5.6 DO function description in detail

Please refer to the "6.5.3 digital input / digital output" for details. The following table is a functional description of IO.

No	Symbol	function	Function explanation
0	OFF	Always invalid	Forced output OFF.
1	ON	Always valid	Forced output ON.
2	RDY	Servo ready	OFF：Servo main power supply is off; Or alarm occurs; ON ：Servo main power supply is normal，no alarm occurs.
3	ALM	Alarm	OFF：Alarm occurs; ON ： No alarm occurs.
4	ZSP	Zero speed	OFF：Servomotor speed is higher than parameter P160 (in CCW or CW); ON ： Servomotor speed is lower than parameter P160 ((in CCW or CW).
8	BRK	Electromagnetic brake	OFF：Electromagnetic brake applies the brake; ON ： Electromagnetic brake releases the brake.
9	RUN	Servo is in motion	OFF：Servomotor is not operated; ON ： Servomotor in operation.
11	TRQL	Torque limit	OFF: motor torque does not reach the limit value; ON: motor torque reaches a limited value.
12	SPL	Speed limit	When torque control, OFF: motor speed is not limited. ON: the speed of the motor reaches the limit.
13	HOME	Homing complete	After homing has completed，the HOME output is ON.
23	BRKNET	Electromagnetic brake（EtherCAT controll）	OFF: brake of electromagnetic brake; ON: the electromagnetic brake is released. The output state is determined by the bit0 in 60FE.
24	NETIO0	EtherCAT Corresponding control IO	Refer to the "6.6.3 digital input / digital output" section for details.
25	NETIO1		
26	NETIO2		
27	NETIO3		
28	NETIO4		

Chapter 6 Communication functions

6.1 Common object description

1. 6040h Control Word

See part of the "6.3.2 control word 6040h".

2. 6041h Status Word

See the "6.3.3 state word 6041h" section.

3. 6060h Mode Of Operation

At present, only four modes of operation are supported.
6: origin regression model; 8: synchronous position mode;
9: synchronous speed mode; 10: synchronous torque mode.

Before sending the enable command, it is necessary to determine the value of the object and enable the subsequent running mode to receive the object value of the enable command.

4. 607Ah Target Position

The target position is taken into effect in the CSP position mode.The position instruction received by the current cycle indicates the absolute position that the servo needs to run in the current cycle, the unit is User Unit.

5. 60FFh Target Velocity

The Target Velocity description takes effect in the CSV speed mode, and the speed instruction received by the current cycle indicates the speed of the target that the servo runs in the current cycle operation, the unit is User Unit/s.

6. 6071h Target Torque

The Target Torque is taken into effect in the CST speed mode, and the torque instructions received by the current cycle represent the target torque that the servo runs during the current cycle operation, with a unit of 0.1% rated torque.

7. 6064h Position ActualValue

Position Actual Value, the unit is User Unit.

The original data of the single loop value of the encoder can be read out by 2601h, and the readout data is most high aligned. If the encoder digit is less than 32

bits and the low bit complement 0, for example, the encoder resolution is 17 bits, the bit31 to bit15 is the 17bit single loop value of the encoder, and the bit14 to bit0 bit complement 0.

The original data of the encoder's multi circle value can be read out through 2602h.

8. 606Ch VelocityActualValue

The actual speed velocity is User Unit/s.

9. 6077h TorqueActualValue

The actual torque value is 0.1% torque per unit.

10. 2600h Err Code

When the servo driver has an error alarm, it can read the driver's error code (except ERR60) through this object.

ERR60 indicates that the communication between the servo driver and the EtherCAT host (OP mode) fails, and the ERR60 will be automatically cleared after the communication of the servo drive with the EtherCAT host is successful.11. 2601h Absolute Position

The absolute position of the absolute value is the absolute position of the single loop of the encoder. The type is 32 digits, the encoder position is unified into 32 bits, and the low bit is zero.

Example: 17 bit absolute value encoder. The data range is 0x0000 0000H～0xffff 8000H。

20 bit absolute value encoder. The data range is 0x0000 0000H～0xffff f000H。

23 bit absolute value encoder. The data range is 0x0000 0000H～0xffff fe00H。

23 bit absolute value encoder. The data range is 0x0000 0000H to 0xFFFF fe00H.

12. 2602h Multi Turn

Multi Turn is the multi loop information of the encoder. It is only valid for the multi circle absolute encoder, and the multi circle display range is 0x0000H to 0xffffH.

13. 2603h First Z Event： First Z Event is only valid when adapting the incremental encoder. After the Z signal appears, the value is changed to 1, when Absolute Position is corrected to the true value.

14. 2604h Vibration Period： The parameters are not used for the time being.

15. 2605h DC Bus Voltage： Servo drive DC bus voltage, unit: V.

16. 2606h Power Module Internal Temperature

The internal temperature of the module, unit: centigrade.

17. **2670h Accumulative Loop Rate**：Cumulative load rate per unit:%.
18. **2671h Regenerative Loop Rate**：Regenerative braking load rate per unit:%.
19. **2680h Sub Index 1：Pos Loop Command**

    The position instruction value received by the servo unit is User Unit/s.

20. 2680h Sub Index 2：Pos Loop Fedback

    The motor position feedback value, the unit is User Unit/s.

21. **2680h Sub Index 3：Pos Loop Error**

    Servo position tracking error, the unit is User Unit/s.

22. **2681h Sub Index 1：Velocity Loop Motor Speed**

    Servo speed loop feedback speed, unit: RPM.

23. **2682h Sub Index 1：Torque Loop Motor Actual Torque**

    Actual torque of servo torque ring, unit: % rated torque.

24. **2682h Sub Index 2：Torque Loop Motor Actual Peak Torque**

    Servo torque loop actual peak torque, unit: % rated torque.

25. **2682h Sub Index 3：Torque Loop Motor Actual Current**

    The actual current of the servo torque loop, unit: 0.1A.

26. **2682h Sub Index 3：Torque Loop Motor Actual Peak Current**

    The actual peak current of the servo torque loop is 0.1A.

27. **26A0h Para Motor Current Rms Rate**： Motor rated current, unit: 0.1A.
28. **26A1h Para Motor Torque rate**： Motor rated torque, unit: 0.1Nm.
29. **26A2h Para Motor Speed Rate**：Motor rated speed, unit: RPM.
30. **27FEh Operation Command**：Internal operation instructions, reserved.
31. **27FFh Operation Status**：Internal operation instructions, reserved.

6.2 EtherCAT communication

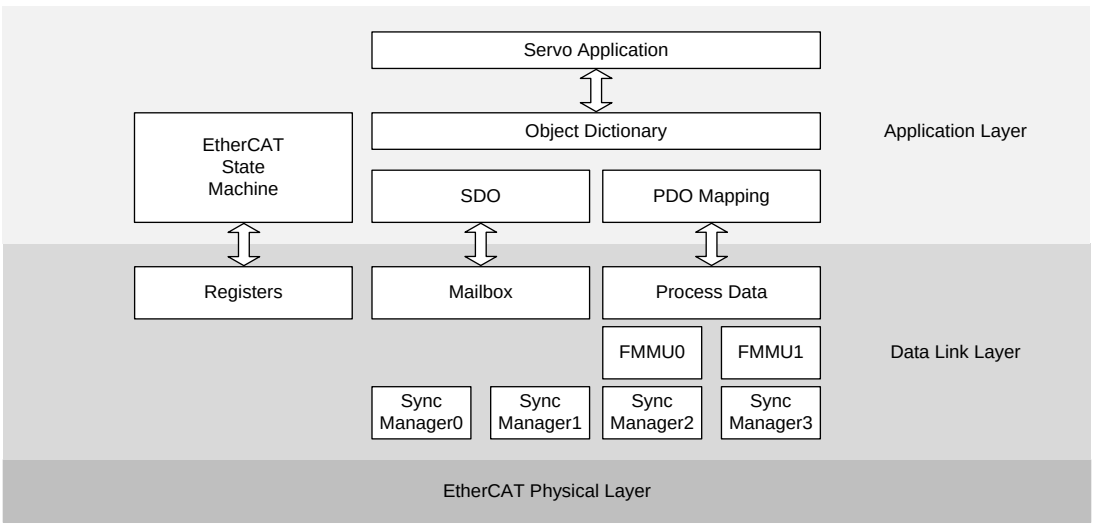
EtherCAT is the Abbreviation of (Ethernet for Control Automation Technology).EtherCAT is a communication mode between the master slave and the real-time Ethernet developed by the German BECKHOFF company, which is managed by ETG （EtherCAT Technology Group）.

The basic concept of EtherCAT communication is that the DataFrame sent through the host passes from the server, sending and receiving Data from the server while receiving and sending the Data from the server.

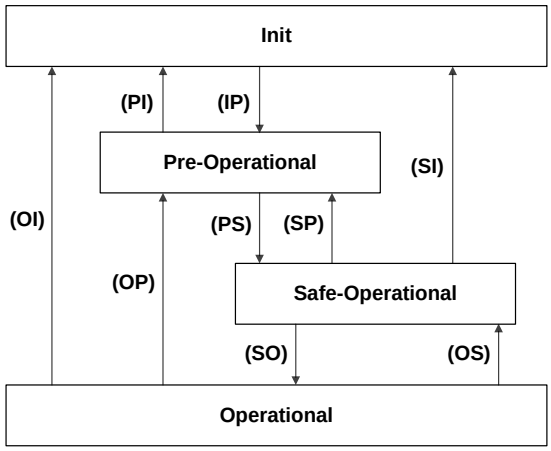
EtherCAT uses a Ethernet framework based on IEEE802.3.

With the same 100BASE-TX Ethernet as Base, the length of the cable is the longest, and the number of receiving servers is up to 65535, so it can form Network indefinitely. And when Ethernet Switch is used alone, it can also be received with the TCP/IP normally used.

6.2.1 CANopen over EtherCAT structure



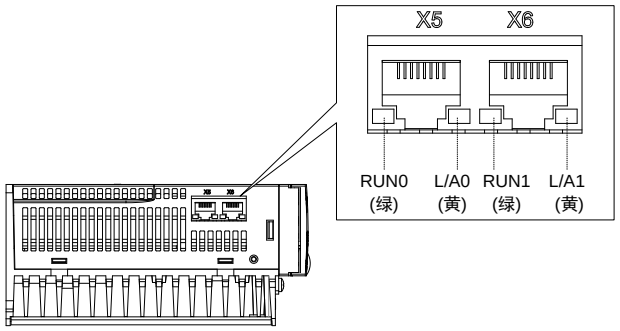
6.2.2 EtherCAT state machine



status	Explaination
Init	Device initialization. Mailbox communication and process data communication can not be used.
Pre-Operational	The current state can be used in mailbox communication.
Safe-Operational	PDO input data (TxPDO) can be read. PDO output data (RxPDO) can not be received.
Operational	Periodic I/O communication can handle PDO output data (RxPDO).
State migration	**Explaination**
IP	Start the mailbox communication.
PI	Interrupt the mailbox communication.
PS	Start to update the input data
SP	Stop to update the input data
SO	Start to update the output data
OS	Stop to update the output data
OP	Stop to update the input data/output data
SI	Stop to update the input data/ mailbox communication
OI	Stop to update all input data/output data/ mailbox communication data.

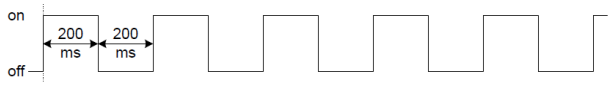
6.2.3 LED status

The status of the EP3E driver LED is located on X5 (IN) and X6 (OUT) socket, as shown in the following figure.

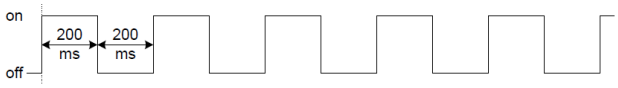
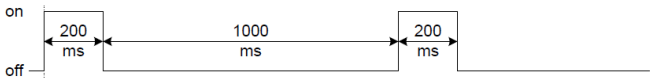


1. L/A0，L/A1（Link Activity）LED（YELLOW LED）

L/A0 LED displays the state of the X5 communication interface, L/A1 LED shows the state of the X6 communication interface. The contents of each LED display are shown in the table below.

Link/Activity LED	Description
Off	Communication unconnected
Flickering	The communication is connected and the communication is activated. 
On	The communication has been connected and the communication is not activated.

2. RUN0，RUN1（Run）LED（GREEN LED）

RUN LED	Description
Off	INIT status
Blinking	Pre-Operationals status。 
Single Flash	Safe-Operational status。 

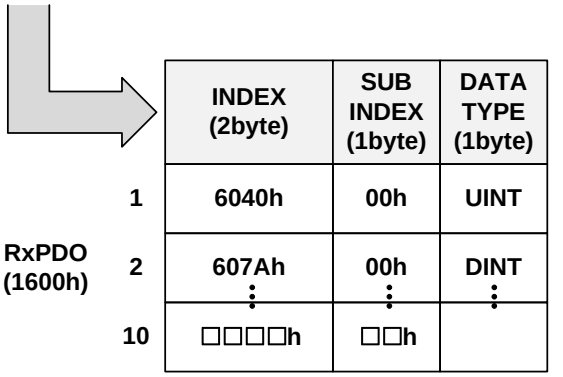
RUN LED	Description
On	Operational status

6.2.4 Data Type

Name	Description	Range
SINT	Signed8bit	-128 ~127
USINT	Unsigned8bit	0 ~ 255
INT	Signed 16bit	-32768 ~ 32767
UINT	Unsigned 16bit	0 ~ 65535
DINT	Signed 32bit	-21247483648 ~ 21247483647
UDINT	Unsigned 32bit	0 ~ 4294967295
STRING	String Value	

6.2.5 PDO mapping

Index	**Sub**-Index	**Name**	**Data Type**
6040h	-	Controlword	UINT
607Ah	-	（Target Position）	DINT

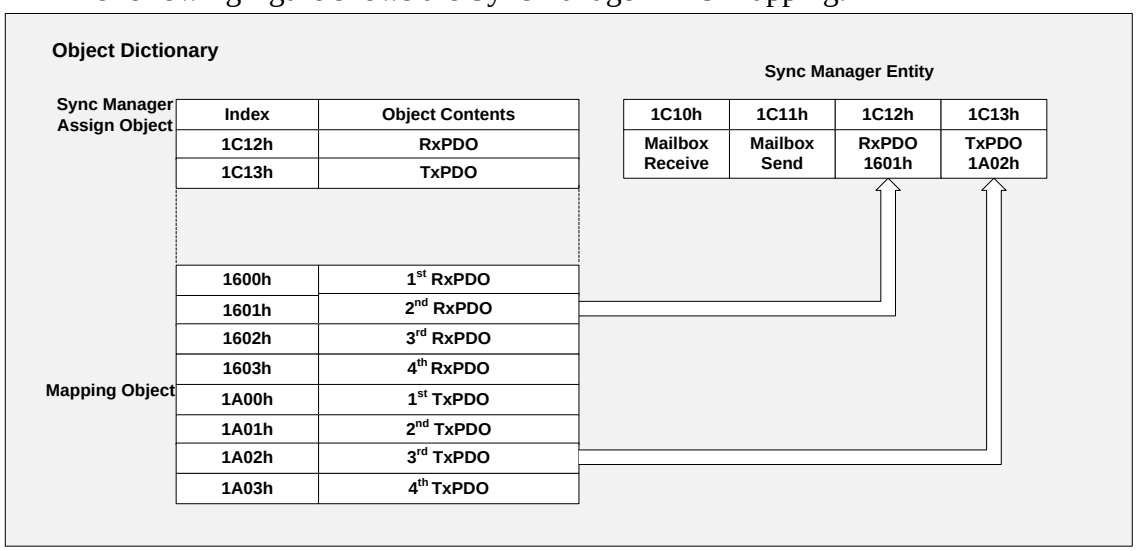


ndex	**Sub**-Index	**Name**	**Data Type**
6041h	-	StatusWord	UINT
6064h	-	（Position Actual Value）	DINT
606Ch	-	（Velocity Actual Value）	DINT

		INDEX (2byte)	SUB INDEX (1byte)	DATA TYPE (1byte)
TxPDO (1A00h)	1	6041h	00h	UINT
	2	6040h	00h	DINT
	3	606Ch	00h	DINT
	⋮	⋮	⋮	⋮
	10	□□□□h	□□h	

SyncManager consist of several PDO. SyncManager PDO Assign Object SyncManager PDO Assign Object (RxPD:1C12h, TxPDO:1C13h) shows the relationship between SyncManger and PDO.

The following figure shows the SyncManager PDO mapping.



PDO mapping

The following table is a PDO mapping that has been basically set up. This setting is defined in EtherCAT Slave Information file (XML file).

1. PDO Mapping

RxPDO (1600h)	Control Word (6040h)	Mode of Operation (6060h)	Target position (607Ah)	Target Velocity (60FFh)	Target Torque (6071h)

TxPDO (1A00h)	Status Word (6041h)	Mode of Operation Display (6061h)	Position Actual Value (6064h)	Velocity Actual Value (606Ch)	Torque Actual Value (6077h)

2. PDO Mapping

RxPDO (1601h)	Control Word (6040h)	Target position (607Ah)

TxPDO (1A01h)	Status Word (6041h)	Position Actual Value (6064h)

3. PDO Mapping

RxPDO (1602h)	Control Word (6040h)	Target Velocity (60FFh)

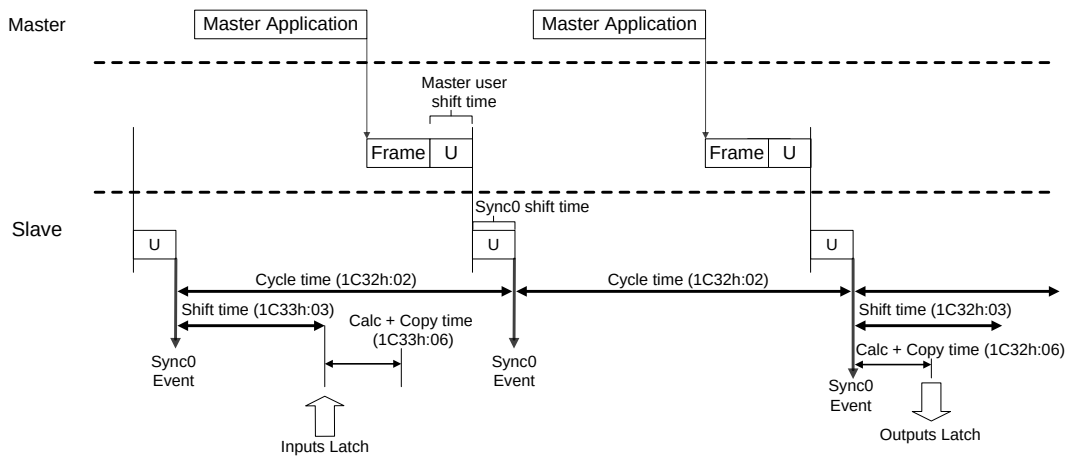
TxPDO (1A02h)	Status Word (6041h)	Position Actual Value (6064h)	Velocity Actual Value (606Ch)

4. PDO Mapping

RxPDO (1603h)	Control Word (6040h)	Target Torque (6071h)

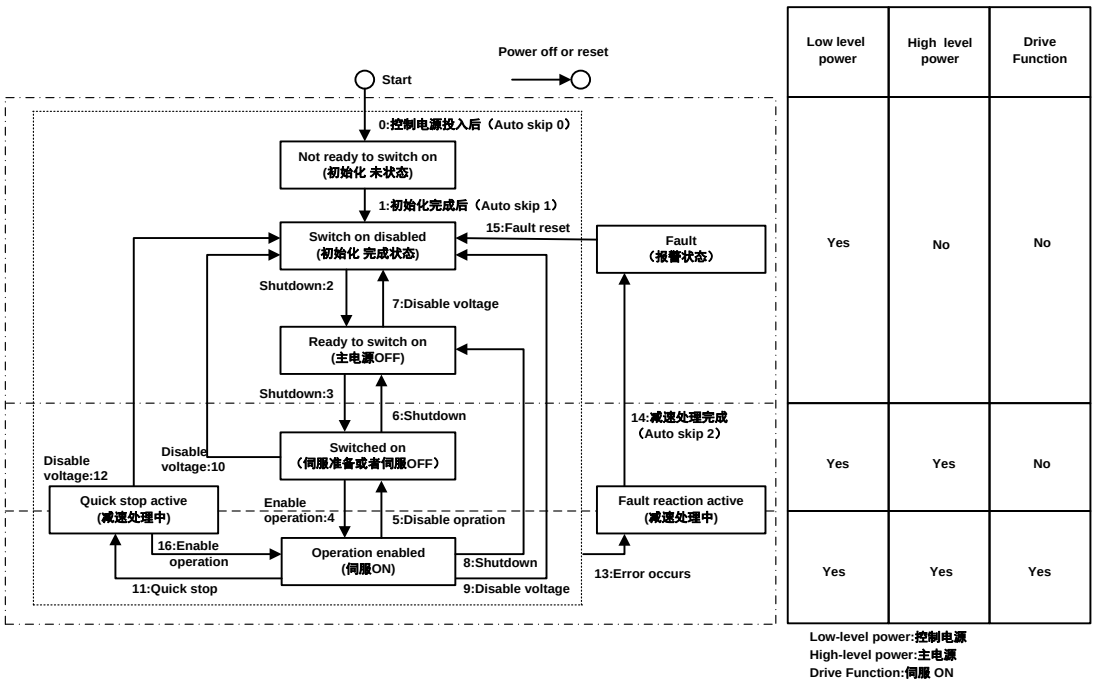
TxPDO (1A03h)	Status Word (6041h)	Position Actual Value (6064h)	Torque Actual Value (6077h)

6.2.6 According to the synchronization of DC (Distributed Clock)



6.3 Drive mode

6.3.1 Servo state machine



Status	Explanation
Not ready to switch on	Connect the control power supply and in the initialization.
Switch on disabled	When the initialization is completed, the servo parameters can be set.The current state is unable to supply the main power supply.
Ready to switch on	The current state can turn on the main power supply and the servo parameters can be set.The drive is in an inactive state.
Switched on	The main power supply is On state, and the servo parameters can be set.The drive is in an inactive state.
Operation enabled	In the non Fault state, the function of the driver is started, the torque can be applied to the motor. The servo parameters can also be set.
Quick Stop active	The Quick stop function has been executed.The servo parameters can be set.
Fault reaction active	The Fault state caused by Quick Stop or servo. The servo parameters can be set.
Fault	After Fault reaction is processed, the driver function is not activated. The servo parameters can be set.

Control command and state switching

The operation mode can be changed through 6060h (operation mode). On the server, the choice of the running mode is carried out at the same time as the associated target changes. If the main server is switched to a new mode of operation, switch to the same mode immediately.

CiA402 Status switching		Control word 6040h	Control word 6041h bit0~bit9*1
0	上电→初始化 Start→Not ready to switch on	No control instruction	0000h
1	初始化→伺服无故障 Not ready to switch on→Switch on disabled	No control instruction If an error occurs in the initialization, go directly into 13	0270h
2	伺服无故障→伺服准备好 Switch on disabled→Ready to switch on	0006h	0231h
3	伺服准备好→等待打开伺服使能 Ready to switch on→Switched on	0007h	0233h
4	等待打开伺服使能→伺服运行 Switched on→Operation enabled	000Fh	1237h
5	伺服运行→等待打开伺服使能 Operation enabled→Switched on	0007h	0233h
6	等待打开伺服使能→伺服准备好 Switched on→Ready to switch on	0006h	0231h
7	伺服准备好→伺服无故障 Ready to switch on→Switch on disabled	0000h	0270h
8	伺服运行→伺服准备好 Operation enabled→Ready to switch on	0006h	0231h
9	伺服运行→伺服无故障 Operation enabled→Switch on disabled	0000h	0270h
10	等待打开伺服使能→伺服无故障 Switched on→Switch on disabled	0000h	0270h
11	伺服运行→快速停机 Operation enabled→Quick stop active	0002h	0217h
12	快速停机→伺服无故障 Quick stop active→Switch on disabled	Quick shutdown mode 605A is selected as 0~3. After shutdown, natural transition is achieved without command.	0270h

CiA402 Status switching		Control word 6040h	Control word 6041h bit0~bit9*1
13	→故障停机 →Fault reaction active	In addition to the "fault" in any other status, once the servo driver fails, it switches to the stop status without any control commands automatically.	021Fh
15	故障→伺服无故障 Fault→Switch on disabled	0080h The rising edge of bit7 is effective. Bit7 remains 1, and other control instructions are invalid.	0270h
16	快速停机→伺服运行 Quick stop active→Operation enabled	Quick shutdown mode 605A is selected as 5~7. After the drive stopped, which send 000fh.	1237h

Note: because the bit10~bit15 (bit14 meaningless) of the state word 6041h is related to the running state of each servo mode, it is expressed in "0" in the upper table, and the specific status please check the running mode of each servo.

6.3.2 Control word 6040h

Index	Sub-Index	Name/ Description	Units	Range	Data Type	Access	PDO	Op-mode	EEPROM
6040h	00h	ControlWord	-	0~65535	UINT	RW	Yes	ALL	Yes

bit	name	description
0	Switch On	1: effective, 0: null and void
1	Enable Voltage	1: effective
2	Quick Stop	1: effective
3	Enable Operation	1: effective
4~6		Related to each servo operation mode
7	Fault Reset	Fault reset for reset fault and warning, performs failure reset function. Bit7 rising edge is effective; bit7 is kept at 1, and other control instructions are invalid.
8	Halt	In the mode of pause, please query the object dictionary 605Dh.
9		Related to each servo operation mode
10~15		Reservation

1. Note:
bit0~bit3 and bit7 have the same meaning under each servo mode. Each bit bit assignment is meaningless and must be combined with other bits to form a control instruction. Each command corresponds to a certain state, and the servo driver is guided into the expected state according to the CiA402 state machine switching process.

Command	Bits of the controlword					Transitions
	Bit 7	Bit 3	Bit 2	Bit 1	Bit 0	
Shut Down	0	×	1	1	0	2，6，8
Switch on	0	0	1	1	1	3
Switch on+enable operation	0	1	1	1	1	3+4 （NOTE）
Disable Voltage	0	×	×	0	×	7，9，10，12
Quick Stop	0	×	0	1	×	7，10，11
Disable Operation	0	0	1	1	1	5
Enable Operation	0	1	1	1	1	4，16
Fault Reset		×	×	×	×	15
NOTE After the Switch on status function is executed, which automatically jumps to the Enable Operation state.						

2. bit4~bit6 is related to each servo mode (see control instructions in different modes).

Op-mode	Bit 9	Bit 6	Bit 5	Bit 4
hm	-	-	-	Start homing
csp	-	-	-	
csv	-	-	-	
cst	-	-	-	

6.3.3 Control word 6041h

Index	Sub-Index	Name/ Description	Units	Range	DataType	Access	PDO	Op-mode	EEPROM
6041h	00h	Statusl Word	-	0~65535	UINT	RO	TPDO	ALL	Yes

Set control instructions:

bit	name	description
0	Ready to Switch On	
1	Switch On	
2	Operation Enable	
3	Fault	
4	Voltage Enable	
5	Quick Stop	
6	Switch On Disable	
7	Warning	
8		Reservation
9	Remote	0: non remote control mode, EP3E series products only support remote control mode. 1: remote control mode
10	Target Reached	0: the position or speed of the target is not reached 1: target location or speed arrive
11	InternalLimit Active	0: position instruction or feedback does not reach the internal position restriction of software. 1: the position instruction reaches the position limit of the software. After the absolute position limit of the software is effective, the servo will run with the position limit value as the target position and stop at the limit value. The input reverse displacement instruction can make the motor exit the overlimit state and zero the position.
12~13		Related to the various servo modes
14~15		Reservation
15	Zero completion	0: the origin is unfinished or unfinished 1: the original point has been returned to zero, the reference point was found

Note:

1. bit0~bit3, bit5 and bit6 are of the same meaning in each servo mode. Each bit bit is read meaningless individually. It must be composed of other bits and feedback the current state of the servo. The control word 6040h sends the command sequentially, and the servo feedback has a definite state.

Status word	PDS state	
xxxx xxxx x0xx 0000 b	Not Ready to Switch on	Initialization unfinished state
xxxx xxxx x1xx 0000 b	Switch on disabled	Initialization finished state
xxxx xxxx x01x 0001 b	Ready to switch on	Main circuit power OFF state
xxxx xxxx x01x 0011 b	Switched on	Servo OFF/ servo preparation
xxxx xxxx x01x 0111 b	Operation enabled	Servo ON
xxxx xxxx x00x 0111 b	Quick stop active	stop
xxxx xxxx x0xx 1111 b	Fault reaction active	abnormal (alarm) judgement
xxxx xxxx x0xx 1000 b	Fault	abnormal (alarm) judgement

1. bit10 and bit12~bit13 are related to each servo mode (see control instructions in different modes).

Op-mode	Bit 13	Bit 12	Bit 10
hm	Original reset error	Homing attained	target reached
csp	Following error	Drive follows command value	-
csv	-	Drive follows command value	-
cst	-	Drive follows command value	-

2. bit4, bit7, bit9 and bit11 have the same meaning under each servo mode, and the state of the servo mode after the feedback servo is executed.

Bit4 (main power on): 1, which indicates that the main circuit relay is absorbed.

Bit7 (alarm): 1 indicates the occurrence of an alarm. Whether the motor is moving during alarm depends on the type of alarm.

When bit9 (remote): ESM is converted to PreOP, it changes to 1.

6.4 Operation mode

EP3E only supports the following running mode for the time being （6060h）

- Cyclic Synchronous Position Mode
- Cyclic Synchronous Velocity Mode
- Cyclic Synchronous Torque Mode
- hm mode

1. Associated target

Index	Sub-Index	Name/ Description	Units	Range	DataType	Access	PDO	Op-mode	EEPROM
6502h	00h	Supported Drive Modes	-	0~ 4294967295	UDINT	RO	TxPDO	ALL	No

- Supported Drive Modes（Modeof operation）。
- The model is supported when the value is 1.

bit	31…16	16…10	9	8	7	6	5	4	3	2	1	0
Op-mode	Ms	r	cst	csv	csp	ip	hm	r	tq	pv	vl	pp
Value	0…0	0…0	1	1	1	0	1	0	0	0	0	0

Ms：manufacturer-specific

r：Reservation

bit	name	ab.	Corresponding
0	Profile position mode（Profile position control mode）	pp	No
1	Velocity mode（speed control mode）	vl	No
2	Profile velocity mode（Profile speed control mode）	pv	No
3	Torque profile mode（Profile torque control mode）	tq	No
5	Homing mode（position control mode of origin regression）	hm	Yes
6	Interpolated position mode（Compensation position control mode）	ip	No
7	Cyclic synchronous position mode（Cyclic position control mode）	csp	Yes
8	Cyclic synchronous velocity mode（Cyclic speed control mode）	csv	Yes
9	Cyclic synchronous torque mode（Cyclic torque control mode）	cst	Yes

Index	Sub-Index	Name/ Description	Units	Range	Data Type	Access	PDO	Op-mode	EEPROM
6060h	00h	Modes of Operation	-	-128~127	SINT	RW	RxPDO	ALL	Yes

- Setting the control mode of the servo drive
- Non - corresponding control patterns are prohibited.

Value	Operation display mode	ab.	Corresponding
-128~1	reserve		
0	No mode change /no mode assigned（模式未变更/模式为设定）		Yes
1	Profile position mode（Profile 位置控制模式）	pp	No
2	Velocity mode（速度控制模式）	vl	No
3	Profile velocity mode（Profile 速度控制模式）	pv	No
4	Torque profile mode（Profile 转矩控制模式）	tq	No
6	Homing mode（原点回归位置控制模式）	hm	Yes
7	Interpolated position mode（补偿位置控制模式）	ip	No
8	Cyclic synchronous position mode（Cyclic 位置控制模式）	csp	Yes
9	Cyclic synchronous velocity mode（Cyclic 速度控制模式）	csv	Yes
10	Cyclic synchronous torque mode（Cyclic 转矩控制模式）	cst	Yes
11~127	reserve		

Index	Sub-Index	Name/ Description	Units	Range	Data Type	Access	PDO	Op-mode	EEPROM
6061h	00h	Modes of Operation Display	-	-128~127	SINT	RO	TxPDO	ALL	No

- Indicate the current control mode
- Definition is the same as 6060h (running mode).

Value	操作显示模式	简称	对应*1
-128~1	reserve		
0	No mode change /no mode assigned （模式未变更/模式为设定）		Yes
1	Profile position mode（Profile 位置控制模式）	pp	Yes
2	Velocity mode（速度控制模式）	vl	No
3	Profile velocity mode（Profile速度控制模式）	pv	Yes
4	Torque profile mode（Profile转矩控制模式）	tq	Yes

6	Homing mode（原点回归位置控制模式）	hm	Yes
7	Interpolated position mode（补偿位置控制模式）	ip	No
8	Cyclic synchronous position mode（Cyclic位置控制模式）	csp	Yes
9	Cyclic synchronous velocity mode（Cyclic 速度控制模式）	csv	Yes
10	Cyclic synchronous torque mode（Cyclic转矩控制模式）	cst	Yes
11~127	reserve		

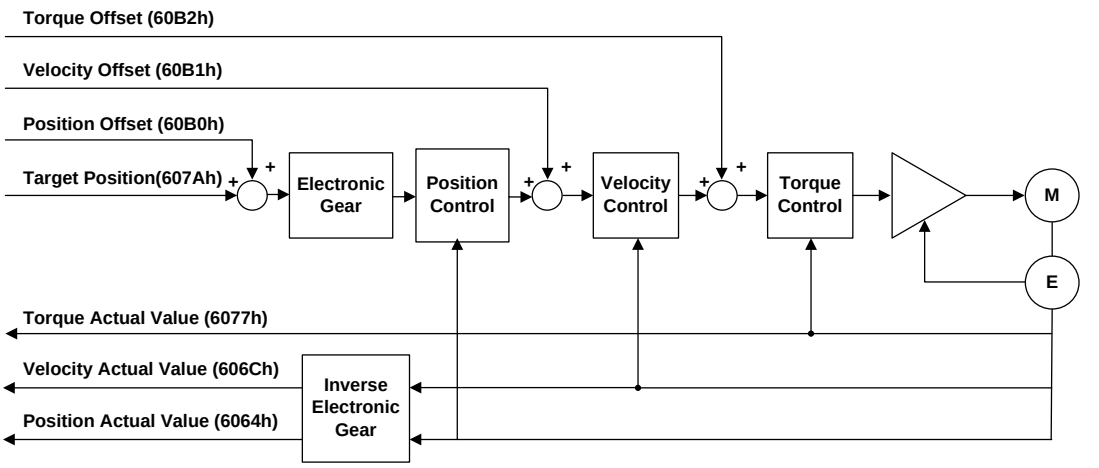
2. Notice of switching control mode

- By changing the value of 6060h (operation mode), which can switch the control mode.
- Please confirm the control mode of the servo drive in 6061h (running display mode).
- When the control mode is switched, please update the RxPDO object associated with 6060h synchronization mode.
- Under the changed control mode, the value of the object that is not supported is uncertain.
- It takes 2ms to change from control mode to handover. During this period, the object values of TxPDO related to 6061h and control mode are uncertain.
- Control mode switch to be executed above 20ms. It will be abnormal if the control mode is continuously switched less than the 20ms interval.
- Control mode switching must be carried out when the motor stop. It is impossible to guarantee the action of control mode switching in the motor action (including the origin of the regression action and the deceleration stop). The mode can not be switched immediately or an exception will occur.
- Under the condition of 6060h=0 and 6061h=0, if you change PDS state to "Operation enabled", abnormal actions will be occurred.
- If 6060h sets a value beyond 0, if 6060h=0 is set, the previous control mode will be maintained.
- If there is no corresponding control mode in 6060h, abnormal protection will occur.

6.4.1 Periodic synchronous position mode

Cyclic Synchronous Position Mode receives the target location (607Ah) running mode through the PDO periodic update of the main server. In this mode, torque deviation (60B2h) and speed deviation (60B1h) can be added up.

1. Structure diagram



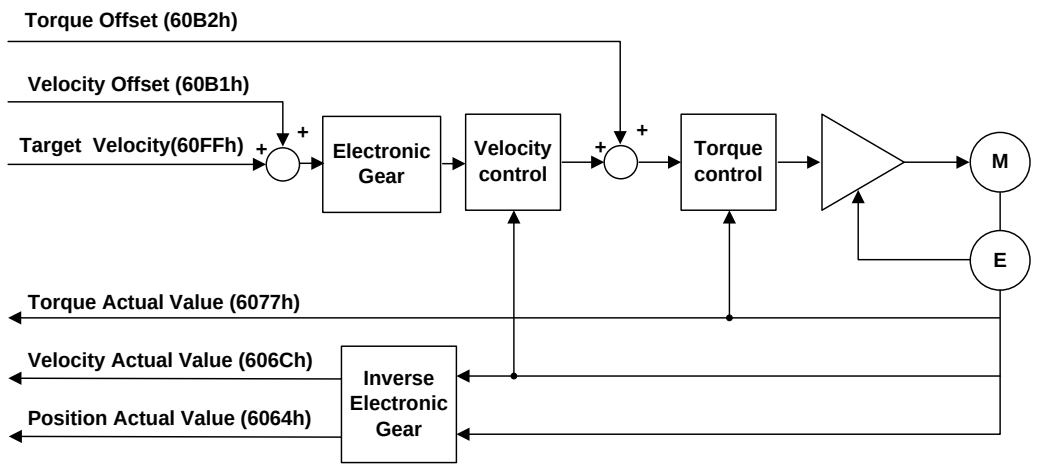
2. Associated target

Index	Sub-Index	Name	Data Type	Access	PDO Mapping	Units
607Ah	-	目标位置（Target Position）	DINT	RW	Yes	PosUnits
60B0h	-	位置偏差（Position Offset）	DINT	RW	Yes	Pos Units
60B1h	-	速度偏差（Velocity Offset）	DINT	RW	Yes	Vel Units
60B2h	-	转矩偏差（Torque Offset）	INT	RW	Yes	0.1%
6077h	-	实际转矩（Torque Actual Value）	INT	RO	Yes	0.1%
606Ch	-	实际速度（Velocity Actual Value）	DINT	RO	Yes	Vel Units
6064h	-	实际位置（Position Actual Value）	DINT	RO	Yes	Pos Units

6.4.2 Periodic synchronization velocity mode

In the cyclic Synchronous velocity mode, the master server specifies the target speed (60FFh) to the driver to limit speed. In this mode, the main server can add additional torque deviation (60B2h).

1. Structure diagram



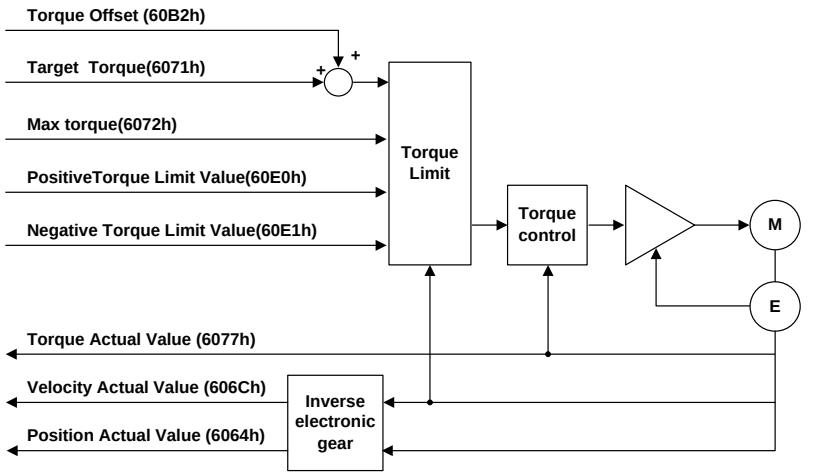
2. Associated target

Index	Sub-Index	Name	Data Type	Access	PDO Mapping	Units
60FFh	-	目标速度（Target Velocity）	DNIT	RW	Yes	Vel Units
60B1h	-	速度偏差（Velocity Offset）	DINT	RW	Yes	Vel Units
60B2h	-	转矩偏差（Torque Offset）	INT	RW	Yes	0.1%
6077h	-	实际转矩（Torque Actual Value）	INT	RO	Yes	0.1%
606Ch	-	速度实际值（Velocity Actual Value）	DINT	RO	Yes	Vel Units
6064h	-	实际位置（Position Actual Value）	DINT	RO	Yes	Pos Units

6.4.3 Periodic synchronous torque mode

In the cyclic Synchronous velocity mode, the main server specifies the target torque (6071h) to control the torque.

1. Structure diagram



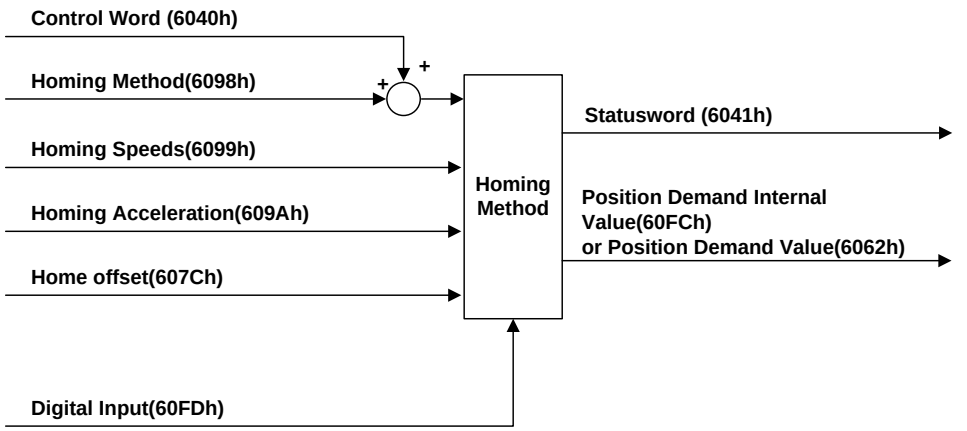
2. Associated target

Index	Sub-Index	Name	Data Type	Access	PDO Mapping	Units
6071h	-	目标转矩（Target Torque）	INT	RW	Yes	0.1%
6077h	-	转矩实际值（Torque Actual Value）	INT	RO	Yes	0.1%
60B2h	-	转矩偏差（Torque Offset）	INT	RW	Yes	0.1%
606Ch	-	实际速度（Velocity Actual Value）	DINT	RO	Yes	Vel Units
6064h	-	实际位置（Position Actual Value）	DINT	RO	Yes	Pos Units
6072h	-	转矩最大值（Max Torque）	DINT	RW	Yes	0.1%
60E0h	-	正转矩限制值（Positive Torque Limit Value）	DINT	RW	Yes	0.1%
60E1h	-	负转矩限制值（Negative Torque Limit Value）	DINT	RW	Yes	0.1%

6.4.4 HM mode

The origin regression method specifies the speed of the action and generates the position instruction in the servo driver to execute the position control mode of the origin regression action. If used in incremental mode, after power input, it is necessary to perform the origin regression action before executing the position.

1. Structure diagram



2. Associated target

Index	Sub-Index	Name	Data Type	Access	PDO Mapping	Units
6040h	00h	Controlword	UNIT	RW	Yes	-
6041h	00h	Statusword	UINT	RO	Yes	-
607Ch	00h-	Home 偏差 （Home Offset）	DINT	RW	No	Pos Units
6098h	00h-	Homing 方法 （Homing Method）	SINT	RW	Yes	-
6099h	-	Homing 速度	-	-	-	-
	00h	项目的总数 （Number of entries）	USINT	RO	No	-

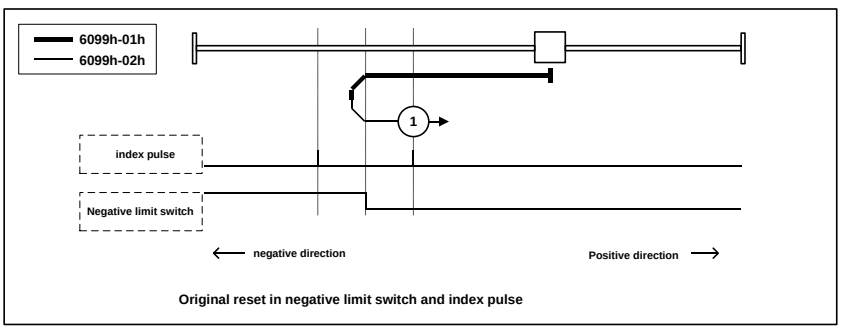
Index	Sub-Index	Name	Data Type	Access	PDO Mapping	Units
607Dh	-	限制软件位置（Software Position Limit）	-	-	-	-
	00h	项目的总数（Number of entries）	USINT	RO	No	-
	01h	位置限制最小（Min.position limit）	DINT	RW	No	Pos Units
	02h	位置限制最大（Max.position limit）	DINT	RW	No	Pos Units
609Ah	-	Homing 加速度（Homing Acceleration）	UDINT	RW	Yes	Acc Units
200Dh	-	基本功能设置（Function Select Switch）	UINT	RW	No	-
200Eh	-	位置刻度分子（Position Scale Numerator）	INT	RW	No	-
200Fh	-	位置刻度分母（Position Scale Denominator）	INT	RW	No	-

Index	Sub-Index	Name	Units	Range	Data Type	Access	PDO
6040h	00h	ControlWord		0~65535	U16	RW	RxPDO
6098h	00h	Homing Method		-128~127	I8	RW	RxPDO
6099h	-	Homing Speeds		-	-	-	-
	00h	Number Of Entries		2	U8	RO	No
	01h	Speed During Searchfor Switch	Command unit /s	0~4294967295	U32	RW	RxPDO
	02h	Speed During SearchForzero	Command unit /s	0~4294967295	U32	RW	RxPDO
609Ah	00h	Homing Acceleration	Command unit $/s^2$	0~4294967295	U32	RW	RxPDO

Method 1

This method is the initialization action direction is negative direction if the negative limit switch is not activated. (The drawing is an inactive state in a low level state)

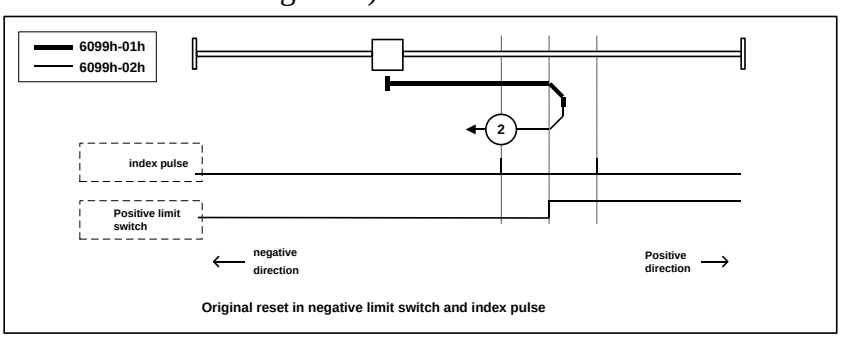
- The position of the origin is the position of the initial index pulse detected in the positive direction position after the negative limit signal is not activated.



Original reset in negative limit switch and index pulse

Method 2

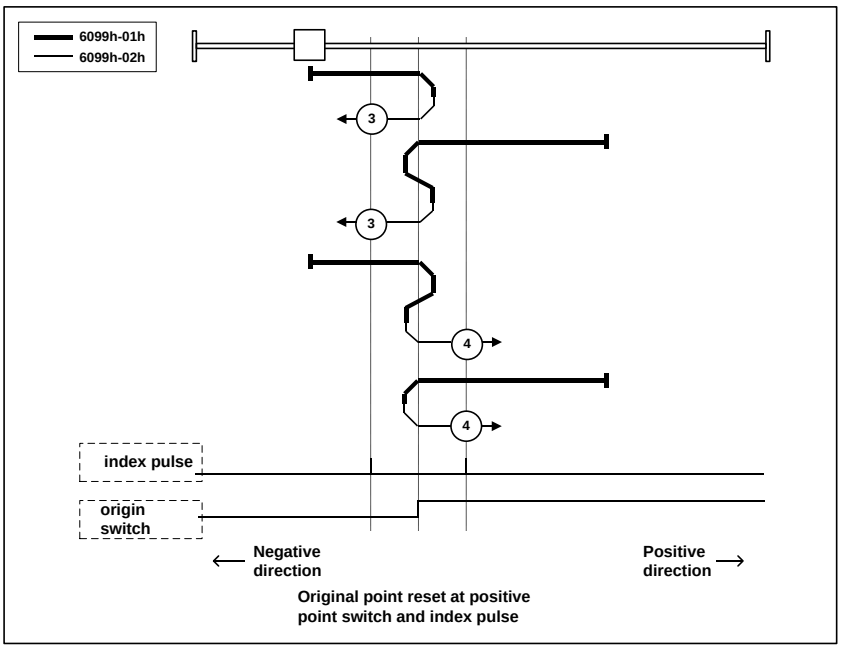
- This method is that if the positive limit switch is not activated then the initialization action direction is positive
  (The drawing is an inactive state in a low level state)
- The location of the origin is the position of the initial index pulse detected in the negative direction position after the positive limiting signal is not activated. (please refer to the following chart)



Original reset in negative limit switch and index pulse

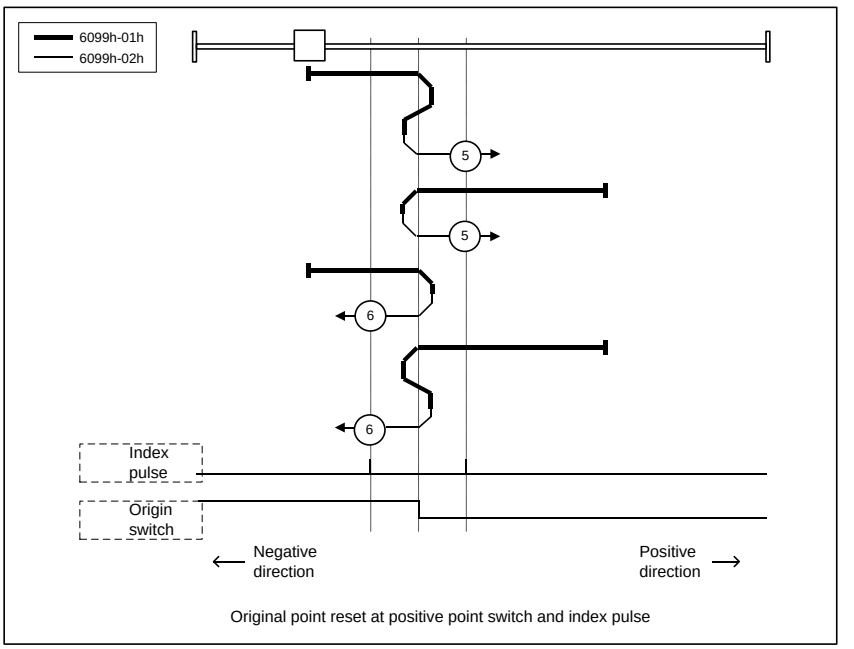
Method 3，4

- This method initializes the direction of action based on the state of the origin switch at startup.
- The location of the origin is the negative direction side after the change of the origin switch, or the detection location of the initial index pulse on the negative direction side. (please refer to the following chart)



Method 5，6

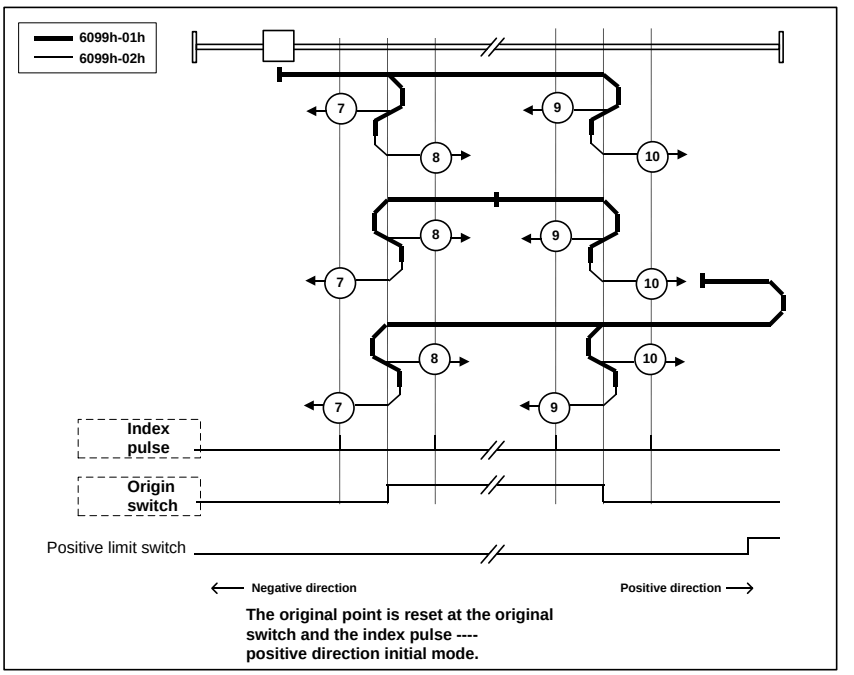
- This method initializes the direction of action based on the state of the origin switch at startup.
- The location of the origin is the negative direction side after the change of the origin switch, or the detection location of the initial index pulse on the positive side. (please refer to the following chart)



Original point reset at positive point switch and index pulse

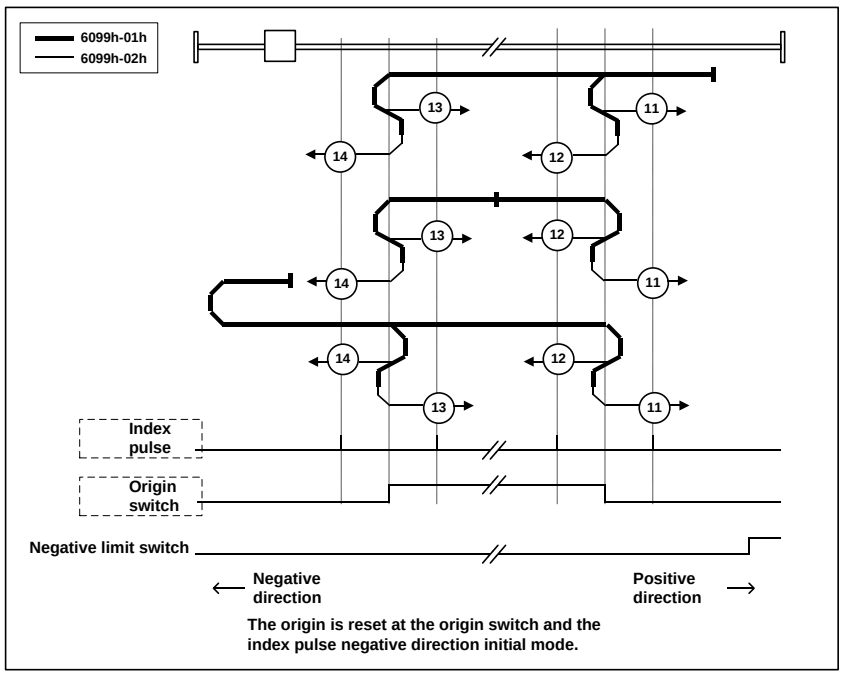
Method 7，8，9，10

- This method uses the origin switch box index pulse.
- The initial action direction of method 7,8 is the origin switch, if it is activated at the beginning of the action, then it is negative direction.
- The initialization action direction of 9, 10 is the origin switch, if it is activated at the beginning of action, then it is positive direction.
- The location of origin is the index pulse near the rising edge of the origin switch or the falling edge. (please refer to the following chart)



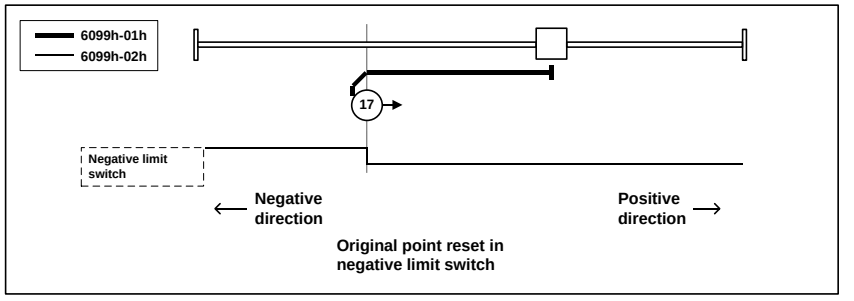
Method 11，12，13，14

- This method uses the origin switch and the index pulse.
- Initialization action direction of Method 11, 12 is the origin switch, if it is activated at the beginning of action, it is positive direction.
- Initialization action direction of Method 13, 14 is the origin switch, if activated at the beginning of action, then it is negative direction.
- The location of origin is the index pulse near the rising edge of the origin switch or the falling edge. (please refer to the following chart)



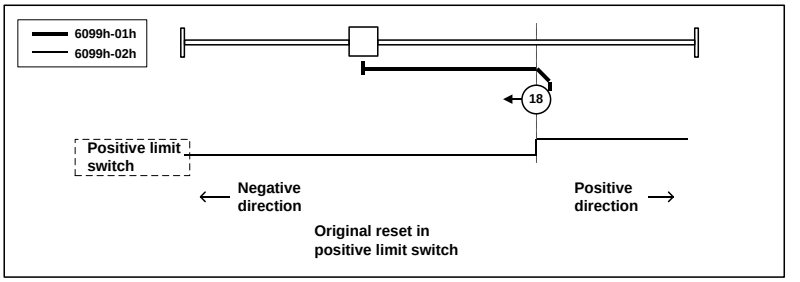
Method 17

- This method is similar to method 1. The difference is that the location of the origin is not the index pulse, but the position of the limit switch. (please refer to the following chart)



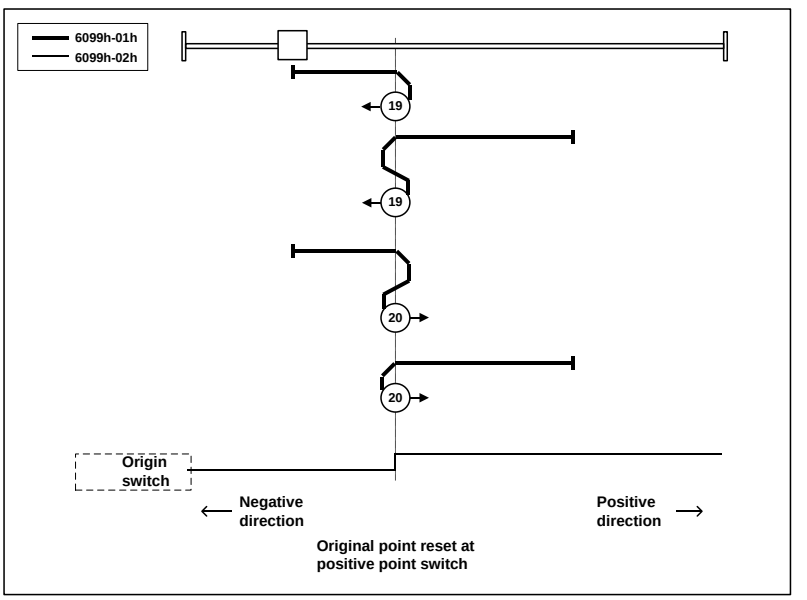
Method 18

- This method is similar to method 2. The difference is that the location of the origin is not the index pulse, but the position of the limit switch. (please refer to the following chart)



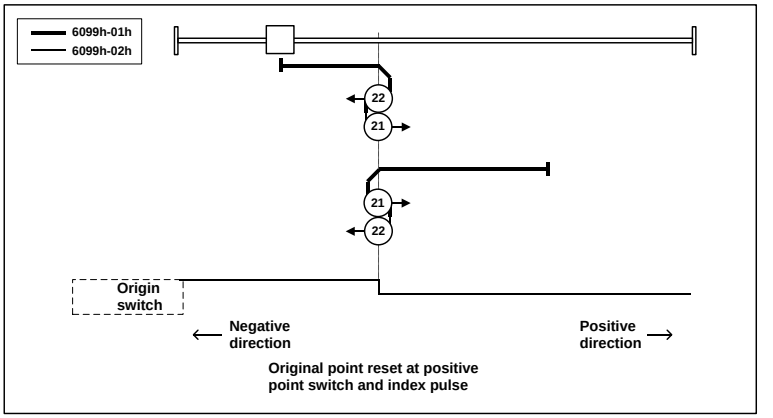
Method 19，20

- This method is similar to method 3,4. The difference is that the location of the origin is not the index pulse, but the change of the origin switch. (please refer to the following chart)



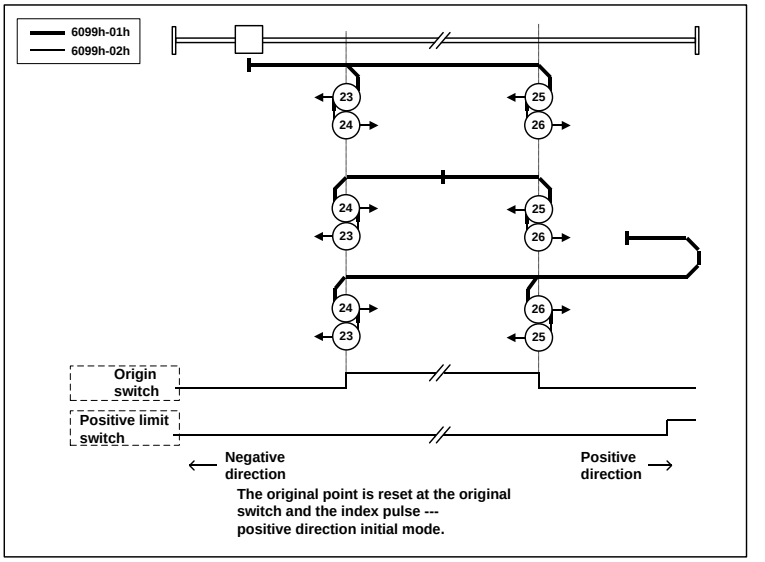
Method 21，22

- This method is similar to method 5,6. The difference is that the location of the origin is not the index pulse, but the change of the origin switch. (please refer to the following chart)



Method 23，24，25，26

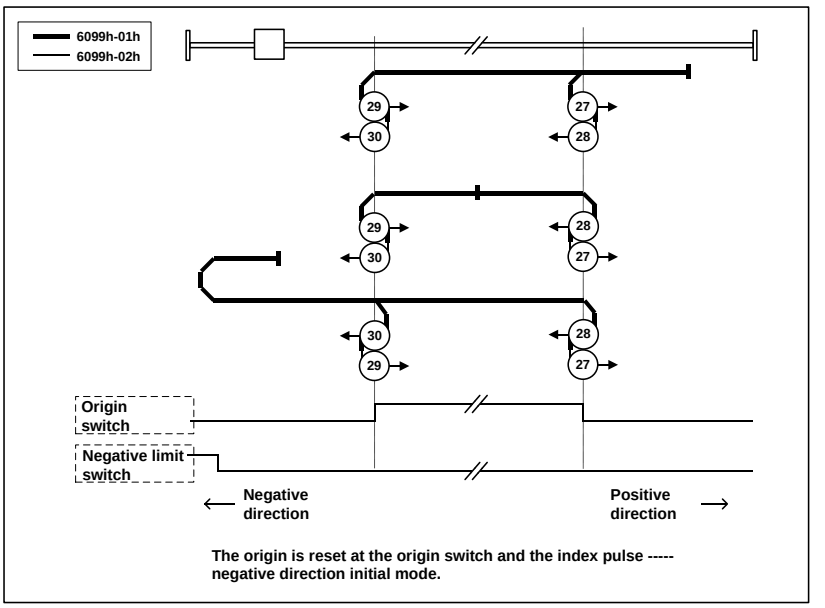
- This method is similar to method 7, 8, 9, and 10. The difference is that the location of the origin is not the index pulse, but the change of the origin switch. (please refer to the following chart)



Method 27，28，29，30

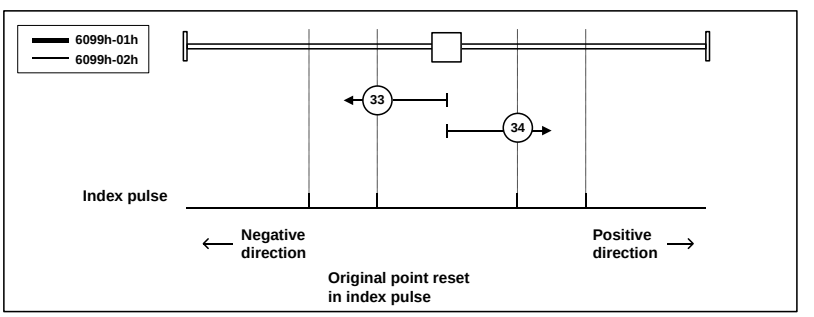
- This method is similar to method 11, 12, 13, 14. The difference is that the location of the origin is not the index pulse, but the change of the origin switch. (please refer to the following chart) 11, 12, 13, 14. The difference is that the

location of the origin is not the index pulse, but the change of the origin switch. (please refer to the following chart)



Method 33，34

- This method is only using the index pulse.
- The index pulse is detected as the location of origin detection in the action shown from the diagram.

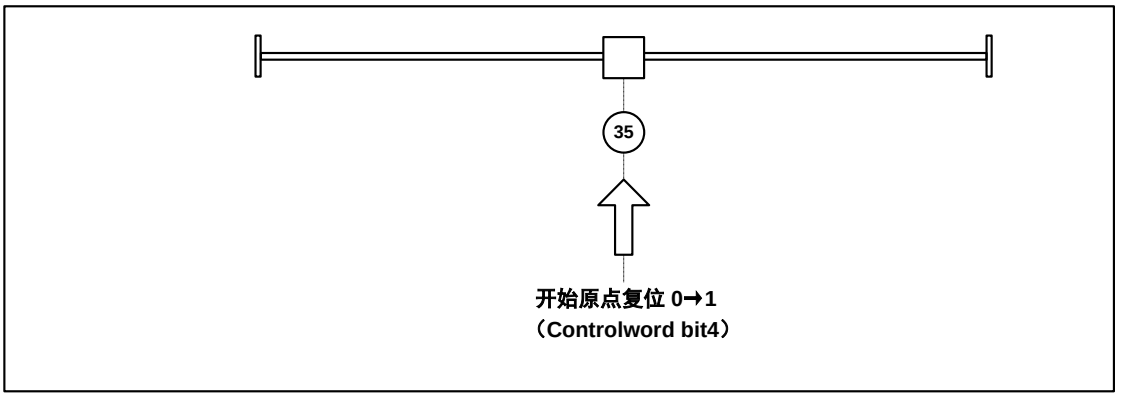


Method 35

- The use of servo driver's coordinate system (location information setting) is implemented.
- 6062h（Position Demand Value）=6064h（Position Actual Value）=607Ch（Home Offset）
  6063h（Position Actual Internal Value）=60FCh（Position Demand Internal Value）= 0

Note: 607Ch (Home Offset) is added to 6062h and 6064h.

- PDS state is not operation enabled state, but can executes.

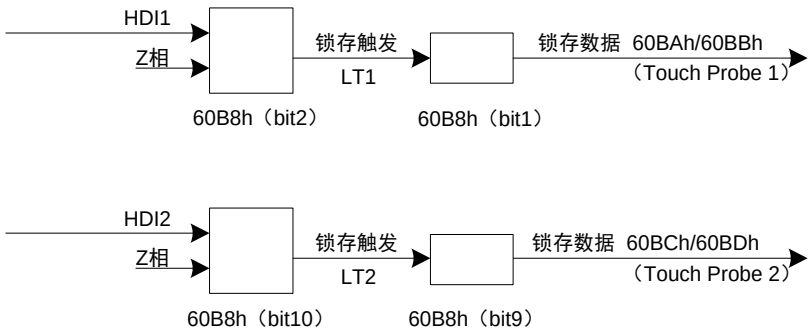


6.5 Pattern common function

6.5.1 Touch Probe function

- This function is to select the trigger signal from the external input (HDI1, HDI2) or the Z phase (the single loop data of the rotary encoder is 0 when the semi closed loop is controlled), and the feedback position is locked.
- The width of the input ON of the trigger signal and the width of the OFF should be kept above 2ms.
- If you choose the trigger to select the Z phase, do not choose the descending edge.
- The Touch probe function is invalid when ESM is Init and works in HM mode.

1. Touch Probe function constitute



- 60B8h：Touch Probe Function

60B8h（Touch Probe Function）			
bit10	LT2	Bit2	LT1
0	HDI2	0	HDI1
1	Z phase	1	Z phase

- 60BAh：Touch Probe Pos1 Pos Value
- 60BBh：Touch Probe Pos1 Neg Value
- 60BCh：Touch Probe Pos2 Pos Value
- 60BDh：Touch Probe Pos2 Neg Value

2. Touch Probe associated object

Index	Sub-Index	Name	Unit	Range	Date Type	Access	PDO
60B8h	00h	Touch Probe Function	-	0~65535	U16	RW	RxPDO
60B9h	00h	Touch Probe Status	-	0~65535	U16	RO	TxPDO
60BAh	00h	Touch Probe Pos1Pos Value	Command unit	-2147483648 ~2147483647	I32	RO	TxPDO
60BBh	00h	Touch Probe Pos1 Neg Value	Command unit	-2147483648 ~2147483647	I32	RO	TxPDO
60BCh	00h	Touch Probe Pos2 Pos Value	Command unit	-2147483648 ~2147483647	I32	RO	TxPDO
60BDh	00h	Touch Probe Pos2 Neg Value	Command unit	-2147483648 ~2147483647	I32	RO	TxPDO

（1） Touch probe function （60B8h）

The start of Touch probe action, the basic object of various settings.

Index	Sub-Index	Name/ Description	Units	Range	Data Type	Access	PDO	Op-mode	EEPROM
60B8h	00h	Touch Probe Function	-	0~ 65535	U16	RW	RxPD0	ALL	No
		Executing the setting of the Touch Probe function							

Corresponding Bit description

bit	value	Note	
0	0	Switch off touch probe 1	Touch Probe 1 执行/停止
	1	Enable touch probe 1	
1	0	Trigger first event	Touch Probe 1 事件模式选择（单发/连续）
	1	Continuous	
2	0	Trigger with touch probe 1 input	Touch Probe 1 触发选择（外部输入/Z 相）
	1	Trigger with zero impulse signal of position encoder	
3	-	Reserved	未使用
4	0	Switch off sampling at positive edge of touch probe 1	Touch Probe 1 上升沿选择
	1	Enable sampling at positive edge of touch probe 1	
5	0	Switch off sampling at negative edge of touch probe 1	Touch Probe 1 下降沿选择
	1	Enable sampling at negative edge of touch probe 1	
6~7	-	Not Supported	未使用
8	0	Switch off touch probe 2	Touch Probe 2 执行/停止
	1	Enable touch probe 2	
9	0	Trigger first event	Touch Probe 2 事件模式选择（单发/连续）
	1	Continuous	
10	0	Trigger with touch probe 2 input	Touch Probe 2 触发选择（外部输入/Z 相）
	1	Trigger with zero impulse signal of position encoder	
11	-	Reserved	未使用
12	0	Switch off sampling at positive edge of touch probe 2	Touch Probe 2 上升沿选择
	1	Enable sampling at positive edge of touch probe 2	
13	0	Switch off sampling at negative edge of touch probe 2	Touch Probe 2 下降沿选择
	1	Enable sampling at negative edge of touch probe 2	
14~15	-	Not Supported	未使用

- If you choose the Z phase according to the trigger settings, please do not choose the falling edge. The action that can not be guaranteed to perform the above setting.
- The rising edge indicates the theoretical state of the object signal from OFF (non active) to ON (active state), which means the time to change the theoretical state of the object signal from ON to OFF.

（2） Touch probe status （60B9h）

The state of the Touch probe action

Index	Sub-Index	Name/ Description	Units	Range	Data Type	Access	PDO	Op-mode	EEPROM
60B9h	00h	Touch Probe Status	-	0~65535	U16	RO	TxPD0	ALL	No
		The state of the Touch Probe function							

Corresponding Bit description

bit	value	Note	
0	0	Touch probe 1 is switch off	Touch Probe 1 动作停止
	1	Touch probe 1 is enabled	Touch Probe 1 动作中
1	0	Touch probe 1 no positive edge value stored	上升沿 Touch Probe 1 未完成状态
	1	Touch probe 1 positive edge value stored	上升沿 Touch Probe 1 完成状态
2	0	Touch probe 1 no negative edge value stored	下降沿 Touch Probe 1 未完成状态
	1	Touch probe 1 negative edge value stored	下降沿 Touch Probe 1 完成状态
3~5	-	Reserved	未使用
6~7	-	Not Supported	未使用
8	0	Touch probe 2 is switch off	Touch Probe 2 动作停止
	1	Touch probe 2 is enabled	Touch Probe 2 动作中
9	0	Touch probe 2 no positive edge value stored	上升沿 Touch Probe 2 未完成状态
	1	Touch probe 2 positive edge value stored	上升沿 Touch Probe 2 完成状态
10	0	Touch probe 2 no negative edge value stored	下降沿 Touch Probe 2 未完成状态
	1	Touch probe 2 negative edge value stored	下降沿 Touch Probe 2 完成状态
11~13	-	Reserved	未使用
14~15	-	Not Supported	未使用

（3） Touch Probe Position 1/2 Positive Value （60BAh～60BDh）

Represents the captured latch position.

Index	Sub-Index	Name/ Description	Units	Range	Data Type	Access	PDO	Op-mode	EEPROM
60BAh	00h	Touch Probe Pos1 Pos Value	Command unit	-2147483648 ~2147483647	I32	RO	TxPDO	ALL	No
		Represents the rising edge latch position of Touch Probe 1.							
60BBh	00h	Touch Probe Pos1 Neg Value	Command unit	-2147483648 ~2147483647	I32	RO	TxPDO	ALL	No
		Represents the drop along the latch position of Touch probe 1.							
60BCh	00h	Touch Probe Pos2 Pos Value	Command unit	-2147483648 ~2147483647	I32	RO	TxPDO	ALL	No
		Represents the rising edge latch position of Touch Probe 2.							
60BDh	00h	Touch Probe Pos2 Neg Value	Command unit	-2147483648 ~2147483647	I32	RO	TxPDO	ALL	No
		Represents the drop along the latch position of Touch Probe 2.							

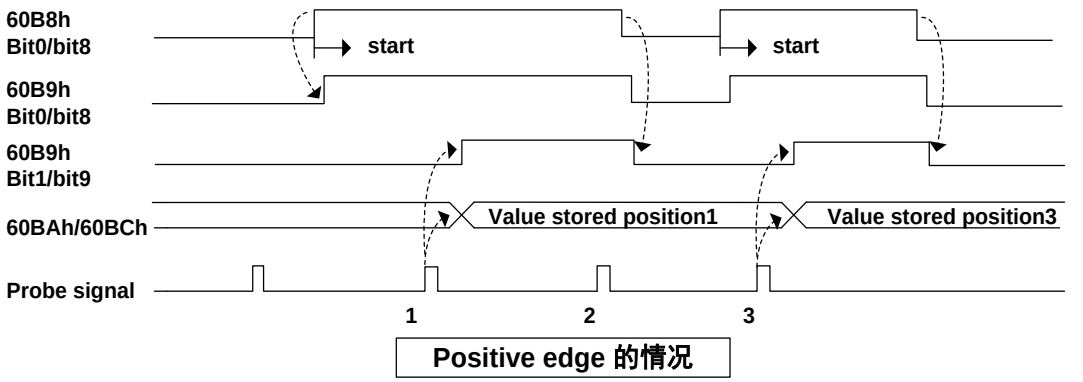
3. The starting of Touch probe action

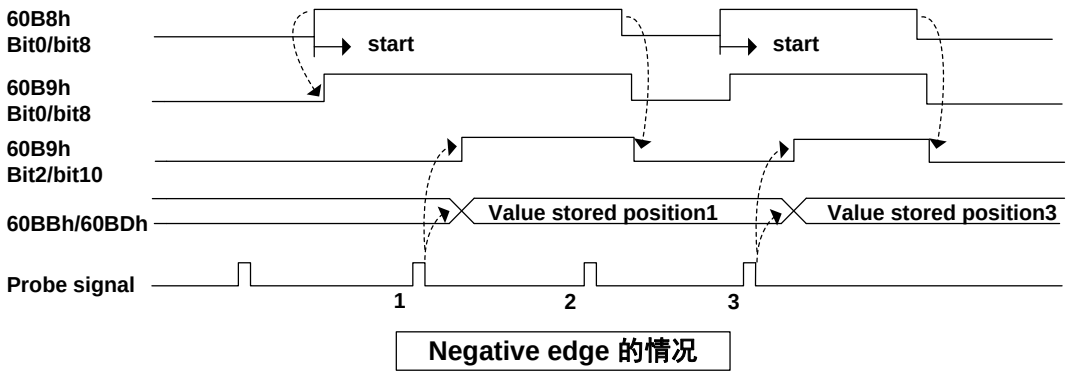
The bit0/bit8 (Touch Probe execution / stop) of 60B8h (Touch Probe Function) gets a variety of setting conditions (60B8h:bit1~7/bit9~15) and starts Touch Probe action under the condition of "0 (stop) - 1 (boot)" change. All the changes in the set conditions are valid. Please return bit0/bit8 to "0 (stop)" and then go to "1 (start)" again.

According to the bit1/bit9 (event mode selection) of 60B8h (Touch Probe Function), the "0 (Trigger First event mode)" and "1 (Continuous mode)" can be selected.

- Trigger First Event mode （60B8h：bit1=0 / bit9=0）

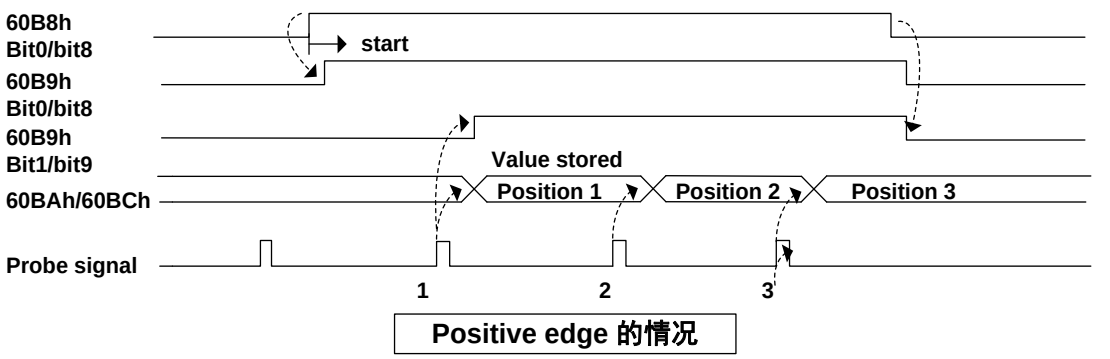
After starting, the mode is only inserted under the trigger signal for the first time. In order to get it again, it is necessary to start Touch Probe again.

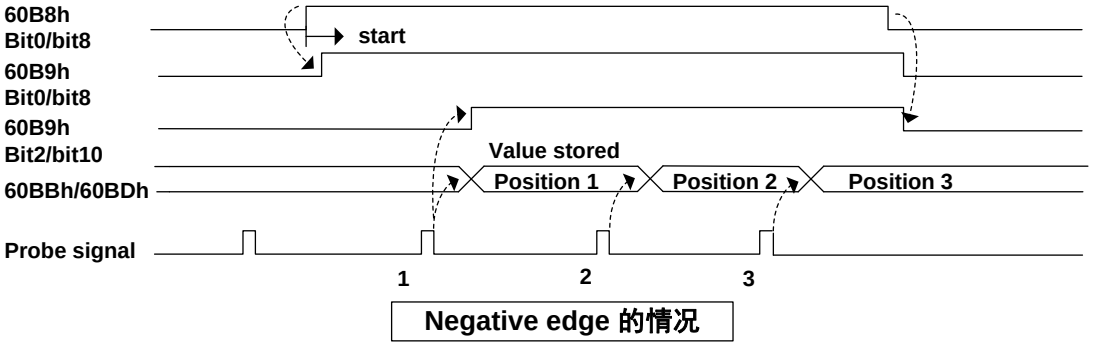




- Continuousmode（60B8h：bit1=1 / bit9=1）

After starting, the pattern of trigger signal is detected every time. The value is maintained until the next Probe latch signal is valid.





Negative edge 的情况

6.5.2 Stop function

The combination uses the deceleration function (selection code) defined by CoE (CiA402) and the deceleration function of the servo (EMG, dynamic brake stop, free running stop, instant stop, etc.) to achieve "stop function".

1. PDS code selection

Index	Sub Index	Name	Units	Range	Date Type	Access	PDO
6007h	00h	Abort Connection Option Code	-	0-3	I16	rw	No
605Ah	00h	Quick Stop Option Code	-	0-7	I16	rw	No
605Bh	00h	Shutdown Option Code	-	0-1	I16	rw	No
605Ch	00h	Disable Operation Option Code	-	0-1	I16	rw	No
605Eh	00h	Fault Reaction Option Code	-	0-2	I16	rw	No

2. A list of related objects

Index	Sub-Index	Name/ Description	Units	Range	Data Type	Access	PDO	Op-mode	EEPROM
6084h	00h	Profile Deceleration	Command unit/s2	0~ 4294967295	U32	RW	RxPDO	pp/ip/ pv	Yes

- Set Profile as deceleration.
- If set to 0, internal processing is the 1 operation.

Index	Sub-Index	Name/ Description	Units	Range	Data Type	Access	PDO	Op-mode	EEPROM
6085h	00h	Quick Stop Deceleration	Command unit /s2	0~ 4294967295	U32	RW	RxPDO	pp/ip/ pv/hm/csp /csv	Yes

- If 605Ah （Quick stop option code） is "2" or "6", setting the deceleration parameter of Quick stop when the motor deceleration stops.
- 605Dh（Halt option code）和 605Eh（Fault reaction option code）is“2”and were used.
- If set to 0, internal processing is the 1 operation.

Index	Sub-Index	Name/ Description	Units	Range	Data Type	Access	PDO	Op-mode	EEPROM
6087h	00h	Torque Slope	Command unit 0.1%/s	0~ 4294967295	U32	RW	RxPDO	tq/cst	Yes

- Cyclic under the same time torque mode (CST), only deceleration stop time is

effective.

- If set to 0, internal processing is the 1 operation.

Index	Sub-Index	Name/ Description	Units	Range	Data Type	Access	PDO	Op-mode	EEPROM
60C6h	00h	Max Deceleration	Command unit /s2	0~ 4294967295	U32	RW	RxPDO	pp/hm/pv/ip	Yes

- Set maximum deceleration
- If set to 0, internal processing is the 1 operation.

（1） EMG Emergency stop

When the EMG (emergency shutdown) in DI is ON,The emergency stop is executed according to the setting of parameter P164 (emergency shutdown mode).

- When P164=0, the motor cuts off the motor current directly and the motor stops.
- When P164=1, the driver maintains the enabling state and the control motor is stopped by the acceleration and deceleration defined by 6085h (Quick stop deceleration).

（2） Quick Stop Option Code（605Ah）

The method of motor deceleration setting

Index	Sub-Index	Name/ Description	Units	Range	Data Type	Access	PDO	Op-mode	EEPROM
605Ah	00h	Quick Stop Option Code	-	0~7	I16	RW	No	ALL	Yes

- Set the timing of Quick stop. The definition varies according to the control mode.
- **csp，csv，hm**

  0：After the motor is free to stop, the motor is moved to switch on Disabled。

  1：Pass 6084h（Profile Deceleration）after the servo motor stopped，migrated to Switch On Disabled。

  2：Pass 6085h（Quick Stop Deceleration）after the servo motor stopped，migrated to Switch On Disabled。

  3：Pass 60C6h（Max Deceleration）after the servo motor stopped，migrated to Switch On Disabled。

  5：Pass 6084h（Profile Deceleration）after the servo motor stopped，migrated to Quick Stop Active。

  6：Pass 6085h（Quick Stop Deceleration）after the servo motor stopped，migrated to Quick Stop Active。

  7：Pass 60C6h（Max Deceleration）after the servo motor stopped，migrated to Quick Stop Active。

cst

0：After the servo motor stopped， migrated to Switch On Disabled。

1，2：Pass 6087h（Torque Slope）after the servo motor stopped，migrated to Switch On Disabled。

5，6：Pass 6087h（Torque Slope）after the servo motor stopped，migrated to Quick Stop Active。

（3） Shutdown Option Code（605Bh）

Set the way to slow down the motor when receiving the "ShutDown" and "Disable Voltage" commands.

Index	Sub-Index	Name/ Description	Units	Range	Data Type	Access	PDO	Op-mode	EEPROM
605Bh	00h	ShutDown Option Code	-	0~1	I16	RW	No	ALL	Yes

- Set the timing of PDS command "Shutdown" and "Disable voltage" when receiving. The definition varies according to the control mode.
- When PDS order “shutdown” and receiving command:

  csp，csv，hm

  0：After the servo motor stopped，migrated to Ready to switch on。

  1：Pass 6084h（Profile deceleration）after the servo motor stopped，migrated to Ready to switch on。

  cst

  0：after the servo motor stopped，migrated to Ready to switch on。

  1：Pass 6087h（Torque slope）after the servo motor stopped，migrated to Ready to switch on。

（4） Disable Operation Option Code（605Ch）

Set the way to slow down the motor when receiving the "Disable operation" command.

Index	Sub-Index	Name/ Description	Units	Range	Data Type	Access	PDO	Op-mode	EEPROM
605Ch	00h	Disable peration option code	-	0~1	I16	RW	No	ALL	Yes

- Set the timing of receiving the PDS command "Disable operation". The definition varies according to the control mode.
- **csp，csv,hm**

  0：When the motor is stopped, the motor is converted toswitched on。

  1：Pass 6084h（Profile deceleration）after the servo motor stopped，migrated to switched on.

  cst

  0：When the servo motor stopped，migrated to switched on。

  1：Pass 6087h（Torque slope）after the servo motor stopped，migrated to switched on。

（5） Fault Reaction Option Code（605Eh）

Set the motor stop method when the alarm occurs.

When the fault occurs, the brakes act immediately and turn PWM into fault state.

6.5.3 Digital input / digital output

1. Digital input（60FDh）

Index	Sub-Index	Name/ Description	Units	Range	Data Type	Access	PDO	Op-mode	EEPROM
60FDh	00h	Digital Inputs	-	0~ 4294967295	U32	RO	TxPD0	ALL	No

- Means the theoretical input state of the external input signal.

bit	**31**	**30**	**29**	**28**	**27**	**26**	**25**	**24**
function	HDI2	HDI1	（reserved）					
bit	23	22	21	20	19	18	17	16
function	DI5	DI4	DI3	DI2	DI1	（reserved）		
bit	15	14	13	12	11	10	9	8
function	（reserved）							
bit	7	6	5	4	3	2	1	0
function	（reserved）				（Not Supported）	homeswitch [HOME]	positive limitswitch [POT]	negative limitswitch [NOT]

Note that when you use the following functions,please configure the DI to the corresponding IO function, otherwise it will produce unpredictable results.

Bit19-23 reflects the original IO state from DI1 to DI5, and the details of each Bit are as follows:

Value	Definition
0	Switched off （Theoretical input state OFF）
1	Switched on （Theoretical input state ON）

2. Digital output（60FEh）

If you use this object to execute set brake signal control, you must use it through PDO.

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name/ Description</th><th>Units</th><th>Range</th><th>Data Type</th><th>Access</th><th>PDO</th><th>Op-mode</th><th>EEPROM</th></tr>
<tr><td rowspan="8">60FEh</td><td>-</td><td>Digital Outputs</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td></td><td colspan="8">● The output of the external output signal is used when the transistor acts.
<table>
<tr><td>bit</td><td>31</td><td>30</td><td>29</td><td>28</td><td>27</td><td>26</td><td>25</td><td>24</td></tr>
<tr><td>function</td><td colspan="8">（Not Supported）</td></tr>
<tr><td>bit</td><td>23</td><td>22</td><td>21</td><td>20</td><td>19</td><td>18</td><td>17</td><td>16</td></tr>
<tr><td>function</td><td colspan="3">（reserved）</td><td>DO5</td><td>DO4</td><td>DO3</td><td>DO2</td><td>DO1</td></tr>
<tr><td>bit</td><td>15</td><td>14</td><td>13</td><td>12</td><td>11</td><td>10</td><td>9</td><td>8</td></tr>
<tr><td>function</td><td colspan="8">（reserved）</td></tr>
<tr><td>bit</td><td>7</td><td>6</td><td>5</td><td>4</td><td>3</td><td>2</td><td>1</td><td>0</td></tr>
<tr><td>function</td><td colspan="7">（reserved）</td><td>set brake</td></tr>
</table></td></tr>
<tr><td rowspan="2">00h</td><td>Number of entries</td><td>-</td><td>2</td><td>U8</td><td>RO</td><td>No</td><td>ALL</td><td>No</td></tr>
<tr><td colspan="8">● The number of Sub-Index for 60FEh.</td></tr>
<tr><td rowspan="2">01h</td><td>Physical outputs</td><td>-</td><td>0~ 4294967295</td><td>U32</td><td>RW</td><td>RxPD0</td><td>ALL</td><td>Yes</td></tr>
<tr><td colspan="8">● Operate the output of the external output signal.</td></tr>
<tr><td rowspan="2">02h</td><td>Bit mask</td><td>-</td><td>0~ 4294967295</td><td>U32</td><td>RW</td><td>RxPD0</td><td>ALL</td><td>Yes</td></tr>
<tr><td colspan="8">● When set to "1", the corresponding Physical output is normal; when "0", the corresponding Physical output is invalid.</td></tr>
<tr><td colspan="9">Bit16-20 can control the output state of DO0-4. Note that DOx is also configured as the corresponding function, and bit mask is not supported.
When bit0 is 1, it indicates that the brake is sucking; when the brake is released at 0, it supports bit mask.</td></tr>
</table>

6.5.4 Position information

1. The initialization time of the location information

The servo driver initializes the following location information objects when the communication is established (ESM state Init to PreOP conversion).

- 6062h（Position Demand Value）
- 6063h（Position Actual Internal Value）
- 6064h（Position Actual Value）
- 60FCh（Positon Demand Internal Value）

  Therefore, the implementation of electronic gear function, polarity and origin offset is implemented when communication is established.

2. Electronic gear function

The electronic gear is the function of converting the amount of movement set by the user through the instruction unit to the number of pulses needed in the actual mobile servo. The use of this function can set the motor rotation movement of each instruction unit at will. The EP3E EtherCAT series is not based on the parameters P027, P028 (the number of instructions per rotation of the motor 1 times), the P029 (electronic gear molecule), and P030 (electronic gear denominator) set by the electronic gear ratio, but the 608Fh (Position EncoderResolution), 6091h (Position EncoderResolution) according to the CoE (CiA402). Stant) set the ratio of the electronic gear.

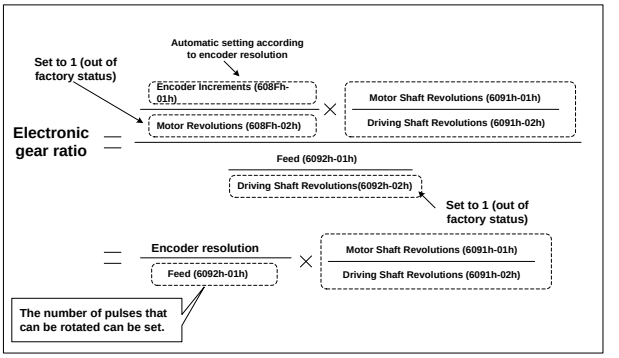
The relationship between user defined units (command units) and internal units (pulse) is calculated based on the following equations.

$$\text{Electronic gear ratio} = \frac{\text{Position Encoder Resolution} \times \text{Gear Ratio}}{\text{Feed Constant}}$$

$$\text{Position Demand Value} \times \text{Electronic gear ratio} = \text{Position Demand Internal Value}$$

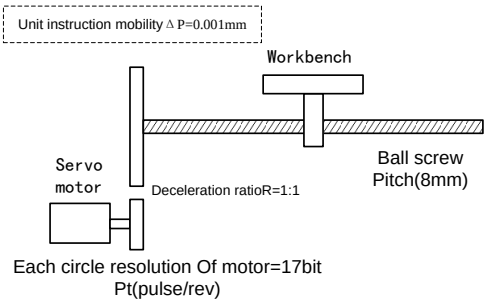
- Note: the electronic gear ratio is in the range of 1000 times to 1/1000 times. Exceptions are protected if the range is beyond the range.
- The setting of electronic gear ratio is effective from Init to PreOP.
- The value of electronic gear ratio should be set in the range of -231 (-2147483648) to +231-1 (2147483647), and if it exceeds the range, it will be abnormal.

3. Calculation formula of electronic gear



4. Example of electronic gear

（1）Application of electronic gear in ball screw



- Mechanical specifications: ball screw pitch Pitch is 8mm; reduction ratio 1/1
- Encoder resolution is 131072 (17bit)
- Unit is ΔP 0.001mm
- The number of instructions for the rotation of the load axis

$$Feed(6092h-01h)=\frac{Pitch}{\Delta P}=\frac{8mm}{0.001mm}=8000$$

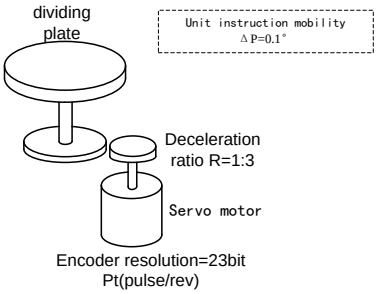
- Calculation of electronic gear ratio

$$\text{电子齿轮比}=\frac{\text{编码器分辨率}}{Feed(6092h-01h)}\times\frac{Motor\ Shaft\ Revolution\ s(6091h-01h)}{Driving\ Shaft\ Revolution\ s(6091h-02h)}$$

$$=\frac{131072}{8000}\times\frac{1}{1}$$

- Parameters set：Feed（6092h-01h）set is 8000，Motor Shaft Revolutions（6091h-01h）set is 1，Driving Shaft Revolutions（6091h-02h）set is 1。

（2）Application of electronic gear in indexing plate



- Mechanical specifications: a circle of rotation angle 360 degrees; reduction ratio 1/3
- Encoder resolution 8388608（23bit）
- Unit is ΔP 0.1°
- Calculation of the number of instruction pulses for a load axis

$$Feed(6092h-01h)=\frac{360°}{\Delta P}=\frac{360°}{0.1°}=3600$$

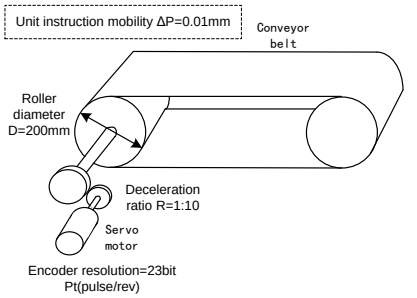
- Calculation of the electronic gear ratio

$$\text{电子齿轮比}=\frac{\text{编码器分辨率}}{Feed(6092h-01h)}\times\frac{Motor\ Shaft\ Revolution\ s(6091h-01h)}{Driving\ Shaft\ Revolution\ s(6091h-02h)}$$

$$=\frac{8388608}{3600}\times\frac{3}{1}$$

- Parameters set：Feed（6092h-01h）set is 3600，Motor Shaft Revolutions（6091h-01h）set is 3，Driving Shaft Revolutions（6091h-02h）set is 1。

（3）Application of electronic gear in the conveyor belt



- Mechanical specifications: roller diameter 200mm; reduction ratio 1/10
- Encoder resolution is 8388608（23bit）
- Unit is ΔP 0.01mm
- The number of instructions for the rotation of the load axis

$$Feed(6092h-01h)=\frac{\pi D}{\Delta P}=\frac{3.14\times 200mm}{0.01mm}=62800$$

- Calculation of the electronic gear ratio

$$\text{电子齿轮比} = \frac{\text{编码器分辨率}}{Feed(6092h-01h)} \times \frac{Motor\ Shaft\ Revolution\ s(6091h-01h)}{Driving\ Shaft\ Revolution\ s(6091h-02h)}$$

$$= \frac{8388608}{62800} \times \frac{10}{1}$$

- Parameters set：Feed（6092h-01h）set is 62800，Motor Shaft Revolutions（6091h-01h）set is10，Driving Shaft Revolutions（6091h-02h）set is 1。

5. Preservation of the set value of electronic gear

Electronic gear Association objects (6091h-01h, 6091h-02h, 6092h-01h, 6092h-02h) are objects that are saved. After modification, save operation is recommended (write to EEPROM). Object editor using host computer software can execute and save objects.

Main Index	Sub Index	Object Name	Data Type	Attrib	Min - Max	Setting Value	Units
0x2003	00	软件版本	S16	RO	0-32767	61.01	--
0x2005	00	速度环增益	S16	RW	1-3000	45	Hz
0x2006	00	速度环积分时间常数	S16	RW	1.0-1000.0	1.5	ms
0x2007	00	转矩滤波时间常数	S16	RW	0.10-50.00	0.13	ms
0x2009	00	位置环增益	S16	RW	1-1000	40	Hz
0x2011	00	负载转动惯量比	S16	RW	0.0-200.0	1.0	倍
0x2012	00	速度环PDEF控制系数	S16	RW	0-100	100	%
0x2013	00	速度检测滤波时间常数	S16	RW	0.50-50.00	0.50	ms
0x2015	00	位置环前馈增益	S16	RW	0-100	0	%
0x2016	00	位置环前馈滤波时间常数	S16	RW	0.20-50.00	1.00	ms
0x201B	00	编码器脉冲因子1	S16	RW	1-32767	10000	--
0x201C	00	编码器脉冲因子2	S16	RW	1-32767	1	--
0x201D	00	指令脉冲电子齿轮第1分子	S16	RW	1-32767	1	--
0x201E	00	指令脉冲电子齿轮分母	S16	RW	1-32767	1	--
0x202A	00	CWL/CCWL方向禁止的方式	S16	RW	0-1	0	--
0x203C	00	速度指令加速时间	S16	RW	0-30000	0	ms
0x203D	00	速度指令减速时间	S16	RW	0-30000	0	ms
0x203F	00	EMG（紧急停机）的减速时间	S16	RW	0-10000	1000	ms
0x2041	00	内部正转（CCW）转矩限制	S16	RW	0-300	300	%
0x2042	00	内部反转（CW）转矩限制	S16	RW	-300-0	-200	%
0x2043	00	外部正转（CCW）转矩限制	S16	RW	0-300	100	%
0x2044	00	外部反转（CW）转矩限制	S16	RW	-300-0	-100	%
0x2046	00	正转（CCW）转矩过载报警水平	S16	RW	0-300	300	%
0x2047	00	反转（CW）转矩过载报警水平	S16	RW	-300-0	-300	%

（1）Position Encoder Resolution（608Fh）

Index	Sub-Index	Name/ Description	Units	Range	Date Type	Access	PDO	Op-mode	EEPROM
608Fh	-	Position Encoder Resolution	-	-	-	-	-	-	-
		● Automatic setting of the encoder							
	00h	Highest Sub-Index Supported	-	2	U8	RO	No	ALL	No
		● The number of Sub-Index for 608Fh.							
	01h	EncoderIncrements	pulse	0~ 4294967295	U32	RO	No	ALL	No
		● Indicate the amount of encoder movement. The value is the automatic setting of the encoder resolution.							
	02h	Motor Revolutions	R (motor)	0~ 4294967295	U32	RO	No	ALL	No
		● Indicate the number of motor rotation. The value is fixed to 1.							

The resolution of the encoder for each turn of the motor is automatically set according to the information read out from the motor connected to the servo driver.

$$\text{Position Encoder Resolution} = \frac{\text{Encoder Increments (608Fh - 01h)}}{\text{Motor Revolutions (608Fh - 02h)}}$$

Example: 17bit/r encoder connection

608Fh-01h（Encoder Increments）=131072

608Fh-02h（Motor Revolutions）=1

Position Encoder Resolution =131072 / 1=131072

（2）Gear ratio（6091h）

Index	Sub-Index	Name/ Description	Units	Range	Data Type	Access	PDO	Op-mode	EEPROM
6091h	-	Gear Ratio	-						
		● Set gear ratio							
	00h	Number of Entries	-	2	U8	RO	No	ALL	No
		● The number of Sub-Index for 6091h							
	01h	Motor Revolutions	R (motor)	0~ 4294967295	U32	RW	No	ALL	Yes
		● Set up the number of motor rotation							
	02h	Shaft Revolutions	R (shaft)	0~ 4294967295	U32	RW	No	ALL	Yes
		● Set axis rotation number							

This object defines the number of motor revolutions and the number of shaft revolutions after the output of the electronic gear.

$$\text{Gear ratio} = \frac{\text{Motor Shaft Revolutions (6091h-01h)}}{\text{Driving Shaft Revolutions (6091h-02h)}}$$

（3）Feed Constant（6092h）

Index	Sub-Index	Name/ Description	Units	Range	Data Type	Access	PDO	Op-mode	EEPROM
6092h	-	Feed Constant	-	-	-	-	-	-	-
		● Set the feed constant							
	00h	Highest Sub-index Supported	-	2	U8	RO	No	ALL	No
		● The number of Sub-Index for 6092h							
	01h	Feed	Command unit	0-4294967295	U32	RW	No	ALL	Yes
		● Set the amount of feed							
	02h	Shaft Revolutions	r（shaft）	0-4294967295	U32	RW	No	ALL	Yes
		● Set axis rotation number							

This object represents the amount of action of the 1 turns of the shaft after the output of the electronic gear.

$$\text{Feed Constant} = \frac{\text{Feed (6092h - 01h)}}{\text{Driving Shaft Revolution s (6092h - 02h)}}$$

（4）Polarity（607Eh）

For position instruction / speed command / torque command and each offset, polarity can be set (motor rotation direction).

Index	Sub-Index	Name/ Description	Units	Range	Data Type	Access	PDO	Op-mode	EEPROM
607Eh	00h	Polarity	-	0-255	U8	RW	No	ALL	Yes

Set the polarity of the position, speed, torque and position offset, speed offset (speed addition), torque offset (torque added) from the object to the internal processing, and the polarity of the position feedback, speed feedback, torque feedback value from the internal processing to the object. The objects involved are as follows:

- Command set object
  607Ah（Target Position）、60B0h（Position Offset）、60FFh（Target Velocity）、60B1h（Velocity Offset）、6071h（Target Torque）、60B2h（Torque Offset）
- Monitor object
  6062h（Position Demand Value）、6064h（Position Actual Value）、606Bh（Velocity Demand Value）、606Ch（Velocity Actual Value）、6074h（Torque Demand）、6077h（Torque Actual Value）
- External input object
  60FDh-00h（Digital Input）的 bit1（positive Limit Switch（POT））、60FDh-00h（Digital Input）的 bit0（Negative Limit Switch（NOT））、External input signal POT、NOT

Set value	Contents
0	No reversal of position, speed, and torque
224	Reversal of position, speed, and torque
Others	Not supported （PLEASE DON'T SET）

Example: when using the 17bit absolute encoder, the setting and influence of 607Eh are shown in the following table:

607E（set value）	Position information
0 situation （CCW is positive direction）	6063h = M×217+S
	6064h =（6063h×Inverse change value of electronic gear）+607Ch
224 situation （CW is positive direction）	6063h =－（M×217+S）
	6064h =（6063h×Inverse change value of electronic gear）+607Ch

6063h（Position Actual Internal Value）、6064h（Position Actual Value）、607Ch（Home offset）、M is multi loop data and S is single loop data.

6.5.5 The EEPROM operation

Use object 1010h to operate EEPROM from slave station.

<table>
<tr><th>Index</th><th>Sub-Index</th><th>Name /Description</th><th>Units</th><th>Range</th><th>Data Type</th><th>Access</th><th>PDO</th><th>Op-mode</th><th>EEPROM</th></tr>
<tr><td rowspan="6">1010h</td><td rowspan="2">-</td><td>Store Parameters</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td colspan="9">The object data is written to the EEPROM.
The object as a standby object is the object that records "Yes" in the EEPROM column of the object list.</td></tr>
<tr><td rowspan="2">00h</td><td>Number of Entries</td><td>-</td><td>0-255</td><td>U8</td><td>RO</td><td>No</td><td>All</td><td>No</td></tr>
<tr><td colspan="9">The fixed value is 1</td></tr>
<tr><td rowspan="2">01h</td><td>Save All Parameters</td><td>-</td><td>0~ 4294967295</td><td>U32</td><td>RW</td><td>No</td><td>All</td><td>No</td></tr>
<tr><td colspan="9">● The value initialized by object 1010h.01h is 0x01.
● When you need to save parameters, write the object 1010h.01h value (45534554h) through SDO.
● When you need to restore the default value of the parameter, write the object 1010h.01h value (45444546h) through SDO.
● When the value of object 1010h.01h is detected (45534554h), a save driver parameter EEPROM operation (E-SET) will be triggered. During storage, the function of SDO needs to be temporarily suspended until the save operation is completed, otherwise it will cause errors.
● When the value of object 1010h.01h is detected (45444546h), a default driver parameter EEPROM operation (E-DEF) will be triggered. During the default operation, the function of SDO is temporarily suspended until the default operation is completed, otherwise it will cause errors.
● After writing 1010h.01h triggering EEPROM operation (E-SET or E-DEF), if the operation is successful, the value of 1010h.01h is returned to 0; if the operation fails, the value of read 1010h.01h is returned to 1.</td></tr>
</table>

- EEPROM wirrten times are limited.
- EEPROM the longest time to write is 10 seconds (when all objects are changed).

Chapter 7 Alarm

7.1 Alarm list

Err code	No.	603Fh value	Alarm name	Alarm contents	Alarm clear
Err--	0	FF00h	No alarm occurs	Normal operation	
Err 1	1	FF01h	Exceed the speed	Servomotor speed exceeds the max. speed limit	CAN
Err 2	2	FF02h	Over voltage of the main power supply	The voltage of the main power supply exceeds the specified value	CAN
Err 4	4	FF04h	Position deviation exceeds the limit value	The counter of position deviation exceeds the setting limit value.	CAN
Err 7	7	FF07h	Drive inhibition abnormal	CCWL、CWL the inputs of drive inhibition are not effective.	CAN
Err 8	8	FF08h	Overflow of position deviation counter	The absolute value of position deviation counter exceeds 2^{30}	CAN
Err11	11	FF0Bh	Power model fault	Power model fault occurs.	NO
Err12	12	FF0Ch	Over current	Over-current of servomotor	NO
Err13	13	FF0Dh	Overload	Overload of servomotor	NO
Err14	14	FF0Eh	Overload of brake peak power	Instantaneous load is too big in short brake time	NO
Err16	16	FF10h	Over-heat of servomotor	The heat load of servomotor exceeds the setting value (I^2t detection)	NO
Err17	17	FF11h	Overload of brake average power	Average load is too big in brake time	NO
Err18	18	FF12h	Overload of power model	Average output load of power model is too big	NO
Err20	20	FF14h	EEPROM error	EEPROM error occurs when read or white.	NO
Err21	21	FF15h	Logic circuit error	Logic circuit fault outside DSP	NO
Err22	22	FF16h	power panel and control panel are not match	replace the power panel or control panel.	NO
Err23	23	FF17h	AD conversion error	Circuit or current sensor fault	NO
Err25	25	FF19h	FPGA check error	Error of FPGA check	NO
Err27	27	FF1Bh	Phase loss alarm	Check whether the power line is three phase input or not	NO

Err29	29	FF1Dh	Over-torque alarm	The torque of servomotor exceeds the setting value and lasting time	CAN
Err35	35	FF23h	Connection path fault in drive	Connection path fault in drive	NO
Err36	36	FF24h	Fan alarm	Fan alarm	NO
Err40	40	FF28h	Absolute encoder communication error	Drive can not communicate with encoder	NO
Err41	41	FF29h	Mistake of absolute encoder	Mistake of absolute encoder	NO
Err42	42	FF2Ah	Fault internal counting of absolute encoder	Absolute encoder counts abnormally	NO
Err43	43	FF2Bh	Absolute encoder communication responds error	Absolute encoder communication responds abnormally	NO

Err code	No.	603Fh value	Alarm name	Alarm contents	Alarm clear
Err44	44	FF2Ch	Absolute encoder verifies error	The communication content of absolute encoder is fault.	NO
Err45	45	FF2Dh	Absolute encoder EEPROM is error	Absolute encoder EEPROM fault	NO
Err46	46	FF2Eh	Absolute encoder parameter is error	Absolute encoder parameter is destroyed	NO
Err47	47	FF2Fh	The external battery of absolute encoder is error	Battery voltage is too low	NO
Err48	48	FF30h	The external battery of absolute encoder alarms	Battery voltage is low	NO
Err49	49	FF31h	Encoder is too hot	Encoder is too hot	NO
Err50	50	FF32h	The parameter of Motor does not match that of drive.	The power of Motor does not match that of drive	NO
Err51	51	FF33h	Resolver loses of tracking	Encoder wire connection error	NO
Err60	60	FF3Ch	Data receiving unnormal in Op state	Ethernet communication interruption	CAN
Err61	61	FF3Dh	Ethernet communication cycle deviation is too large	Ethernet communication cycle deviation is too large	NO
Err62	62	FF3Eh	Ethernet instruction data beyond range	Ethernet instruction data beyond range	NO
Err65	65	FF41h	SYNC signal initialization error	SYNC signal initialization error	NO

Err66	66	FF42h	SYNC signal and data receiving error	SYNC signal and data receiving phase error	NO
Err68	68	FF44h	EtherCAT failed to operate EEPROM	EtherCAT failed to operate EEPROM	NO
Err80	80	FF50h	internal error 1	Internal calculation error, electronic gear setting is wrong	NO
Err81	81	FF51h	internal error 2	Internal calculation error, parameters set to 0 exceptions	NO
Err82	82	FF52h	internal error 3	Internal calculation error, zero return parameter setting is wrong	NO
Err88	88	FF58h	Operation pattern error 1	The operation mode is not setted when enable status	CAN
Err89	89	FF59h	Operation pattern error 2	Set an invalid mode of operation	CAN

7.2 The reason and handling of alarm

The symbol “☆” in this manual shows the unique function of the multi loop absolute encoder. “★” shows the unique function of incremental encoder.

Err1（over speed）

Potential cause	Check	Handle
Servomotor U、V、W connection is not correct	Check U、V、W wiring	Correct U、V、W wiring. The U、V、W must connect with servo driver terminal U、V、W correspondently.
Speed overshoot	Check the operation status and the parameters	Adjust servo gain to reduce the overshoot; In speed control mode can increase acceleration/deceleration time.
Encoder wiring error	Check the encoder wiring	Correct wiring.

Err2（Main circuit over-voltage）

Potential cause	Check	Handle
The voltage of input AC power supply is too high	Check the voltage of power supply	Use correct power supply according with the specifications.
Regeneration fault	Regenerative resistor and/or IGBT damaged; Connection circuit is open.	Repair.
Regeneration energy too large	Check the regeneration load factor	Decrease the start-stop frequency. Increase acceleration/deceleration time Reduce the torque limit. Reduce the load inertia. Replace a bigger power servo driver and servomotor Replace a bigger brake resistor

Err4（Position deviation）

Potential cause	Check	Handle
Servomotor U、V、W connection is not correct	Check U、V、W wiring	Correct U、V、W wiring. The U、V、W must connect with servo driver terminal U、V、W correspondently.
Encoder zero point changes	Check the encoder zero point	Install the encoder again and adjust the zero point.
The encoder wiring error	Check the encoder wiring	Correct wiring
The servomotor is blocked	Check the servomotor shaft and its mechanical connection	Repair.
The command pulse frequency is too high	Check input frequency and the parameter of division/multiplication	● Slow down the input frequency. ● Adjust the parameter of division/multiplication.
The gain of position loop is too small	Check the parameters P009 and P013	Increasing the gain of position loop.
Torque is not enough big	Check torque	● Increase the torque limit. ● Increase smooth filtering time for position command. ● Reduce load. Replace the servo driver and servomotor with bigger ones.

Err7（Drive inhibition abnormal）

Potential cause	Check	Handle
The CCWL and/or CWL over-travel inhibition is invalid when servo is on	Check CCWL、CWL wiring	● Correct input CCWL、CWL signal. ● If not use CCWL、CWL signal can shield it by setting parameter P097.

Err8（Overflow of position deviation counter）

Potential cause	Check	Handle
The servomotor is blocked	Check the servomotor shaft and its mechanical	Repair.

	connection	
The command pulse is abnormal	Check command pulse	

Err11（IGBT model fault）

Potential cause	Check	Handle
Short-circuit at drive output (U、V、W)	Check U、V、W wiring	Repair or replace the short-circuited wiring.
Motor winding insulation is damaged	Check the servomotor	Replace the servo motor
Servo driver is damaged	Check the servo driver	Known the servomotor to be no fault, and then turn on the power supply again, if the alarm still exists, the servo driver may damage possibly. Replace the servo driver.
Ground is bad	Check the ground wiring	Ground correctly.
Suffer from interference	Check interference source	Adds line filter; Keep away interference source.

Err12（Over-current）

Potential cause	Check	Handle
Short-circuit at drive output (U、V、W)	Check the wiring connections between servo driver and servomotor.	Make sure the wiring U V W is correct
Motor winding insulation is damaged	Check the servomotor	Replace the servomotor.
Servo driver is damaged	Check the servo driver	Known the servomotor to be no fault, and then turn on the power supply again, if the alarm still exists, the servo driver may damage possibly. Replace the servo driver.

Err13（Over-load）

Potential cause	Check	Handle
Excess the rated load for continuous duty operation	Check the load factor	Reduce load or replace the servo driver with bigger one.
System unstable	Check the oscillation when servomotor is in running	Reduce the gains of the system
Acceleration/deceleration is too short	Check the smoothness when servomotor is in running	Increasing acceleration/deceleration time setting.
Encoder zero point changes	Check the encoder zero point	Install the encoder again and adjust the zero point.

Err14（Overload of brake peak power）

Potential cause	Check	Handle
The voltage of input AC power supply is too high	Check the voltage of power supply	Use correct power supply according with the specifications.
Regenerative braking failure	check if the regenerative braking resistor,brake tube is invalid or disconnected	repair
Regeneration energy too	Check the regeneration	Decrease the start-stop

large	load factor	frequency. Increase acceleration/deceleration time Replace a bigger power servo driver and servomotor Replace a bigger brake resistor
Wiring error	check if B1 and B2 are not short connected Check driver type and whether external brake resistor needs to be connected.	Short connection of B1 and B2 Connection brake resistance use

Err16（Motor over-heat）

Potential cause	Check	Handle
Excess the rated load for continuous duty operation	Check the load factor and the rise in temperature of motor	Reduce load or replace the servo driver with bigger one.
Encoder zero point changes	Check the encoder zero point	Install the encoder again and adjust the zero point.

Err17（Brake average power overload)）

Potential cause	Check	Handle
The voltage of input AC power supply is too high	Check the voltage of power supply	Use correct power supply according with the specifications.
Regeneration energy too large	Check the regeneration load factor	● Slow down the starting and stopping frequency. ● Increase acceleration /deceleration time setting. ● Reduce the torque limit. ● Decreasing the load inertia. ● Replace the servo driver and servomotor with bigger ones. Replace a bigger brake resistor

Err18（IGBT model over-load）

Potential cause	Check	Handle
Excess the rated load for continuous duty operation	Check current	Reduce load or replace the servo driver with bigger one.
Encoder zero point changes	Check the encoder zero point	Install the encoder again and adjust the zero point.

Err20（EEPROM Error）

Potential cause	Check	Handle
EEPROM chip is damaged	Turn on the power again and check	If the error still exists, then replace the servo driver.

Err21（Logic circuit error）

Potential cause	Check	Handle
Control circuit fault	Turn on the power again and check	If the error still exists, then replace the servo driver.

Err22（Power panel don’t match control panel）

Potential cause	Check	Handle
Power panel don’t match control panel	check if replace the control panel by yourself	use the corresponding control panel with power panel

Err23（AD conversion error）

Potential cause	Check	Handle
Current sensor and connector fault	Check the main circuit	Replace the servo driver.
AD converter and analog amplifier fault	Check the control circuit	Replace the servo driver.

Err25（FPGA checking error）

Potential cause	Check	Handle
FPGA checking error	turn on again to check	Replace the servo driver.

Err27（Phase loss alarm）

Potential cause	Check	Handle
Phase loss of power supply	Check the wiring of L1, L2,L3	Connect wire correctly
Power supply undervoltage	Check supply power voltage	Ensure correct voltage input
Phase loss checking return circuit error	Check optocoupler, power on again	If error still exists, please replace drive

Err29（Over-torque alarm）

Potential cause	Check	Handle
Unexpected big load occurs	Check load condition	Correctly readjust the load.
Parameter P070、P071、P072 setting is not reasonable	Check the parameters	Correctly readjust parameters.

Err35（Drive interior connection path error）

Potential cause	Check	Handle
Drive interior connection wire error	Check connection wire and terminals	If error still exists, please replace drive
Connection path failure	Check Optocoupler	If error still exists, please replace drive

Err36（Fan alarm）

Potential cause	Check	Handle
fan alarm	check fan	replace fan
hardware circuit error	Check wiring	Connect wiring correctly
hardware circuit error	Check Optocoupler	If error still exists, please replace drive

Err40（Absolute encoder communication error） ☆

Potential cause	Check	Handle
Encoder connection wiring error	Check the encoder connection wiring	Connect wiring correctly
Encoder cables and connectors unsteady	Check cable and connector	Replace cable and connector
Encoder damage	Check encoder	Replace encoder

Err41（Absolute encoder communication error） ☆

Potential cause	Check	Handle
Encoder connection wiring error	Check the encoder connection wiring	Connect wiring correctly
Encoder cables and connectors unsteady	Check cable and connector	Replace cable and connector
Encoder damage	Check encoder	Replace encoder

Err42（Absolute encoder interior counting error） ☆

Potential cause	Check	Handle
Encoder cables and connectors unsteady	Check cable and connector	Replace cable and connector
Encoder damage	Check encoder	Replace encoder

Err43（Absolute encoder communication responds error） ☆

Potential cause	Check	Handle
Encoder cable and connector unsteady	Check cable and connector	Replace cable and connector
Encoder damage	Check encoder	Replace encoder

Err44（Absolute encoder verify error） ☆

Potential cause	Check	Handle
Encoder cable and connector unsteady	Check cable and connector	Replace cable and connector
Encoder damage	Check encoder	Replace encoder

Err45（Absolute encoder EEPROM error） ☆

Potential cause	Check	Handle
Encoder cable and connector unsteady	Check cable and connector	Replace cable and connector
Encoder EEPROM damage	Check encoder	Replace encoder

Err46（Absolute encoder parameter error） ☆

Potential cause	Check	Handle
Encoder cable and connector unsteady	Check cable and connector	Replace cable and connector
Encoder EEPROM damage	Check encoder	Replace encoder

Err47（Absolute encoder external battery error） ☆

Potential cause	Check	Handle
External battery out of power	External battery voltage	Replace battery

Err48（Absolute encoder external battery alarm） ☆

Potential cause	Check	Handle
External battery out of	External battery voltage	Replace battery

power		
First time power on after replacing battery	battery voltage	If voltage is normal, please restart encoder. Refer to chapter 3.6.1

Err49（Encoder is hot）

Potential cause	Check	Handle
Encoder is hot	check if the power of the motor is too small or the environment temperature is too high.	● Replace motor with suitable power rating or temperature rating ● Reduce the temperature of the environment

Err50（Motor parameter does not match that of drive）

Potential cause	Check	Handle
The power of motor does not match that of drive	Check the motor match list of drive	Replace suitable drive or motor

Err51（Resolver loses track）

Potential cause	Check	Handle
Encoder wiring error	Check whether encoder shield is good or not	Connect wiring correctly, including shield wiring
Automatic recognition failure of encoder	Confirm if the type of encoder is supported by the drive	Changing to the corresponding type of encoder

Err60（Data receiving abnormal in Op status）

Potential cause	Check	Handle
Data receiving abnormal in Op status	● check the Ethercat cable ● Check the status of the main station	● Changing the Ethernet cable ● Check the status of main station

Err61（Ethernet communication cycle deviation is too large）

Potential cause	Check	Handle
Industrial Ethernet communication was interrupted	Check the Ethercat cable	Changing the Ethernet cable
Excessive jitter of the Ethernet communication cycle	● Increase communication cycle time ● Reduce main station load	● Increase communication cycle time ● Reduce main station load

Err62（Ethernet instruction data beyond range）

Potential cause	Check	Handle
Current communication cycle instruction data exceed	● Checking user unit settings ● check electronic gear setting	● Change user unit settings ● Change the electronic gear set

Err65（SYNC Signal initialization error）

Potential cause	Check	Handle
No SYNC signal was received after entering the OP status	Check the main station configuration	Check the main station configuration

Err66（SYNC signal and data receiving phase error）

Potential cause	Check	Handle
SYNC signal and SM data receive beat error	Check the main station configuration	Check the main station configuration

Err68（EtherCAT failed to operate EEPROM）

Potential cause	Check	Handle
EtherCAT failed to operate EEPROM	Power on again and check it	If error still exists, please replace drive

Err80（internal error 1）

Potential cause	Check	Handle
abnormal set of related parameters of electronic gear	Related parameters set of electronic gear	set the rightful electronic gear parameters

Err81（internal error 2）

Potential cause	Check	Handle
In internal operations, there is a case of "0"	Relevant parameter settings, such as rated current, rated voltage, rated speed, etc.	Set the parameter value of "legal" (non "0")

Err82（internal error 3）

Potential cause	Check	Handle
Related parameter of "return to zero" set is unlawful	The setting of the related parameters of "return to zero"	Set the legitimate "return zero" parameter

Err88（Operation pattern error 1）

Potential cause	Check	Handle
The operation mode is not set when the in enable status	operation mode set when enable status	After operation mode set then adding enable

Err89（Operation pattern error 2）

Potential cause	Check	Handle
an invalid mode of operation	set the operation mode	set up a valid mode of operation based on 6502h

Chapter 8 Specifications

8.1 Types of servo driver

EP3E - G L 3A0 - E3 S0 EC

Mark	Main power supply voltage
L	AC220V
H	AC380V

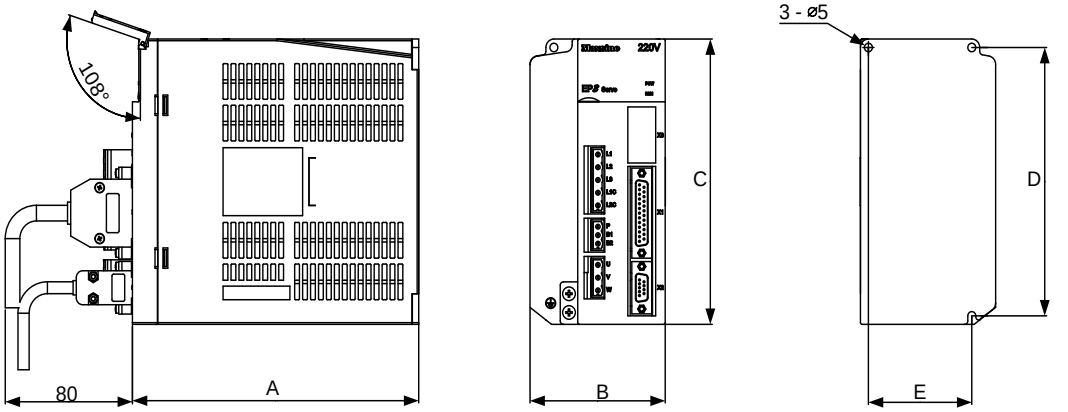
Mark	Power (kW)	Current(A)
GL1A0	0.1	1.0
GL1A8	0.2	1.8
GL3A0	0.4	3.0
GL5A5	1.0	5.0
GL7A5	1.0	7.5
GL120	1.5	11.5
GL160	2.0	15.5
GL190	3.0	19.0
GL240	5.0	24.0
GH2A0	0.6	2.0
GH3A5	1.0	3.5
GH5A4	1.5	5.4
GH8A5	2.0	8.5
GH130	3.0	13.0
GH170	5.0	17.0
GH210	7.5	21.0

Mark	Encoder interface specification
E3	23bit Multi-loop absolute encoder
E6	Absolute value encoder of Panasonic A5 and A6
B0	23bit incremental encoder

Mark	控制方式
S0	X1控制端子DB25

Mark	Specification
EC	EtherCAT bus protocol

8.2 Dimensions of servo driver



model / size（mm）	GL1A0	GL1A8/ GL3A0	GL5A5	GL7A5	GL120	GL160	GL190	GL240
A	150	150	180	180	180	180	180	210
B	55	65	75	85	95	95	105	115
C	168	168	168	168	168	200	220	250
D	158	158	158	158	158	189	209	239
E	-	55	65	65	65	84	94	104

model / size（mm）	GH2A0/GH3A5/GH5A4	GH8A5	GH130	GH170/GH210
A	180	180	180	210
B	95	95	105	115
C	168	200	220	250
D	158	189	209	239
E	65	84	94	104

8.3 Specifications of servo driver

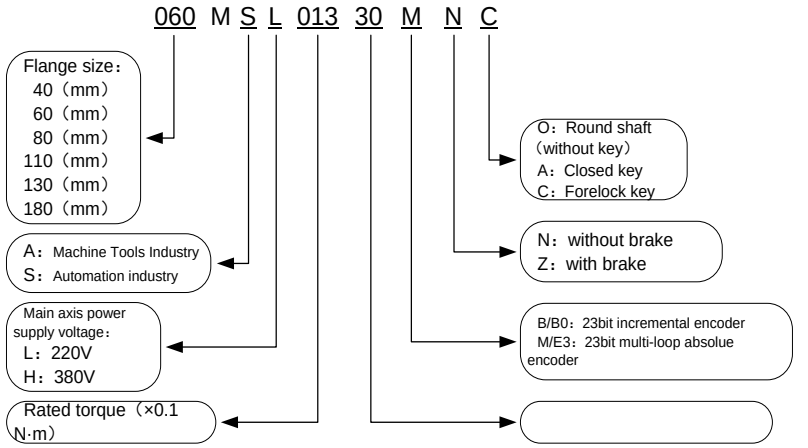
Type		GL 1A0	GL 1A8	GL 3A0	GL 5A5	GL 7A5	GL 120	GL 160	GL 190	GL 240	GH 2A0	GH 3A5	GH 5A4	GH 8A5	GH 130	GH 170	GH 210
Rated output power (KW)		0.1	0.2	0.4	1.0	1.0	1.5	2.0	3.0	5.0	0.6	1.0	1.5	2.0	3.0	5.0	7.5
Rated output current(A)		1.0	1.8	3.0	5.0	7.5	11.5	15.5	19.0	24.0	2.0	3.5	5.4	8.5	13.0	17.0	21.0
Instantaneous maximum output current（A）		3.0	5.4	9.0	11.3	14.9	21.0	24.5	28.5	40.0	6.0	7.1	10.0	12.7	28.3	31.2	39.6
Power supply	Main power supply	Single phase 220VAC -15%～+10% 50/60Hz			Three-phase 220VAC -15%～+10% 50/60Hz						Three-phase 380VAC -15%～+10% 50/60Hz						
	Control power supply	Single phase 220VAC-15%～+10% 50/60Hz									24VDC±15% no less than1.5A						
Environment	Temperature	Operation：0℃～40℃ Storage：-40℃～50℃															
	Humidity	Operation：40%～80%（non-condensing） Storage：93% or less（non-condensing）															
	Atmospheric pressure	86kPa～106kPa															
IP rating		IP20															
Control of main circuit		vector control															
Regeneration		Bulit-out	Built-in/ built-out						Bulit-out	Built-in/ built-out					Bulit-out		
Feedback type		23 bits incremental encoder/absolute encoder															
Control mode		Cyclic Synchronous Position Mode （CSP）、Cyclic Synchronous Velocity Mode （CSV）、Cyclic Synchronous Torque Mode （CST）……															
Digital input		Five programmable input terminals (optical isolation); 2 way high speed optocoupler input															
Digital output		Five programmable output terminals (optical isolation)															
Special function		Mechanical resonant trap and vibration suppression															
Moniter function		Speed, current position, position deviation, motor torque, motor current, instruction pulse frequency, etc.															
Protection function		Overspeed, overvoltage, overcurrent, overload, braking abnormity, encoder exception, location error and so on.															
Characteristic	Frequency response of speed	1.2kHz															
	Fluctuation of speed	＜±0.03%（load 0～100%）；＜±0.02%（power supply-15%～+10%）															
	Speed control range	1:5000															

8.4 Adaptive table for servo motor selections

Servo motor model (220V series)		Torque Nm	Speed r/min	Power kW	Adaptive driver	
					Better adaptation	Average adaptation
MSL series	40MSL00330	0.32	3000	0.10	GL1A0	
	60MSL00630	0.64	3000	0.20	GL1A8	
	60MSL01330	1.27	3000	0.40	GL3A0	
	80MSL01330	1.27	3000	0.40	GL3A0	
	80MSL02430	2.39	3000	0.75	GL7A5	GL120
	80MSL03230	3.18	3000	1.00	GL120	GL7A5
	110MSL03225	3.18	2500	0.83	GL7A5	
	110MSL04825	4.77	2500	1.25	GL7A5	GL120
	110MSL06425	6.37	2500	1.67	GL120	GL190
	130MSL04025	4.00	2500	1.00	GL7A5	
	130MSL04820	4.77	2000	1.00	GL7A5	GL120
	130MSL05025	5.00	2500	1.30	GL120	GL7A5
	130MSL07220	7.16	2000	1.50	GL160	GL190
	130MSL09620	9.55	2000	2.00	GL190	GL160
	130MSL10025	10.00	2500	2.60	GL190	GL160
	130MSL14320	14.30	2000	3.00	GL190	GL240
MAL series	110MAL0403	4.00	3000	1.26	GL7A5	GL120
	110MAL0503	5.00	3000	1.57	GL120	
	110MAL0603	6.00	3000	1.88	GL120	
	130MAL0602	6.00	2500	1.57	GL120	GL7A5
	130MAL0772	7.70	2500	2.02	GL160	GL120
	130MAL1001	10.00	1500	1.57	GL120	
	130MAL1501	15.00	1500	2.36	GL160	GL190

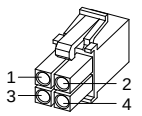
Servo motor model (380Vseries)		Torque Nm	Speed r/min	Power kW	Adaptive driver	
					Better adaptation	Average adaptation
MAH series	110MAH0403	4.00	3000	1.26	GH3A5	GH5A4
	110MAH0503	5.00	3000	1.57	GH5A4	GH8A5
	110MAH0603	6.00	3000	1.88	GH8A5	GH5A4
	130MAH0402	4.00	2500	1.00	GH3A5	
	130MAH0482	4.77	2000	1.00	GH3A5	GH5A4
	130MAH0502	5.00	2500	1.30	GH5A4	GH8A5
	130MAH0602	6.00	2500	1.57	GH5A4	GH8A5
	130MAH0772	7.70	2500	2.02	GH8A5	GH5A4
	130MAH1001	10.00	1500	1.57	GH5A4	GH8A5
	130MAH1501	15.00	1500	2.36	GH8A5	GH130
	180MAH1901	19.00	1500	3.00	GH130	
	180MAH2701	27.00	1500	4.30	GH170	
	180MAH3501	35.00	1500	5.50	GH170	GH210
	180MAH4801	48.00	1500	7.50	GH210	

8.5 Types of servo motor

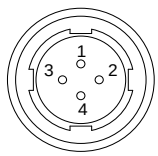


8.6 Servo motor wiring

8.6.1 Winding wiring



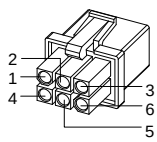
40/60/80 servo motor power connetor



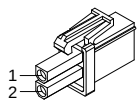
110/130/180 servo motor power connetor

Terminal symbol	Terminal number		Terminal explanation
	40/60/80 motor	110/130/180 motor	
U	1	2	U phase drive input
V	2	3	V phase drive input
W	3	4	W phase drive input
⏚	4	1	Ground terminal of motor case

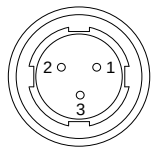
8.6.2 Wiring for brakes



40 servo motor power connector with brake



60/80 servo motor brake connector



110/130/180 servo motor brake connector

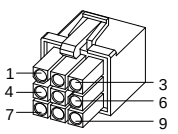
Wiring for servo motor with brake (flange size 40mm):

Terminal symbol	Terminal number	Terminal explanation
U	1	U phase drive input
V	2	V phase drive input
W	3	W phase drive input
PE	4	Ground terminal
BK+	5	Brake terminal
BK-	6	

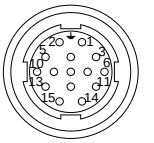
Wiring for servo motor with brake
(flange size 60mm,80mm,110mm,130mm,180mm):

Terminal symbol	Terminal number		Terminal explanation
	60/80 series motor	110/130/180 series motor	
DC+	1	1	Brake power supply is DC power without polarity access requirements
DC-	2	2	
PE	——	3	

8.6.3 Encoder



40/60/80 servo motor
encoder connector



110/130/180 servo motor
encoder connector

Encoder wiring for servo motor
(flange size 40mm,60mm,80mm,110mm,130mm,180mm)

Terminal symbol	Terminal number					Terminal explanation
	40motor	60/80motor		110/130/180motor		
	Absolute	Absolute	incremental	Absolute	incremental	
SD+	1	1	1	6	6	Encoder signal wire
SD-	2	2	2	7	7	
VCC	6	6	6	2	2	Encoder 5V power input
GND	7	7	7	3	3	
Battery+ ☆	3	3	——	4	——	3.6V battery power supply
Battery - ☆	8	8	——	5	——	
PE	9	9	9	1	1	Ground terminal

Note: the "☆" in this manual shows the special function of the absolute encoder, and the "★" indicates the special function of the incremental encoder.

Wuhan Maxsine Electric Co.,Ltd.
Address: A6, Hangyu Building, No.7, Wuhan University Science Park Road, Donghu District, Wuhan, Hubei Province, China.
Zip code: 430223
Central office: 027-87921282/027-87921283
Sales Tel: 027-87920040/027-87923040 ext:809/817/818
Sales Fax：027-87921290
After service Tel: 027-87921284/027-87921282 ext:831/832/833
Company Website: www.maxsine.com
Email: maxsine_sales@maxsine.com

Written in January 2018