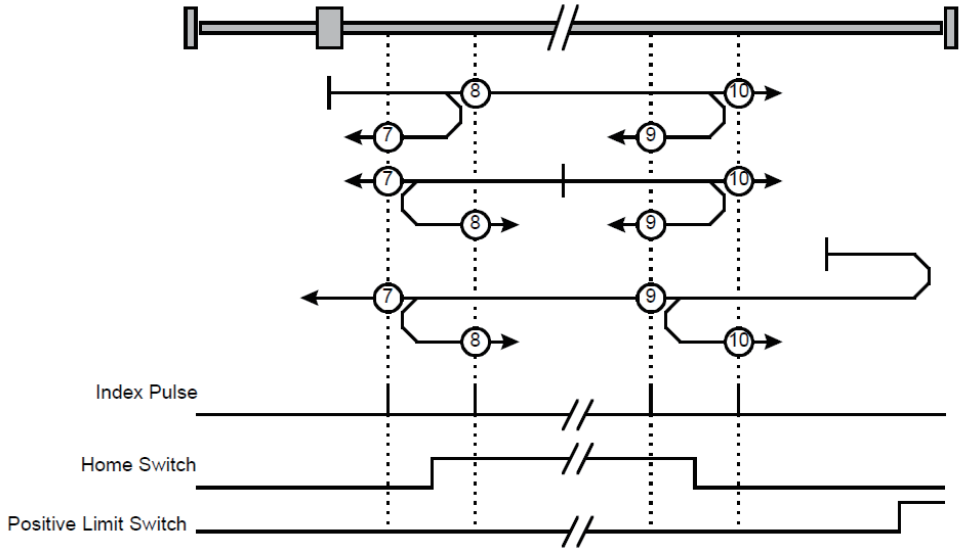
Using these methods as shown in figure, the initial direction of movement shall be dependent on the state of the home switch. The home position shall be at the index pulse to either to the left or the right of the point where the home switch changes state.

If the initial position is situated so that the direction of movement shall reverse during homing, the point at which the reversal takes place is anywhere after a change of state of the home switch.



• Method 7 to 14: Homing on home switch and index pulse

These methods use a home switch, which is active over only a portion of the travel, in effect the switch has a ‘momentary’ action as the axis's position sweeps past the switch. Using the methods 7 to 10, the initial direction of movement shall be to the right, and using methods 11 to 14, the initial direction of movement shall be to the left except if the home switch is active at the start of the motion. In this case, the initial direction of motion shall be dependent on the edge being sought. The home position shall be at the index pulse on either side of the rising or falling edges of the home switch. If the initial direction of movement leads away from the home switch, the drive shall reverse on encountering the relevant limit switch.

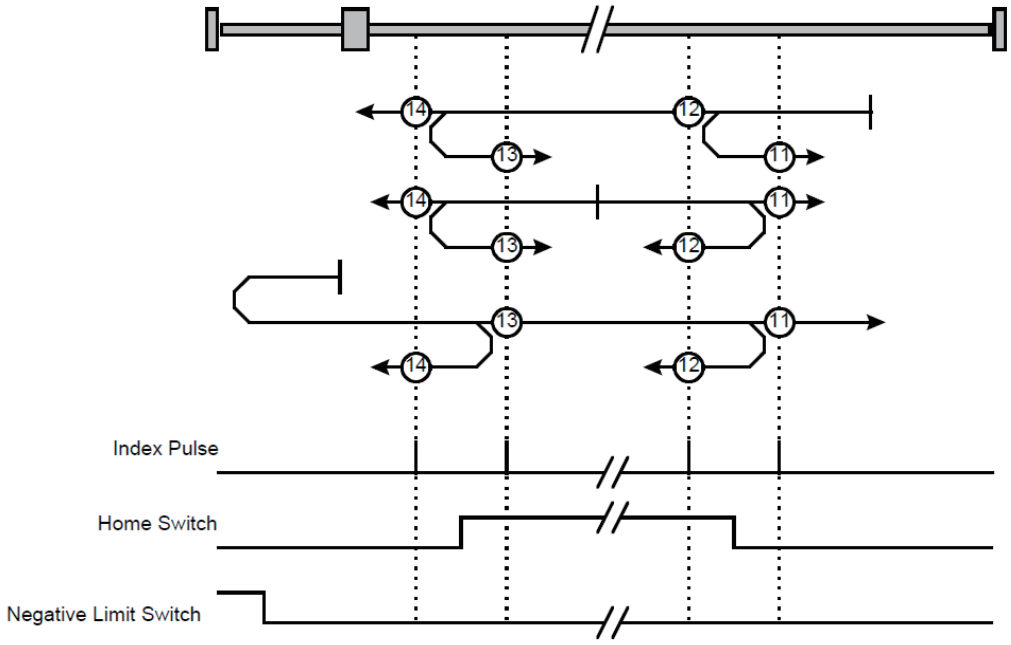


• Method 15 and 16: Reserved

• Method 17 to 30: Homing without index pulse

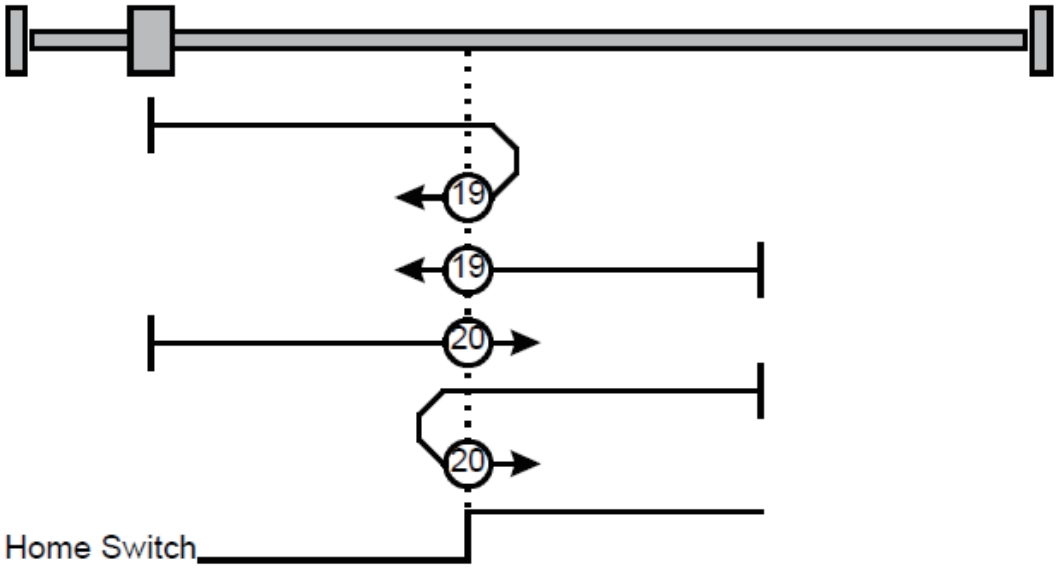
These methods are similar to methods 1 to 14 except that the home position is not dependent on the index pulse but only dependent on the relevant home or limit switch transitions.

For example methods 19 and 20 are similar to methods 3 and 4 as shown in figure.



• Method 31 and 32: Reserved
• Method 33 and 34: Homing on index pulse

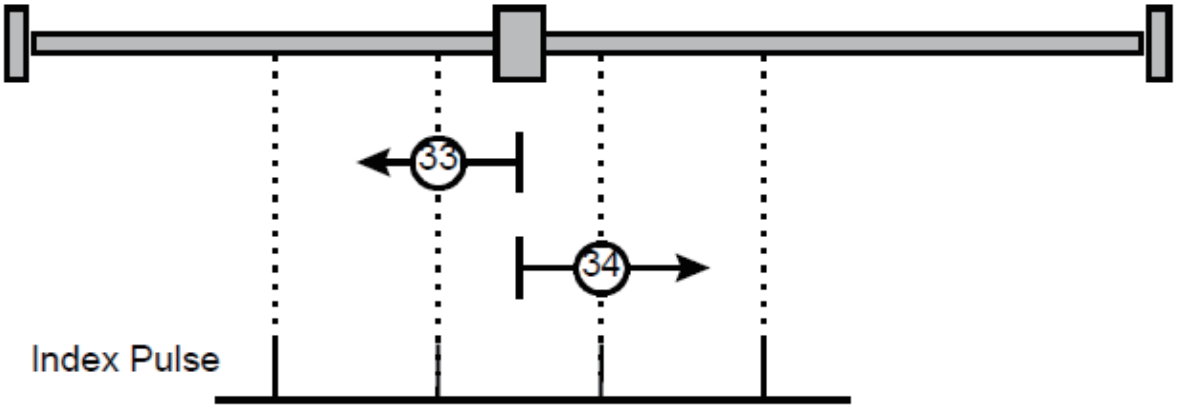
Using these methods, the direction of homing is negative or positive respectively. The home position shall be at the index pulse found in the selected direction as shown in figure.



• Method 35 and 36: Reserved
• Method 37: Homing on current position

This method is mandatory if homing mode is supported. In this method, the current mechanical position shall be defined as a machine home position(in user-defined position units). This method does not require the drive device to be in operation enabled state. At the home position (i.e. after the homing process) the position actual value (6064h) is calculated as follows:

Position actual value (6064h) = Home offset (607Ch)



4.9. 探針功能Touch Probe Function

4.9.1. 定義

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

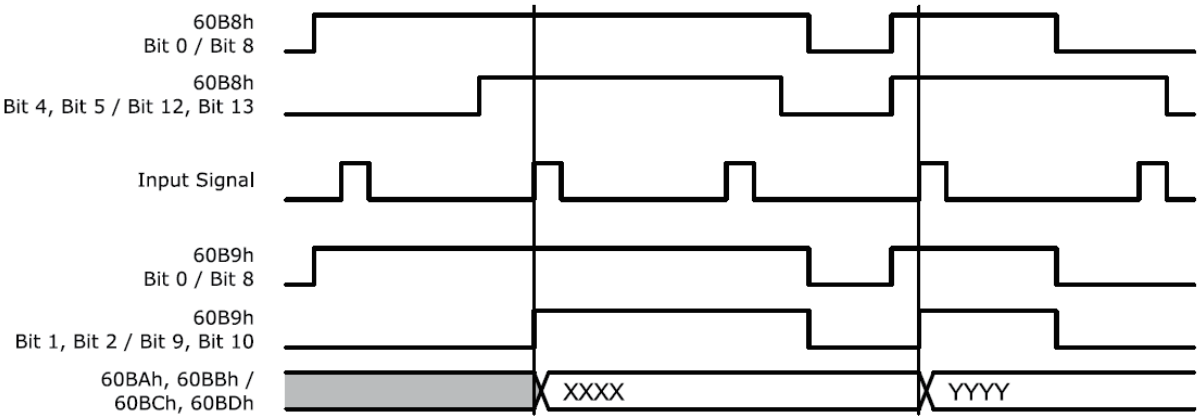
4.9.2. 相關物件

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

4.9.3. 定義

1. Touch Probe Operation : Acknowledge initial signal

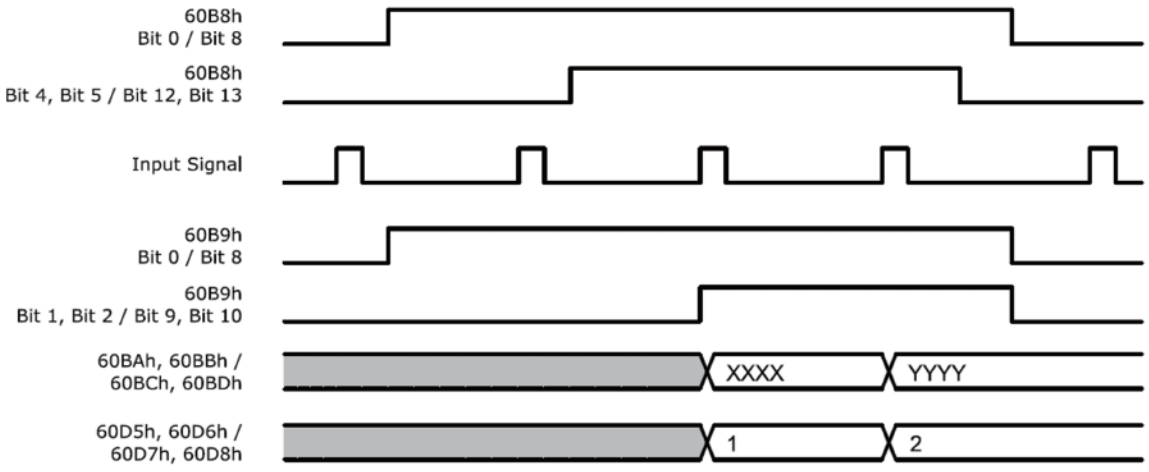
If Touch probe function of bit number 1, 9 has set as 0, Touch probe only uses initially acknowledged signal after Enable. Please refer to Timing chart as follow.



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

2. Touch Probe Operation : Continuous signal acknowledgement

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



4.10. 數位輸入輸出控制Digital Input and Output

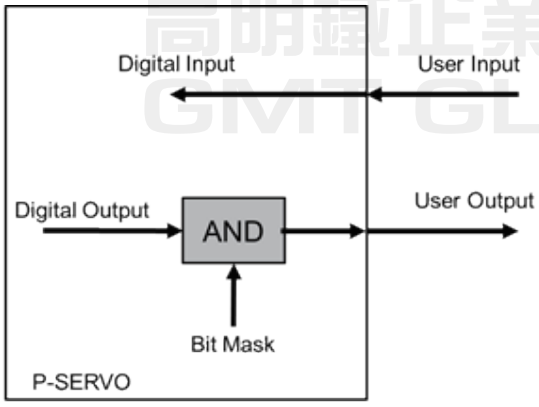
4.10.1. 定義

P-SERVO EC provides 4 default input (ORIGIN, LIMIT+, LIMIT-,EMG) and 8 user inputs and also 1 default output (BRAKE) and 8 user outputs.

4.10.2. 相關物件

Object	Access	Description
Object 60FDh: Digital inputs	RO	Indicates input signals.
Object 60FEh: Digital outputs Sub-Index 1 - Physical Outputs Sub-Index 2 - Bit Mask	 R/W R/W	 Set output signals. Set output signals.
Object 200Bh: REF_LEVEL	R/W	Set Active Level of ORIGIN, LIMIT+, LIMIT- input signals.
Object 200Ch: EMI_BTN_LEVEL	R/W	Set Active Level of the EMI button input signals.
Object 2010h: Brake delay	R/W	Set Delay at BRAKE output
Object 2012h: Limit Switch Opposite	R/W	Set Limit Switch Opposite.

4.10.3. User Input/Output



Digital Input	Open From 24VDC1_GND (Default)	Short To 24VDC1_GND
Value	1	0

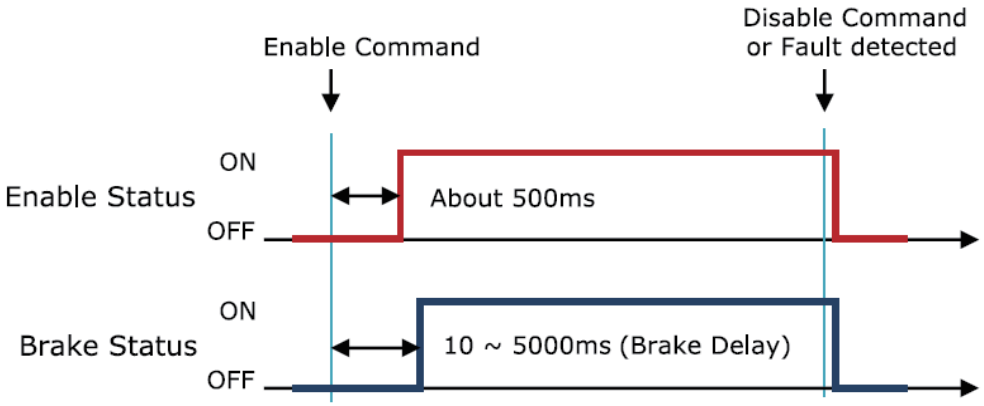
Digital Output	0(Default)	1
Status	Short To 24VDC1_GND	Open From 24VDC1_GND

4.10.4. ORIGIN and LIMIT Input

Active Level of ORIGIN and LIMIT input signal can be changed through REF_LEVEL (200Bh).

4.10.5. BRAKE Output

BRAKE output signal activates according to Operation Enabled of Status word (6041h).
Timing of BRAKE ON can be set by Brake delay (2010h).
BRAKE output can be manually released through Digital outputs (60FEh) Bit 0:Set Brake.
For more detail information, please refer to Object 60FEh: Digital outputs.



4.11. 安全性功能Safety Function

4.11.1. Emergency Button

當觸發緊急按鈕時，狀態機將接收到Fault觸發信號，並自動過渡至等待排除異常的Fault狀態，在自動過渡期間,驅動器所有功能將會被禁能 (SERVO OFF,馬達無激磁狀態)，此時可透過讀取 Error code(0x603F) 得知錯誤代碼，若為緊急按鈕觸發，必須先將緊急按鈕釋放，再利用Controlword進行Fault reset(Bit7)；否則將無法將錯誤狀態清除。

5 . 工作狀態

5.1. 啟動步驟

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

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

5.2. 設定

5.2.1. 安裝步驟

Install motor/controller according to conditions of installation.
Check operation in advance under unload status and recommend to connect Load.
Please refer to. 【安裝注意事項安裝注意事項】

5.2.2. 接線

Check power cable, motor/encoder cable, I/O cable, EtherCAT communication cables are properly con- nected. Please refer to. 【系統方塊圖系統方塊圖】

5.2.3. 輸入電源

Turn power onto controller and check followings.
Check Power LED (Red Color) of Drive status LED lights.

5.2.4. PDO Mapping

Set Module and PDO Mapping by setting function of Master.

5.2.5. Set Communication Status

Change EtherCAT State Machine as ‘OP’ status by controlling Master.
• Check State Machine of Master can be changing to ‘OP’ status.
• Check State Machine of Controller can be changing to ‘OP’ status.

5.3. 運作設定

5.3.1. Drive Status Control

Change Drive State Machine as 'Operation Enabled' by setting of Control word (6040h).
• Check Status word (6041h) whether it can be changing to 'Operation Enabled'.
• In case of changing to 'Fault' status, check type of error by Error code (603Fh).
Execute appropriate action according to type of error.

5.3.2. Set Mode

Set Mode of operation (6060h) according to operation mode will be used.
Check Mode of operation display (6061h) whether it has properly changed.

5.3.3. Set Operation

Change Drive State Machine as 'Operation Enabled' by setting of Control word (6040h).
• Check Status word (6041h) whether it can be changing to 'Operation Enabled'.
• In case of changing to 'Fault' status, check type of error by Error code (603Fh).
Execute appropriate action according to type of error.

5.3.4. Movement Command

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

5.3.5. Check Status

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

5.4. 驅動器設定調整

5.4.1. 設定轉動方向

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

5.4.2. 設定數位輸入輸出信號準位

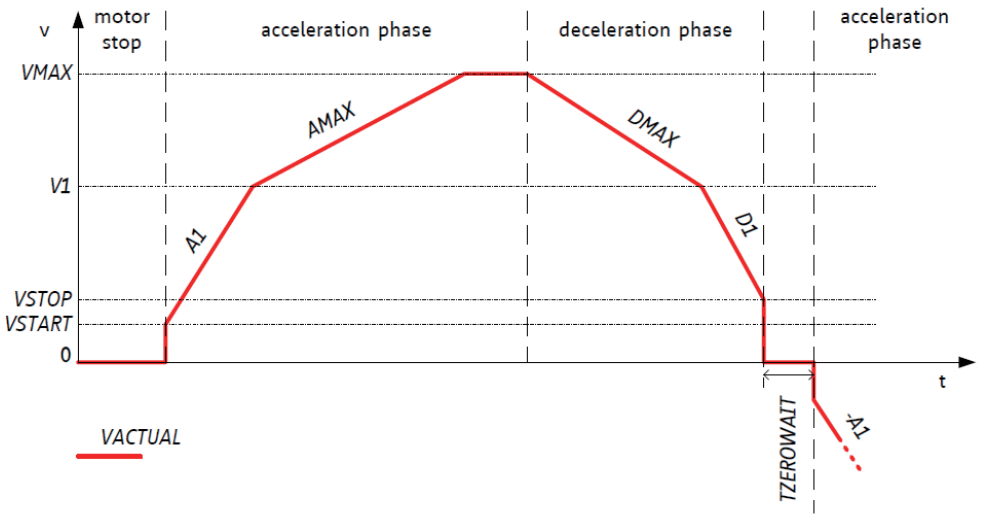
• LIMIT+, LIMIT-, ORIGIN Input Signal

If Active Level of LIMIT+, LIMIT-, ORIGIN input signal has set different from actual connection, indication value of Actual signal input and Digital inputs can be different. Reset Active Level of signals by setting the value of REF_LEVEL (200Bh). Able to set Active Level of Origin signal by REF_LEVEL.

5.4.3. 設定輪廓位置模式細項

Object address	Object Name	Description
0x2001	VSTART	Motor start velocity.
0x2002	VSTOP	Motor stop velocity. Set VSTOP ≥ VSTART to allow positioning for short distances, Do not set 0 in positioning mode, minimum 10 recommend!
0x2003	V1	First acceleration / deceleration phase threshold velocity.
0x2004	A1	First acceleration between VSTART and V1
0x2005	D1	Deceleration between V1 and VSTOP.
0x2006	TZEROWAIT	Defines the waiting time after ramping down to zero velocity before next movement or direction inversion can start. Time range is about 0 to 2 seconds.

根據使用需求設定輪廓位置模式之細項，請參考下圖之速度-時間關係圖。



6 . EtherCAT 物件字典

6.1. 物件型態說明

Following table explains indication type of information for each object.

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

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

Index	Sub index	Name	Type	Access	Constant Value
1008h	0	Device name	STR(8)	RO	P-SERVO EC

6.1.1.

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

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

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

6.1.2. Name

Describes correspondent object.

6.1.3. Data Type

Parameter type of object is as follows.

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

6.1.4. Access

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

Access	Description
RO	Read Only / Parameter only can be read.
RW	Read/Write / Parameter can be read or written.
C	Constant / Parameter could not be modified.

6.1.5. SAVE

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

6.1.6. PDO Mapping

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

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

6.1.7. Constant Value

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

6.1.8. Value Range

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

6.1.9. Default Value

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

6.2. 通用型通訊物件

6.2.1. Object 1000h: Device type

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

Object includes information of Device Type.

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

6.2.2. Object 1001h: Error register

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

This object indicates type of error generated from the controller.

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

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

6.2.3. Object 1008h: Device name

Index	Sub index	Name	Type	Access	Constant Value
1008h	0	Device type	STR(8)	RO	P-SERVO EC

This object indicates name of device.

6.2.4. Object 1009h: Hardware version

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

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

6.2.5. Object 100Ah: Software version

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

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

6.2.6. Object 1010h: Store parameters

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

Able to save all storable object into EEPROM through this object.
Need to input '65766173h' into Sub-Index 01h to store objects into EEPROM.

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

If fails to store, SDO Communication returns 'Abort SDO Transfer (abort code: 0606 0000h)'.
If inputs incorrect value, device does not store EEPROM and returns 'Abort SDO Transfer (abort code:0800 002xh)'.
When reads Sub-Index 01h, following value will be returned.

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

Check 'SAVE' part for each object.

6.2.7. Object 1011h: Restore default parameters

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

It requests to device to restore objects value back to Default value to store into EEPROM. Need to input '64616F6Ch' into Sub-Index 01h to restore objects back to original setting value.

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

If failed to initialize, SDO communication returns 'Abort SDO Transfer (abort code: 0606 0000h)'. If inputs incorrect value, device will not be initialized and return 'Abort SDO Transfer (abort code: 0800002xh)'.
Note: the objects' value will be set to default after power cycle.
In case of reading Sub-Index 01h, following values will be returned.

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

6.2.8. Object 1018h: Identity

Index	Sub index	Name	Type	Access	Constant Value
1018h	0	Number of entries	U8	RO	4
	1	Vendor ID	U32	RO	0000 F888h
	2	Product code	U32	RO	0000 1001h
	3	Revision number	U32	RO	0000 0000h
	4	Serial number	U32	RO	0000 0000h

This object indicates information of device.

Control system type	Product code
Open-loop	0000 0102
Close-loop	0000 0002

6.2.9. Object 10F1h: Error settings

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
10F1h	0	Number of entries	U8	RO	No	No		2
	1	Local error reaction	U32	RO	No	No		0000 0000h
	2	Sync error counter limit	U32	RW	No	No		0000 000Ch

6.3. PDO Mapping物件

This product current firmware only supported static PDO mapping, dynamic PDO mapping will update in the next generation soon.

6.3.1. Object 1600h: RxPDO 1 mapping

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
1600h	0	Number of entries	U8	RW	No	No	0 ～ 10	10
	1	1st PDO object	U32	RW	No	No		6040 0010h
	2	2nd PDO object	U32	RW	No	No		6060 0008h
	3	3rd PDO object	U32	RW	No	No		607A 0020h
	4	4th PDO object	U32	RW	No	No		607E 0008h
	5	5th PDO object	U32	RW	No	No		6081 0020h
	6	6th PDO object	U32	RW	No	No		6083 0020h
	7	7th PDO object	U32	RW	No	No		6084 0020h
	8	8th PDO object	U32	RW	No	No		60FF 0020h
	9	9th PDO object	U32	RW	No	No		0000 0000h
	10	10th PDO object	U32	RW	No	No		0000 0000h

6.3.2. Object 1601h: RxPDO 2 mapping

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

6.3.3. Object 1602h: RxPDO 3 mapping

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
1602h	0	Number of entries	U8	RW	No	No	0 ～ 10	0
	1	1st PDO object	U32	RW	No	No		0000 0000h
	2	2nd PDO object	U32	RW	No	No		0000 0000h
	3	3rd PDO object	U32	RW	No	No		0000 0000h
	4	4th PDO object	U32	RW	No	No		0000 0000h
	5	5th PDO object	U32	RW	No	No		0000 0000h
	6	6th PDO object	U32	RW	No	No		0000 0000h
	7	7th PDO object	U32	RW	No	No		0000 0000h
	8	8th PDO object	U32	RW	No	No		0000 0000h
	9	9th PDO object	U32	RW	No	No		0000 0000h
	10	10th PDO object	U32	RW	No	No		0000 0000h

6.3.4. Object 1A00h: TxPDO 1 mapping

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
1A00h	0	Number of entries	U8	RW	No	No	0 ～ 10	2
	1	1st PDO object	U32	RW	No	No		6041 0010h
	2	2nd PDO object	U32	RW	No	No		6061 0008h
	3	3rd PDO object	U32	RW	No	No		6064 0020h
	4	4th PDO object	U32	RW	No	No		606C 0020h
	5	5th PDO object	U32	RW	No	No		603F 0010h
	6	6th PDO object	U32	RW	No	No		0000 0000h
	7	7th PDO object	U32	RW	No	No		0000 0000h
	8	8th PDO object	U32	RW	No	No		0000 0000h
	9	9th PDO object	U32	RW	No	No		0000 0000h
	10	10th PDO object	U32	RW	No	No		0000 0000h

6.3.5. Object 1A01h: TxPDO 2 mapping

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
1A01h	0	Number of entries	U8	RW	No	No	0 ～ 10	4
	1	1st PDO object	U32	RW	No	No		60F4 0020h
	2	2nd PDO object	U32	RW	No	No		6062 0020h
	3	3rd PDO object	U32	RW	No	No		606B 0020h
	4	4th PDO object	U32	RW	No	No		60FD 0020h
	5	5th PDO object	U32	RW	No	No		0000 0000h
	6	6th PDO object	U32	RW	No	No		0000 0000h
	7	7th PDO object	U32	RW	No	No		0000 0000h
	8	8th PDO object	U32	RW	No	No		0000 0000h
	9	9th PDO object	U32	RW	No	No		0000 0000h
	10	10th PDO object	U32	RW	No	No		0000 0000h

6.3.6. Object 1A02h: TxPDO 3 mapping

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
1A02h	0	Number of entries	U8	RW	No	No	0 ～ 10	9
	1	1st PDO object	U32	RW	No	No		60B9 0010h
	2	2nd PDO object	U32	RW	No	No		60BA 0020h
	3	3rd PDO object	U32	RW	No	No		60BB 0020h
	4	4th PDO object	U32	RW	No	No		60BC 0020h
	5	5th PDO object	U32	RW	No	No		60BD 0020h
	6	6th PDO object	U32	RW	No	No		60D5 0010h
	7	7th PDO object	U32	RW	No	No		60D6 0010h
	8	8th PDO object	U32	RW	No	No		60D7 0010h
	9	9th PDO object	U32	RW	No	No		60D8 0010h
	10	10th PDO object	U32	RW	No	No		0000 0000h

6.3.7. Object 1C12h: Sync Manager 2 RxPDO assignment

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
1C12h	0	Number of entries	U8	RO	No	No	0 ～ 10	1
	1	RxPDO assign 1	U16	RW	No	No		1600h
	2	RxPDO assign 2	U16	RW	No	No		0h
	3	RxPDO assign 3	U16	RW	No	No		0h

6.3.8. Object 1C13h: Sync Manager 3 TxPDO assignment

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
1C13h	0	Number of entries	U8	RO	No	No	0 ～ 10	1
	1	TxPDO assign 1	U16	RW	No	No		1A00h
	2	TxPDO assign 2	U16	RW	No	No		1A01h
	3	TxPDO assign 3	U16	RW	No	No		1A02h

6.4. 通訊同步管理物件

6.4.1. Object 1C00h: Sync manager type

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

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

6.4.2. Object 1C32h: SM output parameter

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

6.4.3. Object 1C33h: SM input parameter

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

6.5. 驅動配置物件

6.5.1. Object 603Fh: Error code

This object shall provide the error code of the last error which occurred in the drive device. Table 24 specifies the value definition, Table 35 specifies the object description, and Table 36 specifies the entry description.

NOTE In CANopen networks, this object provides the same information as the lower 16-bit of sub-index 01h of the pre-defined error field (1003h).

Attribute	Value
Index	603Fh
Name	Error code
Object code	Variable
Data type	Unsigned16
Category	Optional

Attribute	Value
Sub-index	00h
Access	ro
PDO mapping	See /CiA402-3/
Value range	See Table 24
Default value	No

6.5.2. Object 6040h: Control word

This object shall indicate the received command controlling the PDS FSA. Figure 5 specifies the value structure. The bits 7, 3, 2, 1, and 0 shall be supported. The bits 0 to 9 shall be supported according to the mode of operation. If the related functionality is not available, an appropriate emergency message shall be generated.

The manufacturer-specific bits may be supported. Table 27 specifies the value definition. Table 28 specifies the combinations of controlword bits used in command coding of the PDS FSA. All implemented bits of the controlword are valid independent of the PDS FSA state. Starting of any movement is operation mode specific and is described in the related clause.

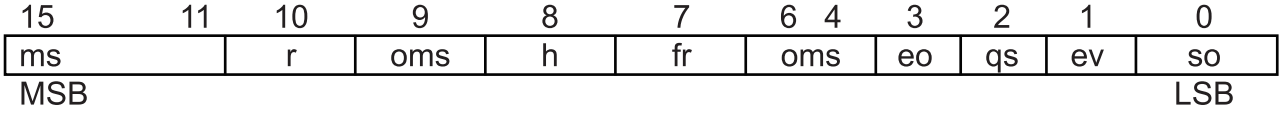


Figure 5 – Value structure

Table 27 – Value definition

Field	Bit	Value	Description
so: switch on	0	0b	Disable
		1b	Enable
ev: enable voltage	1	0b	Disable
		1b	Enable
qs: quick stop	2	0b	Disable
		1b	Enable
eo: enable operation	3	0b	Disable
		1b	Enable
oms: operation mode specific	4 to 6	See the corresponding operation mode	
fr: fault reset	7	0b	Disable
		1b	Enable
h: halt	8	0b	Disable
		1b	Enable
oms: operation mode specific	9	0b	Disable
		1b	Enable
r(eserved)	10	0b	Reserved for future use
ms: manufacturer-specific	11 to 15	0b	Disable
		1b	Enable

Table 28 – Command coding

	Bits of the controlword					
Command	Bit 7	Bit 3	Bit 3	Bit 1	Bit 0	Transitions
Shutdown	0	X	X	1	0	2,6,8
Switch on	0	0	0	1	1	3
Switch on + enable operation	0	1	1	1	1	3 + 4 (NOTE)
Disable voltage	0	X	X	0	X	7,9,10,12
Quick stop	0	X	X	1	X	7,10,11
Disable operation	0	0	0	1	1	5
Enable operation	0	1	1	1	1	4,16
Fault reset	a	X	X	X	X	15
NOTE Automatic transition to enable operation state after executing switched on state functionality.						
a At rising edge of the signal.						

Bits 9, 6, 5, and 4 of the controlword are operation mode specific. The behavior of the halt function (bit 8) depends on the operation mode (see object 6060h). If the bit is 1, the commanded motion shall be interrupted, the PDS shall behave as defined in the halt option code. After releasing the halt function, the commanded motion shall be continued if possible. The bits 11, 12, 13, 14, and 15 are manufacturer-specific.

Table 29 specifies the object description, and Table 30 specifies the entry description.

Table 29 – Object description

Attribute	Value
Index	6040h
Name	Controlword
Object code	Variable
Data type	Unsigned16
Category	Mandatory

Table 30 – Entry description

Attribute	Value
Sub-index	00h
Access	rw
PDO mapping	See /CiA402-3/
Value range	See Table 28
Default value	Device and operation mode specific

6.5.3. Object 6041h: Status word

This object shall provide the status of the PDS FSA. Figure 6 specifies the value structure. Table 31 specifies the value definition. The bits 10, 9, and 6 to 0 shall be supported. The oms bits shall be supported if the mode of operation is supported. If the related functionality of the oms bits is not available, the corresponding bit shall be 0b. The manufacturer-specific bits may be supported. Table 32 specifies the combinations of statusword bits used in state coding of the PDS FSA. All implemented bits of the status word are valid independent of the PDS FSA state.

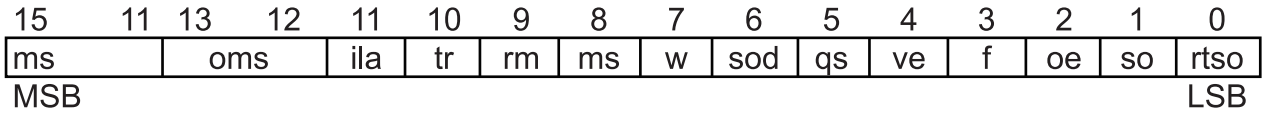


Figure 6 – Value structure

Table 31 – Value definition

Field	Bit	Value	Description
rtso: ready to switch on	0	0_b	Disabled
		1_b	Enabled
so: switched on	1	0_b	Disabled
		1_b	Enabled
oe: operation enabled	2	0_b	Disabled
		1_b	Enabled
f: fault	3	0_b	Disabled
		1_b	Enabled
ve: voltage enabled	4	0_b	Disabled
		1_b	Enabled
qs: quick stop	5	0_b	Disabled
		1_b	Enabled
sod: switch on disabled	6	0_b	Disabled
		1_b	Enabled
w: warning	7	0_b	Disabled
		1_b	Enabled
ms	8	0_b	Disabled
		1_b	Enabled
rm: remote	9	0_b	Disabled
		1_b	Enabled
tr: target reached	10	0_b	Disabled
		1_b	Enabled
ila: internal limit active	11	0_b	Disabled
		1_b	Enabled
oms: operation mode specific	12 to 13	0_b	Disabled
		1_b	Enabled
ms: manufacturer-specific	14 to 15	0_b	Disabled
		1_b	Enabled

Table 32 – State coding

Statusword	PDS FSA state
xxxx xxxx x0xx 0000$_b$	Not ready to switch on
xxxx xxxx x1xx 0000$_b$	Switch on disabled
xxxx xxxx x01x 0001$_b$	Ready to switch on
xxxx xxxx x01x 0011$_b$	Switched on
xxxx xxxx x01x 0111$_b$	Operation enabled
xxxx xxxx x00x 0111$_b$	Quick stop active
xxxx xxxx x0xx 1111$_b$	Fault reaction active
xxxx xxxx x0xx 1000$_b$	Fault

If bit 4 (voltage enabled) of the statusword is 1, this shall indicate that high voltage is applied to the PDS.

If bit 5 (quick stop) of the statusword is 0, this shall indicate that the PDS is reacting on a quick stop request.

If bit 7 (warning) of the statusword is 1, this shall indicate the presence of a warning condition. Warning is not an error or fault (examples: temperature limit exceeded, job refused). The status of the PDS FSA shall not be changed. The cause of the warning may be given in the fault code parameter object (603Fh).
If bit 9 (remote) of the statusword is 1, this shall indicate that the controlword is processed. If it is 0 (local), this shall indicate that the controlword is not processed. Nevertheless, the PDS may provide actual values, and the PDS may accept COB for configuration data transmission for other parameter objects.

If bit 10 (target reached) of the statusword is 1, this shall indicate that the PDS has reached the set-point. The set-point is operation mode specific and is defined in detail in the corresponding clauses of this part of the profile specification. Bit 10 shall also be set to 1, if the operation mode has been changed. The change of a target value by software shall alter this bit. If quick stop option code is 5, 6, 7 or 8, bit 10 shall be set to 1, when the quick stop operation is finished and the PDS is halted. If halt occurred and the PDS has halted then bit 10 shall be set to 1, too. If the same internal value is commanded then bit 10 shall not alter, if bit 10 is supported.

If bit 11 (internal limit active) of the statusword is 1, this shall indicate that an internal limit is active (example: position range limit). The internal limits are manufacturer-specific.
Bit 13 and bit 12 of the statusword are operation mode specific. Bit 14 and bit 15 are manufacturer-specific.
Table 33 specifies the object description, and Table 34 specifies the entry description.

Table 33 – Object description

Attribute	Value
Index	6041h
Name	Statusword
Object code	Variable
Data type	Unsigned16
Category	Mandatory

Table 34 – Entry description

Attribute	Value
Sub-index	00h
Access	ro
PDO mapping	See /CiA402-3/
Value range	See Table 32
Default value	No

6.5.4. Object 605Ah: Quick stop option code

This object shall indicate what action is performed when the quick stop function is executed. The slow down ramp is the deceleration value of the used mode of operation. Table 40 specifies the value definition, Table 41 specifies the object description, and Table 42 specifies the entry description.

This product only supported code 0,1,2.

Table 40 – Value definition

Value	Definition
-32 768 to -1	Manufacturer-specific
0	Disable drive function
※1	Slow down on slow down ramp and transit into switch on disabled
※2	Slow down on quick stop ramp and transit into switch on disabled
※3	Slow down on current limit and transit into switch on disabled
※4	Slow down on voltage limit and transit into switch on disabled
※5	Slow down on slow down ramp and stay in quick stop active
※6	Slow down on quick stop ramp and stay in quick stop active
※7	Slow down on current limit and stay in quick stop active
※8	Slow down on voltage limit and stay in quick stop active
※9 to + 32 767	Reserved

Table 41 – Object description

Attribute	Value
Index	$605A_h$
Name	Quick stop option code
Object code	Variable
Data type	Integer16
Category	Optional

Table 42 – Entry description

Attribute	Value
Sub-index	00_h
Access	rw
PDO mapping	See /CiA402-3/
Value range	See Table 40
Default value	※2

6.5.5. Object 605Bh: Shutdown option code

This object shall indicate what action is performed if there is a transition from operation enabled state to ready to switch on state. The slow down ramp is the deceleration value of the used mode of operation. Table 43 specifies the value definition, Table 44 specifies the object description, and Table 45 specifies the entry description.

Table 43 – Value definition

Value	Definition
-32 768 to -1	Manufacturer-specific
0	Disable drive function (switch-off the drive power stage)
※1	Slow down with slow down ramp; disable of the drive function
※2 to +32 767	Reserved

Table 44 – Object description

Attribute	Value
Index	$605B_h$
Name	Shutdown option code
Object code	Variable
Data type	Integer16
Category	Optional

Table 45 – Entry description

Attribute	Value
Sub-index	00_h
Access	rw
PDO mapping	See /CiA402-3/
Value range	See Table 43
Default value	0

6.5.6. Object 605Ch: Disable operation option code

This object shall indicate what action is performed if there is a transition from operation enabled state to switched on state. The slow down ramp is the deceleration value of the used mode of operation. Table 46 specifies the value definition, Table 47 specifies the object description, and Table 48 specifies the entry description.

This product only supported code 1 or 2.

Table 46 – Value definition

Value	Definition
-32 768 to -1	Manufacturer-specific
0	Disable drive function (switch-off the drive power stage)
※1	Slow down with slow down ramp; disable of the drive function
※2 to +32 767	Reserved

Table 47 – Object description

Attribute	Value
Index	$605C_h$
Name	Disable operation option code
Object code	Variable
Data type	Integer16
Category	Optional

Table 48 – Entry description

Attribute	Value
Sub-index	00_h
Access	rw
PDO mapping	See /CiA402-3/
Value range	See Table 46
Default value	※1

6.5.7. Object 605Dh: Halt option code

This object shall indicate what action is performed when the halt function is executed. The slow down ramp is the deceleration value of the used mode of operation. Table 49 specifies the value definition, Table 50 specifies the object description, and Table 51 specifies the entry description.

This product only supported code 1 or 2.

Table 49 – Value definition

Value	Definition
-32 768 to -1	Manufacturer-specific
0	Reserved
※1	Slow down on slow down ramp and stay in operation enabled
※2	Slow down on quick stop ramp and stay in operation enabled
※3	Slow down on current limit and stay in operation enabled
※4	Slow down on voltage limit and stay in operation enabled
※5 to +32 767	Reserved

Table 50 – Object description

Attribute	Value
Index	$605D_h$
Name	Halt option code
Object code	Variable
Data type	Integer16
Category	Optional

Table 51 – Entry description

Attribute	Value
Sub-index	00_h
Access	rw
PDO mapping	See /CiA402-3/
Value range	See Table 49
Default value	※1

6.5.8. Object 605Eh: Fault reaction option code

This object shall indicate what action is performed when fault is detected in the PDS. The slow down ramp is the deceleration value of the used mode of operation. Table 52 specifies the value definition, Table 53 specifies the object description, and Table 54 specifies the entry description.

This product is only supported code 0,1,2.

Table 52 – Value definition

Value	Definition
-32 768 to -1	Manufacturer-specific
0	Reserved
※1	Slow down on slow down ramp and stay in operation enabled
※2	Slow down on quick stop ramp and stay in operation enabled
※3	Slow down on current limit and stay in operation enabled
※4	Slow down on voltage limit and stay in operation enabled
※5 to +32 767	Reserved

Table 53 – Object description

Attribute	Value
Index	$605E_h$
Name	Fault reaction option code
Object code	Variable
Data type	Integer16
Category	Optional

Table 54 – Entry description

Attribute	Value
Sub-index	00_h
Access	rw
PDO mapping	See /CiA402-3/
Value range	See Table 52
Default value	※2

6.5.9. Object 6060h: Mode of operation

This object shall indicate the requested operation mode. This product only supported 1,3,6,8,9 modes.
Table 55 specifies the value definition, Table 56 specifies the object description, and Table 57 specifies the entry description.
NOTE This object indicates only the value of the requested operation mode, the actual operation mode of the PDS is provided in the object 6061h.

Table 55 – Value definition

Value	Definition
-128 to -1	Manufacturer-specific operation modes
0	No mode change in case of the object 6060h; No mode assigned in case of the object 6061h
※1	Profile position mode
※2	Velocity mode
※3	Profile velocity mode
※4	Torque profile mode
※5	Reserved
※6	Homing mode
※7	Interpolated position mode
※8	Cyclic sync position mode
※9	Cyclic sync velocity mode
※10	Cyclic sync torque mode
※11	Cyclic sync torque mode with commutation angle
※12	Profile position mode with an additional feedback
※13	Profile velocity mode with an additional feedback
※14	Homing mode with an additional feedback
※15	Cyclic sync position mode with an additional feedback
※16	Cyclic sync velocity mode with an additional feedback
※17 to +127	Reserved

Table 56 – Object description

Attribute	Value
Index	6060_h
Name	Modes of operation
Object code	Variable
Data type	Integer8
Category	Conditional: mandatory, if more than one mode of operation is supported

Table 57 – Entry description

Attribute	Value
Sub-index	00_h
Access	rw
PDO mapping	See /CiA402-3/
Value range	See Table 55
Default value	Manufacturer-specific

6.5.10. Object 6061h: Mode of operation display

This object shall provide the actual operation mode. The behavior of the drive in mode of operation 0 is not defined and is manufacturer-specific. Table 55 specifies the value definition, Table 58 specifies the object description, and Table 59 specifies the entry description.

Table 58 – Object description

Attribute	Value
Index	6061_h
Name	Modes of operation display
Object code	Variable
Data type	Integer8
Category	Conditional: mandatory, if more than one mode of operation is supported

Table 59 – Entry description

Attribute	Value
Sub-index	00_h
Access	ro
PDO mapping	See /CiA402-3/
Value range	See Table 55
Default value	No

6.5.11. Object 6062h: Position demand value

This object shall provide the demanded position value. The value shall be given in user- defined position units. Table 177 specifies the object description, and Table 178 specifies the entry description.

Table 177 – Object description

Attribute	Value
Index	6062_h
Name	Position demand value
Object code	Variable
Data type	Integer32
Category	Optional

Table 178 – Entry description

Attribute	Value
Sub-index	00_h
Access	ro
PDO mapping	See /CiA402-3/
Value range	Integer32
Default value	No

6.5.12. Object 6064h: Position actual value

This object shall provide the actual value of the position measurement device. The value shall be given in user-defined position units. Table 181 specifies the object description, and Table 182 specifies the entry description.

Table 181 – Object description

Attribute	Value
Index	6064_h
Name	Position actual value
Object code	Variable
Data type	Integer32
Category	Conditional: mandatory if pp, ip or csp is supported

Table 182 – Entry description

Attribute	Value
Sub-index	00_h
Access	ro
PDO mapping	See /CiA402-3/
Value range	Integer32
Default value	No

6.5.13. Object 6065h: Following error window

This object shall indicate the configured range of tolerated position values symmetrically to the position demand value. If the position actual value is out of the following error window, a following error occurs. A following error may occur when a drive is blocked, unreachable profile velocity occurs, or at wrong closed-loop coefficients. The value shall be given in user- defined position units. If the value of the following error window is FFFF FFFFh, the following control shall be switched off. Table 183 specifies the object description, and Table 184 specifies the entry description.

Table 183 – Object description

Attribute	Value
Index	6065_h
Name	Following errror window
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 184 – Entry description

Attribute	Value
Sub-index	00_h
Access	rw
PDO mapping	See /CiA402-3/
Value range	Unsigned32
Default value	Manufacturer-specific

6.5.14. Object 6066h: Following error time out

This object shall indicate the configured time for a following error condition, after that the bit 13 of the statusword shall be set to 1. The reaction of the drive when a following error occurs is manufacturer-specific. The value shall be given in ms. Table 185 specifies the object description, and Table 186 specifies the entry description.

Table 185 – Object description

Attribute	Value
Index	6066_h
Name	Following errror time out
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 186 – Entry description

Attribute	Value
Sub-index	00_h
Access	rw
PDO mapping	See /CiA402-3/
Value range	Unsigned16
Default value	Manufacturer-specific

6.5.15. Object 6067h: Position window

This object shall indicate the configured symmetrical range of accepted positions relative to the target position. If the actual value of the position encoder is within the position window, this target position shall be regarded as having been reached. As the user mostly prefers to specify the position window in his application in user-defined units, the value is transformed into increments. The target position shall be handled in the same manner as in the trajectory generator concerning limiting functions and transformation into internal machine units before it may be used with this function. The value shall be given in user-defined position units.
If the value of the position window is FFFF FFFFh, the position window control shall be switched off. Table 187 specifies the object description, and Table 188 specifies the entry description.

Table 187 – Object description

Attribute	Value
Index	6067_h
Name	Position window
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 188 – Entry description

Attribute	Value
Sub-index	00_h
Access	rw
PDO mapping	See /CiA402-3/
Value range	Unsigned32
Default value	Manufacturer-specific

6.5.16. Object 6068h: Position window time

This object shall indicate the configured time, during which the actual position within the position window is measured. The value shall be given in ms.
Table 189 specifies the object description, and Table 190 specifies the entry description.

Table 189 – Object description

Attribute	Value
Index	6068_h
Name	Position window time
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 190 – Entry description

Attribute	Value
Sub-index	00_h
Access	rw
PDO mapping	See /CiA402-3/
Value range	Unsigned16
Default value	Manufacturer-specific

6.5.17. Object 606Bh: Velocity demand value

This object shall provide the output value of the trajectory generator. The value shall be given in the user-defined velocity units. Table 226 specifies the object description, and Table 227 specifies the entry description.

Table 226 – Object description

Attribute	Value
Index	$606B_h$
Name	Velocity demand value
Object code	Variable
Data type	Integer32
Category	Optional

Table 227 – Entry description

Attribute	Value
Sub-index	00_h
Access	ro
PDO mapping	See /CiA402-3/
Value range	Integer32
Default value	No

6.5.18. Object 606Ch: Velocity actual value

This object shall provide the actual velocity value derived either from the velocity sensor or the position sensor. The value shall be given in user-defined velocity units. Table 228 specifies the object description, and Table 229 specifies the entry description.

Table 228 – Object description

Attribute	Value
Index	$606C_h$
Name	Velocity actual value
Object code	Variable
Data type	Integer32
Category	Conditional: mandatory if pv or csv is supported

Table 229 – Entry description

Attribute	Value
Sub-index	00_h
Access	ro
PDO mapping	See /CiA402-3/
Value range	Integer32
Default value	No

6.5.19. Object 607Ah: Target position

This object shall indicate the commanded position that the drive should move to in position profile mode using the current settings of motion control parameters such as velocity,

acceleration, deceleration, motion profile type etc. The value of this object shall be interpreted as absolute or relative depending on the abs/rel flag in the controlword. It shall be given in user-defined position units and shall be converted to position increments. Table 98 specifies the object description, and Table 99 specifies the entry description.

Table 98 – Object description

Attribute	Value
Index	$607A_h$
Name	Target position
Object code	Variable
Data type	Integer32
Category	Conditional: mandatory if pp, pc or csp is supported

Table 99 – Entry description

Attribute	Value
Sub-index	00_h
Access	rw
PDO mapping	See /CiA402-3/
Value range	Integer32
Default value	Manufacturer-specific

6.5.20. Object 607Ch: Home offset

This object shall indicate the configured difference between the zero position for the application and the machine home position (found during homing). During homing, the machine home position is found and once the homing is completed, the zero position is offset from the home position by adding the home offset to the home position.

The zero position is calculated by following equation:
zero position = home poition + home offset
All subsequent absolute moves shall be taken relative to this new zero position.
This is illustrated in Figure 42. If this object is not implemented, then the home offset shall be regarded as zero. The value of this object shall be given in user-defined position units. Negative values shall indicate the opposite direction.
The activation of a new value of the object home offset is manufacturer-specific (0x200E:Homing Offset Data). It is recommended to apply the new value only while the drive is in homing mode.

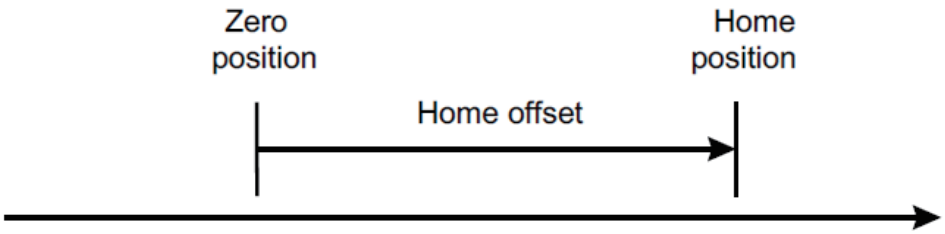


Table 132 specifies the object description, and Table 133 specifies the entry description.

Table 132 – Object description

Attribute	Value
Index	$607C_h$
Name	Home offset
Object code	Variable
Data type	Integer32
Category	Optional

Table 133 – Entry description

Attribute	Value
Sub-index	00_h
Access	rw
PDO mapping	See /CiA402-3/
Value range	Integer32
Default value	0d

6.5.21. Object 607Dh: Software position limit

This object shall indicate the configured maximal and minimal software position limits. These parameters shall define the absolute position limits for the position demand value and the position actual value as specified in Figure 25. Every new target position shall be checked against these limits.

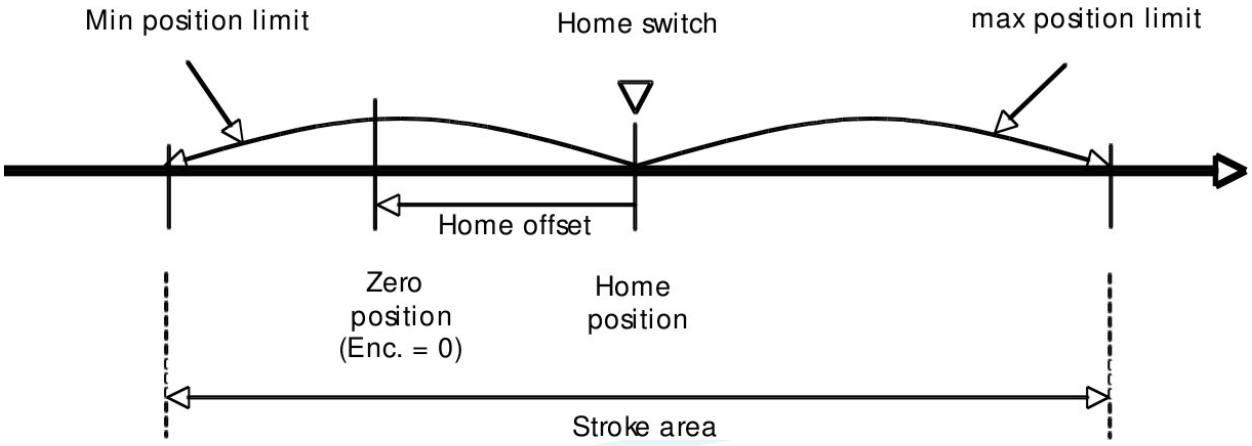


Figure 25 – Software position limits

To disable the software position limits, the min position limit (sub-index 01h) and max position limit (sub-index 02h) shall be set to 0. The limit positions shall be given in user-defined position units (same as target position). Supervision of software position limits requires a defined home position.
NOTE In this version of the profile specification the condition for disabling of software position limits was introduced.
Table 102 specifies the object description and Table 103 specifies the entry description.

Table 102 – Object description

Attribute	Value
Index	$607D_h$
Name	Software position limit
Object code	Array
Data type	Integer32
Category	Optional

Table 103 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See /CiA402-3/
Value range	02_h
Default value	02_h
Sub-index	01_h
Description	Min position limit
Entry category	Mandatory
Access	rw
PDO mapping	See /CiA402-3/
Value range	Integer32
Default value	Manufacturer-specific
Sub-index	02_h
Description	Max position limit
Entry category	Mandatory
Access	rw
PDO mapping	See /CiA402-3/
Value range	Integer32
Default value	Manufacturer-specific

6.5.22. Object 607Eh: Polarity

This object allows the inversion of the motor movement direction (NOTE 3).
If the polarity parameter is not set, a right turning rotary motor leads to a move in positive direction, a left turning rotary motor leads to a move in negative direction.
If the polarity parameter is set, a right turning rotary motor leads to a move in negative direction, a left turning rotary motor leads to a move in positive direction. The bit 7 is valid for the position-related modes of operation such as PP, IP, CSP. The bit 6 is valid for the velocity-related modes of operation PV, CSV. If the bit 0 is set to value 1b, the inversion is valid for all modes of operation. In this case the value of the bit 6 and the bit 7 does not care and shall not be used to set polarity.
NOTE 1 The polarity parameter is not intended to match the mounting position of the position or velocity sensor. For that purpose the object 60F0h (Encoder inversion) and object 60F1h (Encoder inversion additional) used.
NOTE 2 By setting the polarity parameter the meaning of the limit switches changes. The positive limit switch becomes the negative and vice versa.
NOTE 3 The same considerations for direction apply also for linear motors.
Figure 9 specifies the value structure. Table 77 specifies the value definition. Table 78 specifies the object description. Table 79 specifies the entry description.

7	6	5 1	0
Position polarity	Velocity polarity	r(eserved)	Global polarity inversion
MSB			LSB

Figure 9 – Value structure

Table 77 – Value definition

Bit field	Bit	Value	Definition
Global polarity inversion	0	0b 1b	No inversion Inversion
r	1 to 5	reserved (0)	
Velocity polarity	6	0b 1b	Inversion off Inversion on
Position polarity	7	0b 1b	Inversion off Inversion on

Table 78 – Object description

Attribute	Value
Index	607Eh
Name	Polarity
Object code	Variable
Data type	Unsigned8
Category	Optional

Table 79 – Entry description

Attribute	Value
Sub-index	00h
Access	rw
PDO mapping	See /CiA402-3/
Value range	See Figure 9 and
Default value	00h

6.5.23. Object 607Fh: Max profile velocity

This object shall indicate the configured maximal allowed velocity in either direction during a profiled motion. The value shall be given in the very same physical unit as the profile velocity object (6081h). Table 104 specifies the object description, and Table 105 specifies the entry description.

Table 104 – Object description

Attribute	Value
Index	$607F_h$
Name	Max profile velocity
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 105 – Entry description

Attribute	Value
Sub-index	00_h
Access	rw
PDO mapping	See /CiA402-3/
Value range	Unsigned32
Default value	Manufacturer-specific

6.5.24. Object 6080h: Max motor speed

This object shall indicate the configured maximal allowed speed for the motor in either direction. It is used to protect the motor and is taken from the motor data sheet. The value shall be given in micro-steps per second (steps/sec). Table 106 specifies the object description, and Table 107 specifies the entry description.

Table 106 – Object description

Attribute	Value
Index	6080_h
Name	Max motor speed
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 107 – Entry description

Attribute	Value
Sub-index	00_h
Access	rw
PDO mapping	See /CiA402-3/
Value range	Unsigned32
Default value	Manufacturer-specific

6.5.25. Object 6081h: Profile velocity

This object shall indicate the configured velocity normally attained at the end of the acceleration ramp during a profiled motion and shall be valid for both directions of motion. The value shall be given in user-defined velocity units. The velocity units can depend on the user-defined position units (position units per second).
The calculation of the user-defined position units is done via the factor group.
Table 108 specifies the object description, and Table 109 specifies the entry description.

Table 108 – Object description

Attribute	Value
Index	6081_h
Name	Profile velocity
Object code	Variable
Data type	Unsigned32
Category	Conditional: mandatory if pp is supported

Table 109 – Entry description

Attribute	Value
Sub-index	00_h
Access	rw
PDO mapping	See /CiA402-3/
Value range	Unsigned32
Default value	Manufacturer-specific

6.5.26. Object 6083h: Profile acceleration

This object shall indicate the configured acceleration. The value shall be given in user-defined acceleration units. Table 112 specifies the object description, and Table 113 specifies the entry description.

Table 112 – Object description

Attribute	Value
Index	6083_h
Name	Profile acceleration
Object code	Variable
Data type	Unsigned32
Category	Conditional: mandatory if pp or pv is supported

Table 113 – Entry description

Attribute	Value
Sub-index	00_h
Access	rw
PDO mapping	See /CiA402-3/
Value range	Unsigned32
Default value	Manufacturer-specific

6.5.27. Object 6084h: Profile deceleration

This object shall indicate the configured deceleration. If this parameter is not supported, then the profile acceleration object (6083h) value shall be used for deceleration, too. The value shall be given in the same physical units as profile acceleration object (6083h). Table 114 specifies the object description, and Table 115 specifies the entry description.

Table 114 – Object description

Attribute	Value
Index	6084_h
Name	Profile deceleration
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 115 – Entry description

Attribute	Value
Sub-index	00_h
Access	rw
PDO mapping	See /CiA402-3/
Value range	Unsigned32
Default value	Manufacturer-specific

6.5.28. Object 6098h: Homing method

This object shall indicate the configured homing method that shall be used. Table 134 specifies the value definition, Table 135 specifies the object description, and Table 136 specifies the entry description.

Table 134 – Value definition

Value	Definition
-128_d to -1_d	Manufacturer-specific
0_d	No homing method assigned
$+1_d$	Method 1 shall be used
to	
$+37_d$	Method 37 shall be used
$+38_d$ to $+127_d$	Reserved

Table 135 – Object description

Value	Definition
-128_d to -1_d	Manufacturer-specific
0_d	No homing method assigned
$+1_d$	Method 1 shall be used
to	
$+37_d$	Method 37 shall be used
$+38_d$ to $+127_d$	Reserved

Table 136 – Entry description

Attribute	Value
Index	6098_h
Name	Homing method
Object code	Variable
Data type	Integer8
Category	Conditional: mandatory if hm is supported

6.5.29. Object 6099h: Homing speeds

This object shall indicate the configured speeds used during homing procedure. The values shall be given in user-defined velocity units. Table 139 specifies the object description, and Table 140 specifies the entry description.

Table 139 – Object description

Attribute	Value
Index	6099_h
Name	Homing speeds
Object code	Array
Data type	Unsigned32
Category	Conditional: mandatory if hm is supported

Table 140 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See /CiA402-3/
Value range	02_h
Default value	02_h
Sub-index	01_h
Description	Speed during search for switch
Entry category	Mandatory
Access	rw
PDO mapping	See /CiA402-3/
Value range	Unsigned32
Default value	Manufacturer-specific
Sub-index	02_h
Description	Speed during search for zero
Entry category	Mandatory
Access	rw
PDO mapping	See /CiA402-3/
Value range	Unsigned32
Default value	Manufacturer-specific

6.5.30. Object 609Ah: Homing acceleration

This object shall indicate the configured acceleration and deceleration to be used during homing operation. The value shall be given in user-defined acceleration units. Table 141 specifies the object description, and Table 142 specifies the entry description.

Table 141 – Object description

Attribute	Value
Index	$609A_h$
Name	Homing acceleration
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 142 – Entry description

Attribute	Value
Sub-index	00_h
Access	rw
PDO mapping	See /CiA402-3/
Value range	Unsigned32
Default value	Manufacturer-specific

6.5.31. Object 60B8h: Touch probe function

This object shall indicate the configured function of the touch probe. Table 143 specifies the value definition, Table 144 specifies the object description, and Table 145 specifies the entry description.

able 143 – Value definition

Bit	Value	Definition
0	0	Switch off touch probe 1
	1	Enable touch probe 1
1	0	Trigger first event
	1	continous
3, 2	00_b	Trigger with touch probe 1 input
	01_b	Trigger with zero impulse signal or position encoder
	10_b	Touch probe source as defined in object 60D0h, sub-index 01h
	11_b	Reserved
4	0	Switch off sampling at positive edge of touch probe 1
	1	Enable sampling at positive edge of touch probe 1
5	0	Switch off sampling at negative edge of touch probe 1
	1	Enable sampling at negative edge of touch probe 1
6, 7	–	User-defined (e.g. for testing)
8	0	Switch off touch probe 2
	1	Enable touch probe 2
9	0	Trigger first event
	1	Continous
11, 10	00_b	Trigger with touch probe 2 input
	01_b	Trigger with zero impulse signal or position encoder
	10_b	Touch probe source as defined in object 60D0h, sub-index 02h
	11_b	Reserved
12	0	Switch off sampling at positive edge of touch probe 2
	1	Enable sampling at positive edge of touch probe 2
13	0	Switch off sampling at negative edge of touch probe 2
	1	Enable sampling at negative edge of touch probe 2
14, 15	–	User-defined (e.g. for testing)

Table 144 – Object description

Attribute	Value
Index	$60B8_h$
Name	Touch probe function
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 145 – Entry description

Attribute	Value
Sub-index	00_h
Access	rw
PDO mapping	See /CiA402-3/
Value range	See Table 143
Default value	Manufacturer-specific

6.5.32. Object 60B9h: Touch probe status

This object shall provide the status of the touch probe. Table 146 specifies the value, Table 147 specifies the object description, and Table 148 specifies the entry description.

Table 146 – Value definition

Bit	Value	Definition
0	0	Touch probe 1 is switched off
	1	Touch probe 1 is enabled
1	0	Touch probe 1 no positive edge value stored
	1	Touch probe 1 positive edge position stored
2	0	Touch probe 1 no negative edge value stored
	1	Touch probe 1 negative edge position stored
3 to 5	0	Reserved
6, 7	–	User-defined (e.g. for testing)
8	0	Touch probe 2 is switched off
	1	Touch probe 2 is enabled
9	0	Touch probe 2 no positive edge value stored
	1	Touch probe 2 positive edge position stored
10	0	Touch probe 2 no negative edge value stored
	1	Touch probe 2 negative edge position stored
11 to 13	0	Reserved
NOTE Bit 1 and bit 2 are set to 0_b when touch probe 1 is switched off (object $60B8_h$ bit 0 is 0_b). Bit 9 and 10 are set to 0_b when touch probe 2 is switched off (object $60B8_h$ bit 8 is 0_b).		

NOTE The value definitions for bit 1 (value 1), bit 2 (value 1), bit 9 (value 1), bit 10 (value 1) were false in IEC 61800-7-201:2015 and were corrected in this profile specification.

Table 147 – Object description

Attribute	Value
Index	$60B9_h$
Name	Touch probe status
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 148 – Entry description

Attribute	Value
Sub-index	00_h
Access	ro
PDO mapping	See /CiA402-3/
Value range	See Table 146
Default value	No

6.5.33. Object 60BAh: Touch probe 1 positive value

This object shall provide the position value of the touch probe 1 at positive edge. The value shall be given in user-defined position units. Table 149 specifies the object description, and Table 150 specifies the entry description.

Table 149 – Object description

Attribute	Value
Index	$60BA_h$
Name	Touch probe 1 positive edge
Object code	Variable
Data type	Integer32
Category	Optional

Table 150 – Entry description

Attribute	Value
Sub-index	00_h
Access	ro
PDO mapping	See /CiA402-3/
Value range	Integer32
Default value	No

6.5.34. Object 60BBh: Touch probe 1 negative value

This object shall provide the position value of the touch probe 1 at negative edge. The value shall be given in user-defined position units. Table 151 specifies the object description, and Table 152 specifies the entry description.

Table 151 – Object description

Attribute	Value
Index	$60BA_h$
Name	Touch probe 1 positive edge
Object code	Variable
Data type	Integer32
Category	Optional

Table 152 – Entry description

Attribute	Value
Sub-index	00_h
Access	ro
PDO mapping	See /CiA402-3/
Value range	Integer32
Default value	No

6.5.35. Object 60BCh: Touch probe 2 positive value

This object shall provide the position value of the touch probe 2 at positive edge. The value shall be given in user-defined position units. Table 153 specifies the object description, and Table 154 specifies the entry description.

Table 153 – Object description

Attribute	Value
Index	$60BC_h$
Name	Touch probe 2 positive edge
Object code	Variable
Data type	Integer32
Category	Optional

Table 154 – Entry description

Attribute	Value
Sub-index	00_h
Access	ro
PDO mapping	See /CiA402-3/
Value range	Integer32
Default value	No

6.5.36. Object 60BDh: Touch probe 2 negative value

This object shall provide the position value of the touch probe 2 at negative edge. The value shall be given in user-defined position units. Table 155 specifies the object description, and Table 156 specifies the entry description.

Table 155 – Object description

Attribute	Value
Index	$60BD_h$
Name	Touch probe 2 negative edge
Object code	Variable
Data type	Integer32
Category	Optional

Table 156 – Entry description

Attribute	Value
Sub-index	00_h
Access	ro
PDO mapping	See /CiA402-3/
Value range	Integer32
Default value	No

6.5.37. Object 60C2h: Interpolation time period

This object shall indicate the configured interpolation cycle time. The interpolation time period (sub-index 01h) value shall be given in 10(interpolation time index) s(econd). The interpolation time index (sub-index 02h) shall be dimensionless.
Table 215 specifies the object description, and Table 216 specifies the entry description.

Table 215 – Object description

Attribute	Value
Index	$60C2_h$
Name	Interpolation time period
Object code	Record
Data type	Interpolation time period record (0080h)
Category	Conditional: mandatory if ip, csp, csv or cst mode is supported

Table 216 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See /CiA402-3/
Value range	02_h
Default value	02_h
Sub-index	01_h
Description	Interpolation time period value
Entry category	Mandatory
Access	rw
PDO mapping	See /CiA402-3/
Value range	Unsigned8
Default value	01_h
Sub-index	02_h
Description	Interpolation time index
Entry category	Mandatory
Access	rw
PDO mapping	See /CiA402-3/
Value range	–128 to +63 (80_h to $3F_h$)
Default value	–3 (FD_h)

6.5.38. Object 60D0h: Touch probe source

This object shall provide the source of the touch probe functions. Table 157 specifies the value definition, Table 158 specifies the object description, and Table 159 specifies the entry description.

Table 157 – Value definition

Value	Definition(Input Source)
0	ORG Switch
1	Extend User Input1(IN6)
2	Extend User Input2(IN7)
3	Z phase Signal

Table 158 – Object description

Attribute	Value
Index	$60D0_h$
Name	Touch probe source
Object code	Array
Data type	Integer16
Category	Optional

Table 159 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See /CiA402-3/
Value range	01h to FE_h
Default value	No
Sub-index	01_h
Description	Touch probe 1 source
Entry category	Mandatory
Access	ro
PDO mapping	See /CiA402-3/
Value range	See Table 157
Default value	No
Sub-index	02_h
Description	Touch probe 2 source
Entry category	Optional
Access	ro
PDO mapping	See /CiA402-3/
Value range	See Table 157
Default value	No
to	
Sub-index	FE_h
Description	Touch probe 254 source
Entry category	Optional
Access	ro
PDO mapping	See /CiA402-3/
Value range	See Table 157
Default value	No

6.5.39. Object 60D5h: Touch probe 1 positive edge counter

This object shall provide a continuous counter that is incremented with each positive edge at touch probe
1. The counter is only valid if the touch probe input is enabled
(60B8h, bit 0 = 1b). For single event measuring only the value of bit 0 shall be evaluated. For continuous measuring the value is an unsigned 16-bit value with overflow.
Table 168 specifies the object description, and Table 169 specifies the entry description.

Table 168 – Object description

Attribute	Value
Index	$60D5_h$
Name	Touch probe 1 positive edge counter
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 169 – Entry description

Attribute	Value
Sub-index	00_h
Access	ro
PDO mapping	See /CiA402-3/
Value range	Unsigned16
Default value	No

6.5.40. Object 60D6h: Touch probe 1 negative edge counter

This object shall provide a continuous counter that is incremented with each negative edge at touch probe
1. The counter is only valid if the touch probe input is enabled
(60B8h, bit 0 = 1b). For single event measuring only the value of bit 0 shall be evaluated. For continuous measuring the value is an unsigned 16-bit value with overflow.
Table 170 specifies the object description, and Table 171 specifies the entry description.

Table 168 – Object description

Attribute	Value
Index	$60D6_h$
Name	Touch probe 1 negative edge counter
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 171 – Entry description

Attribute	Value
Sub-index	00_h
Access	ro
PDO mapping	See /CiA402-3/
Value range	Unsigned16
Default value	No

6.5.41. Object 60D7h: Touch probe 2 positive edge counter

This object shall provide a continuous counter that is incremented with each positive edge at touch probe
2. The counter is only valid if the touch probe input is enabled (60B8h, bit 8 = 1b).
For single event measuring only the value of bit 0 shall be evaluated. For continuous measuring the value is an unsigned 16-bit value with overflow.
Table 172 specifies the object description, and Table 173 specifies the entry description.

Table 172 – Object description

Attribute	Value
Index	$60D7_h$
Name	Touch probe 2 positive edge counter
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 173 – Entry description

Attribute	Value
Sub-index	00_h
Access	ro
PDO mapping	See /CiA402-3/
Value range	Unsigned16
Default value	No

6.5.42. Object 60D8h: Touch probe 2 negative edge counter

This object shall provide a continuous counter that is incremented with each negative edge at touch probe
2. The counter is only valid if the touch probe input is enabled (60B8h, bit 8 = 1b).
For single event measuring only the value of bit 0 shall be evaluated. For continuous measuring the value is an unsigned 16-bit value with overflow.
Table 174 specifies the object description, and Table 175 specifies the entry description.

Table 174 – Object description

Attribute	Value
Index	$60D8_h$
Name	Touch probe 2 negative edge counter
Object code	Variable
Data type	Unsigned16
Category	Optional

Table 175 – Entry description

Attribute	Value
Sub-index	00_h
Access	ro
PDO mapping	See /CiA402-3/
Value range	Unsigned16
Default value	No

6.5.43. Object 60E3h: Supported homing methods

This object shall provide the supported homing methods of the drive. Table 134 specifies the value definition. Table 137 specifies the object description, and Table 138 specifies the entry description.

Table 137 – Object description

Attribute	Value
Index	$60E3_h$
Name	Supported homing methods
Object code	Array
Data type	Integer8
Category	Optional

Table 138 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See /CiA402-3/
Value range	01h to FE_h
Default value	Manufacturer-specific
Sub-index	01_h
Description	1st supported homing method
Entry category	Mandatory
Access	c
PDO mapping	See /CiA402-3/
Value range	See Table 134
Default value	※37d
Attribute	Value
Sub-index	02_h
Description	2nd supported homing method
Entry category	Optional
Access	c
PDO mapping	See /CiA402-3/
Value range	See Table 134
Default value	Manufacturer-specific
	to
Sub-index	FE_h
Description	254th supported homing method
Entry category	Optional
Access	c
PDO mapping	See /CiA402-3/
Value range	See Table 134
Defaulz value	Manufacturer-specific

6.5.44. Object 60F4h: Following error actual value

This object shall provide the actual value of the following error. The value shall be given in user-defined position units. Table 191 specifies the object description, and Table 192 specifies the entry description.

Table 191 – Object description

Attribute	Value
Index	$60F4_h$
Name	Following errror actual value
Object code	Variable
Data type	Integer32
Category	Optional

Table 192 – Entry description

Attribute	Value
Sub-index	00_h
Access	ro
PDO mapping	See /CiA402-3/
Value range	Integer32
Default value	No

6.5.45. Object 60FDh: Digital inputs

This object shall provide digital inputs. This object shall represent the logical input levels.
Figure 103 specifies the object structure.
NOTE In IEC 61800-7-201:2015 this object was wrongly dedicated for physical input levels and corrected to logical input levels in this profile specification.

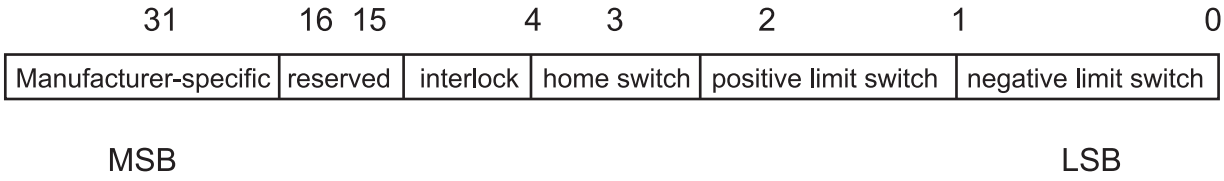


Figure 103 – Object structure

Bit 3 (interlock) provides the state of the interlock input. If the logical input signal changes to not activated, the drive shall enter the switch on disabled or fault reaction active state. This means the power stage of the drive is disabled and locked against switching on.

Table 343 specifies the values.

Table 343 – Value definition

Field	Value	Definition
negative limit switch	0b	Negative limit switch not reached
	1b	Negative limit switch reached
positive limit switch	0b	Positive limit switch not reached
	1b	Positive limit switch reached
home switch	0b	Home switch not reached
	1b	Home switch reached
interlock	0b	Interlock not activated
	1b	Interlock activated
reserved (each bit)	0b	Reserved
Manufacturer-specific (each bit)	0b	Function not activated
	1b	Function activated

NOTE The value definition for “reserved” and “manufacturer-specific” fields from this table in IEC 61800-7- 201:2015 was specified more exactly in this profile specification.

Table 344 specifies the object description and Table 345 specifies the entry description.

Table 344 – Object description

Attribute	Value
Index	$60FD_h$
Name	Digital inputs
Object code	Variable
Data type	Unsigned32
Category	Optional

Table 345 – Entry description

Attribute	Value
Sub-index	00_h
Access	ro
PDO mapping	See /CiA402-3/
Value range	Unsigned32
Default value	no

6.5.46. Object 60FEh: Digital outputs

This object shall command the digital outputs. This object shall represent the logical output levels. Figure 104 specifies the structure of sub-index 01h. Table 346 specifies the values for sub-index 01h. Table 347 specifies the values for sub-index 02h.

NOTE In IEC 61800-7-201:2015 this object was wrongly dedicated for physical output levels and corrected to logical output levels in this profile specification.

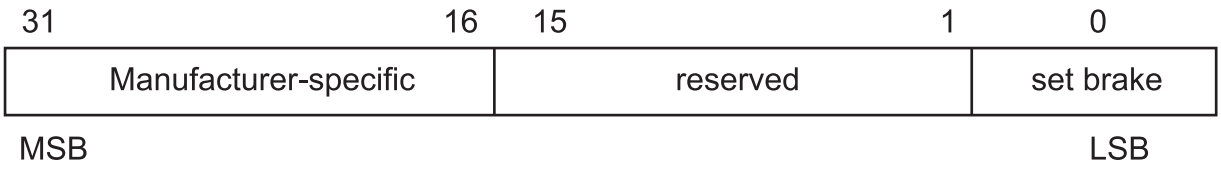


Figure 104 – Structure of sub-index 01h

NOTE The title of this figure in IEC 61800-7-201:2015 was corrected in this profile specification.

Table 346 – Value definition for sub-index 01_h

Field	Value	Definition
set brake	0_b	Switch off/do not set brake
	1_b	Switch on/set brake
reserved (each bit)	0_b	Reserved
Manufacturer-specific (each bit)	0_b	Switch off
	1_b	Switch on

NOTE The title and the content of this table in IEC 61800-7-201:2015 was corrected in this profile specification.

Table 347 – Value definition for sub-index 02h

Field	Value	Definition
Each bit	0_b	Disable output
	1_b	Enable output

NOTE In IEC 61800-7-201:2015 no value definition for sub-index 02h was defined. It was added in this profile specification.

Table 348 – Object description

Attribute	Value
Index	$60FE_h$
Name	Digital outputs
Object code	Array
Data type	Unsigned32
Category	Optional

Table 349 – Entry description

Attribute	Value
Sub-index	00_h
Description	Highest sub-index supported
Entry category	Mandatory
Access	c
PDO mapping	See /CiA402-3/
Value range	01h or 02_h
Default value	Manufacturer-specific
Sub-index	01_h
Description	Physical outputs
Entry category	Mandatory
Access	rw
PDO mapping	See /CiA402-3/
Value range	Unsigned32
Default value	$0000\ 0000_h$
Sub-index	02_h
Description	Bit mask
Entry category	Optional
Access	rw
PDO mapping	See /CiA402-3/
Value range	Unsigned32
Default value	$0000\ 0000_h$

6.5.47. Object 6502h: Supported drive modes

This object shall provide information on the supported drive modes. Figure 7 specifies the value structure, Table 60 specifies the value definition, Table 61 specifies the object description, and Table 62 specifies the entry description. This product value is 0x01A5.

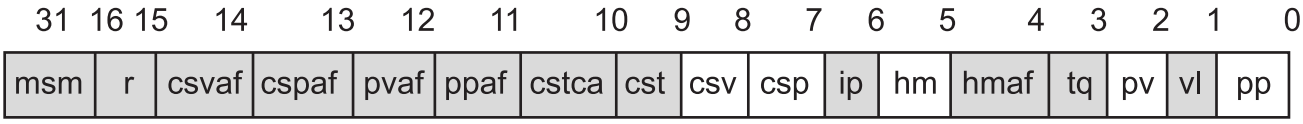


Figure 7 – Value structure

Table 343 – Value definition

Fielda	Bit	Value	Description
pp: profile position	0	0_b 1_b	Not supported Supported
vl	1	0_b 1_b	Not supported Supported
pv	2	0_b 1_b	Not supported Supported
tq	3	0_b 1_b	Not supported Supported
hmaf	4	0_b 1_b	Not supported Supported
hm	5	0_b 1_b	Not supported Supported
ip	6	0_b 1_b	Not supported Supported
csp	7	0_b 1_b	Not supported Supported
csv	8	0_b 1_b	Not supported Supported
cst	9	0_b 1_b	Not supported Supported
cstca	10	0_b 1_b	Not supported Supported
ppaf	11	0_b 1_b	Not supported Supported
pvaf	12	0_b 1_b	Not supported Supported
cspaf	13	0_b 1_b	Not supported Supported
csvaf	14	0_b 1_b	Not supported Supported
r	15	0_b	Reserved
ms: manufacturer-specific mode	16 to 31	0_b 1_b	Not supported Supported

Table 61 – Object description

Attribute	Value
Index	6502_h
Name	Supported drive modes
Object code	Variable
Data type	Unsigned32
Category	Mandatory

Table 62 – Entry description

Attribute	Value
Sub-index	00_h
Access	ro
PDO mapping	See /CiA402-3/
Value range	See Figure 7
Default value	Manufacturer-specific

6.6. 驅動器製造商定義物件

6.6.1. Object 2001h: VSTART

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2001h	0	VSTART	U32	RW	Yes	No	0~262143(DEC)	00_h

The detail description please refer to 5.4.3.(Unit: ustep/s)

6.6.2. Object 2002h: VSTOP

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2002h	0	VSTOP	U32	RW	Yes	No	10~262143(DEC)	$0A_h$

Recommend minimum value is 10.
The detail description please refer to 5.4.3.(Unit: ustep/s)

6.6.3. Object 2003h: V1

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2003h	0	V1	U32	RW	Yes	No	0~1048575(DEC)	00_h

The detail description please refer to 5.4.3.(Unit: ustep/s)

6.6.4. Object 2004h: A1

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2004h	0	A1	U32	RW	Yes	No	0~65535(DEC)	00_h

The detail description please refer to 5.4.3.(Unit: ustep/s^2)

6.6.5. Object 2005h: D1

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2005h	0	D1	U32	RW	Yes	No	0~65535(DEC)	01_h

Recommend minimum value is 1.
The detail description please refer to 5.4.3.(Unit: ustep/s^2)

6.6.6. Object 2006h: TZEROWAIT

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2006h	0	TZEROWAIT	U16	RW	Yes	No	0~65535(DEC)	00_h

The detail description please refer to 5.4.3. (Unit: 0~2s / 0~65535)

6.6.7. Object 2007h: IHOLD

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2007h	0	IHOLD	U8	RW	Yes	No	1~100(DEC)	00_h

This Object is for setting the motor lock in current position' s current percent value.
Unit: 100%. (max 100% = 3.1 Arms)
The higher value was set, the motor will become hot.

6.6.8. Object 2008h: IRUN

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2008h	0	IRUN	U8	RW	Yes	No	1~100(DEC)	00_h

This Object is for setting the motor execute movement' s current percent value.
Unit: 100%. (max 100% = 3.1 Arms)
The higher value was set, the motor will become hot.

6.6.9. Object 2009h: IHOLDDELAY

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2009h	0	IHOLDDELAY	U8	RW	Yes	No	0~15(DEC)	00_h

Controls the number of clock cycles for motor power down after a motion.
0:instant power down.
1~15:Delay per current reduction step in multiple of 2^{18} clocks.
The smooth transition avoids a motor jerk upon power down.

6.6.10. Object 200Ah: Encoder Resolution(CloseLoop Only)

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
200Ah	0	Encoder Resolution	U32	RW	Yes	No	500~ 100000(DEC)	9600

This Object sets the encoder resolution. (Unit: ustep counts)

6.6.11. Object 200Bh: Ref_logic_level

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
200Bh	0	Ref_logic_level	U8	RW	Yes	No	0~1(DEC)	00_h

This Object sets Logic of Refence Switch input signals, include ORGIN, LIMIT+ and LIMIT-.

Value	Definition
0	Low active
1	High active

6.6.12. Object 200Ch: EMI_logic_level

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
200Ch	0	EMI_logic_level	U8	RW	Yes	No	0~1(DEC)	00h

This Object sets Logic of Emergency button input signals.

Value	Definition
0	Low active
1	High active

6.6.13. Object 200Dh: Unit mode

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
200Dh	0	Unit mode	U8	RW	Yes	No	0~1(DEC)	-

This object is setting PID controller or not (only for CSP mode)

Unit Mode type	Value
CSP mode without PID controller	0
CSP mode with PID controller	1

6.6.14. Object 200Eh: Homing offset data

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
200Eh	0	Unit mode	U8	RW	Yes	No	-2147483648~ 2147483647	00h

This Object sets Homing offset data of Homing function. (Unit: ustep)
More detail please refer to 6.5.18.

6.6.15. Object 200Fh: Limit stop method

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
200Fh	0	Limit stop method	U8	RW	Yes	No	0~2(DEC)	00_h

This Object sets the stop method when the LIMIT Switch is been triggered .

Value	Definition
0	Ignore the signal
1	Slow deceleration and stop
2	Emergency stop

6.6.16. Object 2010h: Break delay

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2010h	0	Break delay	U8	RW	Yes	No	0~1000(DEC)	00_h

This Object sets the break function delay time. (Unit: ms)

6.6.17. Object 2011h: Slowdown deceleration

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2011h	0	Slowdown deceleration	U32	RW	Yes	No	1~4291468 (DEC)	00_h

This Object sets the deceleration of the slowdown stop method. (Unit: ustep/s^2)

6.6.18. Object 2012h: Limit Switch direction exchange

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2012h	0	Limit Switch direction exchange	U8	RW	Yes	No	0~1(DEC)	00_h

Value	LIMIT Switch	LIMIT Switch Software Status
0	LIMIT +	LIMIT +
	LIMIT -	LIMIT -
1	LIMIT +	LIMIT -
	LIMIT -	LIMIT +

6.6.19. Object 2013h: MicroStepResolutionSelection

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2013h	0	Micro Step Resolution Selection	U8	RW	Yes	No	0~8	0

This object is setting micro step resolution of motor driver.

MicroStepResolution type	Value
256	0
128	1
64	2
32	3
16	4
8	5
4	6
2	7
1	8

6.6.20. Object 2014h: CSP_PID_Controller_P

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2014h	0	CSP_PID_ Controller_P	U16	RW	Yes	No	0~65535	176

This object is setting P gain of CSP PID Controller (only available when Unit mode = 1).

6.6.21. Object 2015h: CSP_PID_Controller_I

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2015h	0	CSP_PID_ Controller_I	U16	RW	Yes	No	0~65535	0

This object is setting I gain of CSP PID Controller (only available when Unit mode = 1).

6.6.21. Object 2016h: CSP_PID_Controller_D

Index	Sub index	Name	Type	Access	SAVE	PDO Mapping	Value Range	Default Value
2016h	0	CSP_PID_ Controller_D	U16	RW	Yes	No	0~65535	707

This object is setting D gain of CSP PID Controller (only available when Unit mode = 1).

7. 歷史版本

版本	日期	更改性質	詳細內容
V0.0	2021-11-22	文檔	初版說明書發布
V0.1	2021-07-21	文檔	更新: 1.EtherCAT規格之描述更新 2.EtherCAT相關名詞縮寫與定義解釋之描述更新 3.通訊物件: 0x1018:Identity之描述更新 4.PDO Mapping物件列表之描述更新 新增內容: 1.驅動配置物件: 0x6066:Following error time out新增描述 2.驅動配置物件: 0x6068:Position window time新增描述 3.驅動配置物件: 0x6080: Max motor speed新增描述

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