Technical Guide

SV-DA300Series AC Servo Drive

——EtherCAT

上海英威腾工业技术有限公司
INVT INDUSTRIAL TECHNOLOGY (SHANGHAI) CO., LTD.

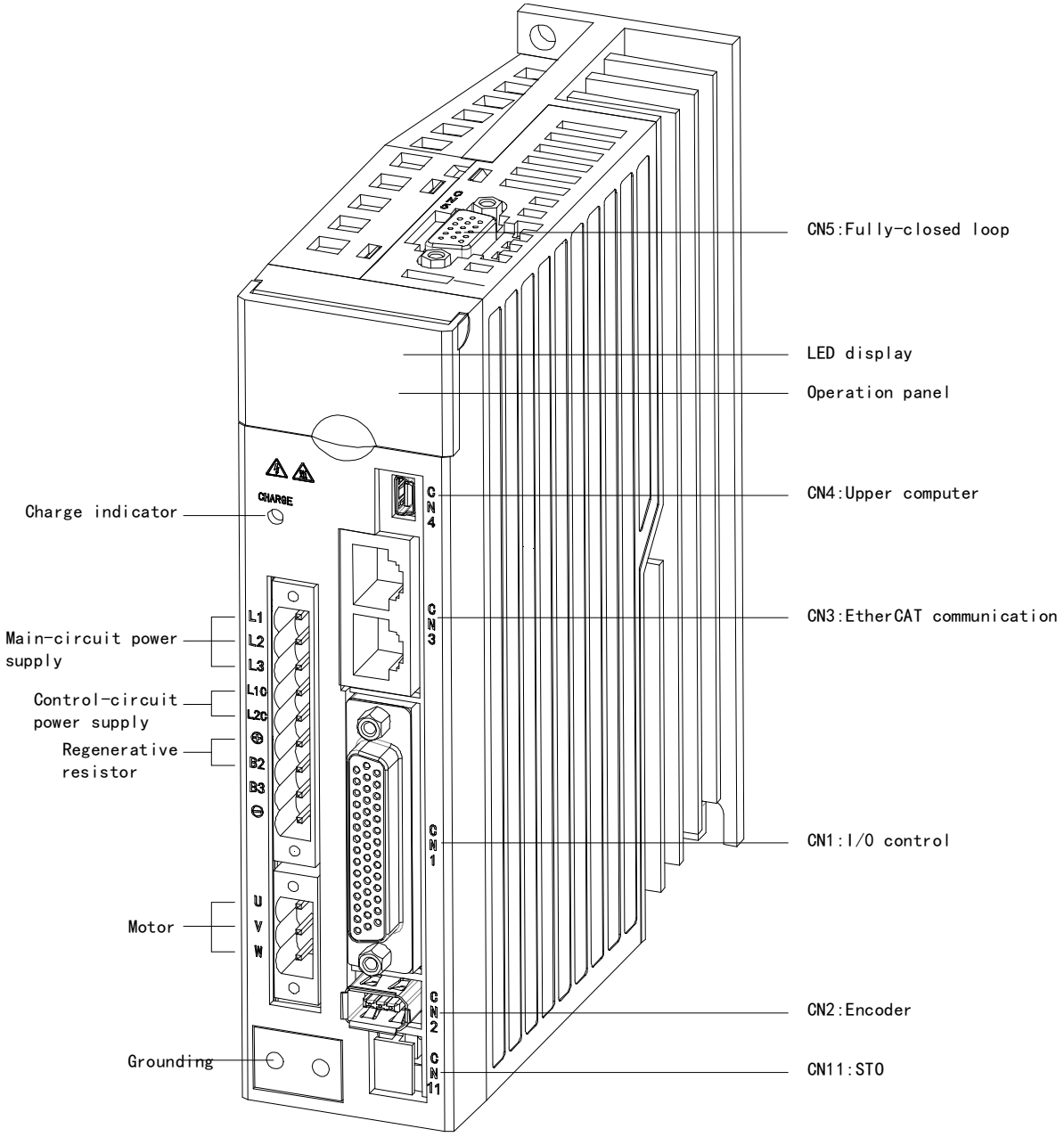
Feb18, 2021

Contents

1 Hardware configuration

1.1 Terminal wiring

CN3 terminal is the connection terminal of EtherCAT. The line connecting mode of CN3 terminal is top-in and bottom-out.



Pin assignment of RJ45 connectors

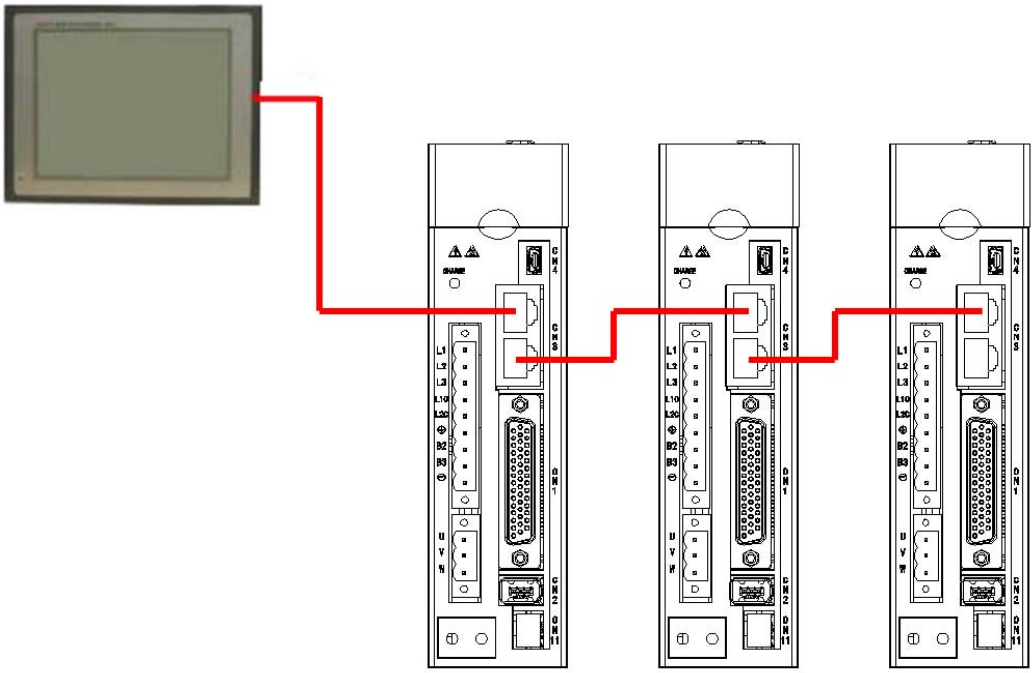
Pin No.	Signal name	Abbreviation	Signal direction
1	Send data+	TD+	Output
2	Send data-	TD-	Output
3	Receive data+	RD+	Input
4	-	NC*	-
5	-	NC	-
6	Receive data--	RD-	Input
7	-	NC	-
8	-	NC	-

Enclosure	Protection ground	FG	-

*:NC is unused.

1.2 Drive wiring

EtherCAT network is normally comprised of one master (IPC or CNC) and multiple slaves (servo drive or bus extension terminal). Each EtherCAT slave carries two standard Ethernet interfaces. The wiring diagram is shown below:

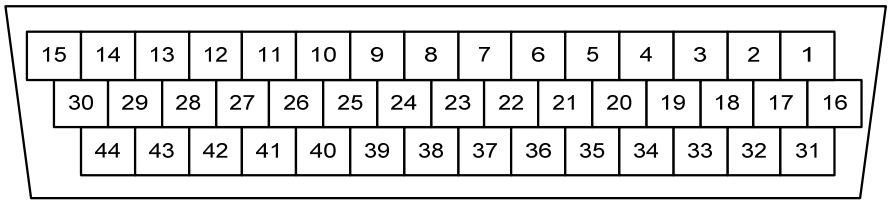


1.3CN1 terminal definition

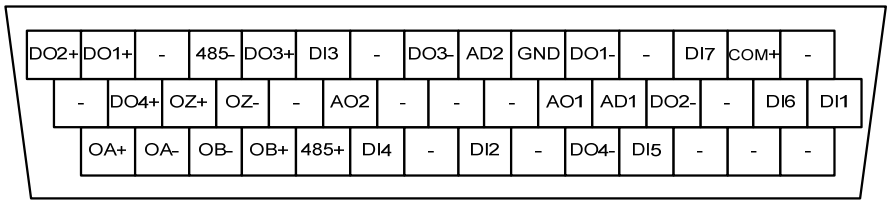
CN1 terminal definition of DA300 EtherCAT type is as below:

Pin No.	Symbol	Function name	Pin no.	Symbol	Function name
1	-	(Reserved)	23	-	(Reserved)
2	COM+	DI input common port	24	-	(Reserved)
3	DI7	Digital input7	25	AO2	Analog output 2
4	-	(Reserved)	26	-	(Reserved)
5	DO1-	Digital output 1-	27	OZ-	Differential output - of Z phase
6	GND	Digit signal ground	28	OZ+	Differential output + of Z phase
7	AD2	Analog input 2	29	DO4+	Digital output4+
8	DO3-	Digital output3-	30	-	(Reserved)
9	-	(Reserved)	31	-	(Reserved)
10	DI3	Digital input3	32	-	(Reserved)
11	DO3+	Digital output3+	33	-	(Reserved)
12	485-	RS485-	34	DI5	Digital input5
13	-	(Reserved)	35	DO4-	Digital output4-
14	DO1+	Digital output1+	36	-	(Reserved)
15	DO2+	Digital output2+	37	DI2	Digital input2
16	DI1	Digital input1	38	-	(Reserved)

Pin No.	Symbol	Function name	Pin no.	Symbol	Function name
17	DI6	Digital input6	39	DI4	Digital input4
18	-	(Reserved)	40	485+	RS485+
19	DO2-	Digital output 2-	41	OB+	Differential output + of B phase
20	AD1	Analog input 1	42	OB-	Differential output - of B phase
21	AO1	Analog output 1	43	OA-	Differential output - of A phase
22	-	(Reserved)	44	OA+	Differential output + of B phase



CN1 plug pin layout

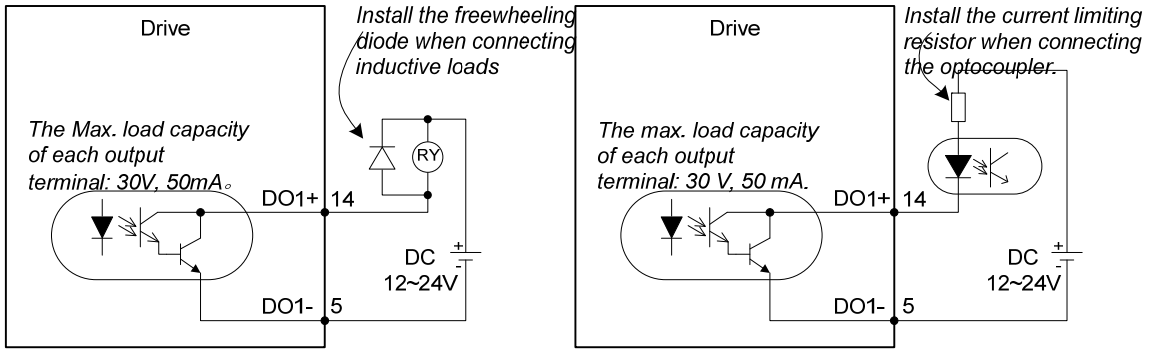


CN1plug signal layout

EtherCAT type has 7 digital inputs and 4 groups of differential digital outputs. The external wiring of the digital inputs is similar to the standard type. For details, refer to the DA300 *Manual*.

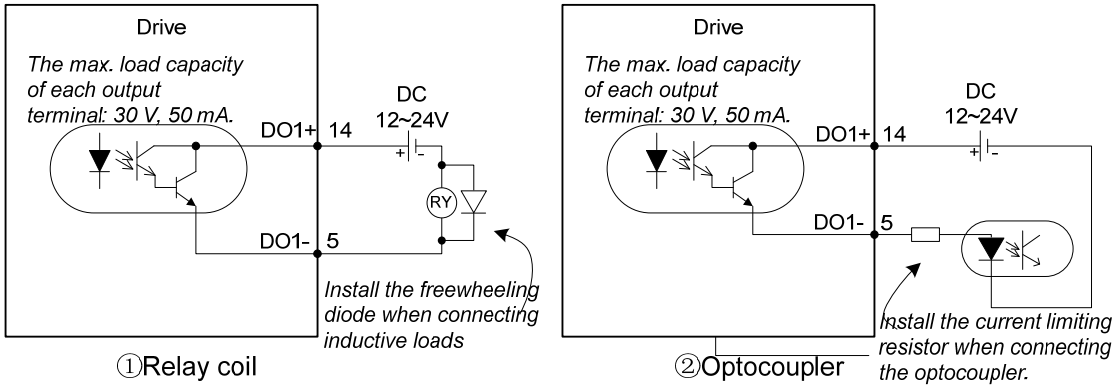
The external wiring of the differential digital output is connected as follows, taking DO1 for example:

Connection diagram when the power supply is self-provided by user:



①Relay coil ② Optocoupler

It can also be connected as follows:


Drive
The max. load capacity of each output terminal: 30 V, 50 mA.
DO1+
14
DC
12~24V
RY
DO1-
5
Install the freewheeling diode when connecting inductive loads
①Relay coil
Drive
The max. load capacity of each output terminal: 30 V, 50 mA.
DO1+
14
DC
12~24V
DO1-
5
Install the current limiting resistor when connecting the optocoupler.
②Optocoupler

2 Software configuration

2.1 Basic setup of EtherCAT application

It is necessary to configure the following four parameters before conducting EtherCAT application with SV-DA300 servo drive:

1. Set **P0.03Control mode** to **8 EtherCATmode** via LED panel or ServoPlorer.

2. In most cases, you don't need to set the node number parameter, you can use the default physical node order addressing, such as Twincat. If you need to set the node number (such as Omron PLC), you can set the parameter **P4.00EtherCAT communication node** through LED panel or ServoPlorer software. The default value of -1 means no communication mode is set.

3. Set **P4.08EtherCAT synchronization type** via LED panel or ServoPlorer (**0**: Free-Run; 2: DC Sync0);

4. Set **P4.07EtherCAT synchronization cycle** via LED panel or ServoPlorer (0: 250 us; 1: 500 us; **2**:1 ms; 3: 2 ms; 4: 4 ms; 5: 8 ms);

5. Set **P4.09EtherCAT fault detection time** via LED panel or ServoPlorer (Set the detection time of offline fault or PDO data loss fault as needed);

6. Set **P4.25EtherCAT control unit type** via LED panel or ServoPlorer (**0**: Manufacturer mode; 1: CIA402 Unit; 2: CIA402 OMRON);

7. Set **P4.26EtherCAT PDO input offset** via LED panel or ServoPlorer (**0**-63, unit: 125 us);

8. Set **P4.27Compensation value of EtherCAT position interpolation mode** via LED panel or ServoPlorer (**0**-10);

9. The digital value is controlled by the servo (default). If it is controlled by the master station via EtherCAT communication, it is necessary to set **P4.28** Digital output control enabling of EtherCAT to 1 (enabled) via LED panel or ServoPlorer, or control the digital output through 0x60FE in TPDO.

Note:

1. As the first four configuration parameters are **valid after restarting**, so it is necessary to repower again or reset the drive. The last three parameters are instantly valid.

2. When control mode (0x6060) is set to position interpolation mode (**8**), P4.07 **EtherCAT synchronization cycle** is the same with CNC interpolation cycle.

3. The meaning of P4.25 **EtherCAT control unit type**:

0: Manufacturer mode: support twincat NC function of Beckhoff;

Position unit is pulse, speed unit is rpm, acceleration unit is ms (the time needed for accelerating from zero speed to rated motor speed).

Support the touch probe of z signal. The capture value of external IO is stored in manufacturer parameters. For details, refer to the following text.

1: CIA402 Unit: support most of motion controllers, such as CodeSys, BaoYuan and ACS EtherCAT master.

Position unit is pulse, speed unit is pulse/s, and acceleration unit is pulse/s².

Support the touch probe of z signal and standard touch probe 1 IO capture.

2: CIA402 OMRON: support OMRON NJ controller.

The content is basically the same as 1. Modify 0x6041 status word feedback parameters to satisfy OMRON NJ requirement on status machine.

4. The default pulse per revolution of DA300 is 10000, which can be modified by **P0.22Pulse per revolution**

of motor or by modifying P0.25 **Numerator of electronic gear ratio** and P0.26 **Denominator of electronic gear ratio** after setting P0.22 to 0. Please note that the modification of P0.22 will be effective after reset, and the value defined with P0.22 should not exceed the actual resolution rate of the encoder.

5. P4.26 and P4.27 need to be modified only when the master cycle is unstable or packet loss or other problems occurred to communication.

6. **P4.26 EtherCAT PDO input offset** is used to adjust the time from receiving DC signal to processing PDO, thus PDO input time can be in the middle of the master cycle, reducing the data loss caused by the unstable master clock. This parameter needs to be set according to the cycle of P4.07. If P4.07 is 1 ms, then the range of P4.26 is 0-7. 0 means no offset while 7 means 7*125 us offset. The actual set value should be based on actual conditions with the purpose of achieving stable data-receiving.

7. **P4.27Compensation value of EtherCAT position interpolation mode** is effective only when it is under DC mode and control mode is position interpolation mode (**8**), this is to ensure that position command smoothing effect can be achieved by adding position command forecast function if one or multiple cycle position command are lost, with precondition that P4.26 is set properly. If it is set to non-zero, compensation will be made based on previous position increment when position command loss occurred, and the compensation cycle is equal to the value defined with P4.27.

8. The torque limit parameters in PDO parameter list in EtherCAT xml configuration file of DA300, if any, should be set to non-zero, otherwise the servo torque will be limited to 0, and cause malfunction or alarm. For instance, the unit for **Positive torque limit, Negative torque limit** and **Max torque** is 1% of rated torque, when these parameters were set to 1000, it means 100% of rated torque. Torque limit parameters are effective in all control modes.

9. **Max profile velocity** in EtherCAT xml configuration files of DA300, if any, means the maximum speed limit under torque loop, and the unit is related to P4.25. For instance, the unit is rmp if P4.25 is manufacturer unit and puu/s if P4.25 is set to other values. Set this parameter to a non-zero value if torque loop operation is required.

10. Transceiving of PDO can be configured dynamically by the master, however, the max. number of each PDO parameter is 10, exceeds which the slave will be unable to enter op status.

11. The connecting mode of network cables should adopt top-in and bottom-out, otherwise some nodes may be unable to enter op status.

12. This instruction manual applies to versions later than V1.11/XML V1.00.

2.2 EtherCATcommunication

2.2.1 CANopen over EtherCAT (CoE) reference model

The network model of CANopen over EtherCAT (CoE) of DA300 drive is shown below.

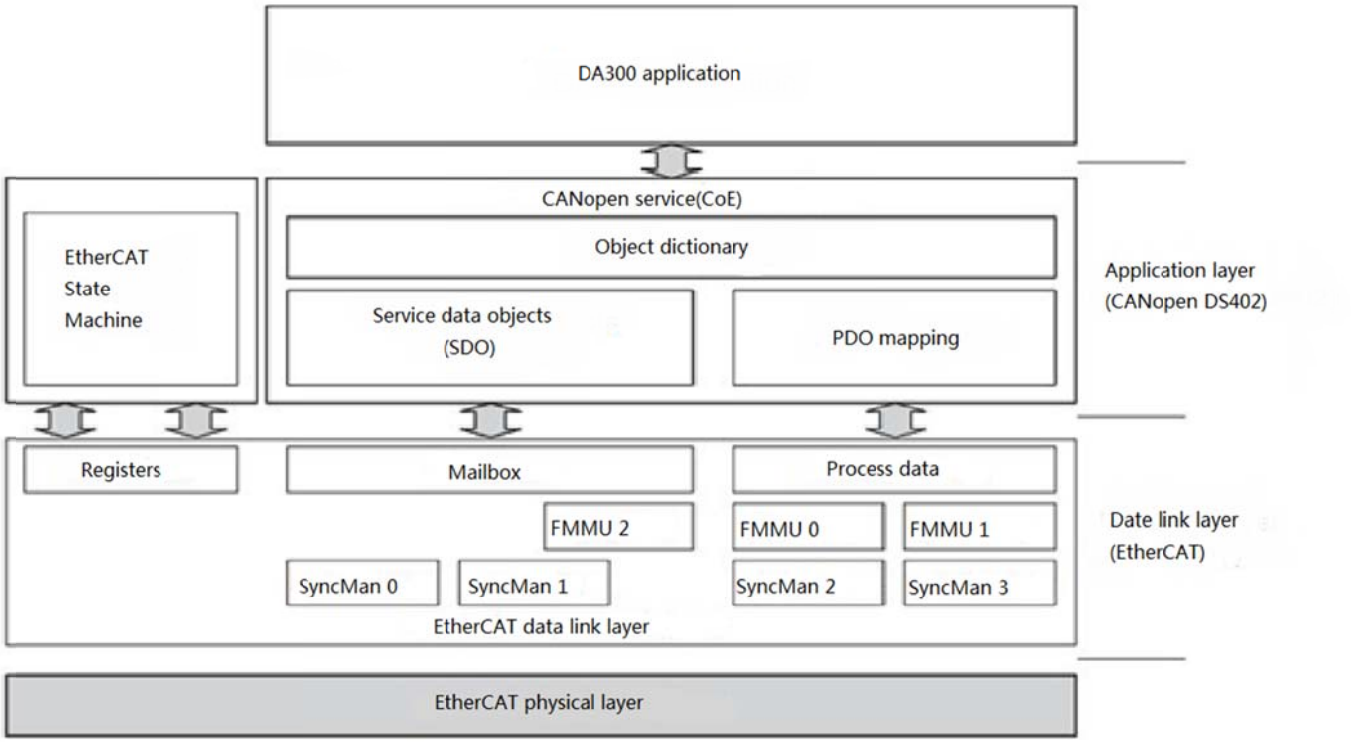


Figure 2-1 CoE reference model

EtherCAT (CoE) network reference model consists of data link layer and application layer. Data link layer is in charge of EtherCAT communication protocol while application layer is embedded with CANopen drive profile (DS402) communication protocol. The object dictionary in CoE contains parameters, application data, and PDO mapping configuration information.

Process data object (PDO) is constituted by objects which can conduct PDO mapping in object dictionary. The content in PDO data is defined by PDO mapping. The R/W of PDO data is cyclic, thus removing the need to look up the object dictionary while service data object (SDO) is acyclic communication, and requires a look-up in object dictionary during R/W.

Note: It is necessary to configure FMMU and Sync Manager to ensure SDO and PDO data can be properly analyzed in EtherCAT data link layer, as shown in the table below:

Sync Manager	Assignment(Fixed)	Size	Start Address(Fixed)
Sync Manager 0	Assigned to Receive Mailbox	40 ~ 512Byte	0x1000
Sync Manager 1	Assigned to Transmit Mailbox	40 ~ 512Byte	0x1200
Sync Manager 2	Assigned to Receive PDO	1 ~ 128Byte	0x1400
Sync Manager 3	Assigned to Transmit PDO	1 ~ 128Byte	0x1480

FMMU setup

FMMU	Settings
FMMU 0	Mapped to Receive PDO
FMMU 1	Mapped to Transmit PDO
FMMU 2	Mapped to Fill Status of Transmit Mailbox

2.2.2 EtherCATslave information

EtherCAT slave information file (XML file) is used for master reading and building the configuration between the master and slave. XML file contains information required by EtherCAT communication setup. INVT provides “INVT_DA300_EtherCAT_***.xml” file for DA300 drive.

2.2.3 EtherCATstate machine

EtherCAT state machine is used to describe the state and state change of slave application. The request of state change is usually initiated by the master and responded by the slave. The state transition mode is shown as below:

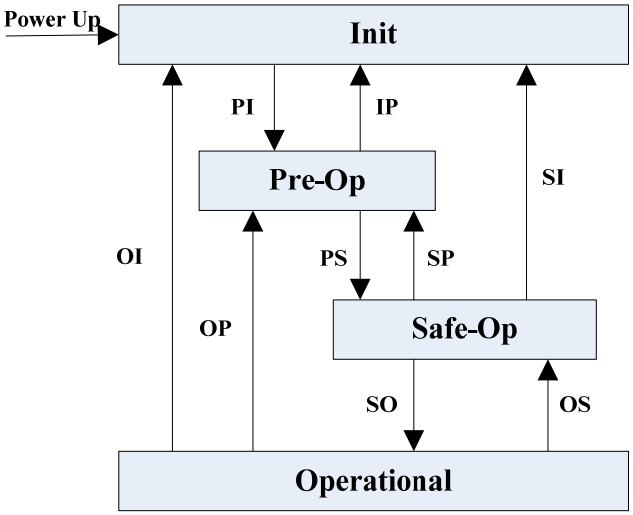


Figure 2-2 Diagram of slave state machine

Table 2-2 State instruction

State	Description
Init	● Mail communication is unavailable ● PDO communication is unavailable
Init→ Pre-Op	● Master configures link layer address and SM channel, and initiates mail communication ● Master initializes DC clock synchronization ● Master requests transferring to Pre-Op state ● Master sets AL control register ● Slave determines whether mail is initialized normally
Pre-Operation (Pre-Op)	● Mail communication is activated ● PDO communication is unavailable
Pre-Op → Safe-Op	● Master is channel for process data configuration sync manager channel and FMMU ● Master configures PDO data mapping and Sync manager PDO parameter setup via SOD ● Master requests Safe-Op state transition ● Slave checks whether the Sync Manager configuration in charge of PDO data is correct. If the slave sends the request to initiate synchronization, check whether the distributed clock is set correctly
Safe-Operation (Safe-Op)	● The slave application program will transmit actual input data and no operation will be performed on output ● Output is set to "safe state"
Safe-Op → Op	● Master sends valid output data ● Master requests transferring to Op state
Operational (Op)	● Mail communication is available ● PDO communication is available

2.2.4 Mapping of PDO process data

Process data of EtherCAT slave is constituted by sync manager channel objects, with each object describing the uniform region of EtherCAT process data and containing multiple process data objects. The EtherCAT slave equipped with application control function should support PDO mapping and R/W of SM PDOs Assign objects.

PDO mapping:

PDO mapping designs the mapping relation between the object dictionary to PDOs application object. Index 0x1600 and 0x1A00 in the object dictionary are stored in RxPDO and TxPDO mapping table respectively. Example of PDO mapping is shown below:

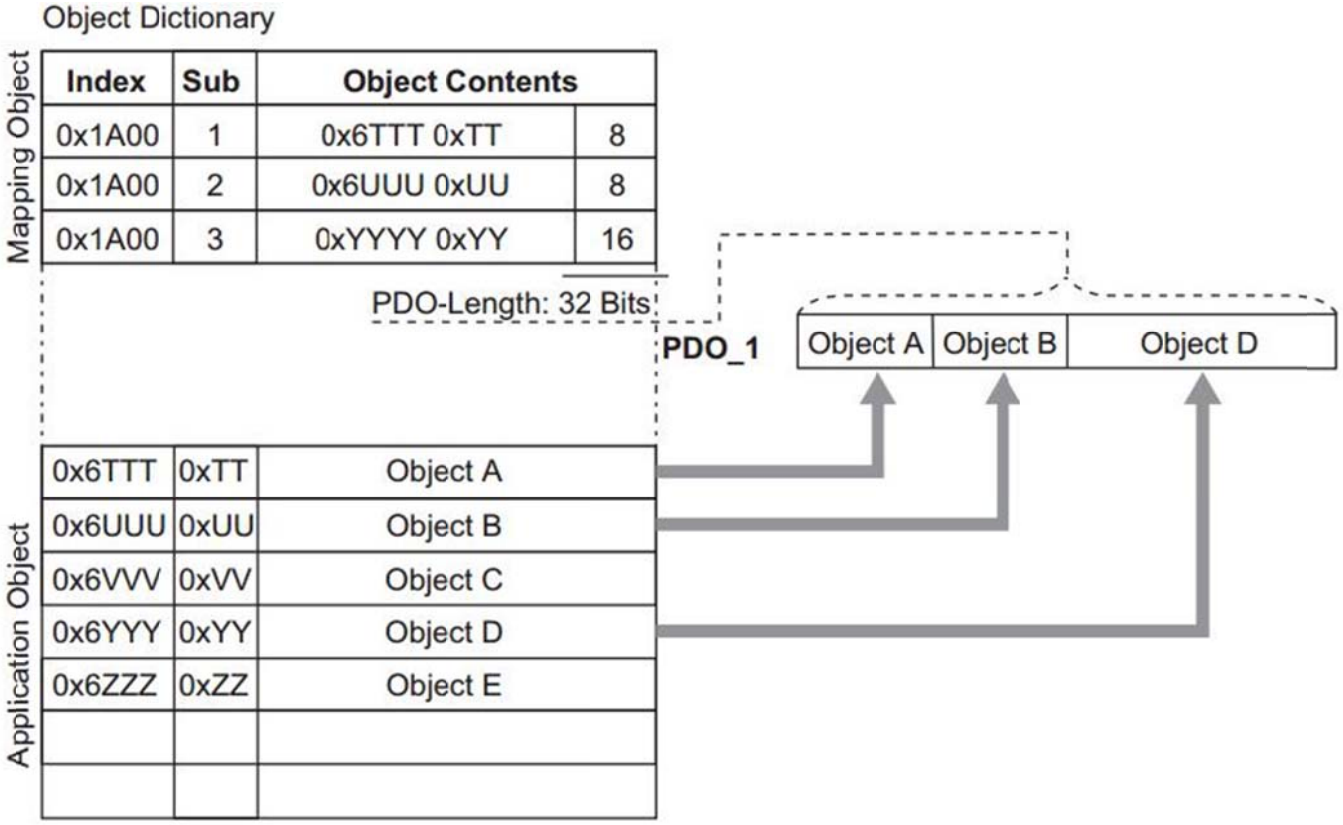


Figure 2-3 Example of PDO mapping

PDO distribution:

In order to realize process data interaction of EtherCAT communication, it is necessary to distribute PDOs to Sync Manager. Sync Manager PDO distributes objects (Sync Manager PDO Assign objects: 0x1C12 and 0x1C13) to establish the relationship between PDOs and Sync Manager.

Example of Sync Manager PDO distribution is shown below:

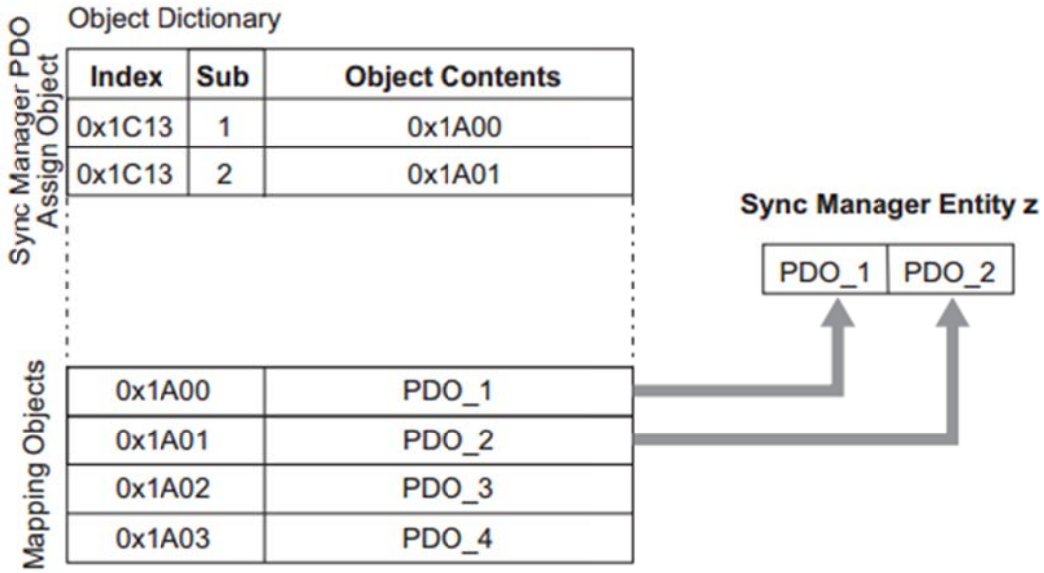


Figure 2-4 Example of PDO distribution

Note:

PDO mapping object (0x1600–0x1603 and 0x1A00–0x1A03) and SM PDO Assign object (0x1C12 and 0x1C13) can only be effective in write operation under Pre-Op state.

Operation steps of PDO mapping:

1. Stop PDO distribution function (Set the sub-index 0 of 0x1C12 and 0x1C13 to 0).
2. Stop PDO mapping function (Set the sub-index 0 of 0x1600–0x1603 and 0x1A00–0x1A03 to 0).
3. Set the mapping entry of PDO mapping object (0x1600–0x1603 and 0x1A00–0x1A03).
4. Set the value of mapping entry of PDO mapping object (0x1600–0x1603 and 0x1A00–0x1A03).
5. Set PDO distribution object (Set sub-index 1 of 0x1C12 and 0x1C13).
6. Re-open PDO distribution function (set sub-index 0 of 0x1C12 and 0x1C13 to 1).

Default PDO mapping (Position, Speed, Torque, Torque limit, and Touch probe):

RxPDO (0x1600)	**Controlword (0x6040)**	**Target Position (0x607A)**	**Target Velocity (0x60FF)**	**Mode of Operation (0x6060)**	**/**	**Target torque (0x6071)**	**Touch probe control (0x60B8)**	**Positive torque limit (0x60E0)**	**Negtive torque limit (0x60E1)**	**Max profile velocity (0x607F)**
TxPDO (0x1A00)	**Statusword (0x6041)**	**Position Actual Value (0x6064)**	**Speed Actual Value (0x606C)**	**Torque Actual Value (0x6077)**	**Operation Mode Display (0x6061)**	**Current Actual Value (0x6078)**	**Touch Probe Status (0x60B9)**	**Touch Probe Value (0x60BA)**	**Digital inputs (0x60FD)**	**/**

Note: For detailed PDO mapping information, see xml file.

2.2.5 Network synchronization based on distributed clock

Distributed clock can make all EtherCAT devices use the same system time, thus controlling the sync execution of each device task. Among the slave clock connected to the master, EtherCAT network takes the first slave clock equipped with distributed clock function as the reference clock for the whole network, and the remaining slaves and masters take the reference clock as their basis for synchronization.

DA300 EtherCAT communication card adopts the following sync modes, in which sync mode can be switched by configuring sync control register (ESC 0x980 and 0x981).

- Free-Run (ESC*register: 0x980 = 0x0000, P4.08 = 0)

In this mode, the local application program cycle, communication cycle, and master cycle of the servo drive are independent of each other.

- DC mode (ESC register: 0x980 = 0x0300, P4.08 = 2)

In this mode, the local application program is in sync with Sync0 time.

*Note: ESC is the abbreviation of EtherCAT Slave Controller.

Index	Sub	Name	Access	PDO Mapping	Type	Value
0x1C32	Sync Manager channel 2 (process data output) Synchronization					
	1	Synchronization type	RO	No	UINT	Current status of DC mode 0:Free-run 2:DC Mode(Synchronous with Sync0)
	2	Cycle time	RO	No	UDINT	Sync0 event cycle[ns](This value is set by master via ESC register) range:12500 * n(n = 2,4,8,16)[ns]
0x1C33	Sync Manager channel 2 (process data input) Synchronization					
	3	Shift time	RO	No	UINT	-
	6	Calc and copy time	RO	No	UINT	-

Time sequence diagram of DC mode is shown below:

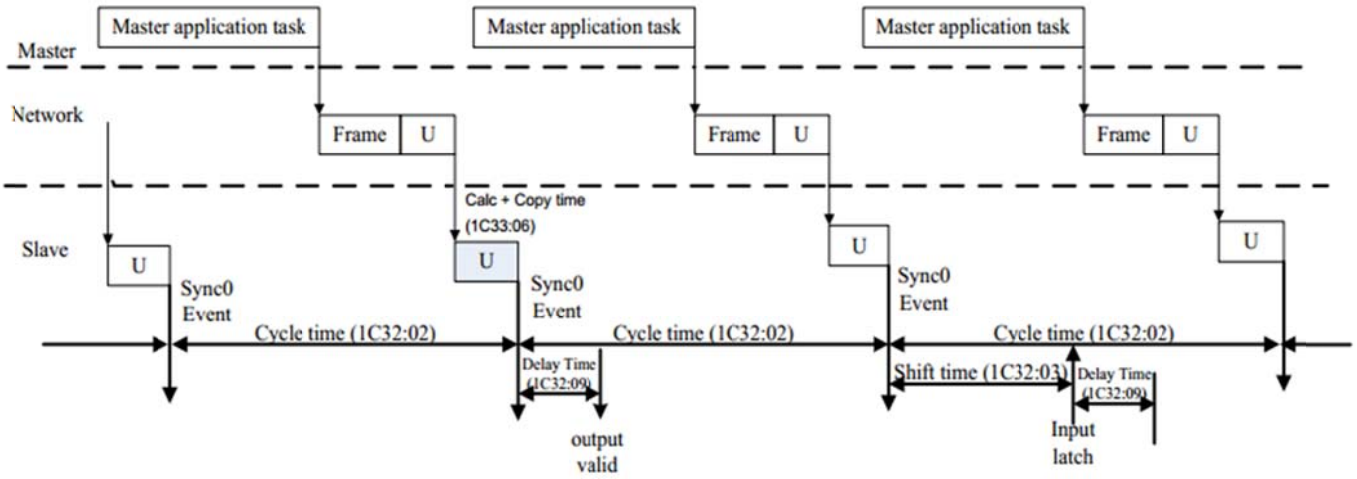


Figure 2-5 Time sequence diagram of DC mode

2.2.6 Emergency Messages

CoE will inform users of the error by an Emergency message when the drive generates an alarm.

Emergency Object:

Byte	0	1	2	3	4	5	6	7
Content	Emergency Error Code		Error register	Panel Error Code		N/A		

2.3 Compatible communication protocol

EtherCAT communication	**Applicable communication standard**	IEC 61158 Type12, IEC 61800-7 CiA402 Drive Profile
	Physical layer	100BASE-TX (IEEE802.3)
	Bus connection	CN7 (RJ45): EtherCAT Signal IN CN8 (RJ45): EtherCAT Signal OUT
	Cable	CAT5
	SyncManager	SM0: output mail, SM1: input valid SM2: output process data, SM3: input process data
	FMMU	FMMU0: mapping to process data (RxPDO) output area FMMU1: mapping to process data (RxPDO) output area FMMU2: mapping to mail state
	PDO data	Dynamic PDO mapping
	Mailbox (CoE)	Emergency, SDO request, response, and SDO information Note: Do not support TxPDO/RxPDO and remote TxPDO/TxPDO
	Distributed clock (DC)	Free-run, DC mode (activate via parameters) Supported DC cycle: 250 us–8 ms
	Slave Information IF	256Bytes (read-only)
	LED indicator	EtherCAT Link/Activity indicator(L/A) × 2 EtherCAT Status indicator × 1 EtherCAT Error indicator × 1
CiA402 Drive Profile		● Homing mode(6) ● Profile position mode(1) ● Profile velocity mode(3) ● Cyclic synchronous position mode(8) ● Cyclic synchronous speed mode(9) ● Cyclic synchronous torque mode(10) ● Touch probe function

3 CiA402device protocol

The master controls DA300 servo drive via Control word (control word, 0x6040), and acquires present drive status by reading Status word (status word, 0x6041). The servo drive achieves motor control function according to master control commands.

3.1 CANopen over EtherCAT(CoE)state machine

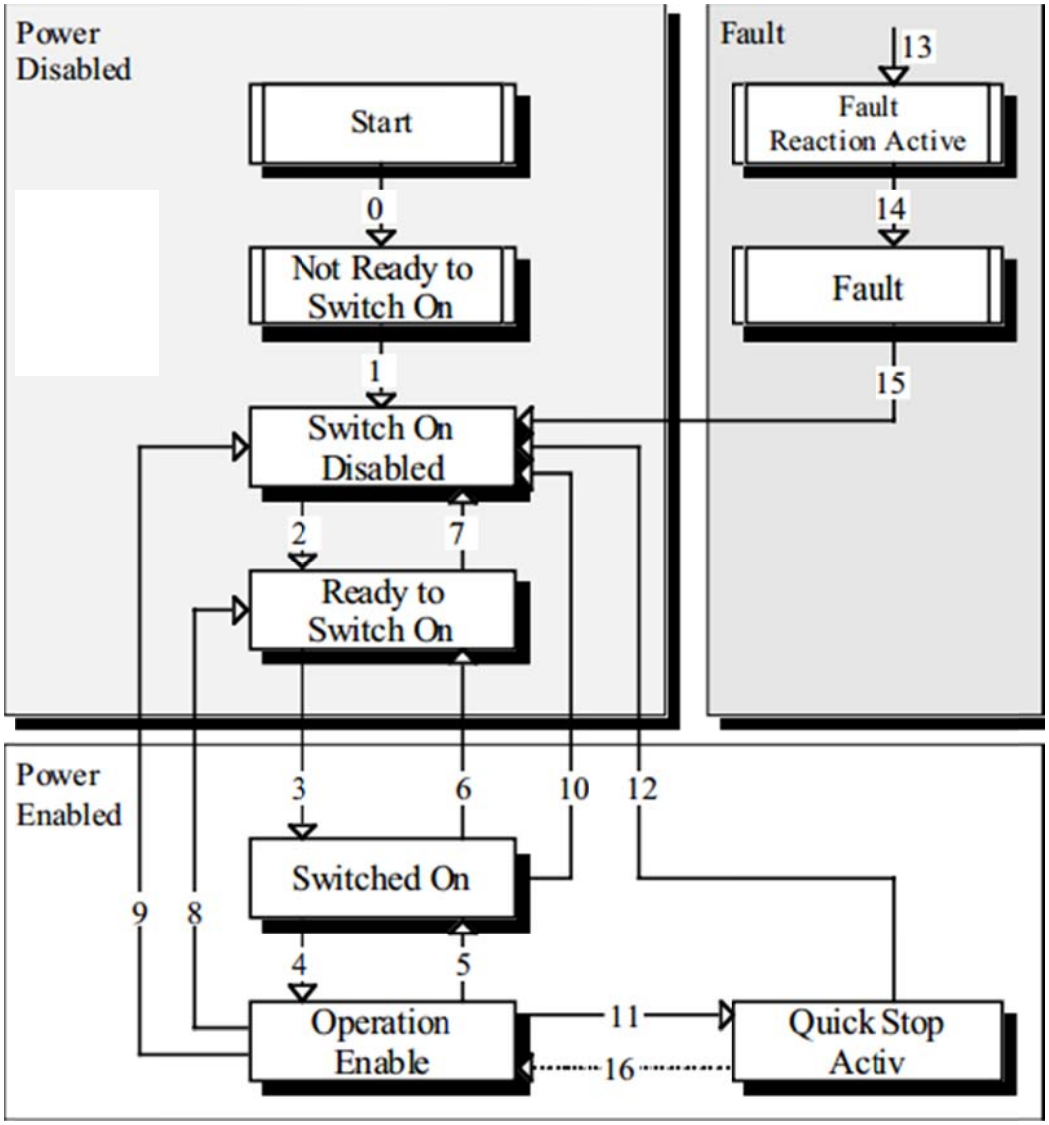


Figure 3-1 CANopen over EtherCAT state machine

State name	instruiction
Not Ready to Switch On	The drive is being initialized.
Switch On Disabled	The Drive initialization is completed.
Ready to Switch On	The drive is waiting to enter Switch On state, and the motor is unexcited.
Switched On	The drive is ready, and the main circuit power is normal.
Operation Enable	The drive is enabled, and the motor is controlled based on the control mode.
Quick Stop Active	The drive stops based on the set mode.
Fault Reaction Active	The drive detects an alarm, stops according to the set mode, and the motor still has an excitation signal.
Fault	The drive in the fault state, and the motor has no excitation signal.

3.1.1 Detail of Controlword(0x6040)

6040h control word contains the following contents:

1. Bits used for status control.

2. Bits related to the control mode.

3. Control bits defined by the manufacturer.

Introduction to each 6040h bit is shown below:

15 11	10 9	8	7	6 4	3	2	1	0
manufacturer specific	reserved	halt	Fault reset	Operation mode specific	Enable operation	Quick stop	Enable voltage	Switch on
O	O	O	M	O	M	M	M	M

MSB LSB

Among which: MSB: Most significant bit; LSB: Least significant bit; O: Optional; M; Mandatory.

Bits 0–3 and 7 (bits used for status control);

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

Among which: X is irrelevant; ↑ is a rising edge jump.

Bits 4, 5, 6, and 8 (bits related to control mode):

Bit	Operation mode		
	Profile position mode	Profile velocity mode	Homing mode
4	New set-point	reserved	Homing operation start
5	Change set immediately	reserved	reserved
6	abs/rel	reserved	reserved
8	Halt	Halt	Halt

Bits 9 and 10: Reserved.

Bits 11–15: Defined by the manufacturer.

3.1.2 Detail of Statusword(0x6041)

6041h status word contains the following content:

1. Present status bit of the drive.

2. Status bits related to the control mode.

3. Status bits defined by the manufacturer.

Introduction to each 6041h bit is shown below:

Bit	Description	M / O
0	Ready to switch on	M
1	Switched on	M
2	Operation enabled	M
3	Fault	M
4	Voltage enabled	M
5	Quick stop	M

Bit	Description	M / O
6	Switch on disabled	M
7	Warning	O
8	Manufacture specific	O
9	Remote	M
10	Target reached	M
11	Internal limit active	M
12 – 13	Operation mode specific	O
14 – 15	Manufacturer specific	O

Bits 0 – 3, 5, and 6:

Value (binary)	State
xxxxxxxx x0xx 0000	Not ready to switch on
xxxxxxxx x1xx 0000	Switch on disabled
xxxxxxxx x01x 0001	Ready to switch on
xxxxxxxx x01x 0011	Switched on
xxxxxxxx x01x 0111	Operation enabled
xxxxxxxx x00x 0111	Quick stop active
xxxxxxxx x0xx 1111	Fault reaction active
xxxxxxxx x0xx 1000	Fault

Among which: X is irrelevant.

Bit 4: Voltage enabled, when this bit is 1, it indicates that main circuit power is normal.

Bit 7: Warning, when this bit is 1, it indicates that the drive generates an alarm.

Bit 8: DC Calibration Status, when this bit is 1, it indicates that the drive clock is synchronized with DC Sync0.

Bit 9: Remote, when this bit is 1, it indicates that the slave is in OP state, and the master can control the drive via PDO remotely.

Bit 10: Target reached, this bit differs in meaning under different control modes. When this bit is 1, in pp mode, it indicates that target position is reached, while in pv mode, it indicates that reference speed is reached; in hm mode, it indicates that homing is completed; if Halt is started, it indicates that the motor speed is 0.

Bit 11: Internal limit active, when this bit is 1, in pp mode, it indicates that position limit is reached, while in pv mode, it indicates that the internal torque exceeds the set value.

Bit 12 and 13: These two bits differ in meaning under different control modes.

Bit	Operation mode		
	pp	pv	hm
12	Set-point Acknowledge	Speed	Homing attained
13	Following error	Max slippage error	Homing error

Bit 14: When this bit is 1, it indicates that the motor is in the zero-speed status.

Bit 15: Reserved.

3.2 Profile Position Mode

3.2.1 Basic description

The servo drive (slave) receives the position command sent by upper PC (master) and such command, after being converted through using electric gear ratio, will be taken by the servo drive as the target position for internal position control.

Position command encoder unit = position command user unit x numerator of actual gear ratio / denominator of actual gear ratio.

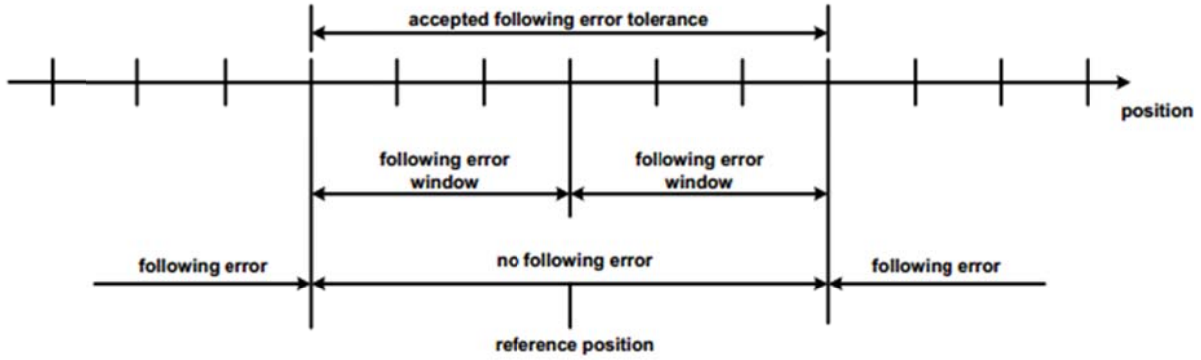
For detailed gear ratio setup, see chapter 2.1.

3.2.2 Operation mode

1. Set 6060h: **Mode of operations** to **1** (Profile position mode).
2. Set 6081h: **Profile velocity** as scheduled speed (the unit is relative to P4.25). The corresponding parameter of the drive is P5.21 (in user unit).
3. Set 6083h: **Profile acceleration** as scheduled speed (the unit is relative to P4.25). Note: Under this mode, both 6083h and 6084h correspond to P5.37 in the drive (in user unit).
4. Set 607Ah: **Target position** as target position (unit: user unit); correspond to P6.01 in the drive.
5. Set 6040h: **Control word** to enable the servo drive and trigger the target position to be effective (set to 0x0F to enable, refer to section 4.5 for other bits).
6. Check 6064h: **Position actual value** to acquire the actual motor position feedback.
7. Check 6041h: **Status word** to acquire status feedback of the servo drive (following error, set-point acknowledge, target reached, and internal limit active).

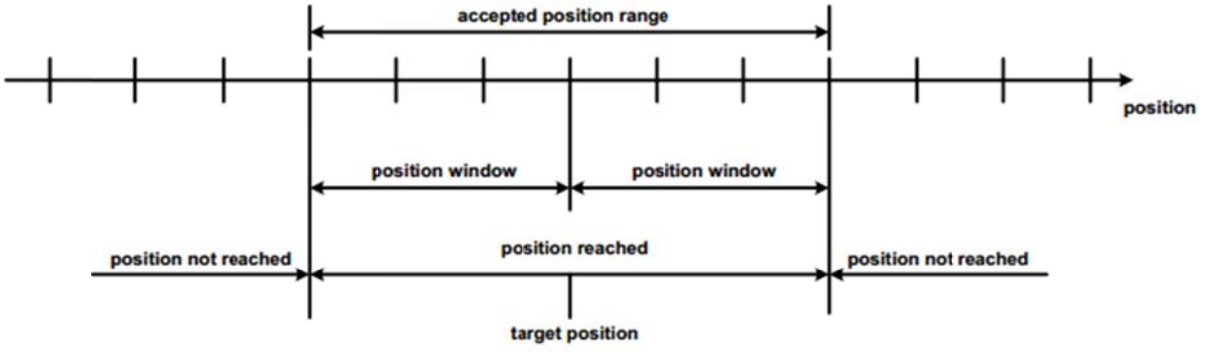
3.2.3 Other objects

1. Check [6064h: Position actual value] to acquire the actual position feedback of the motor (unit: user unit).
2. Check [6063h: Position actual value*] to acquire the actual position feedback increment of the motor (unit: user unit).
3. Set [6065h: Following error window] to modify position out-of-tolerance range (unit: user unit).
4. Check [60F4h: Following error actual value] to acquire the actual motor position deviation (unit: user unit).



Reference position

5. Set [6065h: Following error window] to modify the positioning completion range (unit: user user unit).



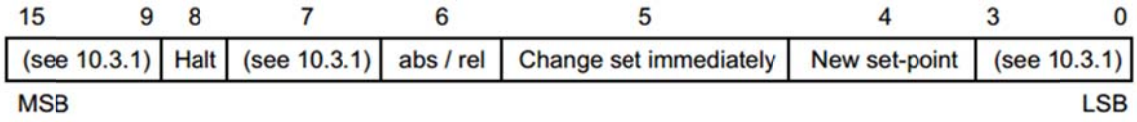
Position reached

3.2.4 Mode-related objects list

Index	Name	Type	Attr.
6040_h	Control word	UNSIGNED16	RW
6041_h	Status word	UNSIGNED16	RO
6060_h	Modes of operation	INTEGER8	RW
6061_h	Modes of operation display	INTEGER8	RO
6063_h	Position actual value*	INTEGER32	RO
6064_h	Position actual value	INTEGER32	RO
6065_h	Following error window	UNSIGNED32	RW
6067_h	Position window	UNSIGNED32	RW
$607A_h$	Target position	INTEGER32	RW
6081_h	Profile velocity	UNSIGNED32	RW
6083_h	Profile acceleration	UNSIGNED32	RW
6093_h	Position factor	UNSIGNED32	RW
$60F4_h$	Following error actual value	INTEGER32	RO

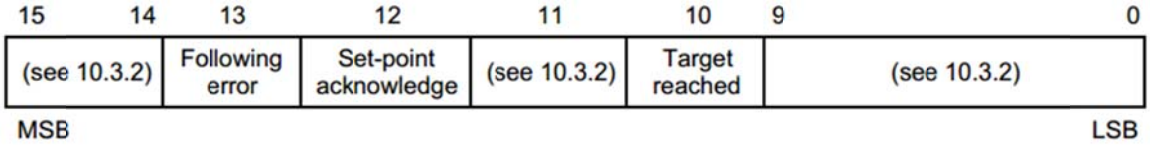
Note: For detailed description of each object, see CiADS402.

3.2.5 Controlword（0x6040）of Profile Position Mode



Name	Value	Description
New set-point	0	Does not assume *target position*
	1	Assume *target position*
Change set immediately	0	Finish the actual positioning and then start the next positioning
	1	Interrupt the actual positioning and start the next positioning
abs / rel	0	*Target position* is an absolute value
	1	*Target position* is a relative value
Halt	0	Execute positioning
	1	Stop axle with *profile deceleration* (if not supported with *profile acceleration*)

3.2.6Statusword（0x6041）of Profile Position Mode



Name	Value	Description
Target reached	0	Halt = 0: *Target position* not reached Halt = 1: Axle decelerates
	1	Halt = 0: *Target position* reached Halt = 1: Velocity of axle is 0
Set-point acknowledge	0	Trajectory generator has not assumed the positioning values (yet)
	1	Trajectory generator has assumed the positioning values
Following error	0	No following error
	1	Following error

3.2.7Application examples

1. Set 6060h to 1, and choose Profile Position Mode.

2. Set 6040h to enable the drive and trigger the position command to be effective.

a. Single set-point:

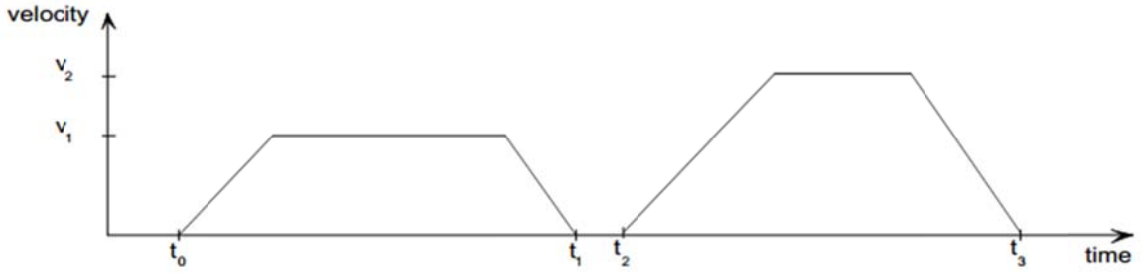


Diagram of single set-point

The following steps are necessary if the target position transmitted is in the increment mode:

(1) Set 6040h to 0x4F (in which bit 6 is to set increment mode, bit 3–bit 0 is to enable the drive).

(2) Set 607Ah as the target position command.

(3) Set 6040h to 0x5F, and trigger the position command to be effective (in which 0->1 jump edge of bit 4 is to trigger target position command to be effective);

(4) The drive sets 6041h.bit12 to 1 after receiving 6040h.bit4 = 1, and then the master clears the bit 4 of 6040h to be ready for sending a next target position command.

The following steps are necessary if the target position transmitted is in the absolute mode:

(1) Set 6040h to 0x0F.

(2) Set 607Ah as the target position command.

(3) Set 6040h to 0x1F, and trigger the position command to be effective.

(4) The drive sets 6041h.bit12 to 1 after receiving 6040h.bit4 = 1, and the master clears bit 4 of 6040h to be ready for sending a next target position command.

b. Change set immediately mode:

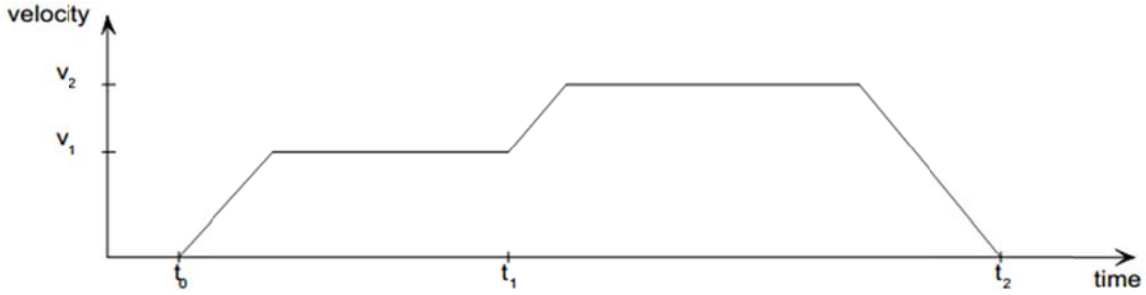


Diagram of change set immediately

The following steps are necessary it the target position transmitted is in the increment mode:

(1) Set 6040h to 0x6F (in which bit 6 is for setting the increment mode, bit 5 is for setting the immediate effective mode, and bit 3–bit 0 is for enabling the drive).

(2) Set 607Ah as the target position command.

(3) Set 6040h to 0x7F, and trigger the position command to be effective (in which 0->1 jump edge of bit 4 is for triggering the target position command to be effective)

(4) The drive sets 6041h.bit12 to 1 after receiving 6040h.bit4 = 1, and then the master clears bit 4 of 6040h to be ready for sending a next target position command.

The following steps are necessary if the target position transmitted is in the absolute mode:

(1) Set 6040h to 0x2F (set immediate-effective by bit 5, and enable the drive by bit3–bit0).

(2) Set 607Ah as the target position command;

(3) Set 6040h to 0x3F, and trigger the position command to be effective.

(4) The drive sets 6041h.bit12 to 1 after receiving 6040h.bit4 = 1, and then the master clears bit 4 of 6040h to be ready for sending a next target position command.

3: Repeat step 2 if multiple targets need to be transmitted.

Note: SV-DA300 supports **8**-level target position buffering.

c. PTP stop

There are two stop modes during PTP operation.

(1) Stop through quickstop bit of the control word, that is, the control word sends 0Xb, then the servo is switched from emergency stop to zero speed clamp.

(2) Stop through halt bit of the control word, and this mode is related to 402 parameter 0x605D.

When 0x605D stop mode is -1, direct stop enabling is kept.

When 0x605D stop mode is -1, the control word sends 0x10F, the servo stops at the current position, and keeps enabling.

When 0x605D stop mode is 0, the control mode sends 0x10F, and the servo coasts to stop.

If the servo needs to continue to run, it is required to retrigger the PTP.

3.3 Cyclic Synchronous Position Mode

3.3.1 Basic description

The theory of cyclic synchronous position mode is similar to that of position interpolation mode. Interpolation of the position command is achieved by the master while the master also offers additional speed feedforward commands and torque feedforward commands.

Interpolation cycle defines the update interval of the target position. Under this mode, the interpolation cycle is the same with EtherCAT synchronization cycle.

3.3.2 Operation mode

1. Set 6060h: **Mode of operations** to **8** (Cyclic synchronous position mode);

2. Set P4.07: **EtherCAT sync cycle** to the same position interpolation cycle with that of the master and **re-power on**.

3. Set 6040h: **Control word** to enable the servo drive (set to 0x0F to enable, refer to section 4.5 for other bits).

4. Set 607Ah: **Target position** as target position (unit: user unit); the corresponding parameter of the drive is P4.12.

5. Check 6064h: **Position actual value** to acquire the actual motor position feedback.

6. Check 6041h: **Status word** to acquire status feedback of the servo drive (following error, target reached, and internal limit active).

3.3.3 Mode-related object list

Index	Name	Type	Attr.
6040_h	Control word	UNSIGNED16	RW
6041_h	Status word	UNSIGNED16	RO
6060_h	Modes of operation	INTEGER8	RW
6061_h	Modes of operation display	INTEGER8	RO
6064_h	Position actual value	INTEGER32	RO
6065_h	Following error window	UNSIGNED32	RW

6067_h	Position window	UNSIGNED32	RW
6093_h	Position factor	UNSIGNED32	RW
$60F4_h$	Following error actual value	INTEGER32	RO

Note: For detailed description of each object, see CiA DS402.

3.3.4 Application examples

1. Set 6060h to **8**, select Cyclic synchronous position mode.
2. Set 6040h to enable the drive, and send **0x0F**.
3. Set 607Ah as the target position (absolute position) gradually to conduct the position control.

3.4 Homing Mode

3.4.1 Basic description

Under homing mode, the drive finds the origin position by itself. Users can set the running speed of homing mode.

Note: Under this mode, it is required to connect the limit switch and origin switch signal to digital input terminal CN1 of the drive. If the limit switch signal is connected to the upper PC or PLC, it is necessary to apply the homing process conducted by the upper PC.

3.4.2 Operation mode

1. Set 6060h: **Mode of operations** to **6** (homing mode).
2. Set 6098h: **Homing method**, setting range is 1–35 (refer to DS402 standard for details).
3. Set 607Ch: **Homing offset**, set origin offset, corresponding to P5.14 of the drive.
4. Set 6099h: **Sub-1: Homing speeds**, modify the speed in finding limit switch during homing (the unit is related to P4.25), corresponding to P5.12 of the drive.
5. Set 6099h: **Sub-2: Homing speeds**, modify the speed in finding zero position during homing (the unit is related to P4.25), corresponding to P5.13 of the drive.
6. Set 609Ah: **Homing acceleration**, set the acceleration/deceleration time of homing, corresponding to P5.09 of the drive (the unit is related to P4.25).
7. Set 6040h: **Control word** to enable the servo drive, homing operation starts (bit 4) from the change of **0->1** and interrupts homing process from the change of **1->0**.
8. Motor searches for limit switch and home switch to complete homing action.
9. Check 6041h: **Status word** to acquire status feedback of the servo drive (Homing error, Homing attained, and Target reached).

3.4.3 Mode-related objects list

Index	Name	Type	Attr.
6040_h	Control word	UNSIGNED16	RW
6041_h	Status word	UNSIGNED16	RO
6060_h	Modes of operation	INTEGER8	RW
6061_h	Modes of operation display	INTEGER8	RO
$607C_h$	Homing offset	INTEGER32	RW
6098_h	Homing method	UNSIGNED32	RW
6099_h	Homing speeds	ARRAY	RW
$609A_h$	Homing acceleration	UNSIGNED32	RW

Note: For detailed description of each object, see CiA DS402.

3.4.4 Application examples

The following steps are necessary when homing mode is applied:

1. Set 6060h to **6**, select homing mode.

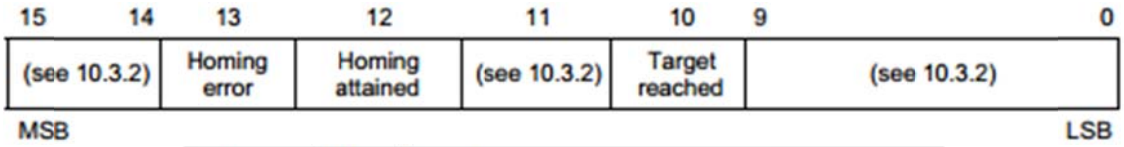
2. Set 6098h, select the homing mode to be used.

3. Set 6040h to enable the drive and trigger homing action: send **0x0F** first, and then send **0x1F** to trigger homing.

4. Homing will be interrupted if **0x0F** is sent, and the drive will be disabled if **0x0** is sent.

5. Check the completion of homing by bit 12 of 6041h, and check whether a fault occurs during homing by bit 13.

3.4.5 Statusword of Homing Mode

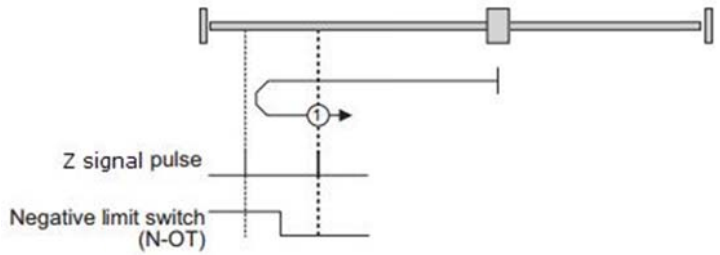


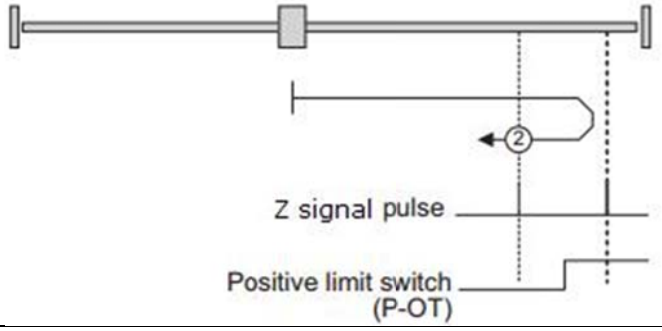
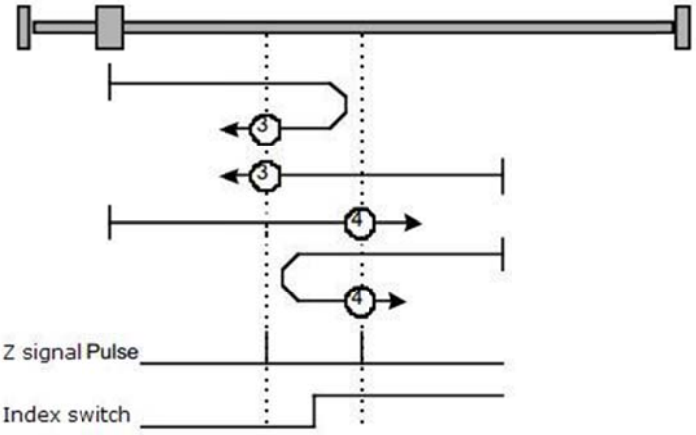
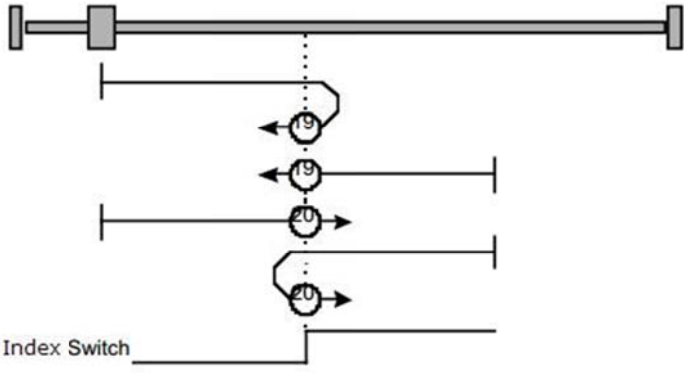
Name	Value	Description
Target reached	0	Halt = 0: Home position not reached Halt = 1: Axle decelerates
	1	Halt = 0: Home position reached Halt = 1: Axle has velocity 0
Homing attained	0	Homing mode not yet completed
	1	Homing mode carried out successfully
Homing error	0	No homing error
	1	Homing error occurred; Homing mode carried out not successfully; The error cause is found by reading the error code

3.4.6 Introduction to homing mode

There are four kinds of signals related to homing mode, they are: positive limit switch (POT), negative limit switch (NOT), reference point switch (Index) and encoder Z signal (C-phase).

Definition of homing mode:

Homing mode (DS402)	Start direction	Target position	Reference point position	Homing mode (P5.10)	Detailed introduction
1	Negative	NOT	Z pulse	1	Use Z pulse and negative limit switch: the drive moves towards negative limit switch at high speed, then returns at low speed and searches for target zero position (the first encoder Z pulse position after leaving NOT) after reaching NOT. 
2	Posit	POT	Z	0	Use Z pulse and positive limit switch: the drive moves

Homing mode (DS402)	Start direction	Target position	Reference point position	Homing mode (P5.10)	Detailed introduction
	ive		pulse		towards positive limit switch at high speed, then returns at low speed and searches for target zero position (the first encoder Z pulse position after leaving NOT) after reaching POT. 
3	Negative	Index	Z pulse	2	The initial direction movement of the drive depends on the switch state of the reference point. The target zero position is the first Z pulse position on the left or right side of the Index. 
4	Positive	Index	Z pulse	12	
17	Negative	NOT	NOT	21	These four types of homing methods are similar to 1–4 phases except that the target zero position is related to the change of limit switch or Index switch rather than using Z pulse. The figure below is diagram for 19 and 20, which are similar to method 3 and 4. 
18	Positive	POT	POT	20	
19	Negative	Index	Index	22	
20	Positive	Index	Index	22	
35	-	Present position	Present position	8	Present position is the system zero point.

3.5 Profile Velocity Mode

3.5.1Basic description

Under the profile velocity mode, the drive receives the speed command sent by the master, and conducts speed planning according to the acceleration planning parameters.

3.5.2 Operation mode

1. Set 6060h: **Mode of operations** to **3** (Profile velocity mode).
2. Set 6083h: **Profile acceleration** to modify acceleration curve (the unit is related to P4.25), it corresponds to P0.54 of the drive.
3. Set 6084h: **Profile deceleration** to modify deceleration curve (the unit is related to P4.25), it corresponds to P0.55 of the drive.
4. Set 6040h: **Control word** to enable the servo drive and start the motor.
5. Set 60FFh: **Target velocity** to set the target speed (the unit is related to P4.25), it corresponds to P4.13 of the drive.
6. Check 6041h: **Status word** to acquire status feedback of the servo drive (Speed zero, Max slippage error, Target reached, and Internal limit active).

3.5.3 Other objects

1. Check 606Ch: **Velocity actual value** to acquire actual speed feedback (the unit is related to P4.25).

3.5.4 Mode-related objects list

Index	Name	Type	Attr.
6040_h	Control word	UNSIGNED16	RW
6041_h	Status word	UNSIGNED16	RO
6060_h	Modes of operation	INTEGER8	RW
6061_h	Modes of operation display	INTEGER8	RO
$606C_h$	Velocity actual value	INTEGER32	RO
6083_h	Profile acceleration	UNSIGNED32	RW
6084_h	Profile deceleration	UNSIGNED32	RW
$60FF_h$	Target velocity	INTEGER32	RW

Note: For detailed description of each object, see CiA DS402 standard.

3.5.5 Application examples

The following steps are necessary when profile velocity is used:

1. Set 6060h to **3**, select Profile velocity mode.
2. Set 6040h to enable the drive. Send **0x0F** to enable or **0x0** to disable.
3. Set 60FFh to modify the target speed command.
4. Set 6083h and 6084h to modify acceleration and deceleration time.

3.6 Cyclic Synchronous Velocity Mode

3.6.1Basic description

Cyclic synchronous speed mode is basically the same as Profile velocity mode except that the speed command interpolation of the former is completed by the master, and the master can provide additional torque feedforward command.

Interpolation cycle defines update interval of target speed. Under this mode, the interpolation cycle is the same with EtherCAT sync cycle.

3.6.2 Operation mode

1. Set 6060h: **Mode of operations** to **9** (Cyclic synchronous speed mode).
2. Set 6083h: **Profile acceleration** to modify acceleration curve (the unit is related to P4.25), corresponding to P0.54 of the drive.
3. Set 6084h: **Profile deceleration** to modify deceleration curve (the unit is related to P4.25), corresponding to P0.55 of the drive.
4. Set 6040h: **Control word** to enable the servo drive and start the motor.
5. Set 60FFh: **Target speed** to set the target speed (the unit is related to P4.25), corresponding to P4.13 of the drive.
6. Check 6041h: **Status word** to acquire status feedback of the servo motor (Speed zero, Max slippage error, Target reached, and Internal limit active).

3.6.3 Other objects

1. Check 606Ch: **Velocity actual value** to acquire actual speed feedback (the unit is related to P4.25).

3.6.4 Mode-related object list

Index	Name	Type	Attr.
6040_h	Control word	UNSIGNED16	RW
6041_h	Status word	UNSIGNED16	RO
6060_h	Modes of operation	INTEGER8	RW
6061_h	Modes of operation display	INTEGER8	RO
$606C_h$	Velocity actual value	INTEGER32	RO
6083_h	Profile acceleration	UNSIGNED32	RW
6084_h	Profile deceleration	UNSIGNED32	RW
$60FF_h$	Target velocity	INTEGER32	RW

Note: For detailed description of each object, see CiA DS402 standard.

3.6.5 Application examples

The following procedures are required when profile velocity mode is used:

1. Set 6060h to **9**, select Cyclic synchronous velocity mode.
2. Set 6040h to enable drive, and send **0x0F** to enable or **0x0** to disable.
3. Set 60FFh to modify the target speed command.
4. Set 6083h and 6084h to modify acceleration and deceleration time.

3.7 Cyclic Synchronous Torque Mode

3.7.1Basic description

Cyclic synchronous torque mode is basically the same as profile torque mode except that the torque command interpolation is completed by the master. The interpolation cycle defines the update interval of target torque. Under this mode, the interpolation cycle is the same as EtherCAT sync cycle.

3.7.2 Operation mode

1. Set 6060h: **Mode of operations** to **10** (Cyclic synchronous torque mode).
2. Set 6040h: **Control word** to enable servo drive and starts the motor.
3. Set 6071h: **Target torque** to set the target torque (unit: 0.1% of rated torque), corresponding to P4.14 of the

drive.

4. Set 607Fh: **Max profile velocity** to set the max speed (the unit is related to P4.25).

5. Set 60E0h: **Positive torque limit** to set the positive torque limit (unit: 0.1% of the rated torque).

6. Set 60E1h: **Negative torque limit** to set the reverse torque limit (unit: 0.1% of the rated torque).

7. Set 6072h: **Max torque** to set the max torque limit (unit: 0.1% of the rated torque).

8. Check 6041h: **Status word** to acquire status feedback of the servo drive (target reached).

3.7.3 Other objects

1. Set 6072h: **Max torque** to modify the maximum torque limit (unit: 0.1% of the rated torque).

2. Check 6074h: **Torque demand value** to acquire actual internal torque command (unit: 0.1% of the rated torque).

3. Check 6076h: **Motor rated torque** to acquire rated motor torque (unit: mNm).

4. Check 6077h: **Torque actual value** to acquire actual torque feedback (unit: 0.1% of the rated torque).

5. Check 6078h: **Current actual value** to acquire actual output current (unit: mA).

3.7.4 Mode-related object list

Index	Name	Type	Attr.
6040_h	Control word	UNSIGNED16	RW
6041_h	Status word	UNSIGNED16	RO
6060_h	Modes of operation	INTEGER8	RW
6061_h	Modes of operation display	INTEGER8	RO
6071_h	Target torque	INTEGER16	RO
6072_h	Max torque	UNSIGNED16	RW
6073_h	Max current	UNSIGNED16	RO
6075_h	Motor rated current	UNSIGNED32	RO
6076_h	Motor rated torque	UNSIGNED32	RO
6077_h	Torque actual value	INTEGER16	RO
6078_h	Current actual value	INTEGER16	RO
6079_h	DC link circuit voltage	UNSIGNED32	RO
$607F_h$	Max Profile Velocity	UNSIGNED32	RW

Note: For detailed description of each object, see CiA DS402 standard.

3.7.5 Application examples

The following steps are necessary when Cyclic synchronous Torque is used:

1. Set 6060h to **10**, and select Cyclic synchronous torque mode.

2. Set 6040h to enable the drive, and send **0x0F** to enable or **0x0** to disable.

3. Set 6071h to modify the target torque command.

4. Set 6087h to modify the torque gradient time.

3.8 Touch Probe Function

3.8.1 Basic description

Touch probe function is used to latch the position feedback when trigger signal or event occurs. For DA300, only the encoder Z signal (C-phase) and touch probe1 can be used as trigger signals.

When the encoder Z signal is used as a trigger signal, only the rising edge of Z signal can be captured, and the captured result is stored in 60BAh.

Rising edge capture is available when touch probe1 is used and the capture result is stored in 60 BAh. The

result of falling edge is stored in 60BBh.

By default, digital input 1 of CN1 is used as a trigger input port of touch probe1.

It is necessary to set digital input as invalid by upper PC ServoPlorer or by setting P3.00 to 0. The setting will be effective after restart.

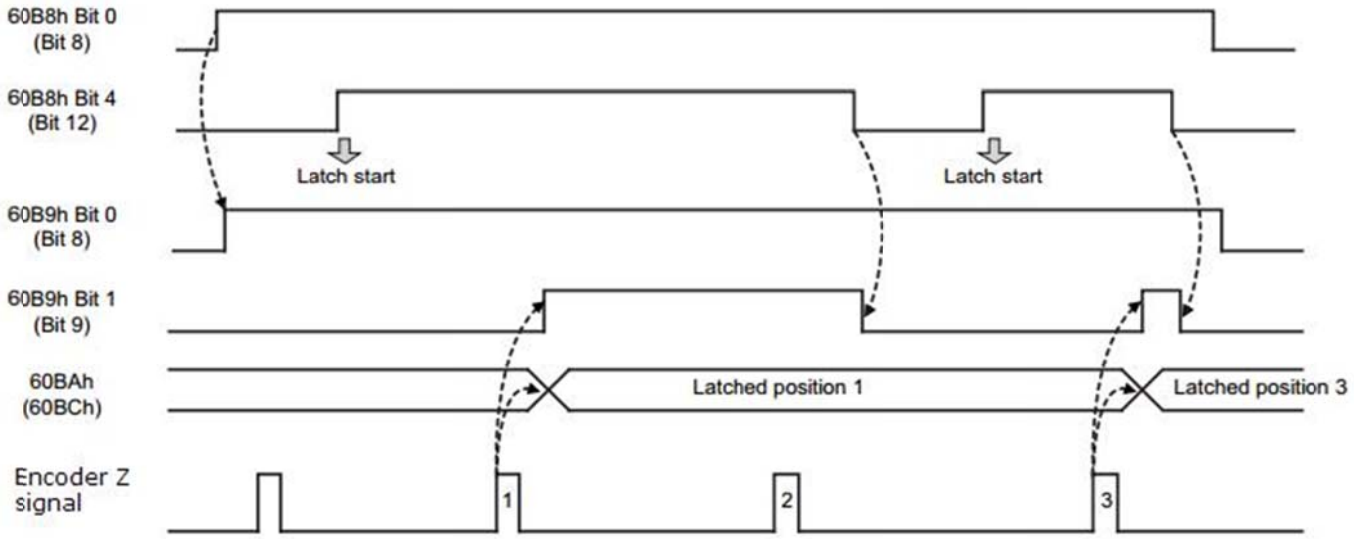
3.8.2Mode-related object list

Index	Name	Type	Attr.
$60B8_h$	Touch Probe Control word	UNSIGNED16	RW
$60B9_h$	Touch Probe Status word	UNSIGNED16	RW
$60BA_h$	Probe 1 positive edge value(Encoder zero signal)	INTEGER32	RO
$60BB_h$	Probe 2 positive edge value(Encoder zero signal)	INTEGER32	RO

3.8.3Description of control word & status word

Bit	$60B8_h$	$60B9_h$
0	Probe 1 enable	Probe 1 enabled
1	Probe 1 continuous mode	Probe 1 positive edge value stored
2	Probe 1 zero pulse	Probe 1 negative edge value stored
3	-	-
4	Probe 1 enable latch on positive edge(used also for encode zero signal)	-
5	Probe 1 enable latch on negative edge	-
6	-	Probe 1 positive edge value stored(continuous mode only,bit toggles if latch status changed)
7	-	Probe 1 negative edge value stored(continuous mode only,bit toggles if latch status changed)
8	Probe 2 enable	Probe 2 enabled
9	Probe 2 continuous mode	Probe 2 positive edge value stored
10	Probe 2 zero pulse	Probe 2 negative edge value stored
11	-	-
12	Probe 2 enable latch on positive edge(used also for encode zero signal)	-
13	Probe 2 enable latch on negative edge	-
14	-	Probe 2 positive edge value stored(continuous mode only,bit toggles if latch status changed)
15	-	Probe 2 negative edge value stored(continuous mode only,bit toggles if latch status changed)

3.8.4Application examples (single trigger mode)


60B8h Bit 0
(Bit 8)
60B8h Bit 4
(Bit 12)
Latch start
Latch start
60B9h Bit 0
(Bit 8)
60B9h Bit 1
(Bit 9)
60BAh
(60BCh)
Latched position 1
Latched position 3
Encoder Z
signal
1
2
3

4 Object dictionary

4.1 Object specification

4.1.1 Object type

Object name	Definition
VAR	Individual variable value such asUNSIGNED8、Boolean、float、INTEGER16,etc.
ARRAY	An array of multiple data constituted by basic variables of the same type. Sub-index 0 is UNSIGNED8 type which indicates the number of data in the array. Sub-index is not taken as part of the ARRAY data.
RECORD	A structure which is comprised of basic variables of the same or differing type. Sub-index 0 is UNSIGNED8 type which indicates the number of data in the array, and is not taken as part of the RECORD data.

4.1.2 Date type

See CANopen Standard 301.。

4.2 Overview of Object Group 1000_h

Index	Object Type	Name	Data Type	Access	Mappable
CANopen DS301					
1000_h	VAR	Device type	UNSIGNED32	RO	N
1001_h	VAR	Error register	UNSIGNED8	RO	Y
1008_h	VAR	Manufacturer device name	STRING	RO	N
1009_h	VAR	Manufacturer hardware version	STRING	RO	N
$100A_h$	VAR	Manufacturer software version	STRING	RO	N
1018_h	RECORD	Identity Object	IDENTITY	RO	N
1600_h~03_h	RECORD	Receive PDO mapping	PDOMAPPING	RW	N
$1A00_h$~03_h	RECORD	Transmit PDO mapping	PDOMAPPING	RW	N
$1C00_h$	RECORD	Sync manager type	UNSIGNED8	RW	N
$1C12_h$	ARRAY	Receive PDO assign	UNSIGNED16	RW	N
$1C13_h$	ARRAY	Transmit PDO assign	UNSIGNED16	RW	N
$1C32_h$	RECORD	Sync manager output para.	SMPAR	RW	N
$1C33_h$	RECORD	Sync manager input para.	SMPAR	RW	N

4.3 Overview of Object Group 6000_h

Index	Object Type	Name	Data Type	Access	Mappable
CANopen DS402					
$603F_h$	VAR	Error code	UNSIGNED16	RO	Y
6040_h	VAR	Control word	UNSIGNED16	RW	Y
6041_h	VAR	Status word	UNSIGNED16	RO	Y
$605D_h$	VAR	Halt option code	INTEGER16	RW	N
6060_h	VAR	Mode of operation	INTEGER8	RW	Y
6061_h	VAR	Mode of operation display	INTEGER8	RO	Y
6063_h	VAR	Position actual value*	INTEGER32	RO	N
6064_h	VAR	Position actual value	INTEGER32	RO	Y
6065_h	VAR	Following error window	UNSIGNED32	RW	N
6066_h	VAR	Following error time out	UNSIGNED16	RW	N
$606C_h$	VAR	Velocity actual value	INTEGER32	RO	Y

Index	Object Type	Name	Data Type	Access	Mappable
6071_h	VAR	Target torque	INTEGER16	RW	Y
6072_h	VAR	Max torque	UNSIGNED16	RW	Y
6073_h	VAR	Max current	UNSIGNED16	RO	N
6075_h	VAR	Motor rated current	UNSIGNED32	RO	N
6076_h	VAR	Motor rated torque	UNSIGNED32	RO	N
6077_h	VAR	Torque actual value	INTEGER16	RO	Y
6079_h	VAR	DC link circuit voltage	UNSIGNED32	RO	N
$607A_h$	VAR	Target position	INTEGER32	RW	Y
$607B_h$	ARRAY	Position range limit	INTEGER32	RW	N
$607C_h$	VAR	Home offset	INTEGER32	RW	N
$607F_h$	VAR	Max profile velocity	UNSIGNED32	RW	Y
6081_h	VAR	Profile velocity	UNSIGNED32	RW	Y
6083_h	VAR	Profile acceleration	UNSIGNED32	RW	Y
6084_h	VAR	Profile deceleration	UNSIGNED32	RW	Y
6091_h	ARRAY	Gear ratio	UNSIGNED32	RW	N
6093_h	ARRAY	Position factor	UNSIGNED32	RW	N
6098_h	VAR	Homing method	INTEGER8	RW	N
6099_h	ARRAY	Homing speeds	UNSIGNED32	RW	N
$609A_h$	VAR	Homing acceleration	UNSIGNED32	RW	N
60B2	VAR	Torque offset	INTEGER16	RW	Y
$60B8_h$	VAR	Touch probe control value	UNSIGNED16	RW	Y
$60B9_h$	VAR	Touch probe status value	UNSIGNED16	RO	Y
$60BA_h$	VAR	Touch probe latch value	INTEGER32	RO	Y
$60E0_h$	VAR	Positive Torque Limit	UNSIGNED16	RW	Y
$60E1_h$	VAR	Negative torque Limit	UNSIGNED16	RW	Y
$60F4_h$	VAR	Following error actual value	INTEGER32	RO	Y
$60FD_h$	VAR	Digital inputs	UNSIGNED32	RO	Y
$60FE_h$	VAR	Digital outputs	UNSIGNED32	RW	Y
$60FF_h$	VAR	Target velocity	INTEGER32	RW	Y
6502_h	VAR	Support drive mode	UNSIGNED32	RO	N

4.4 Overview of Object Group 2000_h- 4000_h

0x2000-0x3000 Manufacturer's parameter list:

Index	Data Type	Name	Access	Mappable
SV-DA300 manufacture parameter				
0x2000	int32	P0.00Motor model (1)	RW	N
0x2001	int16	P0.01Encoder type (1)	RW	N
0x2002	int16	P0.02 Forward rotation of motor (1)	RW	N
0x2003	int16	P0.03 Control mode (1)	RW	N
0x2004	int16	P0.04 Internal servo enabling (1)	RW	N
0x2005	int16	P0.05 JOG speed (1)	RW	N
0x2006	int32	P0.06 Numerator of frequency division output coefficient (1)	RW	N

0x2007	int32	P0.07 Denominator of frequency division output coefficient (1)	RW	N
0x2008	int16	P0.08 Reversal of frequency division output (1)	RW	N
0x2009	int16	P0.09 Torque limit mode setting (1)	RW	N
0x200A	int16	P0.10 Max. torque limit 1 (0.1)	RW	N
0x200B	int16	P0.11 Max. torque limit 2 (0.1)	RW	N
0x200D	int16	P0.13 Power of the external braking resistor (1)	RW	N
0x200E	int16	P0.14 Resistance of the external braking resistor (1)	RW	N
0x200F	int16	P0.15 Default monitoring parameters (1)	RW	N
0x2010	int16	P0.16 Parameter modification operation locked (1)	RW	N
0x2011	int16	P0.17 EEPROM write mode (1)	RW	N
0x2012	uint16	P0.18 Factory password (1)	RW	N
0x2014	int16	P0.20 Position command selection (1)	RW	N
0x2016	int32	P0.22 Pulse per revolution of motor (1)	RW	N
0x2017	int16	P0.23 Pulse input form (1)	RW	N
0x2018	int16	P0.24 Reversal of pulse input direction (1)	RW	N
0x2019	int32	P0.25 Numerator of 1st electronic gear ratio (1)	RW	N
0x201A	int32	P0.26 Denominator of electronic gear ratio (1)	RW	N
0x201B	int32	P0.27 Numerator of 2nd electronic gear ratio (1)	RW	N
0x201C	int32	P0.28 Numerator of 3rd electronic gear ratio(1)	RW	N
0x201D	int32	P0.29 Numerator of 4th electronic gear ratio(1)	RW	N
0x2021	int16	P0.33 Smooth filtering of position command (0.1)	RW	N
0x2022	int16	P0.34 FIR filtering of position command (0.1)	RW	N
0x2023	int32	P0.35 Software limit of forward position control (1)	RW	N
0x2024	int32	P0.36 Software limit of reverse position control	RW	N
0x2025	int16	P0.37 Position command mode (1)	RW	N
0x2026	int16	P0.38 Fully-closed loop enable (1)	RW	N
0x2028	int16	P0.40 Speed command selection (1)	RW	N
0x2029	int16	P0.41 Setting of speed command direction (1)	RW	N
0x202A	int32	P0.42 Gain of analog input 1 (1)	RW	N
0x202B	int16	P0.43 Reversal of analog input 1 (1)	RW	N
0x202D	int16	P0.45 Dead zone of analog input 1 (0.001)	RW	N
0x202E	int16	P0.46 Internal speed 1/Speed limit 1 (1)	RW	N
0x202F	int16	P0.47 Internal speed 2/Speed limit 2 (1)	RW	N
0x2030	int16	P0.48 Internal speed 3/Speed limit 3 (1)	RW	N
0x2031	int16	P0.49 Internal speed 4/Speed limit 4 (1)	RW	N

0x2032	int16	P0.50 Internal speed 5 (1)	RW	N
0x2033	int16	P0.51 Internal speed 6 (1)	RW	N
0x2034	int16	P0.52 Internal speed 7 (1)	RW	N
0x2035	int16	P0.53 Internal speed 8 (1)	RW	N
0x2036	int32	P0.54 ACC time (1)	RW	N
0x2037	int32	P0.55 DEC time (1)	RW	N
0x2038	int16	P0.56 ACC time of S curve (1)	RW	N
0x2039	int16	P0.57 DEC time of S curve (1)	RW	N
0x203A	int16	P0.58 Zero speed clamp mode (1)	RW	N
0x203B	int16	P0.59 Speed threshold of zero speed clamp (1)	RW	N
0x203C	int16	P0.60 Torque command selection (1)	RW	N
0x203D	int16	P0.61 Torque command direction setting (1)	RW	N
0x203E	int32	P0.62 Gain of analog input 2 (1)	RW	N
0x203F	int16	P0.63 Reversal of analog input 2 (1)	RW	N
0x2041	int16	P0.65 Dead zone of analog input 2 (0.001)	RW	N
0x2042	int16	P0.66 Internal torque command (0.1)	RW	N
0x2043	int16	P0.67 Speed limit mode setting (1)	RW	N
0x2044	int16	P0.68 RAMP time of torque command (1)	RW	N
0x2045	int16	P0.69 DEC time of fast stop (1)	RW	N
0x2046	int16	P0.70 Absolute encoder mode setting (1)	RW	N
0x2047	int16	P0.71 Absolute encoder multi-turn zeroing (1)	RW	N
0x205A	int16	P0.90 Max. speed limit of control mode switching (1)	RW	N
0x205B	int32	P0.91 Positioning reference of control mode switching (1)	RW	N
0x205C	int16	P0.92 Exit mode of position mode switching (1)	RW	N
0x205D	int16	P0.99 Speed detection FIR filter level (1)	RW	N
0x2063	int16	P1.00 Inertia online automatic estimation (1)	RW	N
0x2100	int16	P1.01 1st inertia ratio (1)	RW	N
0x2101	int16	P1.02 2nd inertia ratio (1)	RW	N
0x2102	int16	P1.03 1st Machine rigidity setting (1)	RW	N
0x2103	int16	P1.04 Inertia offline automatic estimation (1)	RW	N
0x2104	int32	P1.05 Operation mode of inertia identification (1)	RW	N
0x2105	int16	P1.06 Movable range of inertia Identification (0.1)	RW	N
0x2106	int16	P1.07 ACC time constant of inertia Identification (1)	RW	N
0x2107	int16	P1.08 Speed level of inertia identification (1)	RW	N
0x2108	int16	P1.19 Valid resonance detection bit (0.1)	RW	N
0x2113	int16	P1.20 Resonance detection mode (1)	RW	N
0x2114	int16	P1.21 1st mechanical resonance frequency (1)	RW	N

0x2115	int16	P0.99 Speed detection FIR filter level (1)	RW	N
0x2116	int16	P1.22 2nd mechanical resonance frequency (1)	RW	N
0x2117	int16	P1.23 1st notch filter frequency (1)	RW	N
0x2118	int16	P1.24 1st notch filter Q value (0.01)	RW	N
0x2119	int16	P1.25 1st notch filter depth selection (1)	RW	N
0x211A	int16	P1.26 2nd notch filter frequency (1)	RW	N
0x211B	int16	P1.27 2nd notch filter Q value (0.01)	RW	N
0x211C	int16	P1.28 2nd notch filter depth selection (1)	RW	N
0x211D	int16	P1.29 3rd notch filter frequency (1)	RW	N
0x211E	int16	P1.30 3rd notch filter Q value (0.01)	RW	N
0x211F	int16	P1.31 3rd notch filter depth selection (1)	RW	N
0x2120	int16	P1.32 4th notch filter frequency (1)	RW	N
0x2121	int16	P1.33 4th notch filter Q value (0.01)	RW	N
0x2122	int16	P1.34 4th notch filter depth selection (1)	RW	N
0x2123	int16	P1.35 Vibration control mode of position command (1)	RW	N
0x2124	int16	P1.36 1st vibration control frequency (0.1)	RW	N
0x2125	int16	P1.37 1st vibration control filter factor (0.01)	RW	N
0x2126	int16	P1.38 2nd vibration control frequency (0.1)	RW	N
0x2127	int16	P1.39 2nd vibration control filter factor (0.01)	RW	N
0x2200	int16	P2.00 1st speed gain (0.1)	RW	N
0x2201	int16	P2.01 1st speed integration time constant (0.1)	RW	N
0x2202	int16	P2.02 1st position gain (0.1)	RW	N
0x2203	int16	P2.03 1st speed detection filter (1)	RW	N
0x2204	int16	P2.04 1st torque filter (0.01)	RW	N
0x2205	int16	P2.05 2nd speed gain (0.1)	RW	N
0x2206	int16	P2.06 2nd speed integration time constant (0.1)	RW	N
0x2207	int16	P2.07 2nd position gain (0.1)	RW	N
0x2208	int16	P2.08 2nd speed detection filter (1)	RW	N
0x2209	int16	P2.09 2nd torque filter (0.01)	RW	N
0x220A	int16	P2.10 Speed feed-forward gain (0.1)	RW	N
0x220B	int16	P2.11 Speed feed-forward filter time (0.01)	RW	N
0x220C	int16	P2.12 Torque feed-forward gain (0.1)	RW	N
0x220D	int16	P2.13 Torque feed-forward filter time (0.01)	RW	N
0x220E	int16	P2.14 1st IPPI coefficient (1)	RW	N
0x220F	int16	P2.15 2nd IPPI coefficient (1)	RW	N
0x2214	int16	P2.20 2nd gain setting (1)	RW	N
0x2216	int16	P2.22 Position control switching mode (1)	RW	N
0x2217	int16	P2.23 Delay time of position control switching (1)	RW	N
0x2218	int16	P2.24 Switching level of position control (1)	RW	N
0x2219	int16	P2.25 Switching delay of position control (1)	RW	N
0x221A	int16	P2.26 Switching time of position gain (1)	RW	N

0x221B	int16	P2.27 Switching mode of speed control (1)	RW	N
0x221C	int16	P2.28 Delay time of speed control switching (1)	RW	N
0x221D	int16	P2.29 Switching level of speed control (1)	RW	N
0x221E	int16	P2.30 Switching delay of speed control (1)	RW	N
0x221F	int16	P2.31 Switching mode of torque control (1)	RW	N
0x2220	int16	P2.32 Delay time of torque control switching (1)	RW	N
0x2221	int16	P2.33 Switching level of torque control (1)	RW	N
0x2222	int16	P2.34 Switching delay of torque control (1)	RW	N
0x2229	int16	P2.41 Disturbance observer valid (1)	RW	N
0x222A	int16	P2.42 Compensation gain of disturbance observer (1)	RW	N
0x222B	int16	P2.43 Cut-off frequency of disturbance observer (1)	RW	N
0x222C	int16	P2.44 Torque command offset (0.1)	RW	N
0x2232	int16	P2.50 Fully-closed loop vibration suppressor valid (1)	RW	N
0x2233	int16	P2.51 Fully-closed loop vibration suppressor cut-off frequency (0.1)	RW	N
0x2234	int16	P2.52 Fully-closed loop vibration suppressor compensation gain (1)	RW	N
0x2235	uint16	P2.53 Medium-frequency vibration control switch (1)	RW	N
0x2236	uint16	P2.54 Medium-frequency vibration control frequency (1)	RW	N
0x2237	uint16	P2.55 Fine tuning of medium-frequency vibration control inertia (1)	RW	N
0x2238	uint16	P2.56 Medium-frequency vibration control attenuation gain (1)	RW	N
0x2239	int16	P2.57 Fine tuning of medium-frequency vibration control filter time parameter 1 (1)	RW	N
0x223A	int16	P2.58 Fine tuning of medium-frequency vibration control filter time parameter 2 (0.01)	RW	N
0x223C	int16	P2.60 Speed observer valid (1)	RW	N
0x223D	int16	P2.61 Speed observer gain (1)	RW	N
0x2246	int16	P2.70 Friction compensation max-speed (1)	RW	N
0x2247	int16	P2.71 Positive torque coefficient of friction compensation (0.1)	RW	N
0x2248	int16	P2.72 Negative torque coefficient of friction compensation (0.1)	RW	N
0x2249	int16	P2.73 Friction compensation valid (1)	RW	N
0x224A	int16	P2.74 Automatic mode switch (1)	RW	N
0x224B	int16	P2.75 Automatic mode gain (0.1)	RW	N
0x224C	int16	P2.76 Fine tuning of automatic mode inertia (1)	RW	N
0x224D	int16	P2.77 Filter in disturbance observer of automatic mode 1 (0.1)	RW	N
0x224E	int16	P2.78 Filter in disturbance observer of automatic mode 2 (0.1)	RW	N

0x224F	int16	P2.79 Phase compensation of automatic mode speed command (1)	RW	N
0x2250	int16	P2.80 Speed observer gain of automatic mode (1)	RW	N
0x2251	int32	P2.81 Speed command filtering of automatic mode (0.1)	RW	N
0x2252	int32	P2.82 Phase advance correction of automatic mode speed command (0.1)	RW	N
0x2253	int32	P2.83 Disturbance compensation torque filtering time of automatic mode (0.01)	RW	N
0x2254	int32	P2.84 Speed feedback input filtering time of automatic mode speed observer (0.01)	RW	N
0x2255	int16	P2.85 Torque feedforward selection (1)	RW	N
0x2300	uint16	P3.00 Input configuration of digital 1 (1)	RW	N
0x2301	uint16	P3.01 Input configuration of digital 2 (1)	RW	N
0x2302	uint16	P3.02 Input configuration of digital 3 (1)	RW	N
0x2303	uint16	P3.04 Input configuration of digital 5 (1)	RW	N
0x2304	uint16	P3.05 Input configuration of digital 6 (1)	RW	N
0x2305	uint16	P3.06 Input configuration of digital 7 (1)	RW	N
0x2306	uint16	P3.07 Input configuration of digital 8 (1)	RW	N
0x2307	uint16	P3.08 Input configuration of digital 9 (1)	RW	N
0x2308	uint16	P3.09 Input configuration of digital 10 (1)	RW	N
0x2309	uint16	P3.10 Output configuration of digital 1 (1)	RW	N
0x230A	uint16	P3.11 Output configuration of digital 2 (1)	RW	N
0x230B	uint16	P3.12 Output configuration of digital 3 (1)	RW	N
0x230C	uint16	P3.13 Output configuration of digital 4 (1)	RW	N
0x230D	uint16	P3.14 Output configuration of digital 5 (1)	RW	N
0x230E	uint16	P3.15 Output configuration of digital 6 (1)	RW	N
0x230F	uint16	P3.16 Function configuration of DI capture encoder (1)	RW	N
0x2310	uint16	P3.04 Input configuration of digital 5 (1)	RW	N
0x2314	int32	P3.20 Offset of analog input 1 (0.001)	RW	N
0x2315	int16	P3.21 Filter of analog input 1 (0.1)	RW	N
0x2316	int32	P3.22 Voltage protection of analog input 1 (0.001)	RW	N
0x2317	int32	P3.23 Offset of analog input 2 (0.001)	RW	N
0x2318	int16	P3.24 Filter of analog input 2 (0.1)	RW	N
0x2319	int32	P3.25 Voltage protection of analog input 2 (0.001)	RW	N
0x231A	int16	P3.26 Function selection of analog input 1 (1)	RW	N
0x231B	int16	P3.27 Function selection of analog input 2 (1)	RW	N
0x231C	int16	P3.28 Analog speed compensation gain (0.1)	RW	N
0x231D	int16	P3.29 Analog torque compensation gain (0.1)	RW	N
0x2328	int16	P3.40 Travel limit switch setting(1)	RW	N
0x2329	int16	P3.41 Emergency stop switch shield (1)	RW	N
0x232B	int16	P3.43 Digital input filter (1)	RW	N

0x232C	int16	P3.44 Command pulse input invalid setting disabled (1)	RW	N
0x232D	int16	P3.45 Clearing mode of retention pulse (1)	RW	N
0x2332	int32	P3.50 Range of position arrival (1)	RW	N
0x2333	int16	P3.51 Output mode of position arrival (1)	RW	N
0x2334	int16	P3.52 Hold time of position arrival output terminal (1)	RW	N
0x2335	int16	P3.53 Speed matching range (1)	RW	N
0x2336	int16	P3.54 Speed reaching range (1)	RW	N
0x2337	int16	P3.55 Zero speed range (1)	RW	N
0x2338	int16	P3.56 Locked time of servo after braking (1)	RW	N
0x2339	int16	P3.57 Braking delay of electromagnetic brake (1)	RW	N
0x233A	int16	P3.58 Motor speed of brake release (1)	RW	N
0x233B	int16	P3.59 Torque reaching range (0.1)	RW	N
0x2346	int16	P3.70 Analog input 3 function selection (1)	RW	N
0x2347	int32	P3.71 Zero offset of analog input 3 (0.001)	RW	N
0x2348	int16	P3.72 Dead zone of analog input 3 (0.001)	RW	N
0x2349	int32	P3.73 Gain of analog input 3 (1)	RW	N
0x234A	int16	P3.74 Reversal of analog input 3 (1)	RW	N
0x234B	int32	P3.75 Voltage protection of analog input 3 (0.001)	RW	N
0x234C	int16	P3.76 Analog input 3 filter (0.1)	RW	N
0x234D	int16	P3.77 Deadzone mode of analog input (1)	RW	N
0x235A	int16	P3.90 Pulse input filter (1)	RW	N
0x235B	int16	P3.91 1st encoder filter (1)	RW	N
0x235C	int16	P3.92 2nd encoder filter (1)	RW	N
0x2400	int16	P4.00 EtherCAT communication address (1)	RW	N
0x2401	int16	P4.01 485 local communication address (1)	RW	N
0x2402	int16	P4.02 CAN communication baud rate (1)	RW	N
0x2403	int16	P4.03 485 communication baud rate (1)	RW	N
0x2404	int16	P4.04 485 communication parity mode (1)	RW	N
0x2405	int16	P4.05 CAN communication node (1)	RW	N
0x2406	int16	P4.06 485 communication fault clearing mode (1)	RW	N
0x2407	int16	P4.07 EtherCAT synchronous cycle	RW	N
0x2408	int16	P4.08 EtherCAT synchronous type (1)	RW	N
0x2409	int16	P4.09 EtherCAT fault detection time (1)	RW	N
0x240A	int16	P4.10 Upper PC type (1)	RW	N
0x240B	int16	P4.11 Bus servo enabling (1)	RW	N
0x240C	int32	P4.12 Bus position command (1)	RW	N
0x240D	int32	P4.13 Bus speed command (0.1)	RW	N
0x240E	int16	P4.14 Bus torque command (0.1)	RW	N
0x240F	int16	P4.15 Switching command of control mode (1)	RW	N
0x2410	int16	P4.16 Gain switching command (1)	RW	N

0x2411	int16	P4.17 Switching command of electronic gear ratio (1)	RW	N
0x2412	int16	P4.18 Inertia ratio switching command (1)	RW	N
0x2413	int16	P4.19 Zero speed clamp command (1)	RW	N
0x2414	int16	P4.20 Retention pulse clearing (1)	RW	N
0x2415	int16	P4.21 Torque limit switching command (1)	RW	N
0x2416	int16	P4.22 External fault command (1)	RW	N
0x2417	int16	P4.23 Emergency stop command (1)	RW	N
0x2418	int16	P4.24 Input command of vibration control switching (1)	RW	N
0x2419	int16	P4.25 EtherCAT control unit type (1)	RW	N
0x241A	int16	P4.26 EtherCAT PDO input offset (1)	RW	N
0x241B	int16	P4.27 Compensation value of EtherCAT position interpolation mode (1)	RW	N
0x241C	int16	P4.28 Digital output control enabling of EtherCAT (1)	RW	N
0x241D	int16	P4.29 Main cycle period of EtherCAT (1)	RW	N
0x241E	int16	P4.30 Stop mode (1)	RW	N
0x241F	int16	P4.31 Max speed limit (1)	RW	N
0x2420	int16	P4.32 Overspeed level (1)	RW	N
0x2421	int32	P4.33 Pulse range of position deviation (1)	RW	N
0x2422	int16	P4.34 Brake overload detection selection (1)	RW	N
0x2424	int16	P4.36 Undervoltage protection of main power supply (1)	RW	N
0x2425	int16	P4.37 Undervoltage detection time of main power supply (1)	RW	N
0x2427	int16	P4.39 Speed deviation setting (1)	RW	N
0x2428	int16	P4.40 Forward speed limit (1)	RW	N
0x2429	int16	P4.41 Reverse speed limit (1)	RW	N
0x242A	int32	P4.42 Internal speed of high resolution (0.1)	RW	N
0x242D	int16	P4.45 Temperature protection threshold of medium-power motor (1)	RW	N
0x2432	int32	P4.50 Offset of encoder Z phase (1)	RW	N
0x2433	int16	P4.51 Switching time 1 of torque limit (1)	RW	N
0x2434	int16	P4.52 Switching time 2 of torque limit (1)	RW	N
0x2435	int16	P4.53 Current loop response adjustment (0.1)	RW	N
0x2436	int32	P4.54 Initialization time after power on (1)	RW	N
0x2437	int16	P4.55 Communication baud rate of the encoder (1)	RW	N
0x243A	int16	P4.58 Z pulse width of frequency-division output (1)	RW	N
0x243B	int32	P4.59 Z pulse offset of frequency-division output (1)	RW	N
0x243C	int32	P4.60 Frequency division molecular of external linear encoder (1)	RW	N
0x243D	int32	P4.61 Frequency division denominator of external linear encoder (1)	RW	N

0x243E	int16	P4.62 Direction reversal of external linear encoder (1)	RW	N
0x243F	int16	P4.63 External linear encoder Z phase break detection disabling (1)	RW	N
0x2440	int32	P4.64 Large mixed deviation setting (1)	RW	N
0x2441	int16	P4.65 Mixed deviation clearing (1)	RW	N
0x2442	int16	P4.66 Z phase of external linear encoder (1)	RW	N
0x2443	int16	P4.67 External linear encoder pulse output mode of AB phase (1)	RW	N
0x2444	int32	P4.68 External linear encoder (2nd encoder) resolution (1)	RW	N
0x2445	int16	P4.69 Frequency division output source (1)	RW	N
0x2446	int16	P4.70 External linear encoder (2nd encoder) Z signal type (1)	RW	N
0x2457	int32	P4.87 CANopen communication cycle (1)	RW	N
0x2458	int16	P4.88 CANopen heartbeat cycle (1)	RW	N
0x2459	int16	P4.89 Automatic stop at CANopen disconnection (1)	RW	N
0x245A	int16	P4.90 Fault restore (1)	RW	N
0x245B	int16	P4.91 Parameters saving (1)	RW	N
0x245C	int16	P4.92 Restore to the factory value (1)	RW	N
0x245D	int16	P4.93 Reading enable of fault record (1)	RW	N
0x245E	int16	P4.94 Clearing enable of fault record (1)	RW	N
0x245F	int16	P4.95 Group number of fault record (1)	RW	N
0x2460	int16	P4.96 Initial angle test of the encoder (1)	RW	N
0x2461	int16	P4.97 EEPROM operation of absolute encoder (1)	RW	N
0x2462	int16	P4.98 EEPROM block of absolute encoder (1)	RW	N
0x2463	int32	P4.99 Reserved (1)	RW	N
0x2500	int16	P5.00 Program JOG mode selection (1)	RW	N
0x2501	int32	P5.01 JOG movement (1)	RW	N
0x2502	int16	P5.02 JOG speed setting (1)	RW	N
0x2503	int16	P5.03 JOG ACC/DEC time (1)	RW	N
0x2504	int16	P5.04 JOG waiting time (1)	RW	N
0x2505	int16	P5.05 JOG cycle times (1)	RW	N
0x2509	int32	P5.09 Homing ACC/DEC time (1)	RW	N
0x250A	int16	P5.10 Homing mode (1)	RW	N
0x250B	int16	P5.11 Automatic homing after power on (1)	RW	N
0x250C	int16	P5.12 1st speed setting of high speed homing (1)	RW	N
0x250D	int16	P5.13 2nd speed setting of high speed homing (1)	RW	N
0x250E	int32	P5.14 Home setting (1)	RW	N
0x250F	int16	P5.15 Homing trigger command (1)	RW	N
0x2510	int16	P5.16 Correlated action of homing (1)	RW	N
0x2511	int16	P5.17 Speed to designated target after homing (1)	RW	N

0x2512	int16	P5.18 ACC/DEC time to designated target after homing (1)	RW	N
0x2513	int32	P5.19 Position to designated target after homing (1)	RW	N
0x2514	int16	P5.20 PTP trigger command (1)	RW	N
0x2515	int16	P5.21 00 target speed (1)	RW	N
0x2516	int16	P5.01 JOG movement (1)	RW	N
0x2517	int16	P5.23 02 target speed (1)	RW	N
0x2518	int16	P5.24 03 target speed (1)	RW	N
0x2519	int16	P5.25 04 target speed (1)	RW	N
0x251A	int16	P5.26 05 target speed (1)	RW	N
0x251B	int16	P5.27 06 target speed (1)	RW	N
0x251C	int16	P5.28 07 target speed (1)	RW	N
0x251D	int16	P5.29 08 target speed (1)	RW	N
0x251E	int16	P5.30 09 target speed (1)	RW	N
0x251F	int16	P5.31 10 target speed (1)	RW	N
0x2520	int16	P5.32 11 target speed (1)	RW	N
0x2521	int16	P5.33 12 target speed (1)	RW	N
0x2522	int16	P5.34 13 target speed (1)	RW	N
0x2523	int16	P5.35 14 target speed (1)	RW	N
0x2524	int16	P5.36 15 target speed (1)	RW	N
0x2525	int16	P5.37 00 ACC/DEC time (1)	RW	N
0x2526	int16	P5.38 01 ACC/DEC time (1)	RW	N
0x2527	int16	P5.39 02 ACC/DEC time (1)	RW	N
0x2528	int16	P5.40 03 ACC/DEC time (1)	RW	N
0x2529	int16	P5.41 04 ACC/DEC time (1)	RW	N
0x252A	int16	P5.42 05 ACC/DEC time (1)	RW	N
0x252B	int16	P5.43 06 ACC/DEC time (1)	RW	N
0x252C	int16	P5.44 07 ACC/DEC time (1)	RW	N
0x252D	int16	P5.45 08 ACC/DEC time (1)	RW	N
0x252E	int16	P5.46 09 ACC/DEC time (1)	RW	N
0x252F	int16	P5.37 10 ACC/DEC time (1)	RW	N
0x2530	int16	P5.48 11 ACC/DEC time (1)	RW	N
0x2531	int16	P5.49 12 ACC/DEC time (1)	RW	N
0x2532	int16	P5.50 13 ACC/DEC time (1)	RW	N
0x2533	int16	P5.51 14 ACC/DEC time (1)	RW	N
0x2534	int16	P5.52 15 ACC/DEC time (1)	RW	N
0x2535	uint16	P5.53 00 delay time (1)	RW	N
0x2536	uint16	P5.54 01 delay time (1)	RW	N
0x2537	uint16	P5.55 02 delay time (1)	RW	N
0x2538	uint16	P5.56 03 delay time (1)	RW	N
0x2539	uint16	P5.57 04 delay time (1)	RW	N
0x253A	uint16	P5.58 05 delay time (1)	RW	N
0x253B	uint16	P5.59 06 delay time (1)	RW	N
0x253C	uint16	P5.60 07 delay time (1)	RW	N
0x253D	uint16	P5.61 08 delay time (1)	RW	N

0x253E	uint16	P5.62 09 delay time (1)	RW	N
0x253F	uint16	P5.63 10 delay time (1)	RW	N
0x2540	uint16	P5.64 11 delay time (1)	RW	N
0x2541	uint16	P5.65 12 delay time (1)	RW	N
0x2542	uint16	P5.66 13 delay time (1)	RW	N
0x2543	uint16	P5.67 14 delay time (1)	RW	N
0x2544	uint16	P5.68 15 delay time (1)	RW	N
0x2545	uint16	P5.69 PTP trigger buffer switch (1)	RW	N
0x2546	int32	P5.70 Single-turn resolution of disk (1)	RW	N
0x2547	uint16	P5.71 Zero-returning switch of disk (1)	RW	N
0x2548	uint16	P5.72 Multi-turn mode (1)	RW	N
0x2549	uint16	P5.73 Digital trigger mode of PTP (1)	RW	N
0x254A	uint16	P5.74 Digital output mode of PTP (1)	RW	N
0x2600	int16	P5.75 Enable interruption pause of the PTP (1)	RW	N
0x2601	int16	P6.00 Forward low JOG speed (1)	RW	N
0x2602	int16	P6.01 Reverse low JOG speed (1)	RW	N
0x2603	int16	P6.02 Position latch function switch (1)	RW	N
0x2604	int16	P6.03 Position latch save mode (1)	RW	N
0x2605	int16	P6.04 Forward high JOG speed (1)	RW	N
0x2606	int16	P6.05 Reverse high JOG speed (1)	RW	N
0x2614	int16	P6.20 Turret switch	RW	N
0x2615	int16	P6.21 Knives per turret	RW	N
0x2616	Int32	P6.22 Pulse per turret	RW	N
0x2617	Int32	P6.23 Turret start point	RW	N
0x3000	int32	R0.00 Motor speed (0.1)	RO	N
0x3001	int32	R0.01 Speed command (0.1)	RO	N
0x3002	int64	R0.02 Feedback pulse accumulation (1)	RO	N
0x3003	int64	R0.03 Command pulse accumulation (1)	RO	N
0x3004	int32	R0.04 Retention pulse (1)	RO	N
0x3005	int32	R0.05 Hybrid control deviation (1)	RO	N
0x3006	int32	R0.06 Current torque (0.1)	RO	N
0x3007	int32	R0.07 DC voltage of main circuit (0.1)	RO	N
0x3008	int32	R0.08 Voltage of control power (0.1)	RO	N
0x3009	int32	R0.09 Output voltage (0.1)	RO	N
0x300A	int32	R0.10 Output current (0.01)	RO	N
0x300B	int32	R0.11 Drive temperature (0.1)	RO	N
0x300C	int32	R0.12 Torque limit (0.1)	RO	N
0x300D	int32	R0.13 Feedback value of the encoder (1)	RO	Y
0x300E	int32	R0.14 Rotor position relative to Z pulse (1)	RO	N
0x300F	int16	R0.15 Inertia ratio of load (1)	RO	N
0x3010	int32	R0.16 Output power (0.1)	RO	N
0x3011	int32	R0.17 Motor load ratio (0.1)	RO	N
0x3012	int32	R0.18 Molecule of actual electric gear ratio (1)	RO	N
0x3013	int32	R0.19 Denominator of actual electric gear	RO	N

		ratio (1)		
0x3014	int32	R0.20 Position command speed (0.1)	RO	N
0x3015	int32	R0.21 Motor speed (filtering) (0.1)	RO	N
0x3016	int16	R0.22 PTP state (1)	RO	N
0x3017	int32	R0.23 Absolute position feedback of encoder (1)	RO	N
0x3018	int16	R0.24 EEPROM data state of the encoder (1)	RO	N
0x3019	int16	R0.25 Turns of multi-circle encoder (1)	RO	Y
0x301A	int16	R0.26 Available encoder type (1)	RO	N
0x301B	int16	R0.27 Synchronous correction state of EtherCAT clock (1)	RO	N
0x301C	int16	R0.28 State of CANopen state machine (1)	RO	N
0x301D	int16	R0.29 Node no. of PROFIBUS-DP slave station (1)	RO	N
0x301E	int16	R0.30 System state (1)	RO	N
0x301F	uint16	R0.31 IGBT state (1)	RO	N
0x3020	int16	R0.32 Current mode (1)	RO	N
0x3021	uint32	R0.33 Power-on time (1)	RO	N
0x3022	uint32	R0.34 Operation time (1)	RO	N
0x3023	int16	R0.35 DSP software version (0.01)	RO	N
0x3024	int16	R0.36 FPGA software version (0.01)	RO	N
0x3026	int32	R0.37 Communication card software version (0.01)	RO	N
0x3027	int32	R0.38 Drive serial No.1 (1)	RO	N
0x3028	int32	R0.39 Drive serial No.2 (1)	RO	N
0x3029	int32	R0.40 Drive serial No.3 (1)	RO	N
0x302A	int32	R0.41 Drive serial No.4 (1)	RO	N
0x302B	int32	R0.42 Drive serial No.5 (1)	RO	N
0x302C	int32	R0.43 Drive serial No.6 (1)	RO	N
0x302D	int32	R0.44 Linear encoder position relative to Z (2^{nd} encoder) (1)	RO	N
0x302E	int32	R0.46 Observing speed of speed observer (0.1)	RO	N
0x302F	int32	R0.47 Feedback speed of speed observer (0.1)	RO	N
0x3030	int32	R0.48 Observing disturbance torque via disturbance observer (0.1)	RO	N
0x3031	int32	R0.49 Compensation value of fully-closed vibration suppressor (0.1)	RO	N
0x3032	int16	P0.50 EtherCAT configuration file version no. (0.01)	RO	N
0x3033	int16	R0.51 Observe load inertia ratio in real time (1)	RO	N
0x3034	int32	R0.52 Position feedback accumulation of linear encoder (1)	RO	N
0x3035	int32	R0.53 Gantry synchronization position deviation (1)	RO	N
0x3036	int32	R0.54 Linear encoder (2nd encoder) position feedback value (1)	RO	N

0x3037	int32	R0.55 Encoder turn number offset after clearing multi-turn position (1)	RO	N
0x3038	int32	R0.56 Encoder feedback value offset after clearing multi-turn position (1)	RO	N
0x3039	int64	R0.57 Position feedback accumulation of 2nd encoder (1)	RO	N
0x303A	int32	R0.58 Position inside the single-turn of the disk (1)	RO	N
0x303C	int32	R0.60 Temperature of medium-power motor (1)	RO	N
0x3063	int16	R0.99 Fault code (1)	RO	N
0x3100	uint16	R1.00 Current state of digital input (1)	RO	N
0x3101	uint16	R1.01 Current state of digital output (1)	RO	N
0x3102	int32	R1.02 Original voltage of analog input 1 (0.001)	RO	N
0x3103	int32	R1.03 Original voltage of analog input 2 (0.001)	RO	N
0x3104	int32	R1.04 Original voltage of analog input 3 (0.001)	RO	N
0x3105	int32	R1.05 Voltage of analog input 1 (0.001)	RO	N
0x3106	int32	R1.06 Voltage of analog input 2 (0.001)	RO	N
0x3107	int32	R1.07 Voltage of analog input 3 (0.001)	RO	N
0x310B	int32	R1.11 Cumulative value of pulse input (1)	RO	N
0x310C	int32	R1.12 Pulse position command (1)	RO	N
0x310D	int32	R1.13 Pulse speed command (0.1)	RO	N
0x310E	int32	R1.14 Analog compensation speed (0.1)	RO	N
0x310F	int32	R1.15 Analog compensation torque (0.1)	RO	N
0x3110	int32	R1.16 One-loop value of DI capture encoder	RO	N

0x4000Manufacture's parameter list:

Index	Object Type	Name	Data Type	Access	Mappable
SV-DA300 manufacture parameter					
4000_h	VAR	Error code	UNSIGNED16	RO	Y
4001_h	VAR	Driver temperature	INTEGER16	RO	N
4002_h	VAR	Parameter save	INTEGER16	RW	N
4003_h	VAR	Parameter restore	INTEGER16	RW	N
4020_h	VAR	Encoder Feedback Cap	INTEGER32	RW	N
4021_h	VAR	multi number of turns Cap	INTEGER16	RW	N
4300h	ARRAY	driver parameters	UNSIGNED32	RW	N

4.5 EncoderFeedback

300Dh Feedback value of the encoder,corresponding to R0.31.

3019h Turns of multi-circle encoder, corresponding to R0.25.

The above two parameters is changed from SDO-only to PDO-readable.

The following two parameters will store the capture value only when P4.25 is set to factory unit.

4020h Feedback capture value of the encoder, it is used to store the encoder position during touch probe1capture.

4021h Turn capture value of multi-circle encoder; it is used to store the encoder multi-turn value during touch probe1 capture.

4.6Digital output control

The digital value is controlled by the servo (default). If it is controlled by the master station via EtherCAT communication, it is necessary to set P4.28 **Digital output control enabling of EtherCAT** to 1 (enabled), or write 0x60FE Control digital output via SDO or PDO.

The xml digital output control parameters (factory default) are put in the PDO parameter written list. If you need to use the PDO control, 0x60FE is required to be configured in the main station to the PDO written list.

EtherCAT servo is configured with 4 differential outputs. For details about its definition, refer to the preceding DB44 terminal definition table.

Note: To ensure fast response of data transmission, the maximum number of parameters that can be configured by the PDO read/written list is 10, otherwise some communication errors occur.

4.7Driver Parameters

0x4300 drive parameter carries three indices, this object can be used to set and read factory parameters.

Subindex 1 is parameter address, 32-bit unsigned data.

Subindex 2 is parameter value, 32-bit unsigned data.

Subindex 3 is operation result, 32-bit unsigned data.

Read:

a. Write subindex 1 to the data address to be read.

b. Read subindex 2 and get parameter value.

c. Read subindex3 and get the reading result which should be 0.

Set:

a. Write subindex 1 to the parameter address to be set.

b. Write subindex 2 to the value to be set.

c. Read subindex 3 and get the set result which should be 4.

The parameter address has referred to CANopen address of DA300. Take P0.05 (jog speed) as example, the index of CANopen is 0x2005, the subindex is 0, so the address parameter should be 0x200500.

The result of twincat reading is shown as below:

4.8 Torque compensation

0x60B2 torque compensation, corresponding to P2.44 torque offset, can be set through PDO and SDO.

It is used to set the compensation value that is added to the variable load of the torque command. It applies to the vertical axis mode, and other control modes other than torque control mode.

5 Fault and diagnosis

5.1 EtherCAT communication interface for obtaining fault codes

1. Obtain fault codes through Emergency of EtherCAT.

2. Access 0x4000 (16-bit) through SDO or PDO to read the current fault code information. The format of fault

codes are shown as below.

Bits	Meaning
15~8	Master fault codes*
7~4	Reserved
3~0	Sub fault codes

*: For details about master and subcodes, refer to the following table.

3. Access 0x603F (402 standard protocol fault code, 16-bit) through SDO or PDO to read the current fault.

For details about the corresponding relation between 0x603F and servo factory code, refer to the following fault code table.

5.2EtherCAT communication fault codes and remedies

Fault code	0x603F	Fault name	Fault causes	Solution
Er24-8	0x8100	EtherCAT fault-initialization fault	Poor contact of EtherCAT chip	Replace the servo
Er24-9	0x8100	EtherCATfault-EEPROM fault	EtherCAT EEPROM has no data or data reading failed	Download xml file to EtherCAT EEPROM with TwinCAT or other tools;
Er24-a	0x8100	EtherCATfault-DC Sync0 signal is abnormal	Set to DC sync operation mode, and DC Sync0 interruption signal is not detected during a period of time.	Check whether data loss occurred due to interference; Check whether EtherCAT master works normally;
Er24-b	0x8100	EtherCAT fault-offline fault	Network cable is inserted improperly or EtherCAT master operation is abnormal after the drive is enabled.	Check whether network cable is connected properly which should be top-in and bottom-out; Check if there is interference; Check EtherCAT master operates normally.
Er24-c	0x8100	EtherCATfault-PDO data loss fault	No PDO data is received after the drive is enabled for a period of time.	Check EtherCAT master operates normally; Check if data loss is caused by interference.

5.3 SV-DA300servo faults and fault codes

Fault code	0x603F	Fault name	Fault cause	Solution
Er01-0	0x2320	IGBT fault	The actual drive output current exceeds the specified value. 1. Drive fault (drive circuit, IGBT fault). 2. Motor cables U, V, W are short circuited; motor cables are grounded or suffer poor contact. 3. Motor burnt down. 4. Phase sequences of motor cables U, V and W are connected reversely. 5. Parameters are inappropriate and cause system divergence. 6. ACC/DEC time is too short during start/stop. 7. Momentary load is too big.	1. Disassemble motor cables and enable the drive, if fault persists, replace the drive. 2. Check whether motor cables and wiring are in good condition. 3. Decrease P0.10 and P0.11 to lower the max. Output torque. 4. Adjust the loop parameter to stabilize the system, and reduce the value of P0.12. 5. Prolong ACC/DEC time properly. 6. Replace with a drive with larger power. 7. Replace the motor.

Fault code	0x603F	Fault name	Fault cause	Solution
Er01-5	0x2334	IPM fault	Same with Er01-0	Same with Er01-0
Er02-0	0x7301	Encoder fault-encoder offline	1. Encoder is not connected. 2. Encoder plug is loosened. 3. Any one of the encoder signal cables U, V, W, A, B and Z phases is disconnected. 4. Encoder A/B phase reversal occurs. 5. Communication interruption or data abnormal caused by noise. 6. Encoder communication is normal, but communication data is abnormal. 7. The FPGA in charge of communication with encoder reports communication timeout. 8. The drive does not support theencoder type	1. Properly connect the encoder according to the wiring mode. Check whether encoder plug is removed properly. Replace the encoder cable if the cable is disconnected. 2. Check whether the encoder power voltage is normal. 3. Reduce the interference source of encoder cable to the minimum extent. Route the encoder cables and motor cables separately, and connect the shielded wire of encoder cable to FG. 4. Check whether the available drive encoder type is consistent with the available motor encoder type according to P0.01 If an encoder disconnection fault is reported upon power-on.
Er02-1	0x7300	Encoder fault-encoder feedback error is too large		
Er02-2	0x7300	Encoder fault-odd/even check error		
Er02-3	0x7300	Encoder fault-CRC check error		
Er02-4	0x7300	Encoder fault-frame error		
Er02-5	0x7300	Encoder fault-short frame error		
Er02-6	0x7300	Encoder fault-encoder reports timeout		
Er02-7	0x7305	Encoder fault-FPGA timeout		
Er02-8	0x5114	Encoder fault-encoder battery low voltage alarm	When multi-turn absolute encoder is used, the voltage of external encoder battery should be between 3.0 V–3.2 V.	1. Check whether the battery connection in the encoder cable is in good condition. 2. Check if the external battery voltage of encoder is less than 3.2 V, if yes, replace the battery. 3. Ensure the drive is powered on during battery replacement; otherwise absolute data of the encoder may be lost.
Er02-9	0x5115	Encoder fault-encoder battery undervoltage fault	When multi-turn absolute encoder is used, the voltage of external encoder battery should be between 2.5 V–3.0 V.	1. Check whether the battery connection in the encoder cable is in good condition. 2. Check if the external battery voltage of encoder is less than 3.0 V, if yes, replace the battery. 3. Ensure the drive is powered on during battery replacement; otherwise absolute data of the encoder may be lost.
Er02-a	0x7300	Encoder fault-encoder overheat	Feedback temperature of the encoder is higher than the set overheat protection value.	1. Ensure the encoder overheat protection value is set correctly. 2. Stop the motor, and

Fault code	0x603F	Fault name	Fault cause	Solution
				cool down the encoder.
Er02-b	0x7300	Encoder fault-encoder EEPROM write error	For the motor equipped with communication encoder, communication transmission error or data check error occurs when the drive updates data to the encoder EEPROM.	1. Check whether the encoder is wired properly, and reduce the interference source of the encoder communication. 2. If write operation fails constantly, replace the motor.
Er02-c	0x7300	Encoder fault-no encoder EEPROM data	For the motor equipped with communication encoder, there is no data when reading the encoder EEPROM during power-up.	1. Select the present motor model via P0.00, and execute the write operation on the encoder EEPROM parameter via P4.97. 2. Mask this fault via P4.98, and perform the initialization accordingly by using the motor parameters in the drive EEPROM.
Er02-d	0x7300	Encoder fault-encoder EEPROM data check error	For the motor equipped with communication encoder. Data check error occurs when reading the encoder EEPROM during power-up.	1. Check whether encoder is wired properly and reduce the interference source of the encoder communication. 2. Select the present motor model via P0.00, execute the write operation on the encoder EEPROM parameter via P4.97, and update data in encoder EEPROM. 3. Mask this fault via P4.98, and perform the initialization accordingly by using the motor parameters in the drive EEPROM.
Er03-0	0x7200	Current sensor fault-U phase current sensor fault	1. Current sensor or detection circuit is abnormal. 2. Power is applied when the motor shaft is in the non-static state.	Re-power on when the motor is in the static state. Replace the drive if fault is reported many times.
Er03-1	0x7200	Current sensor fault-V phase current sensor fault		
Er03-2	0x7200	Current sensor fault-W phase current sensor fault		
Er04-0	0x6100	System initialization fault	Self-test failed after the system power-on initialization completes.	1. Re-power on. 2. If the fault occurred many times, replace the drive.
Er05-1	0x6320	Setting fault-the motor model does not exist	P0.00 parameter setting is wrong	1. Check whether the motor model setting is correct. 2. Check whether the motor parameter model matches drive power class.
Er05-2	0x6320	Setting fault-the motor model does not match the drive model		
Er05-3	0x6320	Setting fault-software limit setting fault	Software limit value is set improperly.	Reset P0.35 and P0.36.

Fault code	0x603F	Fault name	Fault cause	Solution
			The set value of P0.35 (forward position control software limit) is no more than that of P0.36 (reverse position control software limit).	
Er05-4	0x6320	Setting fault-homing mode setting fault	P5.10 mode setting is wrong	Set P5.10 correctly based on the detailed parameter instructions.
Er05-5	0x6320	Setting fault-jogging control travel overflow fault	Single increment of jogging spare travel exceeds (2^{31}-1)	Single travel should not exceed (2^{31}-1) under the absolute position mode.
Er07-0	0x7112	Regenerative discharge overload fault	1. Brake resistor power is too small. 2. Motor speed is too high or the deceleration is too fast, regenerative energy cannot be fully absorbed in the specified time. 3. Action limit of the external brake resistor is limited to 10% duty ratio.	1. Change the internal brake resistor to the external brake resistor, and enlarge the power. 2. Modify deceleration time, and lower the regenerative discharge action rate. 3. Reduce motor speed. 4. Improve the capacity of the motor and drive.
Er08-0	0x7200	Analog input overvoltage fault-analog input 1	The voltage inputted to the analog input 1 port exceeds the value defined with P3.22.	1. Set P3.22, P3.25, and P3.75 properly. 2. Check whether the terminal wiring is in good condition. 3. Set P3.22, P3.25, and P3.75 to 0 to void the protection function.
Er08-1	0x7200	Analog input overvoltage fault-analog input 2	The voltage inputted to the analog input 2 port exceeds the value defined with P3.25.	
Er08-2	0x7200	Analog input overvoltage fault-analog input 3	The voltage inputted to the analog input 3 port exceeds the value defined with P3.75.	
Er09-0	0x5520	EEPROM fault-R/W fault	Data in the parameter storage area is damaged when reading data from EEPROM. EEPROM write operation is interfered.	1. Re-try after power-up again. 2. Replace the drive if the fault occurs constantly.
Er09-1	0x5530	EEPROM fault-data check fault	1. The data read from EEPROM differs from data being written. 2. The drive DSP software version updates.	1. Reset all the parameters. 2. Replace the drive if the fault occurs constantly.
Er10-0	0x7400	Hardware fault -FPGA fault	FPGA chip fault	1. Repower on. 2. Replace the drive if the fault occurs constantly.
Er10-1	0x7500	Hardware fault-communication card fault	The external communication card reports a fault.	1. Repower on. 2. Replace the communication card if the fault occurs constantly.
Er10-2	0x2300	Hardware fault-ground short circuit fault	During the earth test after power-on, one of motor cables V and W is short-circuited to the ground.	1. Check whether the motor cables are connected correctly. 2. Replace the motor cables or test whether the motor insulation is aging.
Er10-3	0x5430	Hardware fault-external input fault	This fault occurs when the digital terminal configured as external fault input function acts.	1. Remove the external fault input, and enable the fault clearance. 2. Re-power on the drive.
Er10-4	0x5430	Hardware fault-emergency stop fault	This fault occurs when E-stop button acts (digital terminal	1. Remove the E-stop input, and enable the fault

Fault code	0x603F	Fault name	Fault cause	Solution
			configured as E-stop function).	clearance. 2. Re-power on the drive.
Er10-5	0x7500	Hardware fault–485 communication fault	Strong EMI of 485 communication circuit causes the serial communication alarm of the drive.	1. Use twisted shielded pairs for 485 communication. 2. Wiring communication cables and motor power cables separately.
Er10-6	0x7500	Hardware fault–AC power phase loss	One of the phases R, S, and	One of the phases R, S, and
Er10-7	0x7500	Hardware fault–Fan fault	The fan built in the servo stops running.	Check whether there is a foreign material. If the alarm persists after the foreign material is found and removed, replace the drive.
Er10-8	0x7500	Hardware fault–Regenerative transistor fault	The external regenerative brake resistor is connected improperly or disconnected.	1. Check the connections B2 and B3 when the regenerative brake resistor is built in. 2. Ensure the external regenerative brake resistor is connected properly.
Er10-9	0x7500	Hardware fault–STO phase loss	There is a phase loss in safety terminal input.	Ensure the safety terminal input wiring is proper.
Er10-a	0x7500	Hardware fault–STO DPIN1 fault	Safety terminal input 1 is abnormal.	Ensure the safety terminal input wiring is proper.
Er10-b	0x7500	Hardware fault–STO DPIN2 fault	Safety terminal input 2 is abnormal.	Ensure the safety terminal input wiring is proper.
Er11-0	0x6100	Software fault-reentry of the motor control task	1. CPU load of DSP software is too high. 2. DSP software is defective.	1. Reduce some unnecessary software function. 2. Contact the customer service, and update the drive DSP software.
Er11-1	0x6100	Software fault-reentry of the cycle task		
Er11-2	0x6100	Software fault-illegal operation		
Er12-0	0x6320	IO fault- repeated assignment of digital input	Two or more digital inputs are configured to the same function.	Reset P3.00–P3.09, and ensure there is no repeated setting.
Er12-1	0x6320	IO fault-repeated assignment of analog input	Analog input 3 is configured as speed command when the drive is standard model.	Configure P3.70 (analog input 3 function) to other values.
Er12-2	0x5430	IO fault–pulse input frequency is too high	The pulse input frequency detected by the drive is higher than the designated value. 1. External input pulse signal frequency is too high. 2. Internal pulse frequency detection circuit of the drive is damaged.	1. Reduce the external input pulse signal frequency. 2. Change the drive if a fault generates when the external input signal is normal.
Er13-0	0x3110	Main circuit overvoltage fault	The drive detects that the main circuit DC voltage exceeds the specified value. 1. Grid voltage is too high. 2. The brake resistor, brake tube or brake resistor is damaged under brake working condition. 3. DEC time is too short during stop.	1. Check whether the grid input voltage exceeds the allowed value. 2. Check whether the shorting link of built-in brake resistor is loosened or built-in/external brake resistor is damaged. 3. Increase the set value

Fault code	0x603F	Fault name	Fault cause	Solution
			4. DC voltage detection current inside the drive is damaged.	of DEC time. 4. Monitor whether the parameter R0.07 is normal when the drive is disabled. If it is abnormal and does not match the grid input voltage, replace the drive.
Er13-1	0x3120	Main circuit undervoltage fault	The drive detects that the main circuit DC voltage is lower than the specified value. 1. The grid voltage is too low. 2. Power-on buffer relay is not closed. 3. Drive output power is too large. 4. Internal DC voltage detection circuit of the drive is damaged.	1. Check whether the grid input voltage exceeds the allowed value. 2. Repower on, and check whether there is pull-in noise of the power-on buffer relay. 3. Monitor whether the parameter R0.07 is normal when the drive is disabled. If it is abnormal and does not match the grid input voltage, replace the drive.
Er14-0	0x5115	Control power undervoltage fault	The drive detects that control power DC voltage is lower than the specified value. 1. The grid voltage is too low. 2. Internal control power DC voltage detection circuit of the drive is damaged.	1. Check whether the grid input voltage exceeds the allowed value. 2. Monitor whether the parameter R0.08 is normal when the drive is disabled. If it is abnormal and does not match the grid input voltage, replace the drive.
Er17-0	0x3230	Drive overload fault	Short-time load of the drive is too heavy	1. The load is too heavy which causes the drive overload. 2. Check whether phase dislocation or phase loss occurred to UVW wiring of the motor, and check whether the encoder is correct. 3. Check whether the motor is compatible with the drive.
Er17-1	0x3230	Drive overload 2	The drive load is too heavy.	1. The drive is overloaded due to heavy load. 2. Ensure there is no phase dislocation or phase loss to the UVW wiring of the motor and the encoder is correct.
Er18-0	0x3230	Motor overload fault	1. Long-term overload running. 2. The load is too heavy during the short time.	1. Replace with the drive and motor of larger power.
Er18-1	0x3230	Motor overtemperature fault	Motor temperature exceeds the protection value	1. Replace with the motor of larger power. 2. Check whether UVW phase sequence is correct.
Er19-0	0x8400	Speed fault-overspeed fault	The absolute value of motor speed exceeds the value defined with P4.32.	1. Check whether the electronic gear ratio parameters are set

Fault code	0x603F	Fault name	Fault cause	Solution
			1. Motor overspeed, U, V, and W phases are connected reversely. 2. Electronic gear ratio or motor speed loop control parameters are set improperly. 3. The value defined with P4.32 is less than that with P4.31 (max. speed limit). 4. The feedback signal of the encoder is interfered.	properly. 2. Check the setting of speed loop control parameters. 3. Check whether the motor cable phase sequence is correct. 4. Check whether the motor encoder is wired properly. 5. Replace with a motor of higher rotating speed.
Er19-1	0x8400	Speed fault-forward overspeed fault	The speed feedback exceeds the value defined with P4.40 by more than 20 ms.	1. Check whether the encoder is normal. 2. Check whether P4.40 parameter is set properly.
Er19-2	0x8400	Speed fault-reverse overspeed fault	The speed feedback exceeds the value defined with P4.41 by more than 20 ms.	1. Check whether the encoder is normal. 2. Check whether P4.41 parameter is set properly.
Er19-3	0x6320	Speed fault-overspeed parameter setup is wrong	The value defined with P4.40 is less than 0 or P4.41 is larger than 0.	1. Check whether the encoder is connected reliably. 2. Check whether P4.40 and P4.41 parameters are set improperly.
Er19-4	0x8400	Speed fault–Out-of-control fault	The motor is out of control due to the incorrect motor power cable connection or wrong motor code setting.	1. Ensure the encoder is connected reliably. 2. Ensure the phase sequence of the power cable is correct. 3. Ensure the motor code is correct. 4. Set P4.35 to 0.
Er20-0	0x8400	Speed out-of-tolerance fault	In non-torque mode, the deviation between motor speed and speed command exceeds the value defined with P4.39. 1. Motor U, V and W phase are connected reversely or motor cable is not connected. 2. Motor load is too heavy and causes motor stall. 3. The drive force is insufficient and causes motor stall. 4. Speed loop control parameters are set improperly. 5. The value defined with P4.39 is too small.	1. Check motor cable phase sequence and ensure the wiring is correct. 2. Check whether the transmission belt or chain is too tight, or the workbench reaches edges or encounters obstacles. 3. Check whether the loop control parameters are set properly or the drive has been damaged, or the servo system model is appropriate. 4. Increase the value defined with P4.39. 5. Set P4.39 to 0 to void speed out-of-tolerance fault detection.
Er21-0	0x8500	Position overtravel-forward overtravel	Under position mode or fully-closed loop mode, the FWD limit switch is touched or the accumulated feedback pulse exceeds P0.35.	1.Check whether FWD limit switch signal is correct; 2. Check whether P0.35 is

Fault code	0x603F	Fault name	Fault cause	Solution
				set properly.
Er21-1	0x8500	Position overtravel-reverse overtravel	Under position mode or fully-closed loop mode, the FWD limit switch is touched or the accumulated feedback pulse exceeds P0.36.	1.Check whether REV limit switch signal is correct; 2.Check whether P0.36 is set properly.
Er22-0	0x8611	Out-of-tolerance fault-position is out of tolerance	1. Residual pulse value exceeds the value defined with P4.33 due to slow response time. 2. The motor load is too heavy and causes motor stall. 3. Pulse input frequency is too high, which exceeds the highest speed capacity of the motor. 4. Position command input step variation exceeds the value defined with P4.33.	1. Check whether the transmission belt or chain is too tight, or the workbench reaches the edges or encounters obstacles. 2. Increase the position loop gain parameters or speed feedforward gain, or pulse range of position deviation (P4.33). 3. Modify electric gear ratio. 4.Reduce position command input variation.
Er22-1	0x8611	Out-of-tolerance fault-mixed control deviation is too large	In full close loop control, the deviation between feedback position of the grating ruler and that of the encoder exceeds the value defined with P4.64.	1. Check the connection between the motor and load. 2. Check the connection between the grating ruler and drive. 3. Check the numerator and denominator of the grating ruler (P4.60 and P4.61), and check whether the direction reversal of the grating ruler (P4.62) is set correctly.
Er22-2	0x8611	Position gain overflow fault	Position command's single variation after being converted by the electric gear ratio exceeds 2^{31}-1.	1. Reduce the single variation of the position. 2. Modify the electric gear ratio to appropriate range.
Er23-0	0x4210	Drive overtemperature fault	1. The ambient environment of the drive exceeds the specified value. 2. The drive overloads.	1. Lower the ambient temperature of the drive, and improve the ventilation condition. 2. Replace with the servo system of larger power. 3. Prolong ACC/DEC time, and reduce the load.
Er24-0	0x6320	PROFIBUS-DP communication fault-PWK ID error	PWK ID error.	Read the manual, and ensure that PWK ID corresponds to the parameter ID.
Er24-1	0x6320	PROFIBUS-DP communication fault-PWK exceed the range	The setting of PWK exceeds the max. range allowed by the corresponding parameter.	Read the manual, and ensure the setting of PWK is in the range allowed by the corresponding parameter.
Er24-2	0x6320	PROFIBUS-DP communication fault–read-only PWK	PWK parameter performs the write operation on the read-only parameters.	Read the manual, and ensure the parameters can be read and written.

Fault code	0x603F	Fault name	Fault cause	Solution
		parameter		
Er24-3	0x6320	PROFIBUS-DP communication fault–PZD parameter does not exist	The selected ID of PZD parameter is not right.	Read the manual, and ensure that PZD ID corresponds to the parameter ID.
Er24-4	0x6320	PROFIBUS-DP communication fault–PZD parameter attribute does not match	The PZD parameter is not valid instantly.	Read the manual, and ensure that the PZD parameter attribute is valid instantly
Er25-4	0xFF00	Application fault–encoder offset angle test timeout	Abnormity occurs during the encoder offset angle test.	Check whether the motor shaft can rotate freely, and execute again after repower-on.
Er25-5	0xFF00	Application fault–encoder offset angle test failed	The current feedback wave fluctuates violently during the encoder offset angle test.	Reduce P4.53 parameter setting, and execute again after repower-on.
Er25-6	0xFF00	Application fault-homing beyond limit	Encounter the limit switches or software limit during homing.	Modify P5.10 parameter setting, and execute again after repower-on.
Er25-7	0xFF00	Application fault-inertia identification failure	1.The vibration lasts for more than 3.5 s when the inertia identification motor stops rotating. 2. Actual ACC time is too short. 3.Identification speed is lower than 150 r/min.	1.Improve the mechanical rigidness properly if vibration occurred when motor stops running. 2.Increase ACC timeconstant P1.07. 3. Increase movable range P1.06.
Er25-8	Null	Application fault–Magnetic pole check failed	1.The power cable phasesequence is incorrect. 2.The encoder directionconflicts with the powercable phase sequence. 3.External force or overloadoccurs in the check.	1.Ensure power cable connectionis correct. 2.Ensure encodersettings arecorrect. 3.Eliminate the condition thatcauses the external force.

5.3 Give instructions without action

If the PDO mapping has torque limit parameters, such as Max torque, Negative torque limit, and Positive torque limit, the default PDO value is 0, under which situation, the motor will not run after the drive is enabled, unless a torque limit value is defined. The unit of torque limit value is generally 0.1% of rated torque, for instance, if the torque limit value is 3000, it means 300% of rated torque.

6 Reference

1. *Hardware Data Sheet ET1100 EtherCAT Slave Controller V1.8.* May 3rd, 2010.
2. Xunji and Liu yanqiang. *Design and Application of Industrial Ethernet Fieldbus EtherCAT Drive Program* (1st ed.). Beijing University of Aeronautics and Astronautics Press. March 2010.
3. *CANopen Application Layer and Communication Profile, CiA Draft Standard 301 (4.02 ed.)*. February 13th, 2002.
4. *CANopen Device Profile Drives and Motion Control, CiA Draft Standard Proposal 402* (2nd ed.). July 26th, 2002.